National Park Service
U.S. Department of the Interior

Fort McHenry National Monument and Historic Shrine
Baltimore, Maryland

Fort McHenry National Monument and Historic Shrine
Shuttle Feasibility Study

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John A. Volpe National Transportation Systems Center
Research and Innovative Technology Administration
U.S. Department of Transportation

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Executive Summary

This study, performed by the U.S. Department of Transportation John A. Volpe National Transportation Systems Center, evaluates the feasibility of a shuttle system that would connect south Baltimore and Fort McHenry National Monument and Historic Shrine with the Inner Harbor area of the city of Baltimore. In addition to examining the creation of a new service, this study also investigates the possible incorporation of a shuttle system into existing and/or proposed transit systems, specifically the Charm City Circulator. The goals of a new shuttle system are to:

- Alleviate traffic congestion along Fort Avenue, the only vehicle access to the fort's entrance, and overcrowding in the fort's parking lot;
- Enhance the visitor experience by providing visitor's a car-free alternative to accessing the fort and other south Baltimore attractions; and
- Provide Baltimore residents and businesses with a transit service that connects south Baltimore to the Inner Harbor and other public transportation systems.

The Volpe Center recommends either of the two Refined Route Concepts presented in this study. The Volpe Center believes these routes, which are separate from the Charm City Circulator, would serve more riders since people would not have to ride long portions of an extended Charm City Circulator Yellow Route to get from one point on the circulator to another. Additionally, to save costs, a separate route does not need to adhere to the Charm City Circulator's hours of operation and headway.

Both of the Refined Route Concepts serve the Baltimore Area Visitor Center, the American Visionary Arts Museum (AVAM), the Baltimore Museum of Industry, Tide Point, and Fort McHenry as well as several concentrations of residential, commercial, and office buildings along Key Highway and Fort Avenue. From the Baltimore Area Visitor Center, Refined Route Concept 1 (Figure 22) provides a loop into the downtown whereas Refined Route Concept 2 (Figure 23) provides a loop to the Convention Center and nearby Camden Station. The Volpe Center believes that either of these concepts will maximize ridership by appealing to both tourists/visitors and residents and employees while still being cost-effective.

Based on input provided by Fort McHenry and several stakeholders, the Volpe Center proposes that the Refined Route Concepts should operate year-round from 7:00 AM to 7:00 PM, seven days a week, and the frequency of service should be 30 minutes. These service characteristics were designed based on a number of factors with the cost of operation as the primary consideration since the service must be affordable to be sustained. The cost of operating either of the Refined Route Concepts would be approximately $284,000 a year. Several of the locations, such as the Baltimore Area Visitor Center, the Maryland Science Center, AVAM, and the Baltimore Museum of Science, would be served twice during the 30-minute route since there is a stop proposed for these locations on both sides of the street.

A simple 7-to-7 schedule should satisfy the needs of most potential riders: commuters in the mornings and evenings, with visitors riding more frequently during mid-day and weekend hours. These year-round, week-long hours of operation, coupled with regular 30-minute service, will help make this service easy to remember for all potential riders. Finally, the extended headways and abbreviated hours of operation, compared to the Charm City Circulator, will help to alleviate concerns about too much bus traffic on neighborhood streets.

Introduction

Fort McHenry National Monument and Historic Shrine is located on the Locust Point peninsula in south Baltimore, Maryland. Fort McHenry is the only fort with a dual designation of National Monument and Historic Shrine in the National Park system. The fort is to be preserved in perpetuity to commemorate the birth of our National Anthem and the successful defense of Fort McHenry during the British bombardment in 1814.

This study evaluates the feasibility of a shuttle system that would connect south Baltimore and Fort McHenry with the Inner Harbor area of the city of Baltimore, which is approximately 2.5 miles away from the fort. A new shuttle system is intended to alleviate long-standing problems of traffic congestion and overcrowding in the fort and along Fort Avenue, the only vehicle access to the fort's entrance. In addition to examining the creation of a new service, this study investigates the possible incorporation of a shuttle system into existing and/or proposed transit systems.

Currently, Fort McHenry experiences annual visitation of over 650,000, and the National Park Service (NPS) estimates an average increase of two percent per year in the coming years. Two major events will likely cause visitation to increase in the near future: the opening of a new Visitor Center in 2010 and the celebration of the Bicentennial of the War of 1812 and the National Anthem (2012-2014).

The fort's existing infrastructure is already unable to support current visitation levels during peak season. The parking area offers only six designated bus spaces. With 30 to 40 buses overwhelming the fort on peak days, cars are forced to park on a grass covered overflow parking lot so the buses can use the paved areas. Additionally, 53 of the existing 161 parking spaces will be lost to accommodate the new Visitor Center. The shortage of parking for cars is estimated at 250 spaces during peak visitation periods.

Project Overview

As a follow-up to the *Alternative Transportation Study* completed by the U.S. Department of Transportation's John A. Volpe National Transportation Systems Center (Volpe Center) in 2004, this report describes and evaluates alternative route concepts for shuttle service from downtown Baltimore to south Baltimore and Fort McHenry. These concepts were developed by the Volpe Center in collaboration with Fort McHenry, the city of Baltimore, and other stakeholders. Funds for this project derive from Fort McHenry's successful application to the Alternative Transportation in Parks and Public Lands (ATPPL) program.

This study discusses the region's existing transportation conditions, four preliminary alternative route concepts, two stakeholder-developed route concepts, two refined route concepts, and finally the service characteristics analysis performed for each concept. Section 1, Existing Conditions, describes the transportation network around Fort McHenry and the southern area of the city of Baltimore. Section 2, Context and Preliminary Route Concepts, describes relevant transportation studies and four preliminary concept variations. Section 3, Workshop Route Concepts, describes the stakeholder's two route concepts that came out of the workshop held in June 2009. Section 4, Refined Route Concepts, describes two refined route concepts. Section 5, Service Characteristics of Refined Route Concepts, describes the analysis performed for each of the eight route concepts. Section 6, Opportunities, Challenges, and Vehicles, describes themes and details that address all of the route concepts. Finally, Section 7, Conclusion, summarizes the findings of this study.

Section 1: Existing Conditions

Overview of the City of Baltimore

Baltimore is a major American city with a rich history and strong economic influence. Established in 1729, Baltimore has always been one of America's most important ports. Today, more than 80,000 tons of cargo pass through the Port of Baltimore daily, and with more than eight million residents, the Baltimore-Washington Metropolitan Area is the fourth largest in America.[1]

After the War of 1812, Baltimore grew into the second largest city in the United States. As America pushed farther west, the city of Baltimore adapted by supporting the Baltimore & Ohio (B&O) Railroad. By 1874, the B&O connected Baltimore to Chicago, and Baltimore's trading industry continued to thrive. Canning became an important industry as the bounties of the Chesapeake Bay were able to be preserved and shipped across the country. During this period, Baltimore was also an important port of immigration, second only to New York in volume of European immigrants. Baltimore was also an important hub for rural Southerners traveling north to seek work in the more industrialized Northeast.

As with many industrial American cities, Baltimore was able to rely on its industries to prosper through difficult times. In the mid-20th century, however, a decline in the city's manufacturing sector coupled with the allure of the Maryland countryside drew many of Baltimore's residents outside city limits, and the city's population began to decline as the suburbs grew.

In the 1970s and 1980s, the city worked on revitalizing the center of its downtown with heavy investment in cultural institutions and the development of the Inner Harbor. As these investments gained strength, the repopulation of Baltimore's urban core followed and continues today. Baltimore's proximity to the nation's capital, and its relative affordability, has made it an attractive alternative to the District of Columbia for both commerce and housing.[2]

Baltimore City Heritage Area

The Baltimore City Heritage Area is a region of Baltimore added to the Maryland Heritage Area Program in 2001. The area includes eleven Target Investment Zones that seek to attract private investment in an effort to diversify the neighborhood's economy while preserving the unique character of the community. The Baltimore Heritage Area is home to 24 National Historic Landmarks, 53,000 buildings in National Register historic districts, 8,000 buildings in local historic districts, 12 Chesapeake Bay Gateways, five Maryland Scenic Byways, and an All-American Road.

On March 30, 2009, President Barack Obama signed the Omnibus Public Land Management Act into law, designating the Baltimore Heritage Area as a NPS National Heritage Area. Beyond name recognition, the new status will include $10 million in federal funding over fifteen years "to develop education programs and exhibits and protect and restore Baltimore's historic sites.[3]

Fort Location

Overlooking the entrance to Baltimore's famous Inner Harbor, Fort McHenry is well-known for its role in the War of 1812 and as the site of the penning of the United States National Anthem, "The Star-Spangled Banner," in 1814. Fort McHenry, its facilities, and 43-acre grounds, have all been under the jurisdiction of the NPS since the 1920s.

Fort McHenry is situated on the easternmost tip of Locust Point, a peninsula community that forms the southern shore of Baltimore's Inner Harbor (Figure 1). Northwest of Locust Point are Riverside and Federal Hill, two urban neighborhoods with a mix of residential and commercial uses. Fort McHenry is connected to these neighborhoods by Fort Avenue, the main through-street in Locust Point and the only road providing access to the fort.

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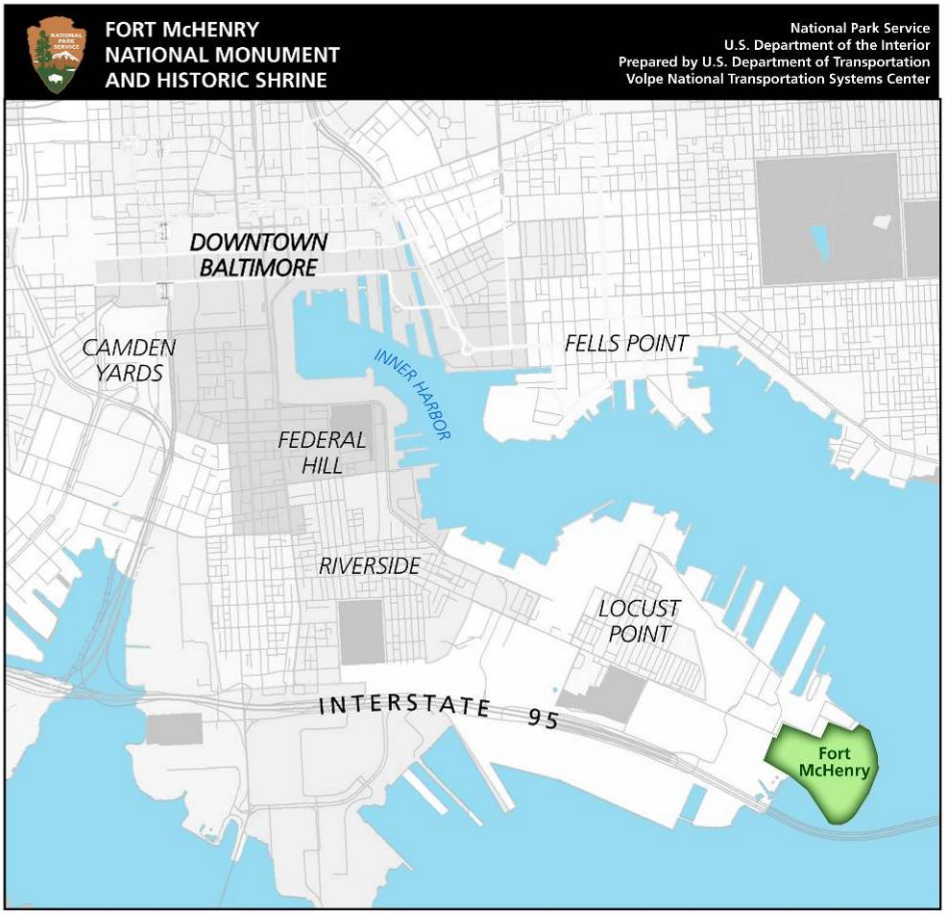
[1] www.marylandports.com and www.census.gov
[2] www.baltimore.org
[3] www.ci.baltimore.md.us/government/heritage/

Figure 1
Location of Fort McHenry National Monument and Historic Shrine.
Source: NPS



Part of the Baltimore City Heritage Area, Locust Point is historically a working class community of small, single-family residences and port-related commerce and industry. In recent years, developers have revived defunct properties into new commercial and residential complexes, taking advantage of the location's proximity to downtown Baltimore, Interstate 95, and the Inner Harbor. Due to Baltimore's relative affordability, developers have capitalized on the neighborhood's proximity to the Interstate and have built high-end multi-family buildings for people working locally or in Washington, DC. The transition has resulted in upgraded office space and housing stock that adds a new cultural dimension to Locust Point.

- Tide Point is a rehabilitation of a former Proctor & Gamble soap factory. Developed by Streuver Brothers as a multi-building business complex, Tide Point is well-occupied and includes the headquarters for sportswear giant Under Armour. The complex is currently on the market for over $100 million.[4]
- Silo Point (Figure 2) is a 24-story condominium project adapted from an historic grain elevator. The unique building opened in late 2008 with more than 200 units for sale.

[4] Sernovitz, Daniel J. "Streuver Bros.'s Tide Point for Sale." Baltimore Business Journal. November 28, 2008. baltimore.bizjournals.com/baltimore/stories/2008/12/01/story5.html

- McHenry Row is a $100 million mixed-use complex currently being built on the former Chesapeake Paperboard Company site. Despite financing problems that halted construction in 2008, work resumed in March of 2009.

Figure 2
New residential development in the Locust Point neighborhood.
Source: Volpe Center

New Visitor Center

Fort McHenry is currently served by an overcrowded Visitor Center, built in 1963, that was designed to accommodate 250,000 annual visitors – about one-third the current visitation. To accommodate increasing visitation at the fort and meet visitor and administration needs, the NPS is in the final planning stages for the construction of a new Visitor Center, to be completed in time for the War of 1812 Bicentennial.

Designed by GWWO Architects in Baltimore, the new 17,200 square foot Visitor Center will, according to the vision statement for the project, "provide a sustainable, functional, and accessible environment to orient visitors to the urban park and to introduce them to the resource and its story" (Figure 3).[5] The project will aim for Gold-level certification from the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) Green Building Rating System™.

[5] GWWO Architects. "Design of the New Fort McHenry Visitor Center Unveiled." September 2007. www.gwwoinc.com/pdf/09-07-07_FOMC_Visitor_Center.pdf

Figure 3
The New Visitor Center at Fort McHenry.
Source: GWWO Architects

The new Visitor Center will be built at the eastern end of the current parking area, and the existing structure will be demolished (Figure 4). The new site was chosen for a number of reasons from protection of the Fort's historic character to improvement of the user's visual experience as s/he approaches from the main entrance. Meanwhile, the fort will lose fifty-three parking spaces for autos (the number of bus spaces will remain the same).

Figure 4
Schematic of the location of the new Visitor Center.
Source: GWWO Architects

Nearby Attractions

According to the Baltimore Area Convention and Visitor's Association, metropolitan Baltimore hosted almost 12 million visitors in 2006. Two-thirds of these visits were for leisure purposes, while the rest were for business.

One of Baltimore's most visited areas is the Inner Harbor. While a number of centrally located cultural and commercial venues line the waterfront, including the National Aquarium and the Museum of Science, there are several other destinations that are closer to Fort McHenry (see Figure 10 for the location of most of these destinations).

- *Baltimore Area Visitor Center*. Opened in 2004, the Baltimore Visitor Center is an 8,000-square foot, state-of-the art facility located on the west shore of the Inner Harbor within walking distance of many of Baltimore's most popular attractions (Figure 5). Visitors gather information on all of the city's tourism amenities at the Visitor Center, and its visible location and distinctive architecture make it an important downtown landmark.

- *Baltimore Museum of Industry*. The Baltimore Museum of Industry (BMI) was founded in 1977 and since 1981 has been located along Key Highway on the south shore of Baltimore's Inner Harbor. BMI's mission is to collect, preserve, interpret, and exhibit the industrial heritage of the Baltimore region. BMI hosts over 160,000 visitors per year. More than half of those visits are school-related; the museum is well-known for its innovative education programs that are all tied to multiple goals in the state's educational curricula. The museum consists of four acres of waterfront campus with historical collections in excess of 50,000 artifacts, over 1,000 cubic feet of documentary materials, and 200,000 photographs.

