Naval Station Norfolk Area Traffic Management Study

HAMPTON ROADS
PLANNING DISTRICT COMMISSION

JUNE 2007

T07-04

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NAVAL STATION NORFOLK AREA TRAFFIC MANAGEMENT STUDY

This report was included in the Work Program for Fiscal Year 2006-2007, which was approved by the Commission and the Metropolitan Planning Organization at their meetings of March 15, 2006.

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HAMPTON ROADS
PLANNING DISTRICT COMMISSION

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ABSTRACT

Located in the northwestern corner of the City of Norfolk, Naval Station Norfolk is the largest Naval installation in the world. With 70,000 active-duty military and civilian personnel working at the base, traffic management is a concern. Traffic flows in the vicinity of the base are affected by a variety of factors, including limited access due to the geography and roadway network of the area, the amount of activity at the base, the varying security levels the base operates under, and ongoing renovations of the security gates. To aid traffic flow into the gates, Naval Station Police currently set up and remove traffic control devices along Hampton Boulevard each weekday morning, a process that requires a significant amount of manpower.

Because of these factors, the Navy and the City of Norfolk requested that HRPDC complete a traffic management study in the vicinity of Naval Station Norfolk. The primary purpose of this study is to recommend solutions that will maximize efficiency and decrease delays leading into and out of Naval Station Norfolk.

ACKNOWLEDGMENTS

This report was prepared by the Hampton Roads Planning District Commission (HRPDC) in cooperation with the U.S. Department of Transportation (USDOT), the Federal Highway Administration (FHWA), the Virginia Department of Transportation (VDOT), Naval Facilities Engineering Command – Mid-Atlantic, and the City of Norfolk. The contents of this report reflect the views of the staff of the Hampton Roads Area Metropolitan Planning Organization (MPO). The MPO staff is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the FHWA, VDOT, or HRPDC. This report does not constitute a standard, specification, or regulation. FHWA or VDOT acceptance of this report as evidence of fulfillment of the objectives of this planning study does not constitute endorsement/approval of the need for any recommended improvements nor does it constitute approval of their location and design or a commitment to fund any such improvements. Additional project level environmental impact assessments and/or studies of alternatives may be necessary.

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INTRODUCTION

Located in the northwestern corner of the City of Norfolk, Naval Station Norfolk is the largest Naval installation in the world. The home to approximately 75 ships and 135 aircraft, Naval Station Norfolk covers 4,300 acres and employs 60,000 active-duty military and 10,000 civilian personnel.

Access to Naval Station Norfolk is limited by the geography and roadway network of the area. With Willoughby Bay to the north and the Elizabeth River to the west, access to Naval Station Norfolk is restricted to the southern and eastern sides of the facility. Primary access to the base is provided from the south by Hampton Boulevard, from the southeast by I-564, and from the east via Granby Street and Bay Avenue.

Traffic flows in the vicinity of Naval Station Norfolk are affected by many factors. The number of ships deployed at any one time varies, with more activity at the base leading to higher traffic volumes. The capacity of the nine entry gates into secure areas of the Naval Station varies based on the security level the base is operating under. Higher security levels lead to longer processing times for each vehicle, which leads to longer wait times and queues at the gates. An ongoing effort to upgrade these security gates has also made traffic management efforts more difficult.

