infrastructure, & flood control strategy
The Transportation, Infrastructure, and Flood Control analysis was prepared by Kimley-Horn & Associates. The following sections provide an overview of the data collection, analyses, and recommendations. Additional and more detailed information can be found in The Technical Support Manual for the Reuse of Fort Monroe.

TRANSPORTATION

Mobility is a critical factor in future development opportunities at Fort Monroe. The ability to move people and resources within this highly historic and isolated area with varying land uses is a key element of creating positive experiences for residents, commuters, area consumers, and tourists. Without proper planning and implementation, transportation could become a significant detriment to the future success of Fort Monroe. As part of the Fort Monroe reuse plan, traffic flow into and out of the area was evaluated to determine the level of mobility needed to support redevelopment of surrounding lands and improve access for recreational opportunities, while preserving the historical assets. In the context of the Fort Monroe reuse plan, the transportation element has three primary goals:

1. Restructure the Fort Monroe entrance to serve multiple users and various developments that will provide the necessary density for a self-sustaining development.

2. Establish an identity for certain areas within the Fort and provide clear access for the variety of users that will enjoy the various attributes.
3. Provide key transportation improvements that will support future economic vitality and an enhanced quality of life for the surrounding communities.

These transportation improvements must consider vehicles and other modes of transportation such as transit, parking, pedestrians, and bicyclists.

Today, all access into and out of Fort Monroe occurs at a single five-legged intersection. There are two roadways in the City of Hampton (Mellen Street and Mercury Boulevard) that intersect from the north to form two of the five legs. These two roadways traverse through the adjacent Phoebus neighborhood and provide access to Interstate 64 (I-64) and other parts of the city. Internal to the Fort, McNair Drive, Ingalls Road, and Stilwell Drive create the remaining three legs of this intersection. As reuse opportunities are considered, the transportation analysis must evaluate not only the roadway network within the confined boundaries of Fort Monroe but also the external connections to the surrounding communities.

There are several key framework streets that provide both external and internal mobility to Fort Monroe including access to existing office/administration facilities and residential developments. The transportation study area includes the entire Fort as well as portions of the Phoebus community. The external corridors within the study area consist primarily of I-64, Mallory Street, Mellen Street, and Mercury Boulevard. The internal corridors consist primarily of McNair Drive, Ingalls Road, Stilwell Drive, and Fenwick Road. The Fort’s roadway network consists of a street network and sidewalk system. Modifications to these existing networks should be minimal and would likely be comprised of minor improvements to provide enhanced access in certain areas. There are three roadways that provide access across the moat but these access points place significant size restrictions on the delivery vehicles, construction equipment, moving vans, and other large vehicles. Along with a narrow two-way ring road with limited parking, these infrastructure limitations may restrict the ability for some private sector uses and public events that generate crowds or large groups.

According to the Hampton Roads Transit (HRT) website, there is no fixed-route transit service between Fort Monroe and other areas of Hampton. Given that there are no HRT routes within Fort Monroe, transit-related passenger amenities are minimal. As reuse options are considered, it is recommended that a majority of the bus stops be marked with a highly visible sign, and actively used areas should be considered for transit stops with shelters.

A broad-level transportation analysis was performed to determine the impacts on the overall access to the Fort, and especially the main entrance, of traffic generated by the proposed reuse scenario. Given the constraints of the existing entrance, geometric improvements are recommended for this intersection for both operational and aesthetic reasons. The proposed configuration will create two separate ways into and out of Fort Monroe. A concept for this is depicted on the illustrative plan contained in Section 3 of this report. Additional maps that describe the details of the street modifications envisioned are contained in the Technical Support Manual for the Reuse of Fort Monroe. In the proposed configuration, those users destined for the historic areas of the Fort would be directed to Ingalls Roads, while residents/visitors of the proposed uses located at the northern/mid-section of Fort Monroe would be directed to Stilwell Drive. However, Fort Monroe is only one end of a trip, and the attraction of Mellen Street and Mercury Boulevard create the need to provide an internal connection along Eustis Lane to provide access to both external roadways. Since Eustis Lane will act as the decision point of the trip (motorists turning right or left), signalization is recommended at its intersections with Ingalls Road and Stilwell Drive.