Figure 5 and Figure 6
The Baltimore Visitor Center (left) and Oriole Park at Camden Yards (right).
Source: Baltimore Area Convention and Visitors Association and Maryland State Archives

- *Camden Yards*. Camden Yards is an historic train station and freight yard near downtown Baltimore. While Camden Station still serves as a train terminal, the grounds and warehouses of Camden Yards have been redeveloped into an important sports complex and entertainment district. Both Oriole Park at Camden Yards (home to the Major League Baseball's Baltimore Orioles, Figure 6) and M&T Bank Stadium (home to the National Football League's Baltimore Ravens) are on the site. Total annual attendance for the Baltimore Orioles was nearly 2 million in 2008. They played more than 80 home games and averaged 25,000 fans per home game. The Ravens only played ten home games in 2008 but averaged more than 70,000 fans per game. Other Camden Yards attractions include the Sports Legends Museum in Camden Station and the Babe Ruth Birthplace and Museum, just a few blocks to the west. They respectively received approximately 25,000 and 40,000 visitors in 2008.
- *B&O Railroad Museum*. Along with Fort McHenry, the B&O Railroad Museum is one of Baltimore's most visited historic sites. An affiliate of the Smithsonian, the B&O Railroad Museum collects, preserves, and interprets artifacts related to early American railroading, welcoming more than 200,000 visitors annually.
- *National Aquarium*. Opened in 1981 and anchoring the Inner Harbor district, the National Aquarium is the most popular attraction in Maryland with more than 1.6 million visitors per year. The Aquarium features many unique exhibits and family-oriented educational opportunities.
- *Maryland Science Center*. Like the Aquarium, the Maryland Science Center is another important learning-oriented institution on the Inner Harbor. Every year, more than half-a-million people visit the museum, which includes permanent and temporary exhibits, a planetarium, and an IMAX movie theater.
- *Waterfront Promenade*. The Baltimore City Heritage Area oversees the Waterfront Promenade, a component of the city's Star-Spangled Trails system. The Waterfront Promenade is a seven-mile walking trail that travels along or near the shores of the Inner Harbor. Downtown, the trail is a continuous walkway along the shoreline, but as it travels away from the city center, the trail loses

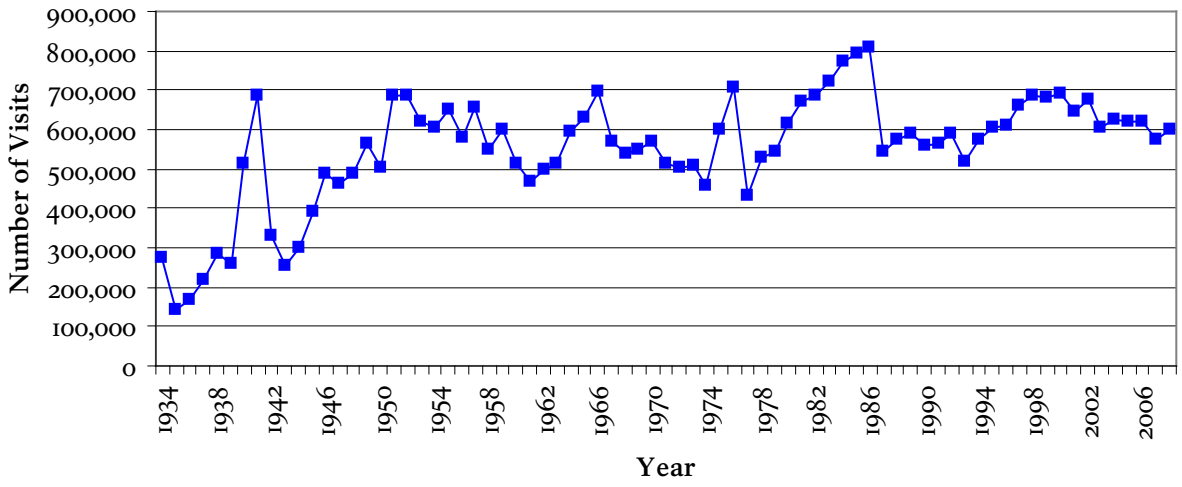
continuity due to private land ownership in more industrial areas. In Locust Point, the developers of the Tide Point complex secured an easement from the city to complete a non-contiguous segment of the Waterfront Promenade that may one day be incorporated into a continuous pathway from downtown.

- *The Baltimore Immigration Memorial.* In recent years, the Baltimore Immigration Memorial has sought to bring recognition to Baltimore's role in the history of foreign immigration to America. To date, sponsors of the project have completed a Liberty Garden and Immigration Memorial on the grounds of the Tide Point development and have expressed interest in one day opening an immigration museum, possibly in Tide Point.

Visitation

The NPS has recorded the number of visitors to Fort McHenry since 1934, at which time the fort welcomed close to 300,000 visitors. Since the 1950s, the total number of recreation visits has generally fluctuated between 500,000 and 700,000 per year, and has dropped below 500,000 only four times since then. Figure 7 shows the fort's total recreation visits since 1934. For visitors arriving by private automobile, the NPS uses a per-vehicle passenger multiplier to estimate the total number of visits. Since 1934, the accepted multiplier has been lowered a number of times to reflect changes in car-travel trends—specifically, fewer passengers per auto. An adjustment in the multiplier can account for significant drops in visitation from one year to the next, as is the case between 1988 and 1989, for example.[6]

Figure 7
Fort McHenry total recreation visits, 1934-2008.
Source: NPS Data and Volpe Center



Fort McHenry currently allows visitors the opportunity to visit the fort via several transportation modes, with most arriving by private automobile, bus (tour bus or school bus), shuttle boat (water taxi), foot, or bicycle. Fort McHenry staff records the mode of transportation as visitors enter the fort using an automatic beam counter. Figure 8 illustrates modal trends since 1999, showing a decrease in the number of arrivals by car, bus, and boat, and an increase in the number of visitors who arrived on foot.

[6] "Fort McHenry: Alternative Transportation Study." U.S. Department of Transportation Volpe Center. 2004.

Figure 8
Visitation by transportation mode, 1999-2008.
Source: NPS Data and Volpe Center

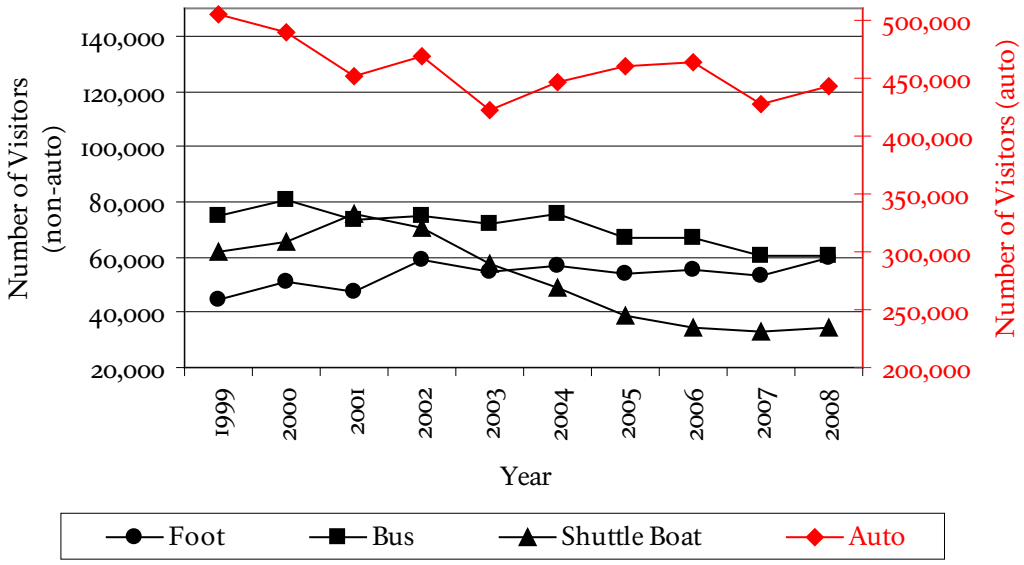
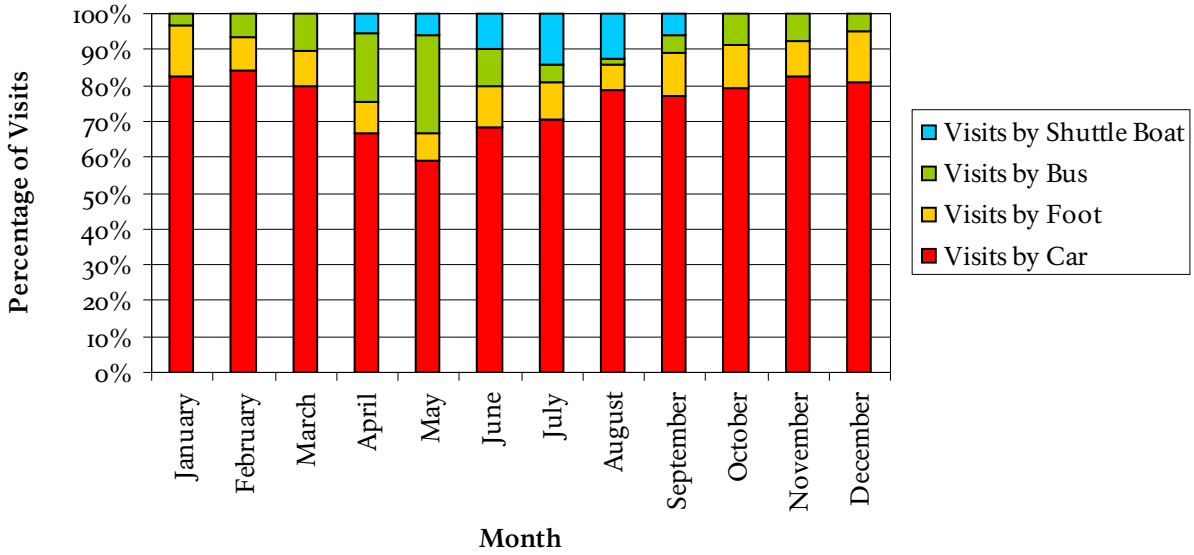


Figure 9 highlights the modal split by month in 2008. While private autos still account for more than 50 percent of the visits in each month of the year, the modal split indicates that seasonality has an influence on how visitors choose to access the fort. Springtime sees the highest percentage of buses, while the summer months show an unsurprising percentage increase in shuttle boat activity. Though more consistent throughout the year, winter months have the greatest percentage of pedestrian visitors.

Figure 9
Modal split by month, 2008.
Source: NPS



The Fort only collects entrance fees at the Visitor Center, but the visitation date is collected at the front gate. Accordingly, entering the Visitor Center is not mandatory for all visitors, and visitation numbers do not translate to actual revenue generated from entrance fees.

Special Events

When the fort hosts special events – such as Living Flag Day (June 14), Defenders' Day (September 12), military tattoos, tall-ships, and Civil War reenactments – the Naval Reserve Center and Maryland Port Administration provide event participants with limited overflow parking at their adjacent properties.

The number of fort visitors can vary significantly as major events take place at the fort throughout the year. Battle reenactments and community concerts, for example, occur somewhat frequently and the fort has grown accustomed to managing that size and type of crowd. Some events, however, are exceptionally popular. A recent event – a Star-Spangled Salute to Michael Phelps in October of 2008 – was held to honor the U.S. Olympian. Attendance for this event at the fort was estimated at between 10,000 and 12,000 visitors. Expecting a high turnout, the city and state partnered to provide shuttle service to the fort from satellite parking areas at M&T Bank Field and Oriole Park at Camden Yards. Advance reservations were required to park in the satellite lots, and the shuttle carried only an estimated 1,300 passengers for the event. The remaining number of visitors walked in from nearby neighborhoods where they lived, drove to and parked, or took transit to and walked.

Visitation to the fort is expected to increase in the coming years, due in large part to the War of 1812's Bicentennial in 2012. A number of major events will be planned during that year, and fort staff believes the Michael Phelps event is an accurate indicator of what to expect with regard to crowd size and management tactics during these major events.

Bus Service

Maryland Transit Administration

The Maryland Transit Administration (MTA) provides public transportation services throughout Maryland, with Baltimore serving as the agency's major urban center. In addition to heavy, commuter, and light rail, MTA's bus system includes almost 1,000 fixed route buses and more than 300 on-demand vehicles.

MTA's Route 1 bus is the only public bus offering direct service to Fort McHenry, with a stop just outside the fort's gates (Figure 13). Specifically, Route 1 leaves Mondawmin Metro station every 35 minutes. The route eventually travels through downtown, passes through Federal Hill and Riverside, then continues eastward on East Fort Avenue through Locust Point to the fort. The bus takes approximately 20 minutes to reach the fort's gates from downtown. After the fort, the Route 1 bus travels back down East Fort Avenue in the opposite direction, before turning north through downtown Baltimore.

MTA ridership data indicate that very few people ride the Route 1 bus to the Fort McHenry stop.[7] The few visitors who do arrive by MTA bus are counted as pedestrians rather than bus riders.

A number of other transportation shuttles have been proposed for the Locust Point neighborhood and/or surrounding areas, but none have come to fruition.

Charm City Circulator

The city of Baltimore is preparing for the introduction of three fare-free, downtown-oriented circulator buses in 2010 (Figure 10). The high-frequency system, called the Charm City Circulator, will link many of the city's core neighborhoods and tourist attractions with free transit service. Table 1 summarizes the service characteristics of the Charm City Circulator. The circulator system will be operated as an

[7] "Fort McHenry: Alternative Transportation Study." U.S. Department of Transportation Volpe Center. 2004.

independent system and is intended to serve downtown residents, workers, and visitors. The circulator is also designed to provide transfer opportunities to MTA bus, MTA rail, and water taxi.

Table 1
Charm City Circulator service characteristics
Source: The Volpe Center

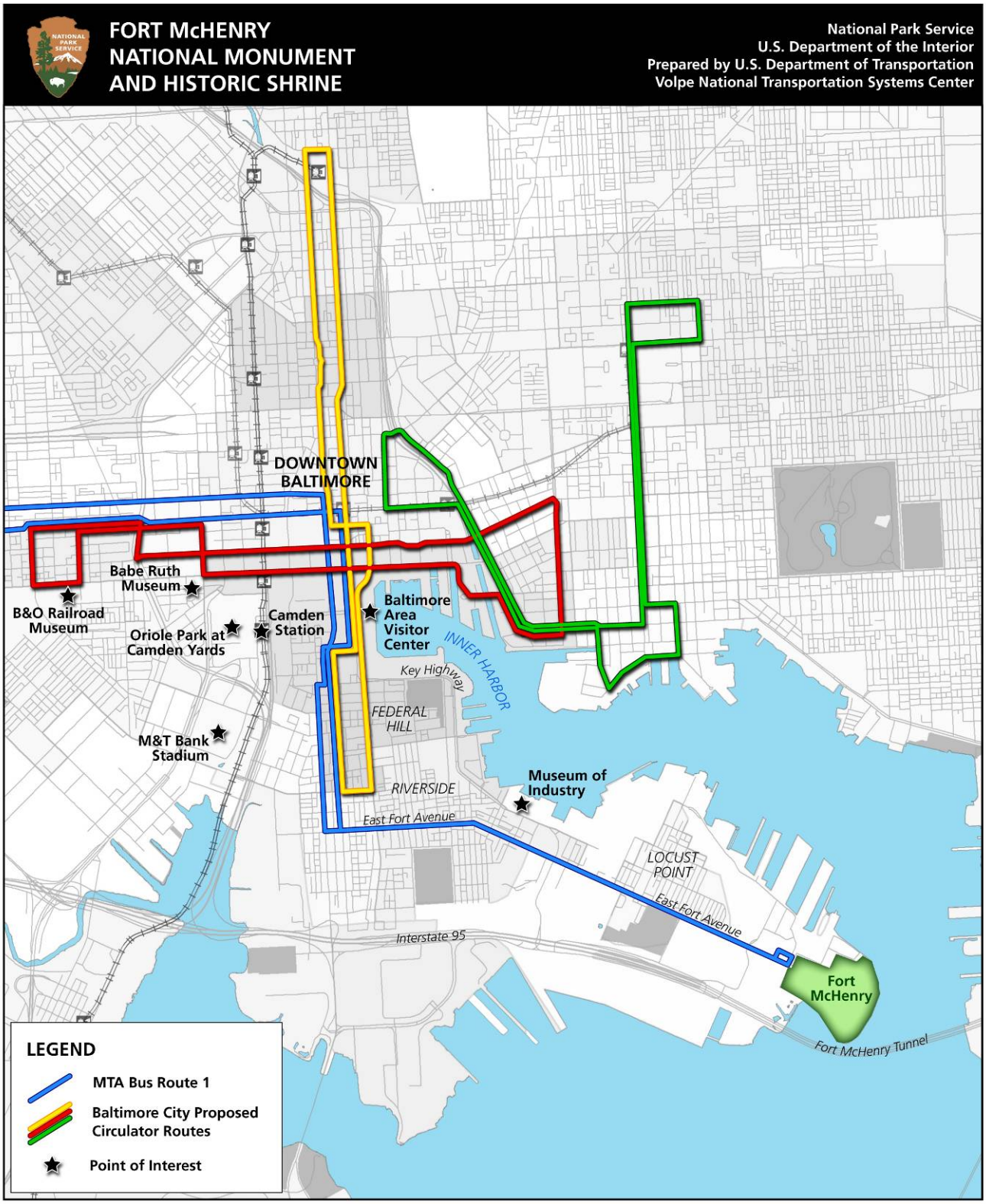
Service Characteristic	Charm City Circulator
Headway/frequency	10 minutes
Hours of operation	6:30 AM to 12:00 AM
Days in operation	7
Weeks in service per year	52

The Charm City Circulator will provide regular service at no cost, with high-end low-emissions vehicles and ten-minute headways. The circulator will be funded by a parking tax, instituted December 1, 2008, which is anticipated to provide a long-term income source for the new system. The system as a whole has been designed to serve both tourists and residents from a variety of income brackets.

The Charm City Circulator will include three routes; alignment and stop locations have not yet been finalized. The general service areas are as follows:

- Green Route: Serves fringe parking areas along Fallsway and Guilford through Harbor East and Fells Point to Johns Hopkins Hospital.
- Red Route: This route is generally an east-west route along Pratt and Lombard Streets, connecting Harbor East to University of Maryland Biopark and Hollins Market Area.
- Yellow Route: This route is a north-south route that travels along Charles and St. Paul Streets, connecting south Baltimore to Penn Station and Station North Arts District.

Figure 10
The Charm City Circulator Routes, the MTA Route 1 Bus, and tourist attractions near Fort McHenry.
Source: Volpe Center



The city operated a downtown shuttle in the recent past. The DASH (Downtown Area Shuttle) was established in 2002 and was funded by state grants. The DASH's primary goal was to shuttle passengers to and from parking lots on the outskirts of downtown, but it averaged only 876 passengers per day. DASH service was eliminated in 2005.

Traffic and Circulation

Private automobiles carry the majority of visitors to Fort McHenry. Tour buses also account for a significant number of visits during spring months. Most notably, these two modes require parking facilities.

Highways

Locust Point and Fort McHenry are well-positioned with regard to access to some of the region's important transportation corridors. Interstate 95 is the major north-south interstate through Baltimore, passing through the southern portion of the Locust Point peninsula before entering the Fort McHenry Tunnel to travel under the harbor. By car, travel time to Fort McHenry from I-95 is only about five minutes from Exit 55.

Key Highway is another important travel corridor that connects downtown Baltimore to I-95 while passing through Locust Point. Recently, an offshoot of Key Highway (Key Highway East) was completed to provide direct access from Key Highway to the new Tide Point complex on the northern shore of Locust Point, relieving the traffic burden for a number of side streets, as discussed further below.