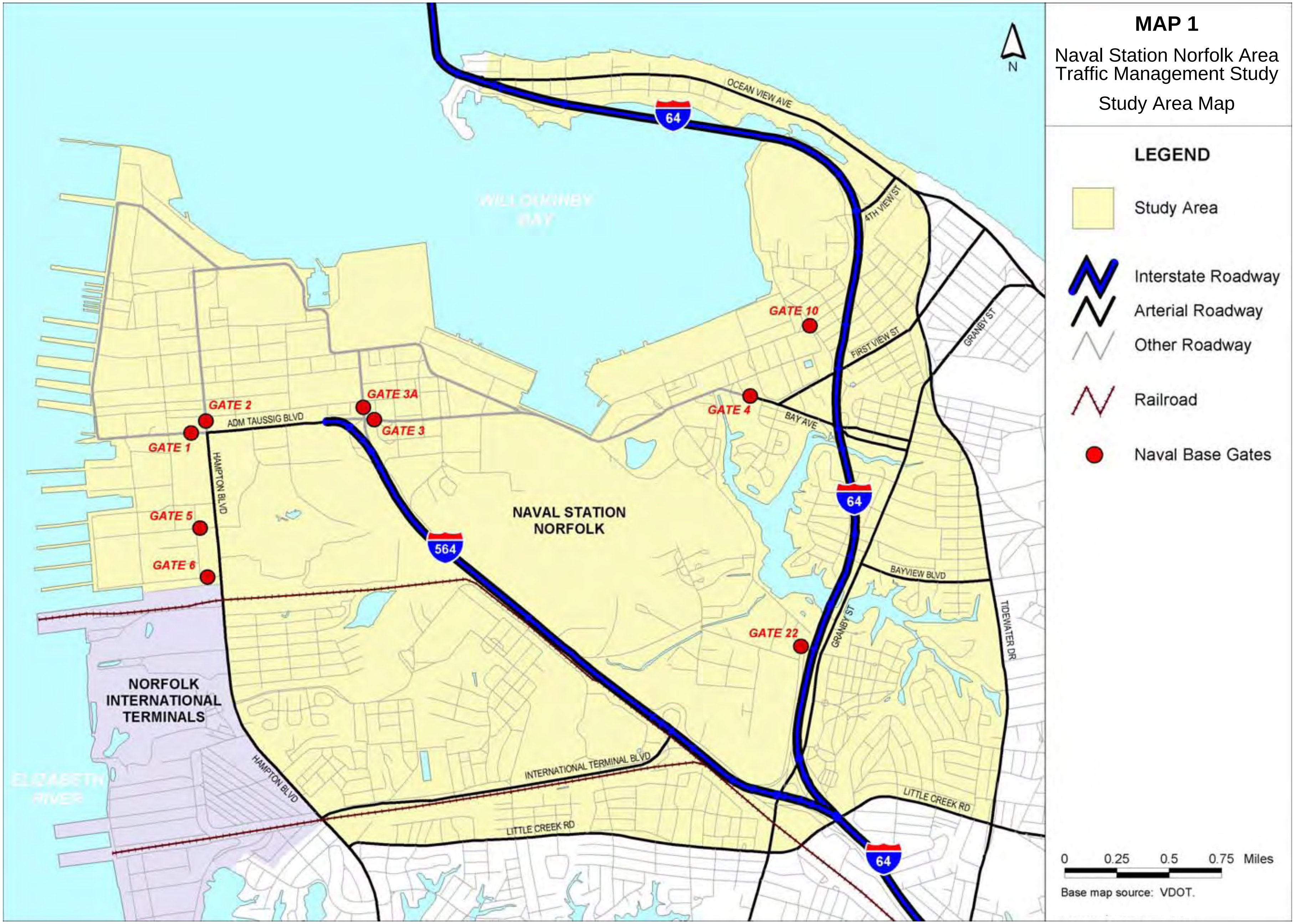
To aid traffic flow into the security gates at Naval Station Norfolk, Naval Station Police currently set up and remove traffic control devices along Hampton Boulevard each weekday morning. While this process has been successful, a significant amount of manpower is required to move these cones and signs twice each weekday.

With these issues in mind, the Navy and the City of Norfolk requested that HRPDC complete a traffic management study in the vicinity of Naval Station Norfolk. The primary purpose of this study is to recommend solutions that will maximize efficiency and decrease delays leading into and out of Naval Station Norfolk.

The study area, which is shown on **Map 1** on page 2, is bounded by the Elizabeth River to the west, Little Creek Road to the south, Tidewater Drive to the east, and the Hampton Roads harbor to the north. Although the study area includes those areas inside the security perimeter of Naval Station Norfolk, this study will only analyze traffic characteristics on those roadways outside of the security perimeter and at the security gates.

This report is divided into the following areas:

- Commuting Characteristics
- Traffic Characteristics
- Transit/Transportation Demand Management
- Planned Projects
- Alternative Analysis (Part II)
- Recommendations
- Appendix


MAP 1
Naval Station Norfolk Area
Traffic Management Study
Study Area Map
LEGEND
Study Area
Interstate Roadway
Arterial Roadway
Other Roadway
Railroad
Naval Base Gates
0 0.25 0.5 0.75 Miles
Base map source: VDOT.
N
WILLOUGHBY BAY
NAVAL STATION NORFOLK
NORFOLK INTERNATIONAL TERMINALS
ELIZABETH RIVER
GATE 1
GATE 2
GATE 3
GATE 3A
GATE 4
GATE 5
GATE 6
GATE 10
GATE 22
64
564
OCEAN VIEW AVE
4TH VIEW ST
FIRST VIEW ST
GRANBY ST
BAY AVE
BAYVIEW BLVD
TIDEWATER DR
ADM TAUSSIG BLVD
HAMPTON BLVD
INTERNATIONAL TERMINAL BLVD
LITTLE CREEK RD

COMMUTING CHARACTERISTICS

This section of the report details the characteristics of commuters that are employed at Naval Station Norfolk. This includes both active-duty military and civilian employees that work at the base. Recent studies have addressed the characteristics of these commuters.