The analysis presented above reflects an analysis of the internal street network on the Fort and the immediate adjacent street networks in the Phoebus community. The analysis was completed without the benefit
of the results of the recently completed tourism study. Based on the recent consideration of a tourism component on Fort Monroe, the Virginia Department of Transportation has expressed concern regarding the potential impact of redevelopment at Fort Monroe on the Interstate 64 Mallory Street and Woodland Road interchanges. Therefore, it is recommended that a more comprehensive traffic study be completed to study the effects of redevelopment and tourism potential on the internal and external street networks, inclusive of the Interstate 64/Mallory Street/Woodland interchanges.

In the future, a connection should be made from Fenwick Road to the Buckroe area at the north end of Fort Monroe. The City of Hampton has prepared a few conceptual alignments for this connection and will be proceeding with further development of these concepts in the near future. The proposed connection is intended to provide a more convenient public access to the proposed recreational uses located at the northern end of Fenwick Road, and would also provide a completely separate alternate route during emergency evacuations of the Fort.

**INFRASTRUCTURE**

In general the Fort’s infrastructure appears to be in better condition than was expected. Kimley-Horn’s experience with other base closures has been that the existing infrastructure, particularly utility infrastructure, is old and not well maintained and typically requires substantial rehabilitation and/or replacement. In 2003, Hurricane Isabel inflicted considerable damage to the Fort’s infrastructure and enabled the Army to secure $90 million in funding for hurricane repairs. This funding allowed for the replacement and upgrading of roads, some of the water distribution system, and some of the storm and sanitary sewer systems. Based on information provided by the Army, Figure 7.3 summarizes the condition of the different infrastructure systems.

<table>
<thead>
<tr>
<th>INFRASTRUCTURE COMPONENT</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
<td>Very Good</td>
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<tr>
<td>Water</td>
<td>Fair to Good</td>
</tr>
<tr>
<td>Sanitary Sewer</td>
<td>Very Good</td>
</tr>
<tr>
<td>Drainage</td>
<td>Good</td>
</tr>
<tr>
<td>Electrical Power</td>
<td>Very Good</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Fair</td>
</tr>
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</table>

While most of the infrastructure is reported to be in generally good condition, proposed development will require some upgrades to the existing systems, as well as extensions to the redevelopment areas primarily for water, sewer, and storm drainage infrastructure. If a northern connection to Buckroe is implemented, then water should be extended from

**Figure 7.2. Infrastructure construction on the Fort**
the north to provide an enhanced looped system on the Fort. As redevelopment and potential private occupancy of existing buildings ensues, separate power and water metering for the various buildings will likely be required and could represent a significant cost overall based on the quantity of buildings that would require metering. Currently, the Fort’s infrastructure systems are predominantly owned by the Army including roads, drainage, water, sanitary sewer, gas, etc. Future ownership, operation, and maintenance of this infrastructure could present significant challenges and possibly costs as it is understood that most of these systems do not meet local municipal, regional, or state standards. At a minimum it is recommended that a study be undertaken to assess the condition of each of these systems to identify deficiencies and upgrades that may be required that would be dependent on future ownership of these systems. As it relates to the aforementioned assessment study and analyses, it is important to note that each of the municipalities that comprise the Hampton Roads region, as well as the Hampton Roads Sanitation District (HRSD), are currently under a consent order with the Virginia Department of Environmental Quality (DEQ). This consent order includes specific requirements that each municipality must meet concerning the condition, operation, and upgrading of their wastewater collection systems. This would likely have an affect on the analyses and subsequent recommended improvements to the City of Hampton’s and HRSD’s systems that the Fort discharges to in the Phoebus area and may represent costs to upgrade these systems as well.

**INFRASTRUCTURE COSTS**

Based on data collection, information provided by the Army and Public Works staff, and preliminary analyses, preliminary cost estimates have been developed for certain infrastructure components that appear to be under capacity for new development or require extension to the new development areas. Costs associated with the new development itself, such as roads, water, sewer, drainage, and street lighting, also are excluded as those costs would likely be included in the development costs for the new development.