Neighborhood Circulation

Within Locust Point, the core residential neighborhood consists of a small grid of residential streets, roughly a quarter mile square. The residential area is surrounded by a system of train tracks and light industrial activity, which detaches the grid from other neighborhood streets. As a result, only three main entry-exit points exist for Locust Point: Fort Avenue from the west, Key Highway from the north, and Andre Street from the south.

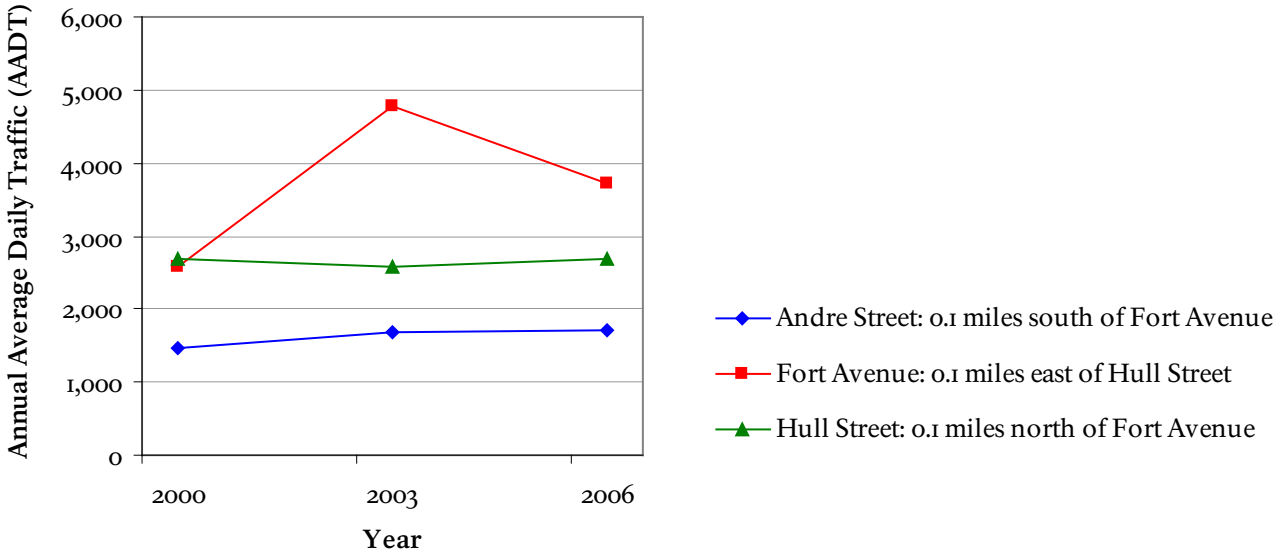
- Fort Avenue is an important east-west route with a number of important cross streets within south Baltimore, including Light Street, Charles Street, and Hanover Street. As a result, getting to Locust Point and Fort McHenry via Fort Avenue is relatively straightforward when traveling from adjacent neighborhoods to the west. Fort Avenue is the only road with access to fort itself, resulting in a one-way-in, one-way-out situation—particularly during major events—that can result in heavy traffic congestion with few obvious route alternatives.
- Accessing Locust Point from Key Highway is less intuitive; however, the new Key Highway extension (Key Highway East) to Tide Point has improved this problem despite overall elevated traffic levels within the neighborhood. Prior to the extension, access to Locust Point required connecting to Fort Avenue via smaller side streets such as Lawrence and Hubbard. With the extension completed, traffic to Tide Point has a direct route, and other local travelers have an additional option to access the neighborhood.
- Andre Street is an important route to Locust Point from I-95. Andre Street was recently resurfaced and its rail crossings improved. In 2004, the city estimated that Andre Street carried only ten percent of the traffic into and out of Locust Point, though its traffic levels were expected to increase after the opening of Silo Point. [8]
- In 2010, the city of Baltimore will begin construction to replace a bridge on Fort Avenue. This particular span, which passes over a CSX railroad right-of-way, is one of a number of small bridges on Fort Avenue. The city is currently in the process of deciding a timeline for construction: if the bridge is replaced all at once, construction will take approximately one year, and traffic will have to follow a detour (possibly on neighborhood streets in Locust Point). If the

[8] www.baltimorecity.gov/government/planning/images/locust%20point%20plan.pdf

city decides to keep one lane of Fort Avenue open, traffic patterns will remain the same, but construction will last approximately three years.

Figure 11 shows the annual average daily traffic for Andre Street, Fort Avenue, and Hull Street, which connects Fort Avenue to Key Highway East and Tide Point. While traffic volumes have been consistent over time for Andre Street and Hull Street, they have been variable for Fort Avenue, which had the highest traffic volume of the three Locust Point streets in both 2003 and 2006. One likely explanation for the decline in traffic volumes on Fort Avenue between 2003 and 2006 is the opening of Key Highway East during this time period.

Figure 11
Annual Average Daily Traffic in Locust Point.
Source: Baltimore Metropolitan Council and the Volpe Center

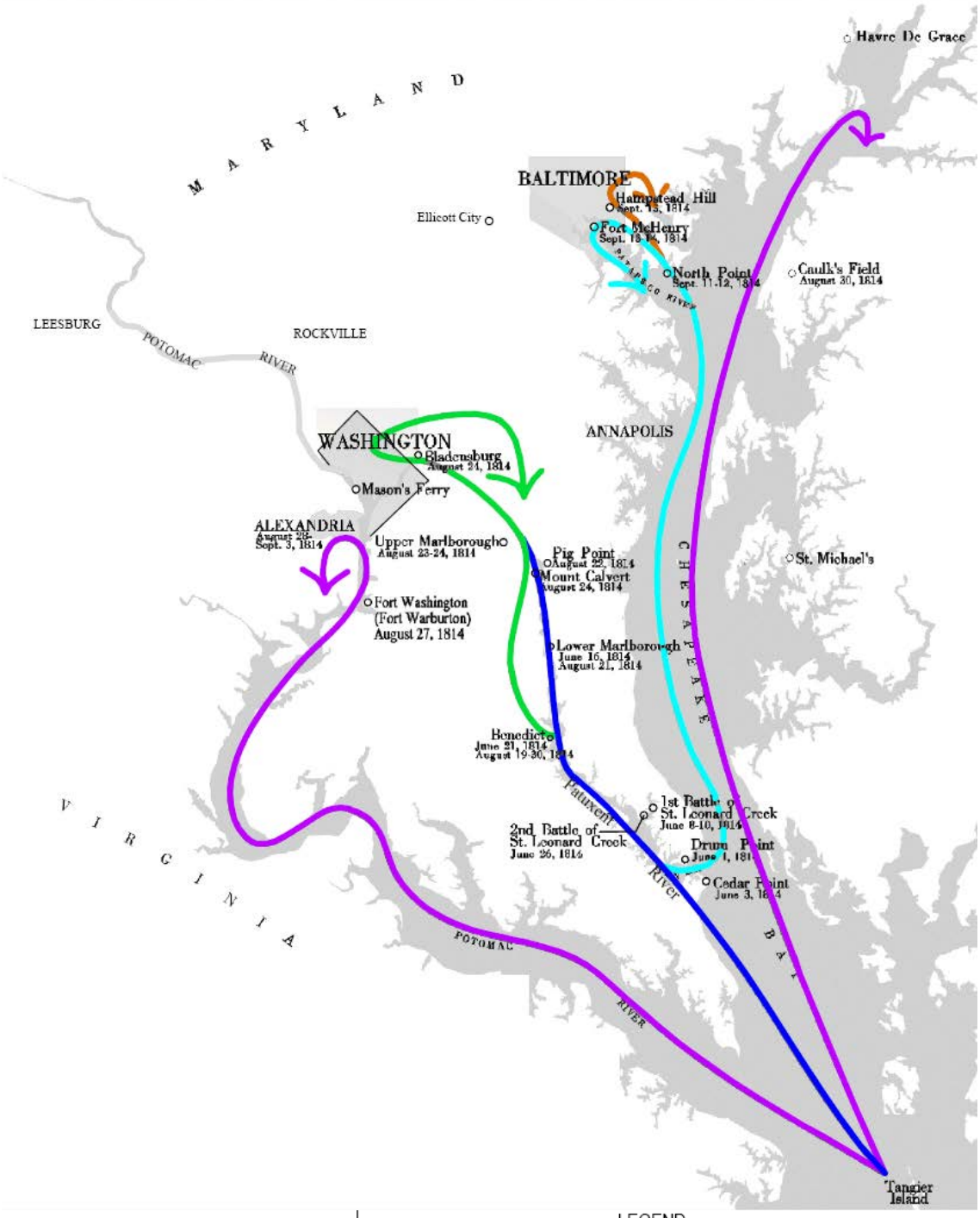


Driving and Historic Trails

The National Historic Seaport Scenic Byway is a component of the Maryland State Scenic Byways and part of the Baltimore City Heritage Area's Star-Spangled Trails system. The five-mile driving trail travels around the Inner Harbor between Canton and Fort McHenry, passing by some of Baltimore's most well-known attractions.

In May of 2008, a bill that would establish the Star-Spangled National Historic Trail, an extended trail following the routes of travel that were prevalent during the War of 1812 (Figure 12), was signed by President Bush. A National Historic Trail is an historic string of historic sites and landmarks. A National Historic Trail need not be continuous and might include land and water segments, marked highways paralleling the route, and sites that together form a chain or network along the route. Though the precise route has not yet been determined, the Star-Spangled Trail will travel through Washington, DC, and the state of Maryland, tracing a number of major events including the American victory at Fort McHenry in 1814.

Figure 12
Star-Spangled Banner National Historic Trail.
Source: NPS



Main Entrance Gate

When East Fort Avenue terminates at Fort McHenry's entrance gate, the wide two-lane road immediately transitions to a 1.5-lane wide fort entrance (Figure 13). The main gate is an historic structure that currently can accommodate only one lane of vehicle traffic at a time and provides poor access for pedestrians and bicyclists. Due to its historic status, the gate cannot be widened. The Volpe Center's 2004 report recommends a non-structural approach to the traffic flow problem, including signage, materials, and pavement markings that ensure safe one-way-at-a-time flow through the gate (Figure 14).

Figure 13
Dimensions of the entrance gate.
Source: The Volpe Center

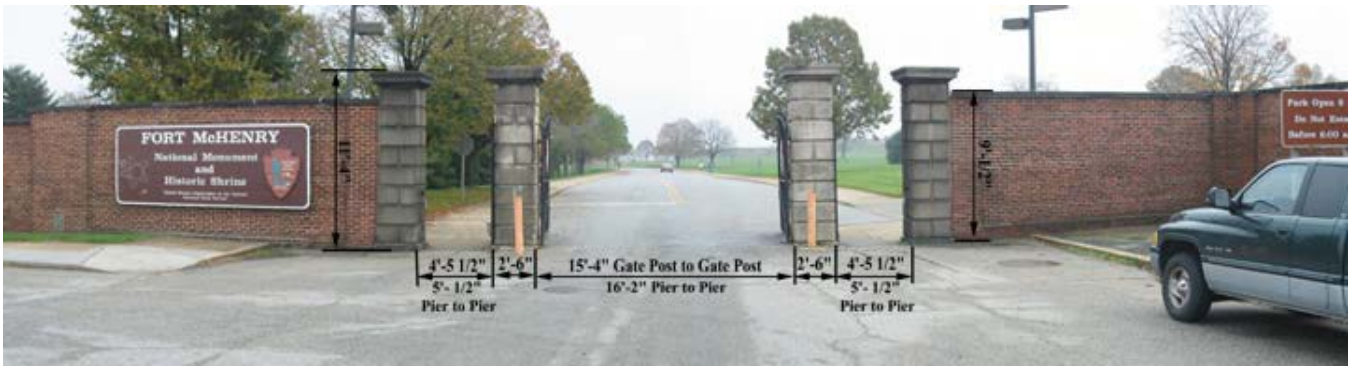
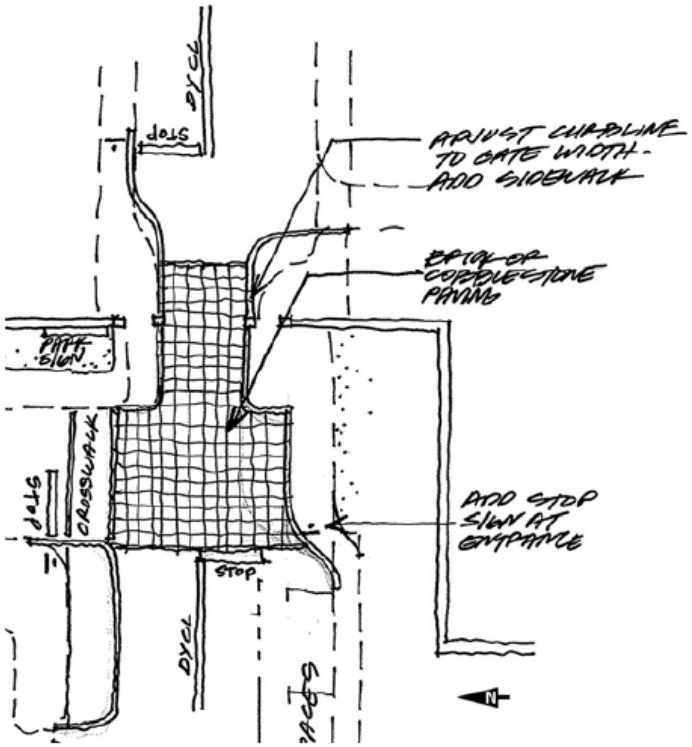


Figure 14
Proposed entrance gate improvements.
Source: The Volpe Center and Kyle Zick, CRJA



Parking

Once through the gate, tour buses, school buses, and private automobiles use the main fort road to approach the Visitor Center, approximately 0.2 miles away. The existing parking area, adjacent to the Visitor Center, consists of 161 designated parking spaces for cars and six spaces designated for buses. During parking overflow events, vehicles park in a concrete-reinforced grassy area west of the existing parking area (see Figure 4). This spillover area can accommodate 125 cars. With the construction of the new Visitor Center, the fort will lose 53 of the existing parking spaces for cars, further exacerbating parking problems that currently exist.

There are a number of days, particularly in the springtime, when buses and school buses bring a large majority of the visitors to the fort. On these days, buses are given priority to the paved parking area, and when it is full, private autos are required to park in the overflow area. According to the 2004 Volpe Center study, car and bus parking demand peaks do not generally overlap; peak demand for buses occurs on weekdays and on weekends for cars.

Pedestrian Facilities

Because Fort McHenry is physically removed from Baltimore's well-traveled tourist districts and accommodations, access by out-of-town pedestrians and cyclists is difficult. On the other hand, local residents often use the fort's grounds, either to visit the fort or to simply walk around. The only area in the fort that is a Federal Fee Area is the Star Fort, with the fee collected at the Visitor Center. Beyond the Star Fort, pedestrians are free to come and go without paying.

The existing pedestrian gates provide two 4-foot 5 ½-inch walkways, each located on either side of the vehicle entrance (Figure 13). Sidewalks extend from each gate down both sides of the road leading to the Visitor Center, but no crosswalks are present at the entrance gate.

Bicycle Facilities

Cyclists traveling to the fort must also use the main entrance at Fort Avenue, but bike lanes do not exist on Fort Avenue or on the fort road leading to the Visitor Center. Due to the unusual configuration of the historical gate, entering and exiting the fort on bicycle can be dangerous. Bike racks for public use are available outside the Visitor Center.

Signage

Currently, the fort is signed from all major highways and large access roads. Fort staff believe the upcoming Bicentennial celebration and National Heritage Area designation will allow for more wayfinding signage throughout the city that helps navigate all users to the fort, including cars, buses, cyclists, and pedestrians. Indeed, the Baltimore City Heritage Area Authority has invested grant funds into the fabrication of new wayside panels along the Inner Harbor promenade and one panel specifically describes Fort McHenry. Fort staff also believe that NPS signage within the fort will be updated in time for the Bicentennial celebration.

Ferry Services

In the past fifteen years, a number of private shuttle boats (or water taxis) have operated in the Inner Harbor, but today, Ed Kane's Water Taxi is the only major service provider for the Inner Harbor. The Water Taxi service is a seasonal offering to the fort from April through September, targeting tourists or anyone wishing to travel to a variety of Inner Harbor destinations. The Water Taxi does run from November 1 to March 31 to the other Inner Harbor destinations, weather permitting (Table 2). The $9.00 adult fare pays for unlimited trips in a single day.

The city of Baltimore owns and maintains a dock at Fort McHenry (Figure 15) that is an important stop on the taxi's route. As highlighted earlier, the number of visitors using shuttle boat service to access the fort has declined over the past ten years.

Table 2
Water Taxi Schedule.
Source: Baltimore Water Taxis[9]

	Frequency		Mon.	Tues.	Wed.	Thu.	Fri.	Sat.	Sun.
November 1 – March 31 *(Weather Permitting)*	Approx. every 40 minutes	Start	11 am	11 am	11 am	11 am	11 am	11 am	11 am
		Stop	6 pm	6 pm	6 pm	6 pm	6 pm	6 pm	6 pm
April 1 – April 30	Approx. every 20-25 minutes	Start	10 am	10 am	10 am	10 am	10 am	10 am	10 am
		Stop	8 pm	8 pm	8 pm	8 pm	11 pm	11 pm	8 pm
May 1 – September 1	Approx. every 15-20 minutes	Start	10 am	10 am	10 am	10 am	10 am	10 am	10 am
		Stop	11 pm	11 pm	11 pm	11 pm	11 pm	11 pm	9 pm
September 2 – October 31	Approx. every 20-25 minutes	Start	10 am	10 am	10 am	10 am	10 am	10 am	10 am
		Stop	8 pm	8 pm	8 pm	8 pm	11 pm	11 pm	8 pm

Figure 15
The Dock at Fort McHenry.
Source: Volpe Center

Train Station and Rail Services

Baltimore is served by a number of passenger trains, including Amtrak, MTA Maryland Area Rail Commuter (MARC), MTA Metro Subway, and MTA Light Rail. The systems are not particularly well integrated, and connecting between systems can be difficult for those who are unfamiliar to the area.