In 2001 a Transportation Needs Assessment Study[1] for Naval Station Norfolk was completed for Traffix, which is the regional Transportation Demand Management program in Hampton Roads (more information about Traffix is included in the Transit/Transportation Demand Management portion of this report). As part of this study, a questionnaire completed by over 1,000 people that work at Naval Station Norfolk included their place of residency (**Table 1**). The Cities of Norfolk and Virginia Beach had the highest number of residents working at Naval Station Norfolk with 32% and 29% of all Naval Station workers respectively. 11% of all respondents lived on base, with the other 89% commuting to the Naval Base.

In 2004 the Naval Facilities Engineering Command Mid-Atlantic conducted the Naval Station Norfolk Commuter Study[2]. This document analyzed the results of a commuter survey taken by 1,900 employees at Naval Station Norfolk, which represents 3% of the total Naval Station Norfolk military and civilian employment. Commuting modes, routes used in commutes, and primary gates used to enter the secure areas of the base were included in this commuter study.

Table 2 shows the time of arrival for commuters at Naval Station Norfolk. The highest number of respondents (37%) arrive at the Naval Station between 6 am and 7 am. Nearly a third of all respondents (30%) arrive at the Naval Station before 6 am, and

TABLE 1 – Naval Station Norfolk Employees Place of Residency, 2001

Commuter Origin	Percent of all Naval Station Employees
Norfolk	32%
Virginia Beach	29%
Chesapeake	10%
Hampton/Newport News	7%
Portsmouth/Suffolk	6%
Other	2%
No Response	14%

Data Source: Traffix.

TABLE 2 – Time of Arrival for Commuters at Naval Station Norfolk,

Time of Arrival at Naval Station	Percent of Survey Respondents
3:00 am - 5:00 am	3%
5:00 am - 6:00 am	27%
6:00 am - 7:00 am	37%
7:00 am - 8:00 am	28%
8:00 am - 9:00 am	2%
Other	3%

Data Source: Naval Station Norfolk Commuter Survey.

1 Traffix, “Transportation Needs Assessment Study for Naval Station Norfolk”, February 2001.
2 Naval Facilities Engineering Command Mid-Atlantic, “Naval Station Norfolk Commuter Survey”, January 2004.

the other third of all respondents (33%) arrive after 7 am.

Table 3 shows the final route used by commuters to access Naval Station Norfolk. The majority of respondents access the Naval Station via I-564/Admiral Taussig Boulevard. The other three primary routes (Hampton Boulevard, Bay Avenue/Fourth View Avenue, and Granby Street) each received nearly 15% of the responses.

Table 4 shows the commuting mode for Naval Station Norfolk employees. Overwhelmingly, Naval Station Norfolk employees access the base via single occupant vehicles. 95% of all respondents commute to Naval Station Norfolk via single occupancy vehicles, with 3% using vehicles with two or more occupants, and 1% using public transportation. It should be noted that the Traffix Transportation Needs Assessment Study had much lower numbers of commuters driving alone to the base (81%) than the Commuter Survey.

Another method of analyzing commuting patterns is to analyze the data that is produced by the regional Travel Demand Forecasting Model. This model, which is maintained by the Hampton Roads Planning District Commission, produces trip end data based on socioeconomic and land use data. A trip end is defined as either the origin or destination of the trip. On **Map 2** and **Map 3** on pages 5 and 6, trip ends produced from trips entering or leaving Naval Station Norfolk via Hampton Boulevard and I-564, respectively, are shown. These trip ends are displayed in the form of dots, with each dot representing 20 trip ends. These trip ends represent all trips that have origins or destinations at Naval Station Norfolk, regardless of time of day or trip purpose.

For trips that enter or leave Naval Station Norfolk via Hampton Boulevard, 64% of all trip ends are in Norfolk according to the model, with most of these trip ends located in the west side of the city. The city of Chesapeake has the second most trip ends (14%) using Hampton Boulevard to access or leave the Naval Base.

For trips that enter or leave Naval Station Norfolk via I-564, Norfolk also has the highest number of trip ends at 54%. Most of these trip ends are located in the east side of the city. Virginia Beach has the second most trip ends using I-564 to access or leave the Naval Base, with 38% of all these trip ends.