The infrastructure components are representative of what would typically be public infrastructure (i.e. water, sewer, stormwater). These costs also are exclusive of any upgrades to the existing infrastructure systems required to bring the infrastructure into compliance with standards of the eventual operator of these systems. These costs cannot be determined until it is known what the system requirements of the eventual operator include and an assessment is conducted to determine the deficiencies, if any, of that system. Infrastructure components that would typically be considered private infrastructure (power, gas, and communications) are not included in these estimates since these costs would be developed by the eventual owners of these systems, such as Dominion Virginia Power, Virginia Natural Gas, Cox Communications, and/or Verizon. The cost information is based on 2008 costs (see Figure 7.4).

**FLOOD CONTROL**

Located on the southernmost point of the Hampton Roads Peninsula, Fort Monroe lies almost entirely in a designated 100-year floodplain. The only part of the base not in a floodplain zone is a strip of land running north-south along the eastern edge of the Fort. The Fort is a National Historic Landmark and many of the buildings have not been elevated or altered since their construction, making them especially prone to flood damage. First floor elevations of these structures, as determined by the U.S. Army Corps of Engineers’ 2004 structure inventory of Fort Monroe, lie below the 100-year floodplain elevation. These elevations also are well below the flood heights reached during Hurricane Isabel. Their preservation for historic purposes limits modifications which can be made to the structures to flood-proof them or raise first floor elevations to conform to current floodplain requirements. Hurricane Isabel flooded Fort Monroe in September of 2003 with a peak flood elevation of 6.26 feet. This flooding was comparable to the 1933 Hurricane, which brought peak storm surges of approximately 7.41 feet. This caused severe flooding at Fort Monroe from the storm surge moving...
### Improvement | Estimated Cost
--- | ---
**Water System Improvements**
System Upgrade Recommendations from URS Study (2004 dollars) | $1,500,000
Escalation to 2008 dollars | $2,623,509
Northern Connection from Buckroe 10,000’ length - assumed 12” diameter | $1,000,000
Extension to new development area 4,000’ length - assumed 12” diameter | $400,000

Water meters for all non-metered existing buildings
Assumes HRSD and NNWW SDC fees would be waived

<table>
<thead>
<tr>
<th>Installation</th>
<th>Escalation for Retrofit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 - 5/8” meters</td>
<td>$400</td>
<td>$600</td>
</tr>
<tr>
<td>39 - 3/4” meters</td>
<td>$500</td>
<td>$750</td>
</tr>
<tr>
<td>22 - 1” meters</td>
<td>$600</td>
<td>$900</td>
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<tr>
<td>10 - 2” meters</td>
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<tr>
<td>10 - 3” meters</td>
<td>$1,000</td>
<td>$1,500</td>
</tr>
<tr>
<td>1 - 4” meter</td>
<td>$1,500</td>
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<tr>
<td>14 - 4” detector checks</td>
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</tr>
<tr>
<td>13 - 6” detector checks</td>
<td>$8,000</td>
<td>$12,000</td>
</tr>
<tr>
<td>8 - 8” detector checks</td>
<td>$10,000</td>
<td>$15,000</td>
</tr>
</tbody>
</table>
Total Water Metering | $477,300
SubTotal Water | $4,500,809

**Wastewater Collection System Improvements**
New Pump Station in new development area | $750,000
Extension to new development area
Assumes pump station will move to central location 2,000’ length - assumed 12” diameter sfm | $200,000
HRSD Pump Station #225 Upgrade and off-site system upgrades (Allowance) | $250,000
SubTotal Wastewater | $1,200,000

**Stormwater Quality Collection and Retention System**
New Regional Stormwater Management Basin (BMP) in new development area - assumed to be 5 acres total of a wet detention system (Allowance) | $1,000,000
New outfall from BMP (Allowance) 600’ length - assumed 42” diameter | $120,000
New inflow pipe from new development area 2 pipes totaling 500’ length - assumed to be 36” diameter | $75,000
SubTotal Stormwater | $1,195,000