The two main center-city stations are Camden Station and Penn Station. Camden Station is closer to Locust Point and is served by MTA MARC and Light Rail. Penn Station is located on the other side of downtown and includes service for Amtrak, MTA MARC, and Light Rail.

Aviation

Baltimore-Washington International Airport (BWI) is a major terminal located south of Baltimore in Linthicum, Maryland. A number of major freeways connect the airport to downtown Baltimore, and travel to the fort from BWI by car takes about fifteen minutes in light traffic via I-195, I-295 and I-95.

For public transportation alternatives, MTA Light Rail offers a direct route from the airport to Camden Station via the Hunt Valley and BWI Marshall line. An alternative option involves taking a free shuttle

[9] www.thewatertaxi.com

from the airport to BWI Station, where MARC and Amtrak trains take passengers to Penn Station in downtown Baltimore.

Section 2: Context and Preliminary Route Concepts

The Volpe Center began its analysis by evaluating four alternative route concpets, each connecting the Inner Harbor to south Baltimore and Fort McHenry. The concepts include two commissioned by the city of Baltimore and two variations on these concepts developed by the Volpe Center.

This section describes these concepts in detail. For each transportation alternative, there is a description of the concept, a map depicting the proposed route, and an explanation of the route. The service characteristics and analysis for each concept are discussed in Section 5. Table 3 lists key adjacent and nearby destinations served by the preliminary route concepts.

Table 3
Key Destinations Served
Source: The Volpe Center

Cultural/Recreation	Office/Retail
• Fort McHenry National Monument and Historic Shrine • Baltimore Area Visitor Center • Maryland Science Center • American Visionary Arts Museum (AVAM) • Baltimore Museum of Industry • Federal Hill Park • Latrobe Park • Baltimore Maritime Museum • General Sam Smith Park	• Tide Point • Harborplace and The Gallery • Florida Crystals / Domino Sugar • Struever Brothers • Southside Shopping Center • C Steinweg • Phillips Food Inc. • Legg Mason • McHenry Row (Under Construction)
Hospitality	**Residential**
• Hyatt Regency Baltimore • The Ritz-Carlton, Baltimore • Renaissance Mayflower Hotel • Sheraton Inner Harbor Hotel • Springhill Suites Inner Harbor • Residence Inn Downtown Harbor • Four Points by Sheraton • Hampton Inn & Suites Baltimore Inner Harbor • Hotel Indigo	• The Ritz-Carlton Residences • Silo Point • Pierside Apartments • Harborhill Apartments • Pinnacle at Harborview • McHenry Point • McHenry Row (Under Construction)

Kittelson Report Concepts

The city of Baltimore hired a private consultant, Kittelson and Associates, to assist with the planning for each of the Charm City Circulator's routes. As part of this work, Kittelson developed two route options serving south Baltimore, Locust Point, and Fort McHenry; considered service feasibility; conducted public meetings; and published their findings in a report completed in 2008. Ultimately, Kittelson recommended that service to south Baltimore not be included in the Charm City Circulator's initial phase and to "hold further discussion about service along Key Highway and Fort Avenue until [the first three] routes are in service."[10] The two concepts from the Kittelson report are summarized below.

Route Concept 1: Linear Alignment

The Linear Alignment is the first route option developed by Kittelson and Associates. The alignment (Figure 16) would connect the Baltimore Visitor Center and Inner Harbor with Fort McHenry via Key Highway and Fort Avenue. This route is approximately 5.8 miles. The Linear Alignment would offer

[10] Kittelson and Associates. "South Baltimore Shuttle Study". November 2008.

access to important cultural destinations, including the American Visionary Arts Museum (AVAM), the Baltimore Museum of Industry, and Fort McHenry. The route would also serve a number of major employers, including those at Tide Point and most of the major industries in Locust Point. Finally, the Linear Alignment could provide a transportation alternative for the residents of Locust Point, including many of the people living in new and historic residential developments along Fort Avenue and in nearby neighborhoods. One benefit of the Linear Alignment over an open loop system, like the Triangular Alignment, is that several of the locations along Key Highway would be served twice during the course of the route since there is a stop proposed for several of these locations on both sides of the street.

Route Concept 2: Triangular Alignment

As developed by Kittelson and Associates, the Triangular Alignment would provide inbound transit along Key Highway and outbound service along Fort Avenue (Figure 17). This route is approximately 6.4 miles. While this alternative would serve many of the same cultural destinations as the Linear Alignment, they would only be accessible via inbound trips. Outbound, the Triangular Alignment travels along Light Street and Fort Avenue, creating greater potential for residential riders who desire access to commercial areas such as Cross Street Market, Southside Shopping Center, and McHenry Row (under construction).

Local use versus tourist use

Kittelson's report states that potential south Baltimore circulator riders would generally fall into one of two categories: locals or tourists. While the transportation needs of each group sometimes overlap, they frequently diverge. South Baltimore locals – either residents of the area or workers who travel to the area daily – form one potential customer base whose transit needs are more heavily focused on residential areas, employment centers, and shopping districts. Tourists' transit needs tend toward attractions such as museums and cultural attractions, public spaces, entertainment venues, restaurants, and hotel districts. South Baltimore has many amenities for both locals and tourists, but certain route alignments would likely serve one group better the other.

MTA Bus Route 1

While out-of-town visitors rarely ride the Maryland Transportation Authority's (MTA) bus routes, service to the Fort does exist. The Kittelson report examines MTA's Route 1, which currently serves Fort Avenue, Locust Point, and Fort McHenry in south Baltimore. According to the report, as an alternative to a south Baltimore circulator route, both the city and the Fort "can work with the MTA to explore further improvements to their Route 1…to ensure any service they undertake is done in coordination with [Circulator] routes…"[11]

The Charm City Circulator

By 2010, the city of Baltimore will offer a new public transportation option for both visitors and residents of the city's central neighborhoods and business districts. The Charm City Circulator will be a system of free, neighborhood buses and water shuttles, managed by the city of Baltimore and funded by a new downtown-area parking tax. As proposed, the Circulator will feature three distinct land-based routes and two water-based routes, connecting Baltimore's core to a number of surrounding urban neighborhoods and destinations (see Appendix A). While the water shuttle circulators are already in operation, the first of the $600,000 state-of-the-art hybrid vehicles is expected to be in service in early 2010. All three of the proposed Charm City Circulator routes are expected to be operational by the end of 2010.

Within south Baltimore, the Charm City Circulator's proposed "Yellow Line" will provide service to Federal Hill along Charles and Light Streets, as far south as Ostend Street. Additionally, each of the two new water shuttle routes provide direct service between Tide Point and Maritime Park in Fell's Point and Waterfront Park in Canton. The impetus for creating the new water shuttle routes was in part due to the

[11] "South Baltimore Shuttle Study." p. 17

lack of land-based service in south Baltimore. Currently, there is no planned land-based connection between the planned Yellow Line and Tide Point.

Volpe Concept Variations

Recognizing that both the Linear and Triangular Alignments were designed as distinct route concepts, the Volpe Center developed two additional route concepts for the consideration of stakeholders, each an adaptation of the Kittelson concepts as an extension of the proposed Charm City Circulator Yellow Line. While these route concepts would be a seamless component of the proposed Yellow Line, they would make the 5.2-mile Yellow Line significantly longer than currently planned. Along with the original Kittelson concepts, these route concepts were presented as a starting point for a stakeholder workshop brainstorming session. The two concept variations, the Linear Extension and the Triangular Extension are described below.

Route Concept 3: Linear Extension

The Linear Extension (Figure 18) is an extension of the north/south Yellow Line of the Charm City Circulator. The distance of the Yellow Line with the inclusion of this route is approximately 10.2 miles.

Route Concept 4: Triangular Extension

The Triangular Extension (Figure 19), connects downtown Baltimore with Fort McHenry, outbound via Fort Avenue, and inbound on Key Highway, as an extension of the proposed Yellow Line. The distance of the Yellow Line with the inclusion of this route is approximately 9.9 miles.

Figure 16
Route Concept 1: Reproduction of Kittelson's Linear Alignment
Source: Kittelson and Associates
Map Design: The Volpe Center

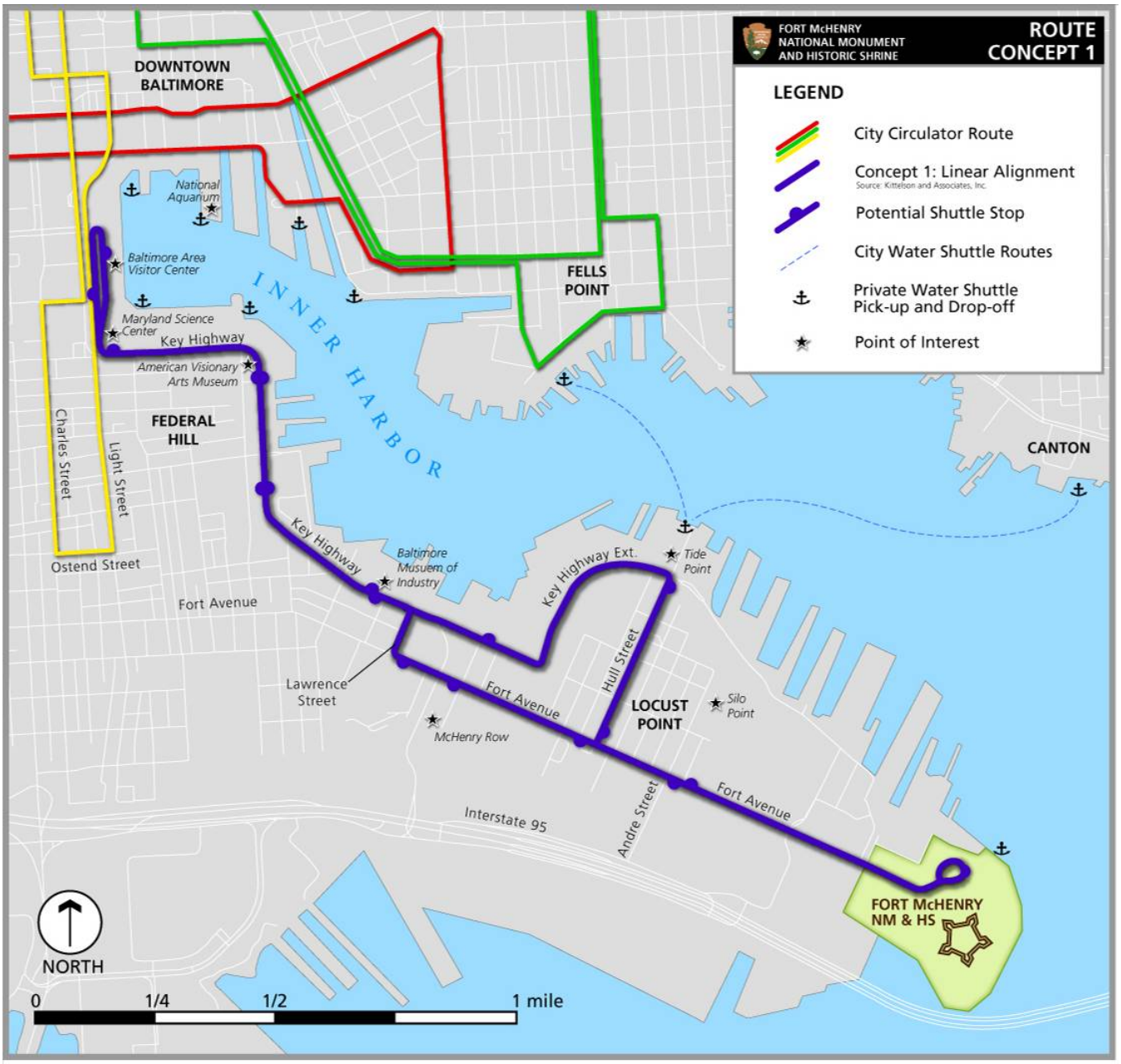


Figure 17
Route Concept 2: Reproduction of Kittelson's Triangular Alignment
Source: Kittelson and Associates
Map Design: The Volpe Center

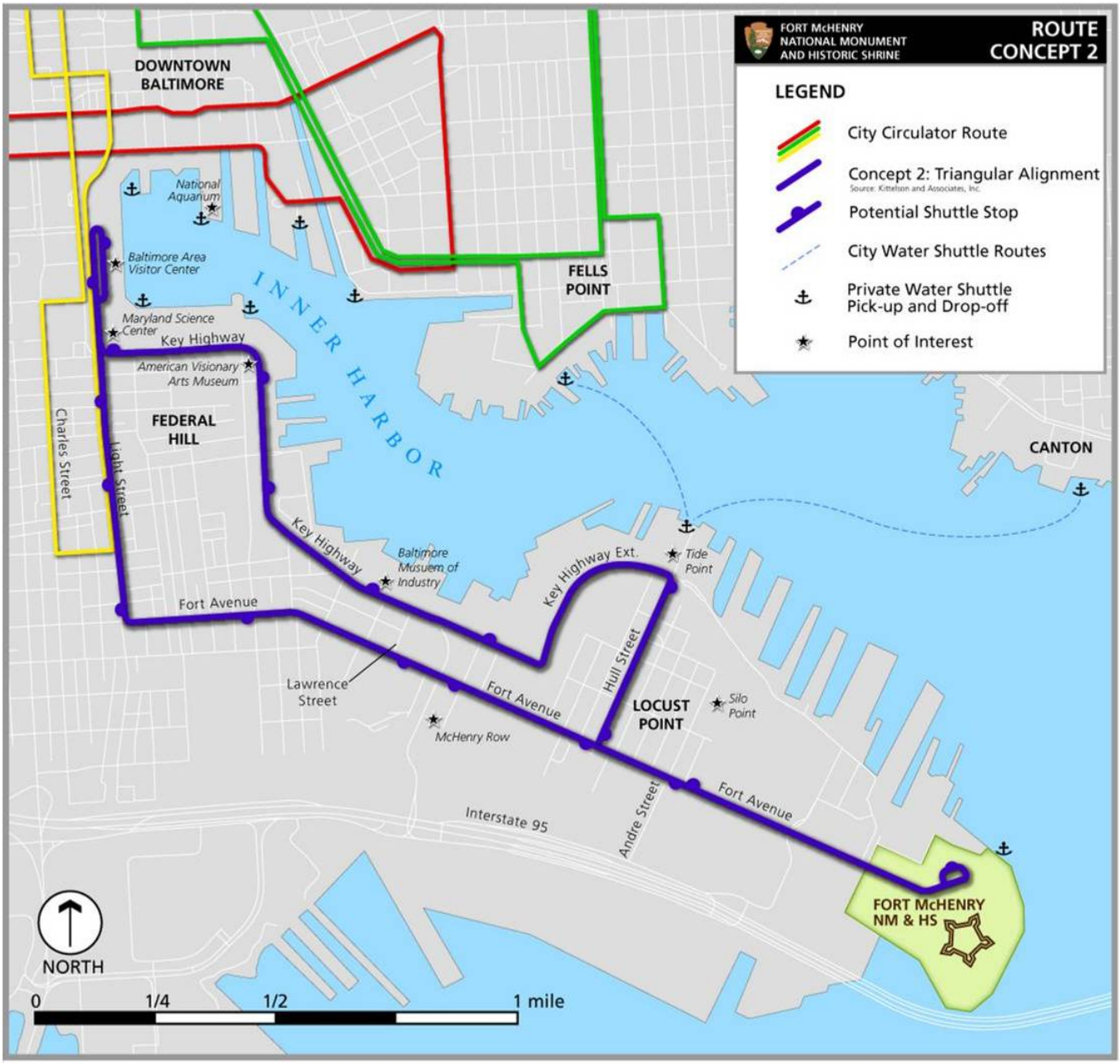


Figure 18
Route Concept 3: Linear Extension
Source: The Volpe Center

Figure 19
Route Concept 4: Triangular Extension
Source: The Volpe Center

Section 3: Workshop Route Concepts

Working with the fort, the Volpe Center organized a half-day shuttle transportation workshop in June 2009 with stakeholders including local residents, business owners, representatives from local private and public agencies, and representatives from nearby cultural attractions. The intent of the workshop was to talk with stakeholders about the planning process for the proposed shuttle and to gather input from the stakeholders to formulate additional concepts. The following section discusses the two concepts that came out of the workshop small groups. Appendix A contains additional details about the format and benefits of the workshop process.

Following presentations by Fort McHenry, the Volpe Center, and the city of Baltimore and a discussion of preferred service characteristics, stakeholders divided into three groups. The groups were asked to generate preferred route alignments factoring in their preferred service characteristics.

Group discussion of service characteristics

Route considerations

Stakeholders suggested potential stops for a prospective shuttle route. The following stops are a list of suggested shuttle stops along with a discussion of their importance:

- *Fort McHenry National Monument and Historic Shrine* – All stakeholders recognized that Fort McHenry is the logical eastern terminus for any south Baltimore shuttle/circulator system.
- *Baltimore Area Visitor Center* – Located on the Inner Harbor, the Visitor Center is a modern, newly constructed building that serves as the focal point for Baltimore's tourism industry. At the center, visitors can purchase tickets to attractions, obtain maps and brochures, and learn about the city's history, arts, neighborhoods, and shopping. The Visitor Center was identified as a logical western point of service for a south Baltimore shuttle route and as a key location for facilitating and attracting tourist-based ridership due to its proximity to Inner Harbor attractions and hotels.
- *American Visionary Arts Museum (AVAM)* – The AVAM, located at the base of Federal Hill, serves as the national repository for artworks created by self-taught artists. It is an important cultural destination and institution in the community.
- *Baltimore Museum of Industry* – The Baltimore Museum of Industry has been a south Baltimore fixture since its inception in 1981. The Museum is dedicated to preserving the city's rapidly disappearing industrial heritage and is located in the historic Platt Oyster Cannery building. The Museum was highlighted as a key stop by stakeholders and Museum officials.
- *Silo Point* – The Silo Point residential development was constructed around the abandoned shell of a former B & O Railroad grain terminal. The development features over 220 residential units and 25,000 square feet of retail space. Silo Point and an adjacent 121 unit townhome development are exemplary of the recent growth occurring in Locust Point, as well as the increasing population density that is well-suited for improved transit access.
- *Tide Point* – Tide Point is a 400,000 square foot corporate office campus located in a former Procter & Gamble soap factory. A number of large corporations, including Under Armour, Inc., have offices in the facility. As part of Phase 1 of the Charm City Circulator, Tide Point is currently being served by a free, regular water shuttle service with "ping-pong" (back and forth) service to the Fells Point and Canton neighborhoods.
- *McHenry Row* – A mixed-use office, commercial, and residential development that is currently under construction, McHenry Row will introduce a number of desired services to south Baltimore, including a new supermarket.