TABLE 3 – Final Route Used by Commuters to Access Naval Station Norfolk, 2004

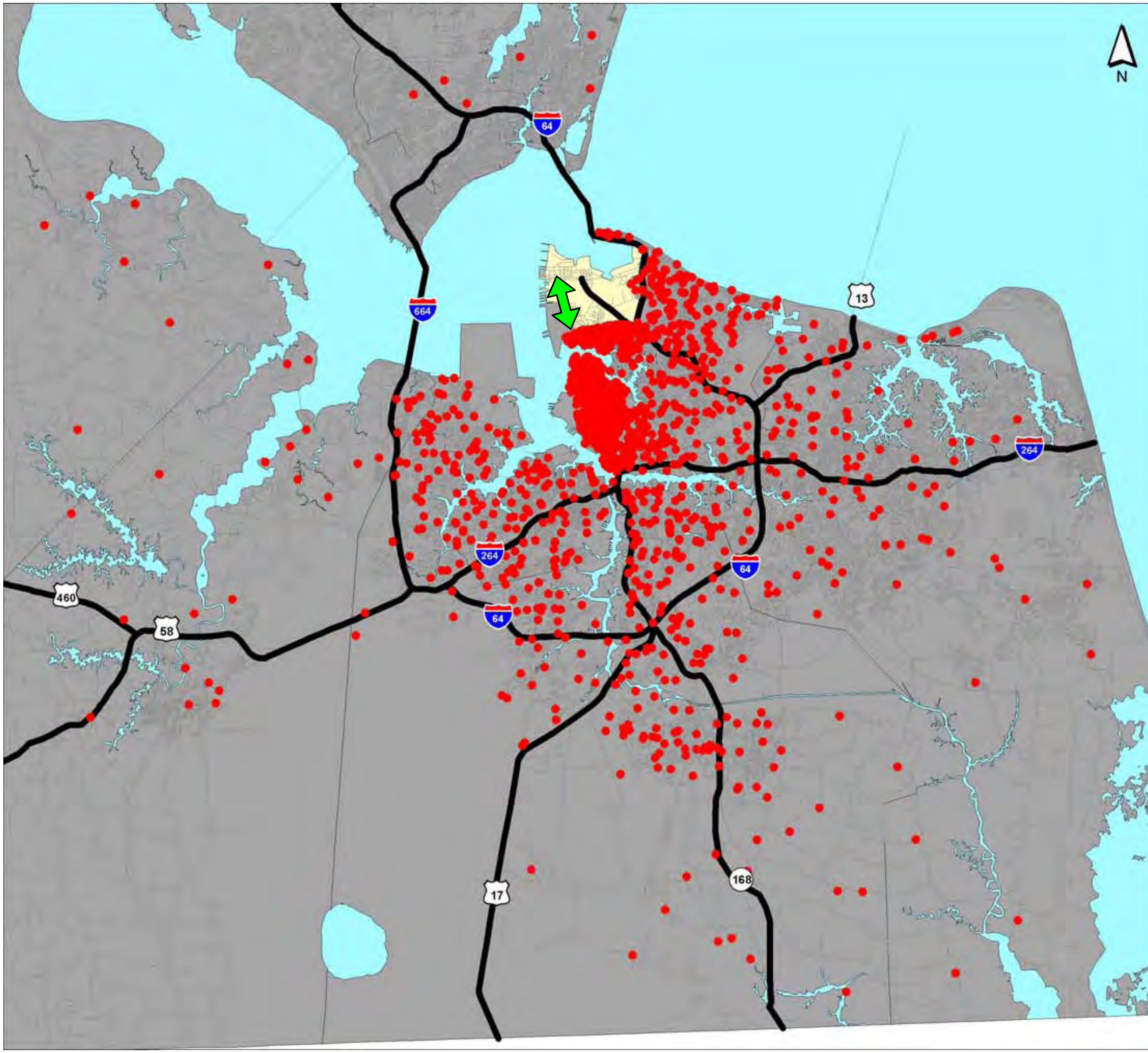
Final Route Used by Commuters to Access Naval Station Norfolk	Percent of Survey Respondents
I-564/Admiral Taussig Blvd	50%
Hampton Blvd	15%
Bay Ave/Fourth View Ave	15%
Granby St	14%
Other	6%

Data Source: Naval Station Norfolk Commuter Survey.

TABLE 4 – Commuting Mode for Naval Station Norfolk Employees, 2004

Commuting Mode for Naval Station Norfolk Employees	Percent of Survey Respondents
Single Occupant Vehicle	95%
High Occupancy Vehicle Rider or Driver	3%
Public Transportation	1%
Walk/Bicycle	< 1%
Other	< 1%

Data Source: Naval Station Norfolk Commuter Survey.