### Improvement | Estimated Cost
--- | ---
**Flood Protection**
Cost from COE Study (2004 dollars) | $26,400,000
Escalation to 2007 dollars | $31,944,000
Minus Portion that was Funded in 2007 | $22,000,000
SubTotal | $9,944,000
Escalation to 2008 dollars | $10,938,400
SubTotal Flood Protection | $10,938,400

**Northern Connection Roadway and Bridge**
2-lane undivided roadway
Right-of-way acquisition costs excluded
Wetlands Mitigation costs excluded
Length of new road (30’ width) = 700’ @ $450 per l.f. | $315,000
Length of road reconstruction (30’ width) = 1,000’ @ $300 per l.f. | $300,000
Length of bridge construction (30’ width) = 300’ @ $175 per s.f. | $1,575,000
SubTotal Northern Connection | $2,190,000

**Reconfigured Main Entrance**
Length of road reconstruction (24’ width) = 1,500’ @ $250 per l.f. | $375,000
New traffic signal | $250,000
SubTotal Reconfigured Main Entrance | $625,000

**Moat Bridge Repairs**
Repair Costs from April 9, 2007 kCI Technologies Bridge Inspection Report (2007 dollars) | $282,350
Escalation to 2008 dollars | $324,703
SubTotal Moat Bridge Repairs | $324,703

TOTAL | $20,973,912
up through storm drains, beach over washes, sea wall topping and failure, backflow through storm sewers and berm blowouts. The storm also caused the collapse of several piers and extensive tree loss from high winds.

In response to the substantial damage sustained on Fort Monroe during Hurricane Isabel, in May 2005 the Norfolk District, U.S. Army Corps of Engineers (ACOE) conducted a flood evaluation and protection study to evaluate the flooding and develop measures to reduce future flooding from storms of similar strength. From these measures a recommended flood protection plan was developed consisting of the following elements:

- Installation of flap roller gates on the outlet from the Fort Monroe moat to prevent back flooding during large storm events.

- Construction of a new seawall in the southern Fenwick Road region with a higher elevation of 9.5 feet NAVD, extending from the Navy Pier to the Battery Parrott to include a “toe” of small armor stone to prevent scouring of the base of the wall.

- Construction of a series of beach berms and breakwaters from the southern end of the northern seawall at Battery Parrott to the intersection of the proposed berm (see next point) and the existing seawall.

- Construction of an interior berm southward across the northern end of the moat and into the southern portion of the base to prevent flooding from Mill Creek. The interior berm would be installed in the moat with an elevation of 8.0 feet (NAVD 88).

- Lowering of the berm existing north of Bowling Alley in Mill Creek to reduce the ponding of water trapped behind the berm during heavy rainfalls and flooding from other locations on the Fort.

In 2007, the Department of Defense approved partial funding to fund some of the improvements proposed in the ACOE study. These improvements are currently under construction and mainly include the following elements of the original recommendations:

- Reconstruction of the flood wall along the southern end of the Fort at an elevation approximately 2.5 feet higher than the existing flood wall elevation.

- Construction of the three southernmost breakwaters.

- Construction of a terminal groin at the southern tip of the Fort.

In addition to these improvements, the Army secured some additional funding to control flooding through the storm sewers and has recently installed backflow prevention valves.
on storm sewers that discharge into the Chesapeake Bay and Mill Creek as well as all of the inflow and outfall pipes located in the moat. This represents a critical element of the original ACOE recommendations as much of the flooding that occurred during Hurricane Isabel was due to storm surge through these drainage systems. The Army indicated that there also may be additional funds available based on the favorable bid that was received for the funded flood protection project. It is possible that these funds would be used to fund more of the improvements in the original ACOE study and could include the construction of three additional breakwaters northward of the three that are currently under construction. As redevelopment planning and implementation for reuse of the Fort continues, it is recommended that a funding source be identified to provide the additional funding required to complete the ACOE recommendations.