- *Maryland Science Center (MSC)* – The Maryland Science Center, located a couple of short blocks from the Visitor Center, was also identified as a potential stop due to its high visitation, IMAX theater, and role in Baltimore's tourism industry.
- *Phillips Seafood Restaurants Distribution Center* – Located on Fort Avenue in Locust Point, it was anecdotally estimated that approximately 40 percent of the employees at this site use public transportation for commuting needs.
- *Domino Sugar* – With its famous sign visible from almost anywhere along Baltimore's waterfront, Domino's Locust Point facility employs approximately 300 people.

In addition to the above stops, stakeholders mentioned additional destinations and/or points of interest. These locations did not have the same amount of consensus as the previous list of suggested stops:

- *Federal Hill Park* – Situated on a hill overlooking the Inner Harbor, Federal Hill Park is a neighborhood park offering panoramic views of downtown Baltimore. Key Highway serves as the northern border of the park, but access from Key Highway can be difficult due to the steepness of the hill itself.
- *Hull Street retail* – The Hull Street corridor passes through the heart of Locust Point between Fort Avenue and Tide Point. Hull Street is predominantly residential, though a number of viable neighborhood businesses offer goods and services to residents. A number of stakeholders at the workshop valued the slow pace of Hull Street, voicing concerns that bus service is not appropriate for the area.
- *Riverside Park* – Located one block south of Fort Avenue, the popular Riverside Park is composed of approximately nine city blocks. The park is at the heart of the Riverside neighborhood and is well visited by locals.
- *Southside Shopping Center* – At the intersection of Lawrence Street and Fort Avenue, Southside Shopping Center provides a number of retail services to local residents. One of its anchors, Shoppers Food Warehouse, is currently the only major supermarket in south Baltimore.

Schedule and frequency considerations

Stakeholders also discussed the hours of operation for the shuttle system. The initial consensus was that the shuttle system would ideally operate along the same or similar hours as the Charm City Circulator and similarly have a frequency of 10 minutes. As the stakeholders gained a better understanding of funding and operating costs, scheduling considerations were altered accordingly. Keeping in mind the operating costs of the shuttle, and recognizing that the final preferred alternative may operate independently of the Charm City Circulator, stakeholders agreed that headways should be maintained at no more than 20 minutes and hours of operation could be aligned with Fort McHenry's hours of operation. Stakeholders also discussed the possibility of seasonal variation in the schedule with more frequent service during peak seasons and less frequent service in the off-peak seasons. However, the stakeholders agreed a consistent year-round service would be preferred.

Integration with Charm City Circulator

Stakeholders emphasized the inclusion of the Fort McHenry route with the marketing of the Charm City Circulator routes as a method of ensuring uniformity and brand awareness among potential users. In doing so, the Fort McHenry shuttle system would become, in essence, the fourth branch of the Charm City Circulator, providing much needed service to the south Baltimore community and attractions.

Contrary to the Charm City Circulator, the Fort McHenry route is envisioned operating at longer headways for shorter periods throughout the day. The reduced operating hours and schedule, favored by stakeholders and Fort McHenry, is intended to lower operating costs while establishing a service that is in-line with community desires and recreational needs. In an effort to simplify circulator operating times and headway, the stakeholders suggested augmenting the route to ensure that headways land on round hours (i.e. every half hour.)

Funding

Stakeholders raised the topic of funding as one of the first discussions at the workshop. Stakeholders noted that the city had engaged in a similar planning process in 2008 and were concerned that without any funding ideas this effort would produce few results. Volpe Center and city of Baltimore staff described the complex nature of securing long-term operational funding and emphasized that a collaborative planning process would demonstrate support for the shuttle and provide decision makers with a clear picture of the necessary funding required to meet the desired level of service. Stakeholders acknowledged that a collaborative process inclusive of stakeholder organizations was the best approach in securing a long-term funding source.

Potential users

Stakeholders also discussed potential riders for the proposed shuttle service. Stakeholders acknowledged the importance of local riders commuting between their homes and jobs in south Baltimore and downtown and/or connecting to other transit services to access other destinations. Stakeholders also agreed that the circulator would reduce parking needs throughout south Baltimore for tourists staying in the Inner Harbor area. Initially, the group disagreed on whether residents or tourists should be the primary focus. By the end of the meeting, most stakeholders agreed that the service should focus on ameliorating tourist-based congestion and parking difficulties.

Stakeholders recognized the advantages of a multimodal hub at Tide Point and the value in providing a land-based connection for the new water shuttle service. City officials noted that because the water shuttle was created as an alternative to land-based circulator service, the water shuttle may be discontinued if land-based service to Tide Point were to become available.

Most stakeholders, particularly local business owners, felt that coordination with MTA would be an essential component to building public support for a shuttle service. Currently, some workers rely on MTA's Route 1 as transportation to and from jobs in Locust Point. A number of stakeholders acknowledged that it would be difficult to shift riders from the existing MTA service to a new south Baltimore shuttle.

Neighborhood impact

A handful of stakeholders raised concerns about Locust Point succumbing to a "parking lot effect" as commuters along I-95 might be inclined to park and use the free shuttles to access downtown Baltimore. To mitigate these concerns, it was suggested that signage to existing parking lots be utilized for those choosing to park and ride. Additionally, the city might consider altering its parking policies in the neighborhood to discourage and/or prohibit long-term non-resident parking.

Stakeholders also described the benefits of using a remote parking facility and shuttle system during major events. Stakeholders cited the successful use of circulator shuttles at the recent Michael Phelps celebration held at Fort McHenry – an indication that traffic concerns could be improved through the effective use and implementation of a shuttle system. Ironically, the shuttle system for this particular event did not meet its desired ridership goals.

One of the greatest concerns brought up by the stakeholders centered around shuttle traffic along Hull Street. Most stakeholders agreed that Hull Street is not well-suited for regular circulator service due to its residential character, frequent stop signs at intersections, and poor pavement condition. Stakeholders generally believed that most bus riders would be willing to walk a short distance from Fort Avenue or Tide Point. They also felt that routing shuttles through the heart of the neighborhood along Hull Street would contribute to congestion problems in the residential area of Locust Point.

Cleaner Greener Baltimore Initiative

As noted by the stakeholders, the Charm City Circulator and potential south Baltimore shuttle are consistent with Mayor Sheila Dixon's Cleaner Greener Baltimore Initiative. The Cleaner Greener Baltimore Initiative is aimed at coordinating green efforts throughout the city, from recycling programs to

the reduction of carbon emissions. The city is encouraging residents to make sustainability a daily priority. The Charm City Circulator and Baltimore Bike Summit are two examples of this initiative.

Small Group Route Concepts

Small Group 1

Concerned primarily with addressing the needs of both residents and visitors, Small Group 1 designed an extension of the Charm City Circulator Yellow Line. The full length of this route is approximately 11.4 miles (which the shuttle would run at peak times) and 10 miles without the spur to Tide Point. Small Group 1's route, represented in Figure 20, conceptually begins at the southern loop of the north/south route, heading north onto Light Street from East Ostend St. At Key Highway, the route turns right, passing by the Maryland Science Center, AVAM, a number of new residential developments, and the Baltimore Museum of Industry. During peak times, the route continues along Key Highway to serve Tide Point, returning linearly before making a left on Lawrence Street. During non-peak times, the route omits the spur to Tide Point. The route then turns left on Fort Avenue, with stops at McHenry Row, Southside Marketplace, Phillips Distribution Center, and Fort McHenry. The route returns along Fort Avenue to Charles Street, where it turns right and returns to the north/south route configuration.

Several considerations guided Small Group 1's decision making. Small Group 1 operated under the assumption that riders would not want to board a separate bus to south Baltimore because they would not want to transfer. Moreover, the group felt that extending the north/south route would provide the best opportunity to capitalize on the Charm City Circulator's momentum, exposure, and brand image. To ensure uniformity, the group recommended the use of the same Charm City Circulator vehicles.

Small Group 1's peak service consideration illustrated the group's desire to meet local community needs while maintaining service to a major employment center, Tide Point. Additionally, Small Group 1's alignment provides a "point-to-point" service to Tide Point and Fort McHenry from Lawrence Street, which indicates the group's preference to keep the shuttle off Hull Street.

Small Groups 2 and 3

Small Groups 2 and 3 agreed on the same fundamental route alignment, most clearly described together as one route alternative. The concept is very similar to the Linear Alignment as developed by Kittelson and Associates (Figure 21). This route is approximately 5.8 miles. The groups chose the Visitor Center as the starting point, noting that the service should be primarily aimed at capturing tourism-based traffic. From the Visitor Center, the shuttle travels south to Key Highway along Light Street, making its first stop at the Maryland Science Center. The route then continues southeast along Key Highway, making stops at AVAM, Harborview/Pierside Apartments, and the Baltimore Museum of Industry.

At the intersection of Lawrence Street and Key Highway, the group proposed splitting the route into two branches, with a morning peak continuing along Key Highway, providing direct service to Tide Point before arriving at Fort McHenry, and a midday and weekend route that would bypass Tide Point. The group thought that the reverse route would also service Tide Point via Hull Street in the afternoon peak period. Meanwhile, the midday route makes a right on Lawrence Street to connect to Fort Avenue as it heads towards Fort McHenry. Along Fort Avenue, the route stops at McHenry Row, Southside Marketplace, Philips Food Inc., and arrives at Fort McHenry. The morning and afternoon peak routes would stop at Tide Point and Domino Sugar.

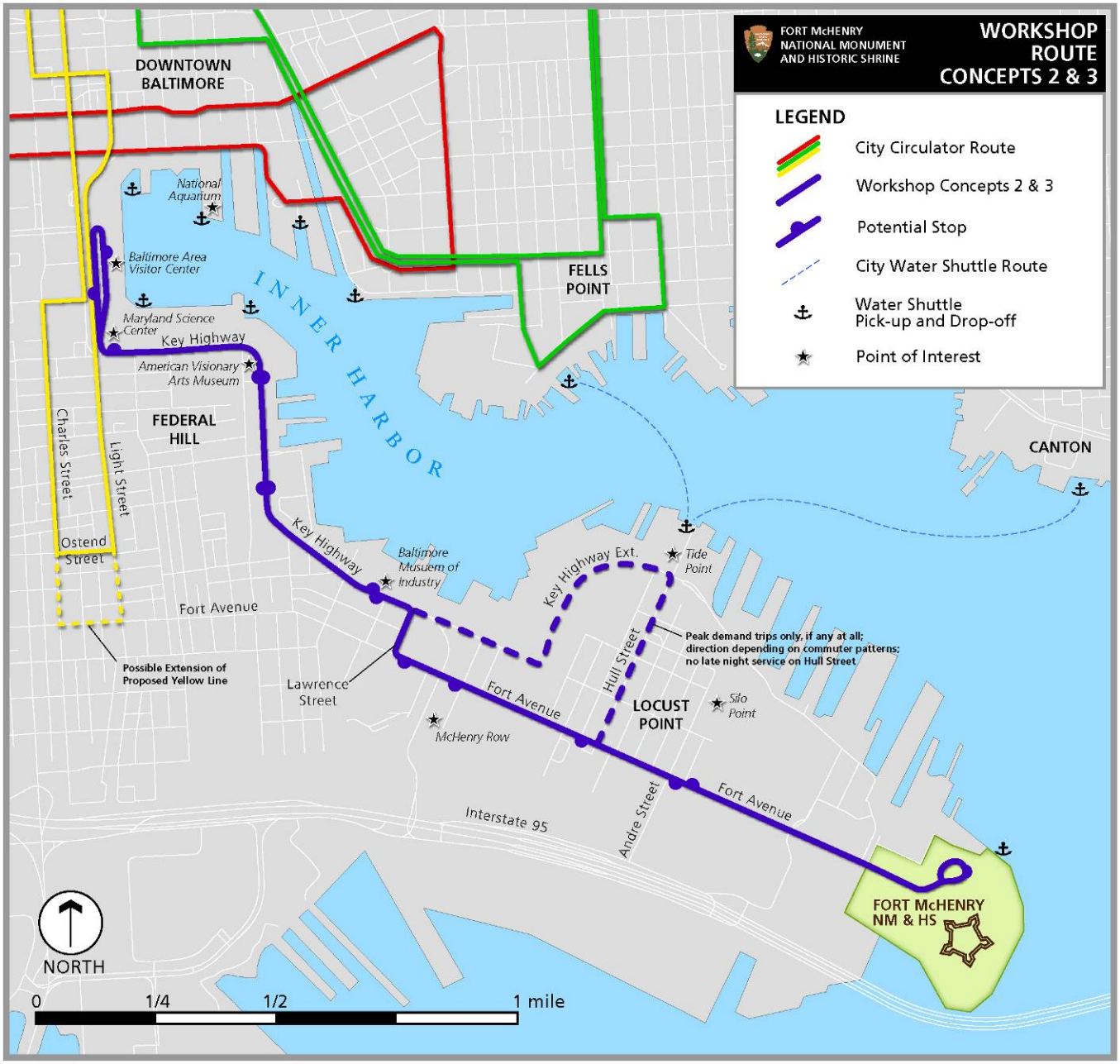
Small Groups 2 and 3 were motivated by the desire to be inclusive of attractions and businesses while serving the needs of both tourists and residents. The group's consideration of providing peak service to Tide Point illustrated the group's desire to meet local community needs while maintaining service to a major employment center. As such, the groups also determined that midday and weekend service to Hull Street was unnecessary.

Small Groups 2 and 3 determined that the shuttle's hours of operation should vary by season, possibly aligned with Fort McHenry's operating hours. One of the Small Groups thought that the frequency of

service along the route should be at 15-minute intervals during the peak seasons and 30-minute intervals during the winter seasons. To ensure uniformity between this route and the Charm City Circulator, this group recommended the use of the same Charm City Circulator vehicles.

Figure 20
Workshop Route Concept 1
Source: The Volpe Center and Small Group 1

Figure 21
Workshop Route Concepts 2 & 3 (combined)
Source: The Volpe Center and Small Groups 2 & 3



Section 4: Refined Route Concepts

Based on the outcomes of the workshop, the Volpe Center worked with the fort and the city to develop two refined route concepts for the south Baltimore shuttle with service between the Baltimore Area Visitor Center and Fort McHenry. While both refined route concepts are similar to the 2008 Kittelson Report Linear Alignment, due to traffic patterns at the Baltimore Area Visitor Center, the lack of a safe turn-around location, and the potential for attracting more riders, two different route extensions are proposed. These loop extensions will allow the shuttle vehicle to safely transition from inbound to outbound trips, while offering access to additional destinations in and around the downtown core and providing connections to existing alternative transportation modes.

Service characteristics and operation costs were primary considerations for each refined route concept. As illustrated in Section 5, operations costs increase significantly as additional vehicles are introduced into the system. Therefore, based on input from the workshop, the city, and Fort McHenry staff, each refined route concept was designed to provide the highest quality service with the fewest number of vehicles.

Each concept should serve tourists, local residents, and employers in the area. The refined route concepts are designed with these diverse users in mind, offering a service frequency and hours of operation that are adequate to balance their diverse needs. The refined route concepts support the city's green campaign by encouraging users to take advantage of sustainable, multimodal transportation options. Detailed alignment and service characteristics for each refined route concept are described below.

Refined Route Concept 1

Alignment

Refined Route Concept 1 (Figure 22) begins conceptually at the Baltimore Area Visitor Center, a critical junction for visitors looking to become better acquainted with the sights and attractions of the Baltimore region. From the Visitor Center, the route travels north along Light Street and continues north onto Calvert Street. At Redwood Street, the route turns west and travels for one block. The route again turns left onto Light Street and travels south toward the Visitor Center. Depending on travel times and bus stop locations, the shuttle could use Lombard Street (as opposed to Redwood Street) between Calvert and Light Streets.

By traveling into downtown, Refined Route Concept 1 establishes multimodal connection points with the Charm City Circulator red (east/west) route, Baltimore Metro Subway (one block offset), and approximately 28 MTA bus routes. The route extension into downtown is designed to provide enhanced service for residents who live and work downtown as well as visitors staying at the many hotels in the Inner Harbor district.

The route continues south along Light Street and stops opposite the Baltimore Area Visitor Center before turning left onto Key Highway. The route travels south and east on Key Highway, with stops at the Science Center, AVAM, and the Museum of Industry. These stops along Key Highway also serve a number of new high-density waterfront residential developments.

After turning left to continue on Key Highway Extension, the shuttle stops at the Domino Sugar plant and continues to Tide Point. Assuming that the water shuttle continue, perhaps not as a fare free service, the Volpe Center, together with some local stakeholders and Fort McHenry, felt that establishing Tide Point as a multimodal hub would increase the viability of the transportation system. The connection at Tide Point will allow transit riders to access virtually the entire Inner Harbor region efficiently and with little to no expense.