MAP 2

Naval Station Norfolk Area Traffic Management Study

Trip Ends Entering or Leaving Naval Station Norfolk in 2000 via Hampton Blvd

LEGEND

Naval Base

Origin & Destination Points

1 Dot = 20 Trip Ends*

% of Trip Ends by Locality Entering or Leaving the Naval Station via Hampton Blvd

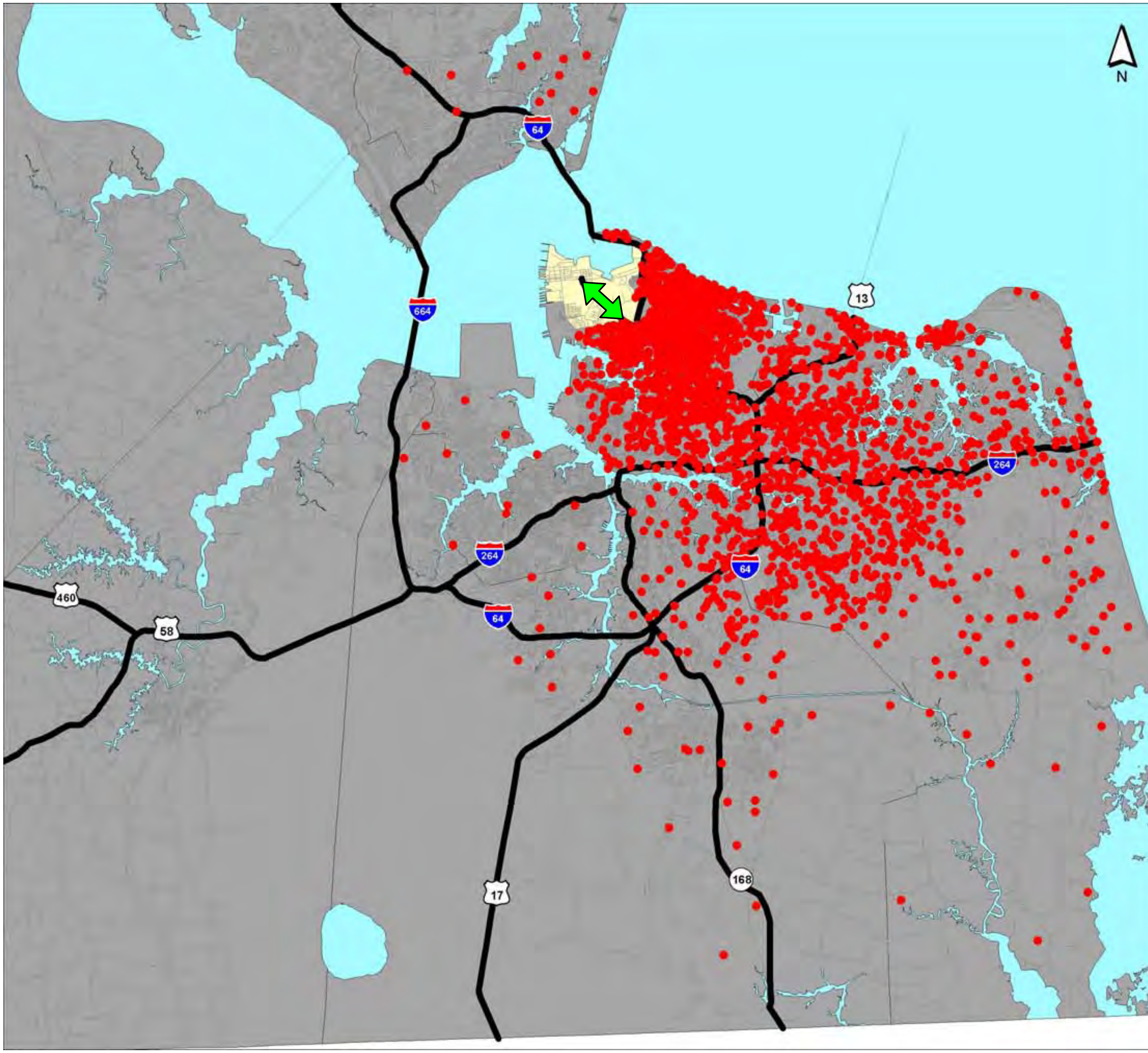
Norfolk	64%
Chesapeake	14%
Portsmouth	8%
Virginia Beach	7%
Suffolk	2%
Other	5%

0 2 4 6 Miles

*Trip ends represent the beginning and end of each trip. Trip ends occurring at Naval Station Norfolk are not shown on this map.

Data Source: HRPDC Regional Demand Forecasting Model

Base Map Source: VDOT



MAP 3

Naval Station Norfolk Area Traffic Management Study

Trip Ends Entering or Leaving Naval Station Norfolk in 2000 via I-564

LEGEND

Naval Base

Origin & Destination Points

1 Dot = 20 Trip Ends*

% of Trip Ends by Locality Entering or Leaving the Naval <u>Station via I-564</u>

Norfolk	54%
Virginia Beach	38%
Chesapeake	5%
Portsmouth	1%
Suffolk	0.2%
Other	2%

0 2 4 6 Miles

*Trip ends represent the beginning and end of each trip. Trip ends occurring at Naval Station Norfolk are not shown on this map.