In order for any future private leaseholds or other private investment in Fort Monroe to take place, it will be important to secure federally subsidized flood insurance and comply with the City of Hampton’s floodplain ordinance. An examination of the existing buildings on the Fort indicates they fall into three general categories.

- The first category consists of historic buildings.
- The second category includes buildings that are not historic but which were built prior to the time of the federal flood insurance study of the City of Hampton in July 1987 (Pre-FIRM buildings).
- The third category is that of buildings constructed since the flood insurance study was completed (Post-FIRM buildings).

FEMA’s regulations indicate that localities can exempt historic structures from the requirements of the National Flood Insurance Program (NFIP) by either exempting them through the definition of substantial improvement or issuing variances to the structures. However, the improvements exempted must not preclude the continued designation as a historic structure. Thus, all historic buildings on the base would qualify for pre-FIRM exemption, as long as they meet the FEMA definition of a historic building. Pre-FIRM buildings will be exempt from FEMA regulations and the Hampton City Flood Ordinance; however, any additions, extensions, or major improvements amounting to more than 50 percent of the market value of the structure will cause the entire structure to meet FIRM regulations.

The Fort engineering office indicates that since 1987, all new buildings have been constructed in accordance with the building requirements of the NFIP. All new construction (post-FIRM) must continue to conform to the current flood zone construction requirements. As noted above, the ACOE has inventoried all structures on the Fort and determined the ground elevation around the structures and the elevation of the first finished floor. This information may be used in the future to assess what, if any, modifications may need to be made to existing buildings for them to be eligible for federal flood insurance if adaptive-
ly reused by private residents or businesses. Additional consultation with FEMA and the City of Hampton will be required to determine the specific procedure for complying with flood insurance program requirements.

The effects of sea level rise need to be considered in any long term infrastructure planning and costs for Fort Monroe. Sea level has been estimated to rise approximately two feet in the next century as predicted by Wetlands Watch in association with the Virginia Institute of Marine Science. Climate changes are anticipated to increase the frequency and intensity of tropical storms and hurricanes. Accordingly, the flood protection measures previously constructed or under construction currently may not be sufficient to deal with the increased flooding potential created by long term sea level rise. Planning for Fort Monroe reuse should include a site specific evaluation of the impact of sea level rise (under various height predictions based on different models) as it relates to the need for additional flood protection measures at the Fort.

**RECOMMENDATIONS – TRANSPORTATION**

Transportation – Complete a comprehensive traffic analysis to study the effects of redevelopment and tourism potential on the Fort’s internal street network as well as the external street networks, inclusive of Interstate 64.

Transportation – Coordinate with the City of Hampton regarding further studies regarding a northern roadway connection to the Buckroe area.

**RECOMMENDATIONS – INFRASTRUCTURE**

Water – Complete a study to assess the condition of the Fort’s water distribution system and identify deficiencies in the system relative to current Newport News Waterworks or regional standards.

Wastewater – Complete a study to assess the condition of the Fort’s wastewater collection system and identify deficiencies in the system relative to current City of Hampton, Virginia Department of Health, and/or regional standards. This study also should include an infiltration and inflow as well as a capacity analysis for the Hampton Roads Sanitation District’s pump station #225.

Power – Request that Dominion Virginia Power perform a comprehensive conditional assessment of their system and provide costs associated with upgrading or replacement of their system inclusive of metering of existing buildings.

**RECOMMENDATIONS – FLOOD PROTECTION AND INSURANCE**

Flood Protection – Identify a funding source to provide the additional funding required to complete the Army Corps of Engineers flood protection recommendations.

Flood Protection – Request that the City of Hampton give Fort Monroe the highest priority in their ongoing watershed and floodplain study.

Flood Insurance – Consult with FEMA and the City of Hampton to determine the specific procedures for complying with flood insurance program requirements.

Flood Protection – Develop a site specific evaluation of the impact of sea level rise (under various height predictions based on different models) for additional flood protection measures at the Fort.

Capital Improvement Costs - Further develop cost analysis for anticipated capital costs as additional studies are undertaken and more data becomes available.