From Tide Point, the shuttle route turns right on Hull Street, heading south to Fort Avenue. A number of stakeholders in Locust Point raised concerns using Hull Street, citing noise, increased traffic, and increased demand for on-street parking. Due to the importance of Tide Point, however, the Volpe Center believes that using Hull Street is essential for connecting Tide Point with Fort McHenry in the safest and most efficient way. Additionally, some of the businesses along Hull Street may benefit by having the

shuttle connecting them to potentially more customers. In response to stakeholder concerns, the Volpe Center has proposed service characteristics (in particular, one-way service only) that should minimize potential problems related to quality of life on Hull Street. Ultimately, if stakeholders' concerns hold true and the shuttle is disruptive, it will be possible to alter the alignment without significantly detracting from the overall goals of the route.

At Fort Avenue, the route turns left, heading east toward Fort McHenry. The route continues through the fort gates to the Fort McHenry Visitor Center. Barring any major traffic, obstacles (such as construction and train crossings), or delayed stops, a one-way trip from the Baltimore Area Visitor Center to the Fort McHenry Visitor Center should take approximately twelve minutes.

Upon departing the Fort McHenry Visitor Center, the route travels west along Fort Avenue stoping at Hull Street and McHenry Row. The return route maintains its heading along Fort Avenue in an effort to service a wider array of south Baltimore destinations and as an added measure to minimize traffic along the Hull Street corridor. At Lawrence Street, the route turns right, returning to Key Highway for the remainder of the journey back to the Baltimore Area Visitor Center.

Refined Route Concept 2

Alignment

The alignment of Refined Route Concept 2 (Figure 23) is very similar to Refined Route Concept 1. The difference is that Refined Route Concept 2 does not extend into the downtown core. Instead, this route provides a connection to Camden Station and the Convention Center.

In Refined Route Concept 2, the shuttle travels inbound on Light Street toward the Baltimore Area Visitor Center and turns left on Lee Street. The shuttle continues with a right on Sharp Street and stops directly in front of the Baltimore Convention Center, just one block from Camden Station light rail and MARC commuter trains. Using the Convention Center's turn-around, the shuttle will travel east on Conway Street before turning right on Light Street, immediately opposite the Baltimore Area Visitor Center.

The city requested that the Volpe Center and fort investigate connecting the shuttle to the light rail. The Volpe Center determined that this service to Camden Station was the most feasible option compared to connections to other light rail stations (Hamburg Street, discussed in Appendix C, and Pratt Street).

Figure 22
Refined Route Concept 1
Source: The Volpe Center

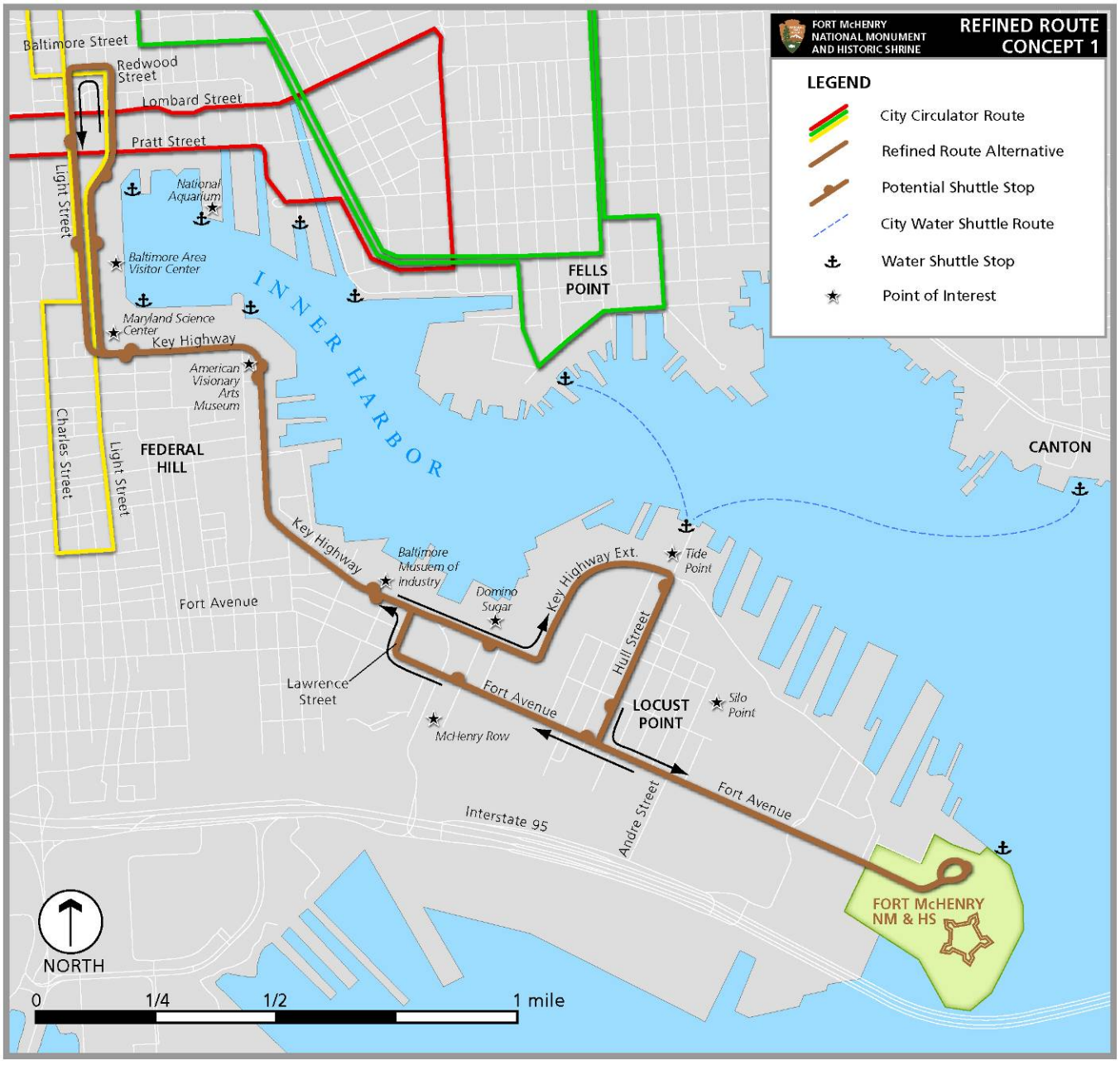
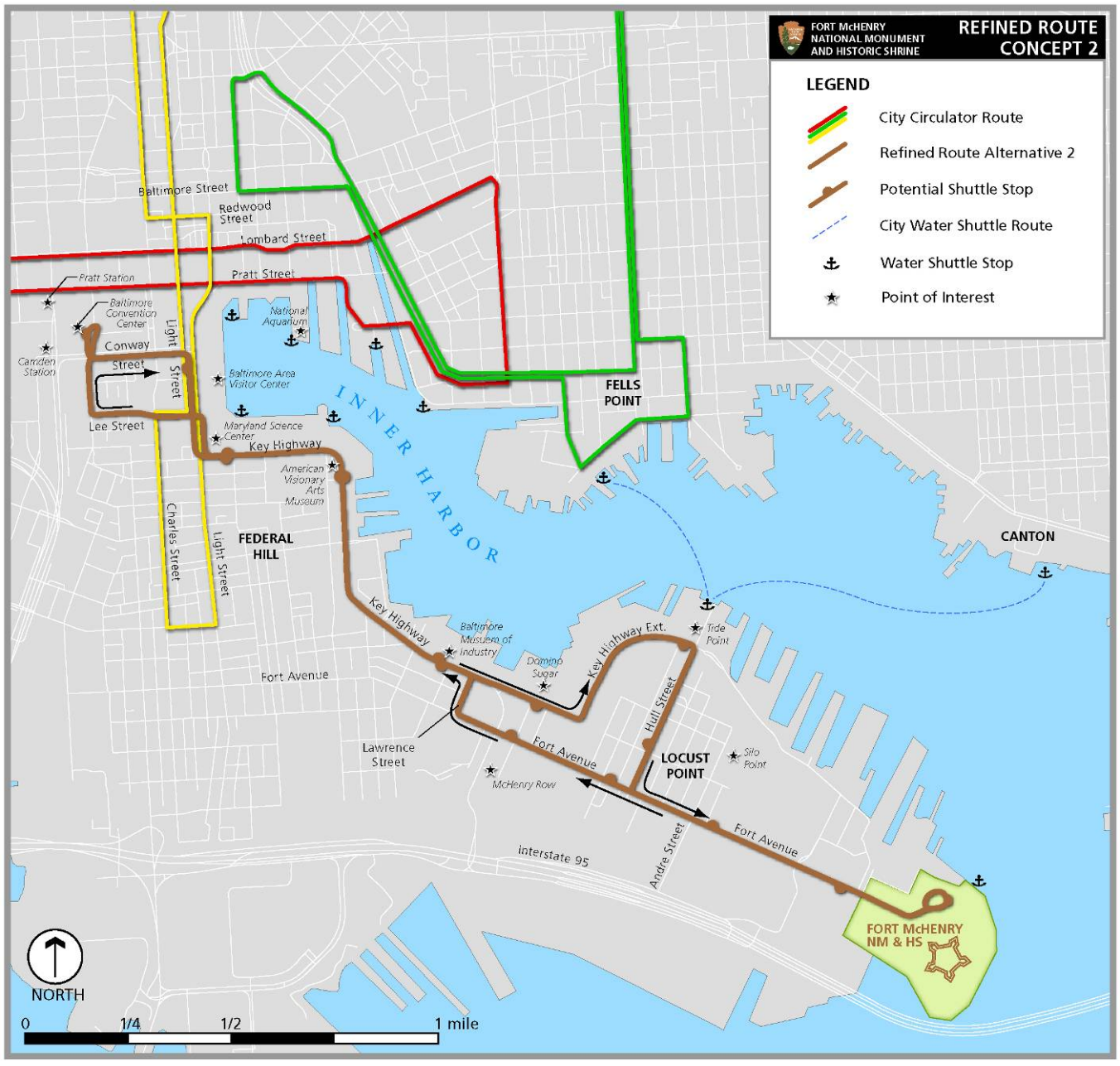


Figure 23
Refined Route Concept 2
Source: The Volpe Center



Section 5: Service Characteristics of Route Concepts

The following section describes the service characteristics for the route concepts developed during the course of this study and mentioned in this report. For all concepts, the shuttle was conceived to be fare free, as is the Charm City Circulator.

The Volpe Center estimated service characteristics for each of the separate routes using a simple spreadsheet model based on the model developed by Kittelson and Associates. Figure 24 displays an illustrative snapshot of this model.[12] A handful of service inputs (represented in yellow) and performance assumptions (represented in blue) are used to estimate service characteristics for each concept as well as each concept's estimated annual operating cost. The model calculates the estimated annual operating cost based on the hours the shuttle service is in operation per day, days in operation, weeks in service per year, the number of buses necessary to run the route, and the estimated hourly operating cost.

Figure 24
Illustrative snapshot of Excel model
Source: The Volpe Center

Service Characteristics

Number of Stops	18					
	Route Distance	Average Speed While Moving (MPH)	Estimated Time in Motion (Min.)	Estimated Dwell Time (Min.)	Assumed Layover Time (Min)	Total Running Time (Min.)
Weekday	5.8	18.3	19	4.5	3.5	27
Weekend	5.8	20.5	17	4.5	3.2	25

	Desired Headway (Min.)	Number of Buses (Calculated)	Number of Buses (Actual)	Trips per Day	Trips per Day per Bus	Mileage per Vehicle per Day
Weekday	10	2.70	3	105	105	609
Weekend	10	2.47	3	105	105	609

	Hours of Operation			Days of Operation	Weekly Service
	Begin	End	Total		
Weekday	6.50	24.00	17.5	5	263
Weekend	6.50	24.00	17.5	2	105
			Total Hours Per Week		368
			Weeks in Service Per Year		52

Operating Costs

Weeks in Service per Year	52
Annual Service Hours	19,110
Estimated Operating Cost ($/hr)	$65
Annual Operating Cost	$1,242,150

[12] The estimated dwell time in the model is 15 seconds per stop and the assumed layover time is 15 percent of the sum of the estimated time in motion and the estimated dwell time. Fifteen seconds per stop is reasonable and perhaps conservative since the bus will be fare free and the recommended low-floor bus has two doors that can be used for boarding and alighting. Furthermore, it is unlikely that the bus will stop at every bus stop on any given run. The layover time of 15 percent is also reasonable and perhaps conservative since the bus in all route concepts operates in a loop, so it is not necessary to factor in turnaround time.

Annual Vehicle Mileage	221,676

Preliminary Route Concepts

Linear and Triangular Alignments

As a starting point for discussions with stakeholders, service characteristics for the Linear and Triangular Alignments were first estimated to be the same as the Charm City Circulator. Table 4 shows the inputs, service characteristics, and estimated costs based on the Charm City Circulator parameters. Though the Triangular Alignment is longer than the Linear Alignment, the model estimated that running either route necessitated the same number of busses in service (three). Accordingly, the cost of operating either preliminary route is approximately $1.2 million with service characteristics similar to the Charm City Circulator.

Table 4
Estimated service characteristics for the preliminary routes
Source: The Volpe Center

	Service Characteristic	Linear Alignment		Triangular Alignment	
		Weekdays	Weekends	Weekdays	Weekends
INPUT	Number of stops	18	18	18	18
	Distance of route (miles)	5.8	5.8	6.4	6.4
	Average speed (MPH)	18.3	20.5	18.3	20.5
	Hours of operations	6:30 AM to 12:00 AM		6:30 AM to 12:00 AM	
	Hours in operation per day	17.5	17.5	17.5	17.5
	Days in operation	5	2	5	2
	Weeks in service per year	52	52	52	52
	Operating cost per hour[13]	$65	$65	$65	$65
ESTIMATE	Time in motion (min.)	19	17	21	19
	Dwell time (min.)	4.5	4.5	4.5	4.5
	Layover time (min.)	3.5	3.2	3.8	3.5
	Total run time (min.)	27	25	29	27
	Desired headway (min.)	10	10	10	10
	Number of buses necessary	3	3	3	3
	Service hours per week	263	105	263	105
	Annual service hours	13,650	5,460	13,650	5,460
	Annual operating cost	$887,250	$354,900	$887,250	$354,900

Based on the inputs shown in Table 4, Table 5 presents changes in the annual operating cost per unit change of inputs on which the annual operating cost is calculated. The information in this table was valuable for stakeholders to see the financial impacts of individual service changes. For example, the greatest cost savings is when one bus per day is removed from the system. However, fewer buses in

[13] Estimate provided by the city of Baltimore.

operation equate to less frequent service. These kinds of trade-offs were discussed at the stakeholder workshop and informed the small groups', and ultimately the refined, route concepts.

Table 5
Estimated changes in annual operating cost per unit change in various service characteristics
Source: The Volpe Center

One Unit Change in each Service Characteristic…	…Equates to this Change in the Annual Operating Cost
+/- one hour of operation per day	+/- $70,980
+/- one weekday in operation per week	+/- $177,450
+/- one week in service per year	+/- $23,888
+/- number of buses necessary per year	+/- $414,050
+/- dollar of operating cost per hour	+/- $19,110

Linear and Triangular Extensions

Based on the service characteristics of the Charm City Circulator, Table 6 shows the additional operating cost necessary to operate the Linear and Triangular Extension route concepts. Each route concept is estimated to necessitate the use of two additional buses, which totals approximately $830,000 per year to operate and maintain.

Table 6
Charm City Circulator Yellow Route with extension service characteristics and estimated operating costs
Source: The Volpe Center

Service Characteristic	Yellow Route Charm City Circulator	Triangular Extension Route Concept	Linear Extension Route Concept
Headway/frequency	10 minutes	10 minutes	10 minutes
Distance	5.3 miles	9.7 miles	10.2 miles
Hours of operation	6:30 AM to 12:00 AM	6:30 AM to 12:00 AM	6:30 AM to 12:00 AM
Days in operation	7	7	7
Weeks in service per year	52	52	52
Operating Costs for Extension Route Concepts			
Additional buses required (estimated)		2	2
Operating cost per hour		$65	$65
Hours in operation per day per bus		17.5	17.5
Hours in operation per week per bus		122.5	122.5
Hours in operation per year per bus		6,370	6,370
Operating cost per year per bus		$414,050	$414,050
Additional operating cost per year		$828,100	$828,100

Workshop Route Concepts

Small Group 1's route concept

Small Group 1 proposed an extension of the Charm City Circulator Yellow Line, which differs from both the Linear and Triangular Extensions, to serve south Baltimore. Accordingly, the service characteristics of this route concept are the same as they will be for the Charm City Circulator. Small Group 1, however, proposed peak commute time service to Tide Point and back, thereby increasing the route length from 10 miles during off-peak times and weekends to 11.4 miles. This additional length would necessitate the use of an additional bus during peak times. Based on these service characteristics, the additional operating cost per year for Small Group 1's route concept is estimated to be approximately $900,000 (Table 7).

Table 7
Charm City Circulator Yellow Route with Small Group 1 route concept service characteristics
Source: The Volpe Center

Service Characteristic	Small Group 1 Route Concept (Peak, Weekday)	Small Group 1 Route Concept (Off-Peak, Weekday)	Small Group 1 Route Concept (Weekend)
Headway/frequency	10 minutes	10 minutes	10 minutes
Distance	11.5 miles	10 miles	10 miles
Hours of operation	6:30 AM to 9:00 AM 4:00 PM to 6:00 PM	9:00 AM to 4:00 PM 6:00 PM to 12:00 AM	6:30 AM to 12:00 AM
Days in operation	5	5	2
Weeks in service per year	52	52	52
Operating Costs for Small Group Route Concepts			
Additional buses required (estimated)	3	2	2
Operating cost per hour	$65	$65	$65
Hours in operation per day per bus	4.5	13	17.5
Hours in operation per week per bus	22.5	65	35
Hours in operation per year per bus	1,170	3,380	1,820
Operating cost per year per bus	$76,050	$219,700	$118,300
Additional operating cost per year	$228,150	$439,400	$236,600

Small Group 2 and 3's route concept

Small Group 2&3 proposed a route concept that is very similar to the Linear Alignment except that it provides only peak service to Tide Point. Aligning the hours of operation of the route to the fort would mean that the service would start at 8:00 AM and end at 5:00 PM. However, the groups also wanted to serve residents and employers. Accordingly, the hours of operation were expanded to 7:00 AM to 6:00 PM during weekdays. Two frequencies of service were modeled: 15-minutes in the summer and 30-minutes in the winter. Table 8 summarizes the model results for the summer months (May to October), which would cost approximately $247,000, and Table 9 summarizes the results for the winter months (November to April), which would cost approximately $123,000. The route would therefore cost approximately $370,000 a year to operate.