Data Source: HRPDC Regional Demand Forecasting Model

Base Map Source: VDOT

TRAFFIC CHARACTERISTICS

This section of the report details the characteristics of traffic in the vicinity of Naval Station Norfolk. The following topics are included in this section:

- Traffic volumes and trends
- Peak hour traffic characteristics
- Accessing the base
- Travel time/speed data
- Rail crossings
- Safety data

Traffic Volumes and Trends

The Virginia Department of Transportation collects 24-hour traffic volumes on major roadways throughout the City of Norfolk every three years, most recently in 2003. Additionally, two locations within the study area, I-564 south of Admiral Taussig Boulevard and International Terminal Boulevard east of Hampton Boulevard, contain permanent count stations. These stations record traffic volumes every day throughout the year.

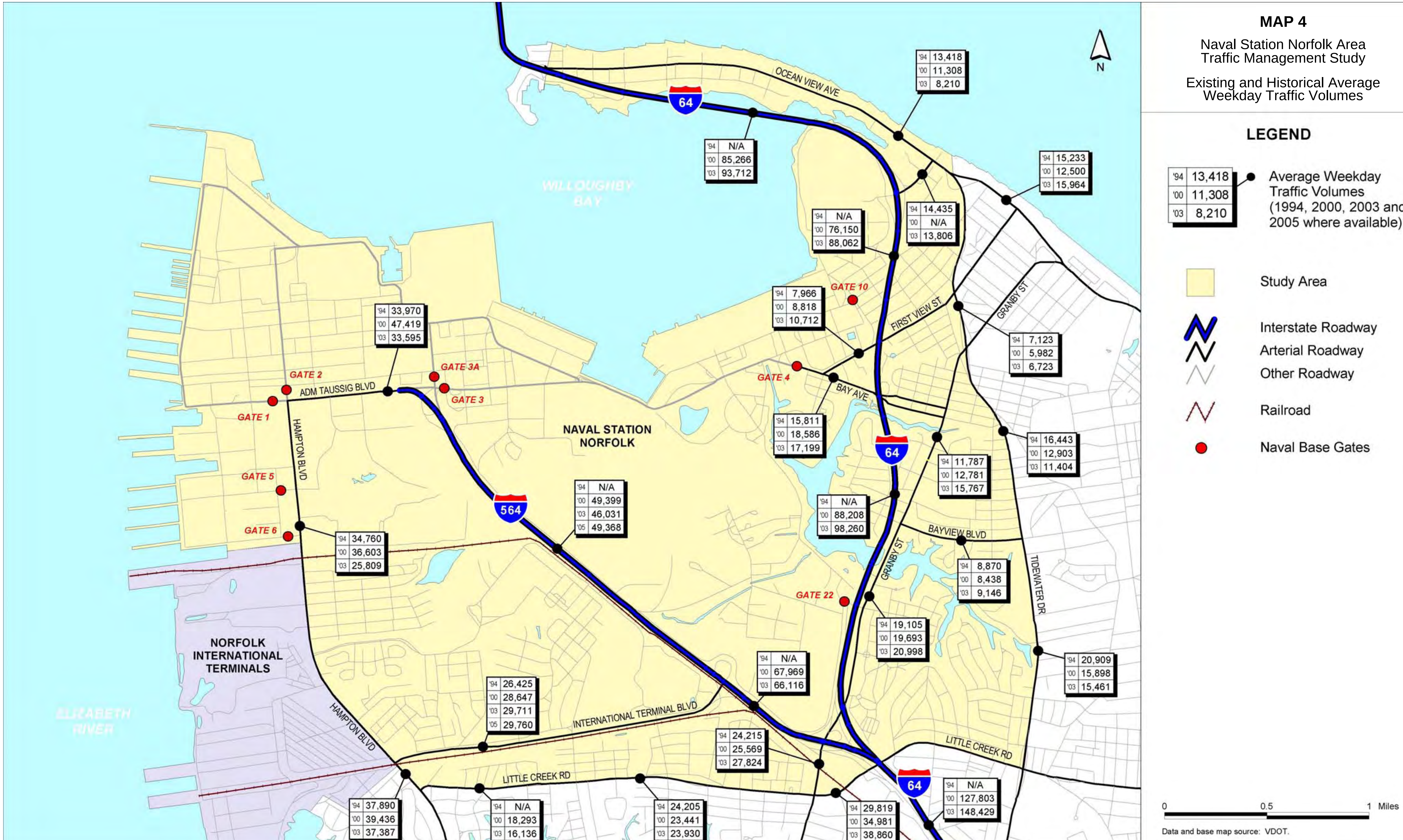
Historical weekday traffic volumes in the study area are shown in **Table 5**, as well as on **Map 4** on page 8. Of the 17 locations in the study area with data available for both 1994 and 2003, 9 experienced a decrease in traffic volumes. These locations include all of Hampton Boulevard and Tidewater Drive within the study area. I-564 also experienced a slight decrease in traffic volumes between 2000 and 2005.

Locations in the study area with increases in traffic volumes between 1994 and 2003 include Bay Avenue, Granby Street, and International Terminal Boulevard. I-64 also

TABLE 5 – Historical Weekday Traffic Volumes in the Vicinity of Naval Station Norfolk

Facility	Location	Average Weekday Traffic Volume			
		1994	2000	2003	2005
Admiral Taussig Blvd	Hampton Blvd and I-564	33,970	47,419	33,595	N/A
Bay Ave	First View St and I-64	15,811	18,586	17,199	N/A
Bayview Blvd	Granby St and Tidewater Dr	8,870	8,438	9,146	N/A
First View St	Bay Ave and Tidewater Dr	7,966	8,818	10,712	N/A
Fourth View St	I-64 and Ocean View Ave	14,435	N/A	13,806	N/A
Granby St	Little Creek Rd and I-564	24,215	25,569	27,824	N/A
Granby St	I-64 and Bayview Blvd	19,105	19,693	20,998	N/A
Granby St	Bayview Blvd and Bay Ave	11,787	12,781	15,767	N/A
Hampton Blvd	Adm. Taussig Blvd and International Terminal Blvd	34,760	36,603	25,809	N/A
Hampton Blvd	International Terminal Blvd and Little Creek Rd	37,890	39,436	37,387	N/A
I-564	Adm. Taussig Blvd and International Terminal Blvd	N/A	49,399	46,031	49,368
I-564	International Terminal Blvd and I-64	N/A	67,969	66,116	N/A
I-64	15th View St and 4th View St	N/A	85,266	93,712	N/A
I-64	4th View St and Bay Ave	N/A	76,150	88,062	N/A
I-64	Bay Ave and I-564	N/A	88,208	98,260	N/A
International Terminal Blvd	Hampton Blvd and I-564	26,425	28,647	29,711	29,760
Little Creek Rd	Hampton Blvd and Diven St	N/A	18,293	16,136	N/A
Little Creek Rd	Diven St and Granby St	24,205	23,441	23,930	N/A
Little Creek Rd	Granby St and I-64	29,819	34,981	38,860	N/A
Ocean View Ave	15th View St and 4th View St	13,418	11,308	8,210	N/A
Tidewater Dr	Little Creek Rd and Bayview Blvd	20,909	15,898	15,461	N/A
Tidewater Dr	Bayview Blvd and Granby St	16,443	12,903	11,404	N/A
Tidewater Dr	Granby St and First View St	7,123	5,982	6,723	N/A

Data Source: VDOT.


MAP 4
Naval Station Norfolk Area
Traffic Management Study
Existing and Historical Average
Weekday Traffic Volumes
LEGEND
'94 13,418 '00 11,308 '03 8,210
Average Weekday Traffic Volumes (1994, 2000, 2003 and 2005 where available)
Study Area
Interstate Roadway
Arterial Roadway
Other Roadway
Railroad
Naval Base Gates
0 0.5 1 Miles
Data and base map source: VDOT.
N
WILLOUGHBY BAY
ELIZABETH RIVER
NAVAL STATION NORFOLK
NORFOLK INTERNATIONAL TERMINALS
OCEAN VIEW AVE
ADM TAUSSIG BLVD
HAMPTON BLVD
FIRST VIEW ST
GRANBY ST
BAY AVE
BAYVIEW BLVD
TIDEWATER DR
INTERNATIONAL TERMINAL BLVD
LITTLE CREEK RD
64
564
GATE 1
GATE 2
GATE 3A
GATE 3
GATE 4
GATE 5
GATE 6
GATE 10
GATE 22
'94 13,418 '00 11,308 '03 8,210
'94 N/A '00 85,266 '03 93,712
'94 15,233 '00 12,500 '03 15,964
'94 N/A '00 76,150 '03 88,062
'94 14,435 '00 N/A '03 13,806
'94 7,966 '00 8,818 '03 10,712
'94 7,123 '00 5,982 '03 6,723
'94 33,970 '00 47,419 '03 33,595
'94 15,811 '00 18,586 '03 17,199
'94 16,443 '00 12,903 '03 11,404
'94 11,787 '00 12,781 '03 15,767
'94 N/A '00 49,399 '03 46,031 '05 49,368
'94 N/A '00 88,208 '03 98,260
'94 34,760 '00 36,603 '03 25,809
'94 8,870 '00 8,438 '03 9,146
'94 19,105 '00 19,693 '03 20,998
'94 20,909 '00 15,898 '03 15,461
'94 N/A '00 67,969 '03 66,116
'94 26,425 '00 28,647 '03 29,711 '05 29,760
'94 24,215 '00 25,569 '03 27,824
'94 N/A '00 127,803 '03 148,429
'94 37,890 '00 39,436 '03 37,387
'94 N/A '00 18,293 '03 16,136
'94 24,205 '00 23,441 '03 23,930
'94 29,819 '00 34,981 '03 38,860

experienced a large increase in traffic volumes between 2000 and 2003.