Table 8
Estimated service characteristics for Small Group 2&3 route concept during the summer (May – October)
Source: The Volpe Center

	Service Characteristic	Small Group 2&3 Route Concept (Peak, Weekday)	Small Group 2&3 Route Concept (Off-Peak, Weekday)	Small Group 2&3 Route Concept (Weekend)
INPUT	Number of stops	18	18	18
	Distance of route (miles)	5.8	5.4	5.4
	Average speed (MPH)	18.3	18.3	20.5
	Hours of operation	7:00 AM to 9:00 AM 4:00 PM to 6:00 PM	9:00 AM to 4:00 PM	8:00 AM to 5:00 PM
	Hours in operation per day	4	7	9
	Days in operation	5	5	2
	Weeks in service per year	26	26	26
	Operating cost per hour[14]	$65	$65	$65
ESTIMATE	Time in motion (min.)	19	18	16
	Dwell time (min.)	4.5	4.5	4.5
	Layover time (min.)	3.5	3.3	3.0
	Total run time (min.)	27	26	23
	Desired headway (min.)	15	15	15
	Number of buses necessary	2	2	2
	Service hours per week	40	70	36
	Annual service hours	1,040	1,820	936
	Annual operating cost	$67,600	$118,300	$60,840

[14] Estimate provided by the city of Baltimore.

Table 9
Estimated service characteristics for Small Group 2&3 route concept during the winter (November – April)
Source: The Volpe Center

	Service Characteristic	Small Group 2&3 Route Concept (Peak, Weekday)	Small Group 2&3 Route Concept (Off-Peak, Weekday)	Small Group 2&3 Route Concept (Weekend)
INPUT	Number of stops	18	18	18
	Distance of route (miles)	5.8	5.4	5.4
	Average speed (MPH)	18.3	18.3	20.5
	Hours of operation	7:00 AM to 9:00 AM 4:00 PM to 6:00 PM	9:00 AM to 4:00 PM	8:00 AM to 5:00 PM
	Hours in operation per day	4	7	9
	Days in operation	5	5	2
	Weeks in service per year	26	26	26
	Operating cost per hour[15]	$65	$65	$65
ESTIMATE	Time in motion (min.)	19	18	16
	Dwell time (min.)	4.5	4.5	4.5
	Layover time (min.)	3.5	3.3	3.0
	Total run time (min.)	27	26	23
	Desired headway (min.)	30	30	30
	Number of buses necessary	1	1	1
	Service hours per week	20	35	18
	Annual service hours	520	910	468
	Annual operating cost	$33,800	$59,150	$30,420

Refined Route Concepts 1 and 2

In line with input provided by Fort McHenry and the stakeholders, the Volpe Center proposes that the Refined Route Concepts should operate from 7:00 AM to 7:00 PM, seven days a week, and the frequency of service should be 30 minutes year round.

These service characteristics were designed with a number of factors in mind. The cost of operation is the primary consideration since the service must be affordable to be sustained. The cost of operation reflects the number of vehicles required to perform the desired service, as well as the total number of hours the vehicles are on the road. The cost of operating either of the Refined Route Concepts would be approximately $284,000 a year.

Based on its model estimates and input from the stakeholders, the Volpe Center determined that operating a shuttle in south Baltimore would be feasible with thirty minute headways, requiring only one vehicle (Table 10). As is apparent by comparing the operating costs in Tables 8 and 9 above, operating a single vehicle keeps the cost low.

Also, a simple 7-to-7 schedule should satisfy the needs of most potential riders – commuters in the mornings and evenings, with visitors riding more frequently during mid-day and weekend hours. These year-round, week-long hours of operation, coupled with regular 30-minute service, will help make this service easy to remember for all potential riders. Finally, the extended headways and abbreviated hours of

[15] Estimate provided by the city of Baltimore.

operation, compared to the Charm City Circulator, will help to alleviate concerns about too much bus traffic on neighborhood streets.

Table 10
Estimated service characteristics for Refined Route Concepts 1 and 2
Source: The Volpe Center

	Service Characteristic	Refined Route Concept 1		Refined Route Concept 2	
		Weekdays	Weekend	Weekdays	Weekend
INPUT	Number of stops	18	18	18	18
	Distance of route (miles)	6.6	6.6	6.5	6.5
	Average speed (MPH)	18.3	20.5	18.3	20.5
	Hours of operation	7:00 AM to 7:00 PM		7:00 AM to 7:00 PM	
	Hours in operation per day	12	12	12	12
	Days in operation	5	2	5	2
	Weeks in service per year	52	52	52	52
	Operating cost per hour[16]	$65	$65	$65	$65
ESTIMATE	Time in motion (min.)	22	19	21	19
	Dwell time (min.)	4.5	4.5	4.5	4.5
	Layover time (min.)	3.9	3.6	3.9	3.5
	Total run time (min.)	30	27	30	27
	Desired headway (min.)	30	30	30	30
	Number of buses necessary	1	1	1	1
	Service hours per week	120	24	120	24
	Annual service hours	3,120	1,248	3,120	1,248
	Annual operating cost	$202,800	$81,120	$202,800	$81,120

[16] Estimate provided by the city of Baltimore.

Section 6: Opportunities, Challenges, and Vehicles

Opportunities and Challenges

Operation

The proposed shuttle should be driven by knowledgeable bus drivers with pre-existing or learned knowledge of both Fort McHenry and south Baltimore sites of interest. As with the Charm City Circulator, the shuttle should be fare-free for all riders seeking transportation among points along the route. Strict police enforcement will be required to remove non-compliant riders. The shuttle service should be consistently marketed to potential riders via print and online media. The Volpe center encourages co-branding the south Baltimore shuttle as a fourth branch of the Charm City Circulator.

Funding

A preliminary budget developed by the city of Baltimore as part of a fiscal year 2009 proposal for the Paul S. Sarbanes Transit in the Parks Program shows that operating costs for a south Baltimore shuttle could be covered by the city's new parking tax.[17] This 16 percent tax, which began in December 2008, increased daily parking fees throughout the city of Baltimore and applies to fees collected from parking garages, parking lots, private parking meters, monthly contracts, and valet parking. The tax is estimated to bring in approximately five million dollars a year. Based on the projected revenues from this tax and other funding sources, including traffic mitigation fees and private corporate contributions, the city has awarded a $30 million contract to Veolia Transportation to operate the Charm City Circulator for the next five years.

Inflation of operating costs must also be considered. Table 11 shows how a four percent inflation rate can impact the operating cost of each of the route concepts discussed in this report. This kind of increase must be anticipated and funded over time.

Table 11
Estimated inflation costs for operating route concepts
Source: The Volpe Center

Alignment	2010	2011	2012	2013	2014	Total
Linear Alignment	$1,242,150	$1,291,836	$1,343,509	$1,397,250	$ 1,453,140	$6,727,885
Triangular Alignment	$1,242,150	$1,291,836	$1,343,509	$1,397,250	$ 1,453,140	$6,727,885
Linear Extension	$ 828,100	$ 861,224	$ 895,673	$ 931,500	$ 968,760	$4,485,257
Triangular Extension	$ 828,100	$ 861,224	$ 895,673	$ 931,500	$ 968,760	$4,485,257
Small Group 1	$ 904,150	$ 940,316	$ 977,929	$1,017,046	$1,057,728	$4,897,168
Small Group 2&3	$ 370,110	$ 384,914	$ 400,311	$ 416,323	$ 432,976	$2,004,635
Refined Route 1	$ 283,920	$ 295,277	$ 307,088	$ 319,371	$ 332,146	$1,537,802
Refined Route 2	$ 283,920	$ 295,277	$ 307,088	$ 319,371	$ 332,146	$1,537,802

South Baltimore Neighborhood Character

Stakeholders at the July 2009 workshop discussed whether bus traffic is appropriate on Hull Street in Locust Point. Most agreed that it was not desirable and many felt that riders could easily walk to a stop if there was one located at the intersection of Hull Street and Fort Avenue. Despite these concerns, the Volpe Center recommends using Hull Street in one direction, providing direct service to Tide Point. In addition to multimodality, discussed below, Tide Point, Domino Sugar, and other smaller businesses along Hull Street and the Key Highway Extension will benefit from a shuttle that would directly serve

[17] City of Baltimore Paul S. Sarbanes Transit in the Parks Program, Project Proposal for Fiscal Year 2009 Funds – Implementation Project. "Extension of Baltimore circulator service to Fort McHenry through purchase of 2 additional hybrid electric buses."

their locations since the shuttle can bring both employees and, for smaller businesses such as restaurants, potential customers to their doors.

Multimodality

Arguably the most important component of a successful alternative transportation system, the concept of multimodality focuses on connectivity between various modes of transportation. Connectivity between modes allows users of alternative transportation to easily transfer from one mode to another, greatly increasing the number of trips that can be taken. By providing a direct connection between bus and water taxi service at Tide Point, all riders – including those with restricted mobility – will be able to utilize the full spectrum of services offered by Baltimore's transportation system. If the water taxi is discontinued once a land route is initiated, having some type of direct transit service to Tide Point is necessary.

Low Impact Vehicles

As discussed previously, the city of Baltimore has invested significant funds to acquire new hybrid-electric buses. Though relatively expensive, these buses will have a minimal negative impact on the quality of life in the neighborhoods they serve since they are significantly quieter than a typical city bus and their emissions are relatively low. The quality of these vehicles and the connectivity they provide may even improve the image and quality of life in Locust Point rather than detracting from it.

Marketing and Branding

Most stakeholders and officials agree that a shuttle would benefit from inclusion in the Charm City Circulator system, regardless of whether or not the south Baltimore shuttle operates with the same service characteristics or even vehicles as the rest of the Charm City Circulator. Its incorporation would prove mutually beneficial – the Charm City Circulator would be able to offer transportation to more popular destinations and neighborhoods, and the south Baltimore shuttle would benefit from an established branding scheme. Marketing the south Baltimore shuttle with the general public, as well as with community groups, business associations, and tourism agencies, will be imperative as the service gets underway.

Signage/Parking

South Baltimore stakeholders expressed a concern that if the south Baltimore shuttle is fare-free, neighborhoods adjacent to the route may be inundated with commuters using neighborhood streets as an informal park-and-ride facility. While this concern may be valid, it should can be anticipated but not addressed until the shuttle service is in operation. If at that time street parking appears to be monopolized by non-resident shuttle riders, options exist for alleviating this problem, including prohibiting non-residents from parking in affected neighborhoods for long periods of time (visitor passes can be made available for household use) and/or creating a dedicated park-and-ride facility. Because these solutions would come at a price, they should not be implemented until parking problems have materialized.

Bridge Construction

Fort Avenue is punctuated by four different bridges, and soon major repairs will begin on the bridge that passes over a CSX rail yard. Clearly, any major construction project will result in altered traffic patterns on Fort Avenue, either in the form of closed lanes or complete detours. These projects, however, should not pre-determine a transit route alignment. As any construction project gets underway, shuttle operators will need to assess the impact on the existing route and try to minimize the effect on transit routes and headways. Regardless, because Fort Avenue is punctuated with bridges, detours and schedule changes will not be uncommon, and riders may need to anticipate delayed travel times while such projects are underway.

Vehicles

At a high level, the Volpe Center evaluated several vehicles for a south Baltimore circulator. The Volpe Center identified two types of vehicles that could meet Fort McHenry's needs: cutaway and traditional low-floor transit buses. Each vehicle style has its advantages and disadvantages. Three specific, illustrative vehicles are discussed below. If funding permits, the same vehicle that will be used for the Charm City Circulator – the DesignLine Ecosaver IV – should be used for the south Baltimore shuttle. This will help ensure that the south Baltimore shuttle will be an integrated part of the city's transportation services. Even though the Refined Route Concepts could be operated with one vehicle, a second vehicle should be purchased as a back-up and can be used to accomplish 15-minute frequencies during peak times if the operating budget allows.

Cutaway models are buses built on a modified truck chassis and are ideally suited for shuttle and point-to-point passenger service. Unlike traditional transit buses, the drivers of cutaway buses usually sit ahead of the entryway in the cab of the vehicle, allowing for forward control and higher driver visibility. A disadvantage of the cutaway bus is the single entrance point, which is viewed as a hindrance to rapid egress.

Low-floor transit buses are better suited for circulator service because of the seat and door configurations. Transit style buses allow for higher passenger capacities and longer lifespan due to heavy-duty engines and suspension systems. However, transit style buses are not well suited for low-passenger systems or high-speed/long-distance travel because of a number of variables including the seat configuration/passenger comfort, vehicle suspension systems, and other general performance concerns.

A number of stakeholders emphasized the importance that any south Baltimore circulator vehicle includes adequate bicycle capacity and stowage. Encouraging bicycle use to/from transit facilities bolsters ridership and the "reach" of transit networks. Most modern transit buses are equipped with a standard front-ended fold down rack, capable of safely transporting two bicycles. Cutaway vehicles can also be equipped with front-loaded racks. In special cases, where vehicle design precludes the installation of a rack, operators have in turn established policies that permit two bicycles aboard, provided that the space is safely available and disabled patrons receive priority seating in accordance with the Americans with Disabilities Act.

DesignLine Ecosaver IV

The Ecosaver IV, manufactured by DesignLine, is the vehicle selected by the city of Baltimore for the Charm City Circulator service. The Ecosaver IV (Figure 25), a low-floor transit bus, is touted as a highly advanced electric bus, equipped with an Auxiliary Power Unit (APU) to extend the driving range. Unlike traditional hybrid systems, the Ecosaver IV's APU is not a drive motor, but rather an electrical generator that provides electrical energy to the batteries. Like a traditional hybrid vehicle, however, the bus also captures energy typically lost in coasting and braking through the regenerative braking system[18]. The vehicle can also operate on a zero-emission battery mode for up to 40 percent of its operating time according to company specifications. DesignLine reports that the Ecosaver IV is approximately 35 percent quieter than typical city buses and is priced in the $620,000 range. A significant setback of the DesignLine Ecosaver IV, is its absence of bicycle racks. A policy could be implemented that allows up to two bicycles on board at any given time.

[18] DesignLine International

Figure 25
DesignLine Ecosaver IV
Source: DesignLine International

Standard Item 363 w/ option HEV

Standard Item 363 (Figure 26) is a cutaway model available through the General Services Administration (GSA). This shuttle is built on an International 3200 chassis. The capacity of this vehicle is 36 adults. Standard Item 359 is powered by a six cylinder diesel engine. A parallel hybrid electric variant power train system is available and included in the $285,354 quoted price.

Figure 26
Standard Item 363
Source: General Services Administration

El Dorado National Low-Floor Transit Buses

El Dorado National Bus Company manufactures a number of affordable low-floor transit buses that would fit within the budget and scope of use of the south Baltimore shuttle. El Dorado National offers Compressed Natural Gas (CNG) variants of all vehicles starting at an additional $55,000 that vary with fuel capacity, making all their buses environmentally sound options. Table 12 depicts the various models available through El Dorado National, comparing their capacity, fuel alternative, and dimensions. The Axess (Figure 27, left) is a heavy-duty transit bus produced by the El Dorado National Company. The seated capacity of this vehicle is 27 adults. The Axess is powered by a Cummins diesel engine. The Axess bus is priced between $310,000 and $320,000. The El Dorado EZ Rider II (Figure 27, right) is a smaller and less expensive medium-duty transit bus. The EZ Rider II is available in 30, 32, and 35-foot lengths and is powered by a Cummins Diesel engine. The Axess bus is priced between $250,000 and $360,000. One of these buses is preferable over a cutaway if there is not enough funding for Ecosaver IVs.

Figure 27
El Dorado Axess (left) and El Dorado EZ Rider II (right)
Source: El Dorado National

Table 12
El Dorado National Bus Technical Specifications
Source: El Dorado National

Model	Length	Power Source	Seated Capacity	Estimated Cost
E-Z Rider II	30', 35'	Diesel, Liquid Petroleum Gas (LPG) Liquid Natural Gas (LNG), CNG	25, 33	$250,000 - $360,000
Axess	35', 40'	Diesel, LNG, CNG	27, 35	$310,000 - $320,000
E-Z Rider II BRT	30', 32', 35'	Diesel, LPG, LNG, CNG, Hybrid	26, 27, 35	$342,000 - $372,000
Transmark RE	29', 33'	Diesel, LPG, LNG, CNG	23, 27	$230,000 - $245,000
XHF	29', 33', 35'	Diesel, LPG, LNG, CNG	23, 27, 33	$260,000-$290,000

Section 7: Conclusion

The Volpe Center recommends either of the two Refined Route Concepts. The Volpe Center believes a separate route would better serve more riders since people would not have to ride long portions of an extended Yellow Route to get from one point on the circulator to another. Additionally, to save costs, a separate route does not need to adhere to the Charm City Circulator's hours of operation and headway.

Refined Route Concept 1 is similar to the 2008 Kittelson Report Linear Alignment but with an extended loop into the downtown with reduced hours of operation (7:00 AM to 7:00 PM) and headway (30 minutes) compared to the hours of operation (6:30 AM to midnight) and headway (10 minutes) of the Charm City Circulator. Refined Route Concept 2 does not extend as far into the downtown core but it does connect with Camden Station and the Convention Center. The Volpe Center believes that either of these concepts will maximize ridership by appealing to both tourists/visitors and residents and employees yet still be cost-effective.

Of the two extension concepts, the Volpe Center prefers the Triangular Extension Concept since it serves and connects attractions and residences along Key Highway and, because it would necessitate the use of one less bus, is more affordable than the Small Group 1 Route Concept. However, Locust Point residents have expressed concern about frequent bus service on Hull Street. This concern should be addressed if an extension concept is pursued.

Both the Triangular and Linear Extensions would cost approximately $828,000 a year to operate. For a fraction of that cost (approximately $284,000), service on one of the Refined Route Concepts could provide 30-minute headways for 12 hours a day. Stakeholders thought that a 30-minute headway would be reasonable for south Baltimore; this headway would reduce the number of buses traveling on Hull Street while providing connectivity and accessibility to the area's many attractions, businesses, and residences. A twelve-hour period of service per day (7:00 AM to 7:00 PM) would also work well for south Baltimore since few businesses and attractions, such as the fort, are open later in the evening. A 7:00 AM start time would still enable commuters to get to work in the morning. Finally, 30-minute service seven days a week from 7:00 AM to 7:00 PM would be an easy schedule for riders to remember.

Appendix

Appendix A: Stakeholder Workshop

On June 11, 2009, Fort McHenry National Monument and Historic Shrine and the U.S. Department of Transportation's Volpe Center invited stakeholders to participate in a half-day shuttle transportation workshop. The purposes of the workshop were to inform local stakeholders of progress related to the city of Baltimore's soon-to-be-launched Charm City Circulator and to brainstorm shuttle transportation options for south Baltimore, a significant portion of which is not served by the proposed circulator. Stakeholders from more than fifty public, private, and non-profit community organizations were invited to the workshop. Stakeholders discussed and developed alternative shuttle route concepts that had the most merit in terms of destinations served, level of service, and cost of operation.

The Volpe Center provided four preliminary route concepts for the consideration of stakeholders. The basis of these route concepts came from an extensive review of fort and community needs as well as the findings of an initial study sponsored by the city of Baltimore conducted in 2008 by Kittelson and Associates. In addition, the Volpe Center developed an evaluation instrument based on this study to compare service characteristics for each route concept, allowing stakeholders to define a handful of service characteristics (operating hours, headways, destinations served, etc.) and weigh the costs and benefits of each.

Transportation Workshop Principles

Advantages of organizing a stakeholder workshop are as follows:

- Promotes enthusiasm for a project, provides an understanding, creates buy-in, and instills a sense of ownership among stakeholders.
- Allows stakeholders to share local knowledge and particular interests and concerns.
- Generates a large quantity of information by splitting stakeholders into small groups to work on tasks simultaneously.
- Provides a forum for people to meet each other and share ideas.
- Saves time and money by soliciting ideas, issues, and concerns for the project, which avoids later iterative redesign activities.
- Identifies partners, available grants, and potential collaborations that may provide expertise, funding, credibility, and support for the project as it moves forward.

To realize these benefits, the Volpe Center set several objectives in advance of the workshop:

- Assure local stakeholders identified as critical to the success of a pilot transit service are represented.
- Maximize interaction among stakeholders and fort staff.
- Assure the fort's interests in improving transit access and mobility between its units are secured in any planning and design proposals developed by the stakeholders in the workshop.
- Design the workshop to elicit preferences and priorities by the stakeholders with respect to route alignment and route stops.
- Design the workshop to elicit expert local context and knowledge for traffic conditions, traffic patterns, visitation patterns, street network connectivity, and parking and loading zone congestion.
- Strengthen partnerships between the fort and local stakeholders to implement a financially sustainable pilot transit service.

Workshop format

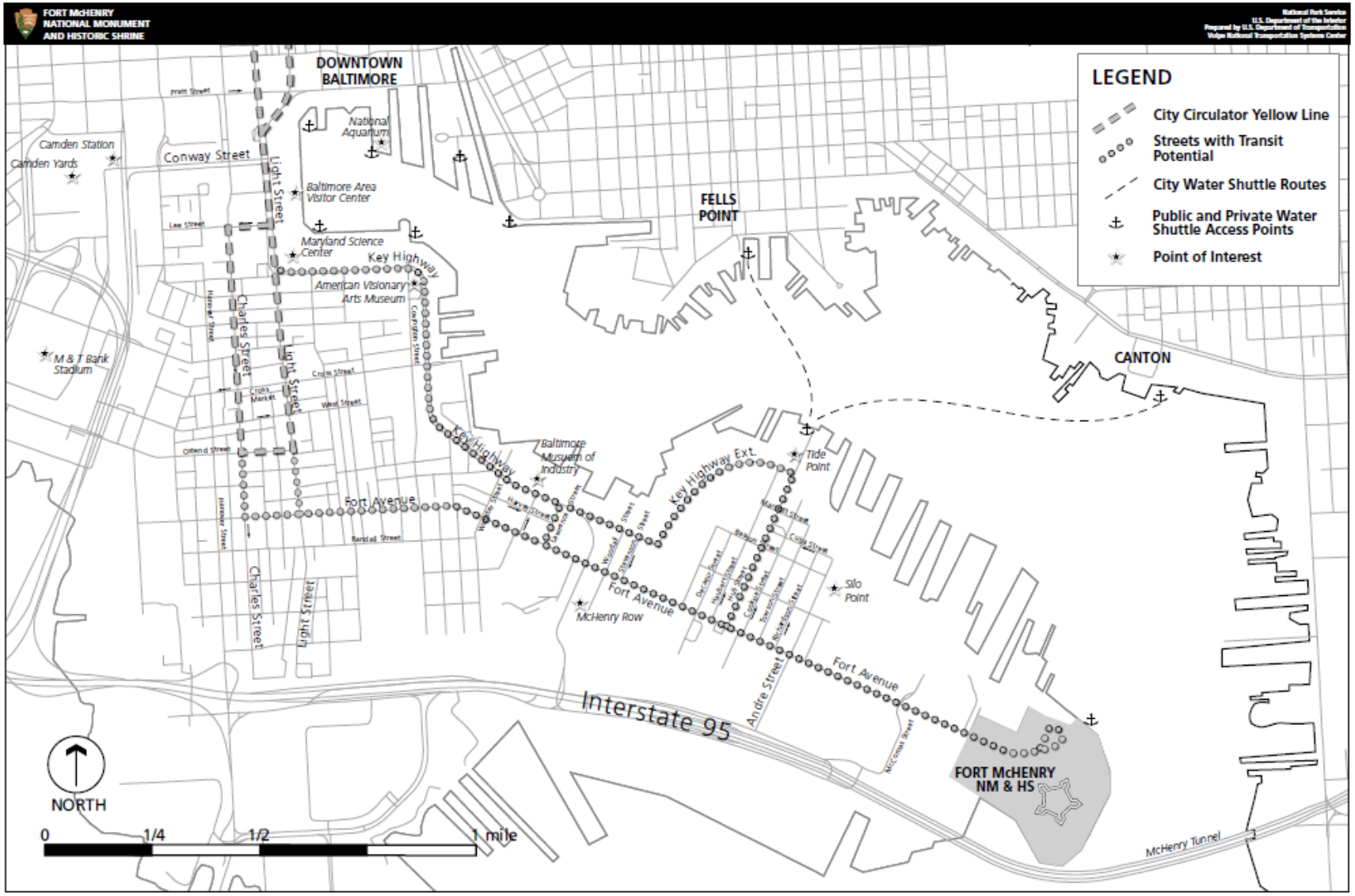
The fort and the Volpe Center identified a core set of partners and local stakeholders to participate in the workshop. The fort sent an invitational email with the Existing Conditions section of this report attached. Over 25 people were able to attend the workshop at the Navy Operational Support Center adjacent to Fort McHenry (Figure A1).

Figure A1
Workshop layout and stakeholders
Source: The Volpe Center

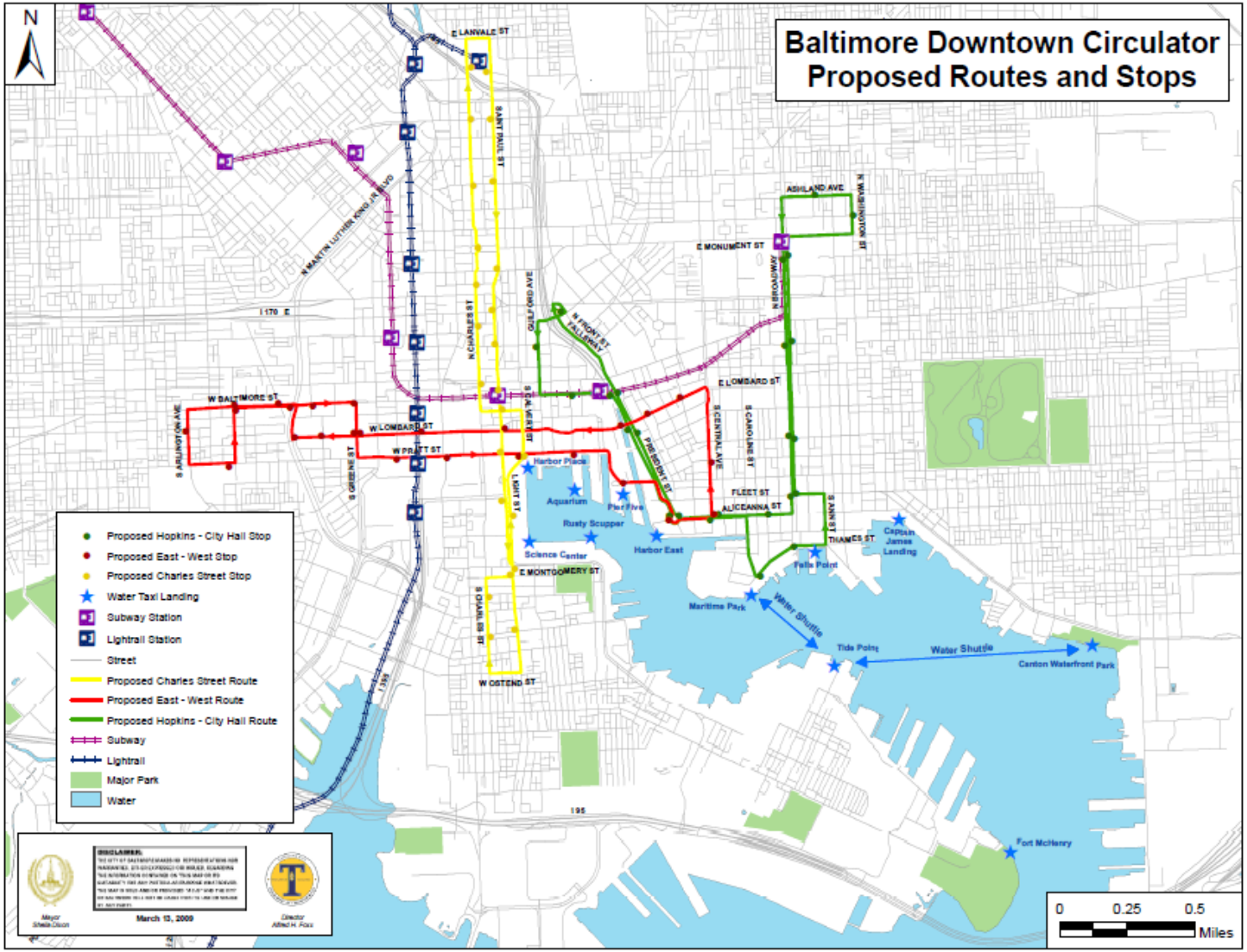
The workshop began with introductions and an overview of the project. Next, city of Baltimore staff discussed the status of the Charm City Circulator and water shuttle. The Volpe Center then presented the four preliminary route concepts and facilitated a discussion about a variety of service needs including potential users, necessary stops, frequency of service, hours of operation, and vehicle options.

Stakeholders split into three groups to map out their desired route concept during the second half of the workshop. Fort staff participated in each group and Volpe Center staff circulated among the groups as necessary. Each group was provided with large maps of the area (Figure A2) and colored markers. The lists of determined service needs were displayed for the groups' reference. At the end of the workshop, each group presented their route concept to each other and discussed similarities and differences.

Figure A2
Map Used at Shuttle Transportation Workshop by small groups



Appendix B
Charm City Circulator proposed route map



Appendix C: The Hamburg Alternative

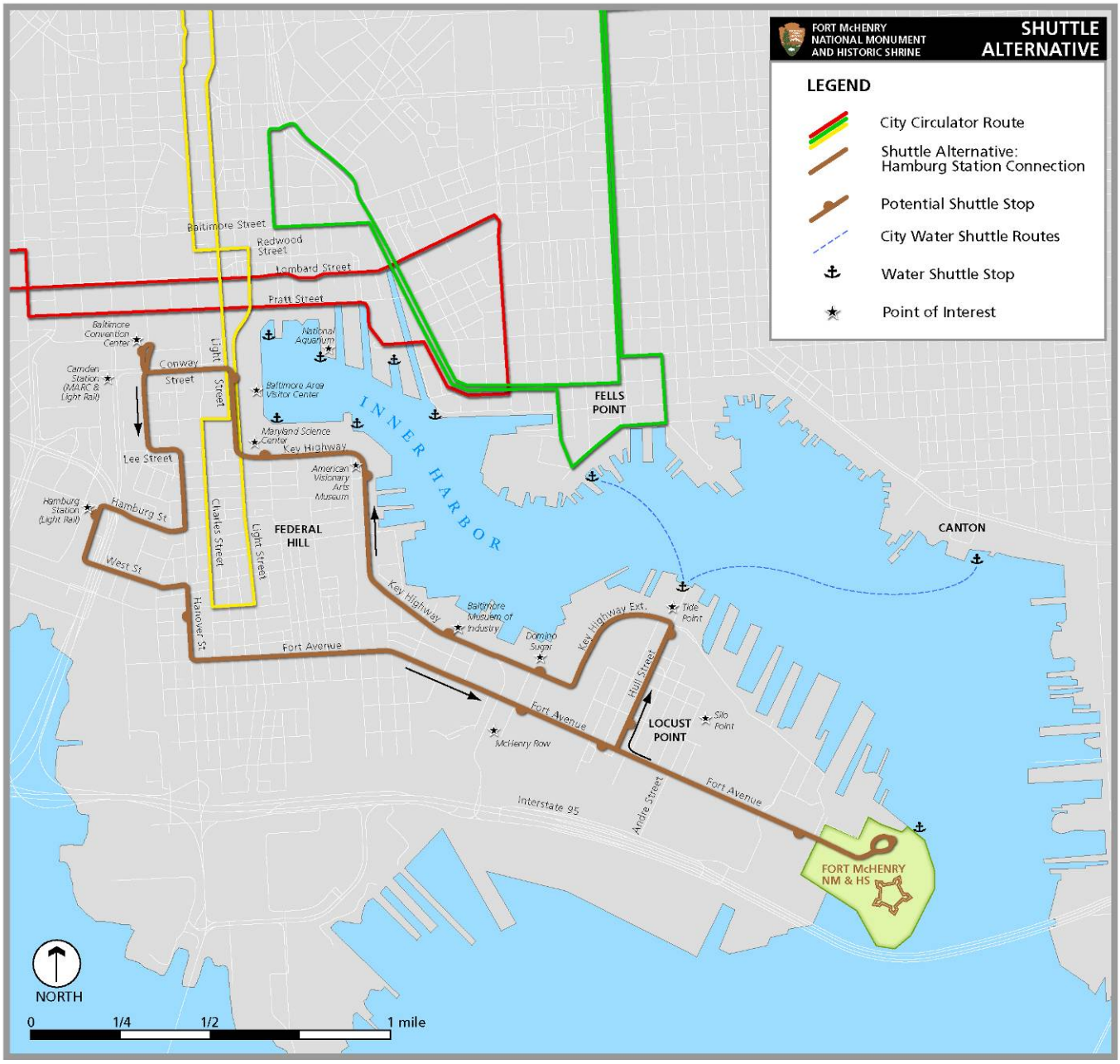
As requested by the fort and the city of Baltimore, the Volpe Center attempted to design a south Baltimore shuttle route that could incorporate MTA's Hamburg Station. Hamburg Station is a light rail stop located on the western edge of the Federal Hill neighborhood, next to the Baltimore Raven's M&T Bank Stadium.

The most reasonable route alignment is depicted in Figure C1. In developing the alignment, the only requirement was that the two major anchors of the route – Fort McHenry and the Baltimore Area Visitor Center – remain. The result is a one-way loop route that is viable for certain trips (Hamburg Station to Fort McHenry, for example), but much less viable for others (Hamburg Station to the Baltimore Area Visitor Center). Additional disadvantages of this route concept include:

- Because this route is an open loop, similar to the Triangular Alignment, there would only be service at several attractions every half hour, as opposed to every 15 minutes, as is the case with the routes similar to the Linear Alignment.
- A 30-minute headway could not be attained using one bus since this route is significantly longer (approximately 7.3 miles) than the other route concepts analyzed in this report. Either the headway would need to be increased to 40 or 45 minutes, thereby reducing the level of service of this route, or another bus would need to be in operation, thereby increasing the expense to operate the route by a factor of two.
- Access to Hamburg Station is problematic. With ingress via Hamburg Street, the shuttle would be required to navigate a large stadium-oriented parking area in order to exit via West Street. During special events at M&T Stadium, there are no reasonable alternatives for accessing Hamburg Station.
- This route overlaps more with the Charm City Circulator's Yellow Route than any of the other routes discussed in this paper, creating duplicative service.

While multimodal connections are an important component of any viable transportation system, the Volpe Center ultimately decided that Hamburg Station is not an ideal connecting point for the south Baltimore shuttle. The best alternative for a light rail connection – Refined Route Concept 2 – is examined in depth in Section 4.

Figure C1
The Hamburg Alternative
Source: The Volpe Center



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This study evaluates the feasibility of a shuttle system that would connect south Baltimore and Fort McHenry National Monument and Historic Shrine with the Inner Harbor area of the city of Baltimore.

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As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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