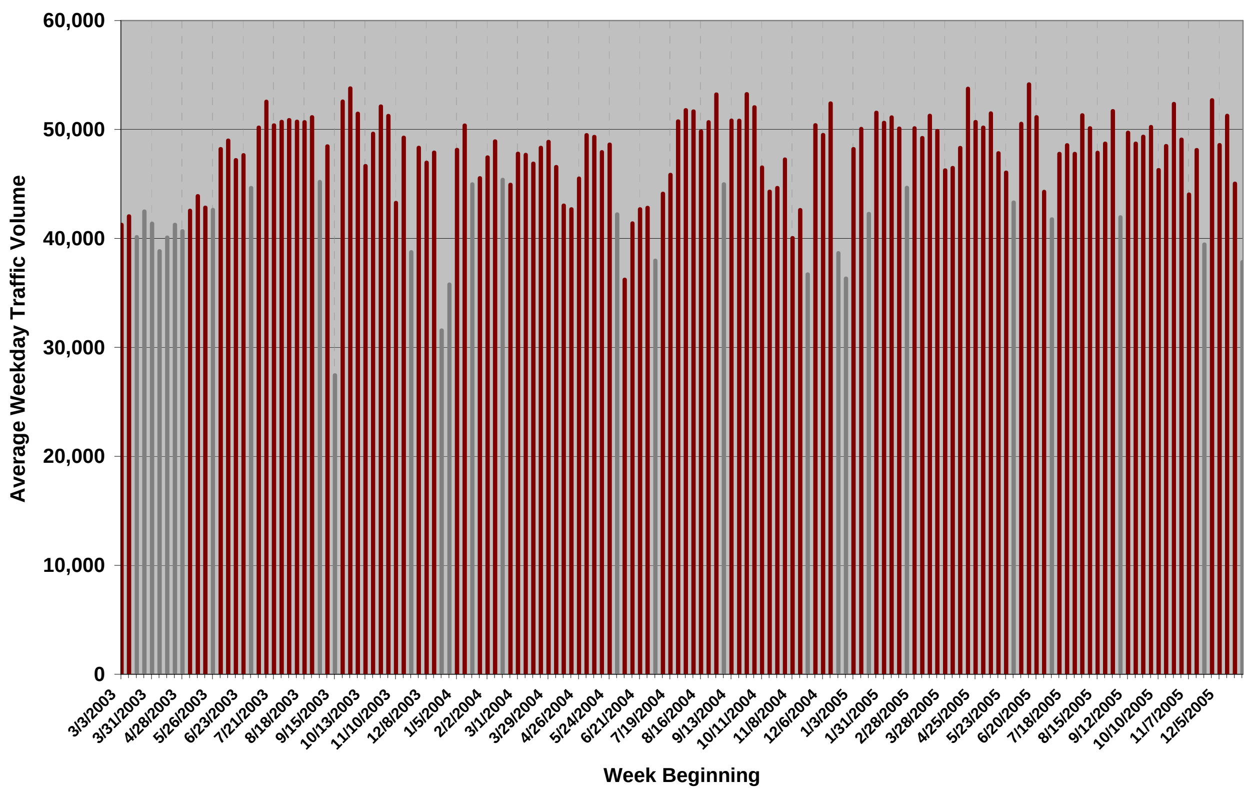
Analyzing traffic volume trends in the vicinity of Naval Station Norfolk is difficult due to the variability in activity at the base. While changes in traffic volumes may be the result of long-term trends, they may also be due to a high or low number of deployments during the two-day period when the traffic volume data was collected.

The variability of traffic volumes can be analyzed using data collected from permanent count stations. As was stated earlier, VDOT maintains a permanent count station on I-564 south of Admiral Taussig Boulevard. **Figure 1** shows the average weekday traffic volumes at this location for each week from March 2003 through the end of 2005.

Although traffic volumes varied significantly throughout the three-year period, most of this variability was due to holidays. The lowest traffic volumes in those weeks without holidays occurred during Operation Iraqi Freedom, which took place between March 20 and May 1, 2003. During this period, I-564 volumes were around 40,700 vehicles per weekday. By comparison, those weeks that did not include holidays or Operation Iraqi Freedom averaged 48,400 vehicles per weekday.

There was also variability in traffic volumes in those weeks without holidays and Operation Iraqi Freedom. 46 of these 119 weeks had average weekday traffic volumes of over 50,000 vehicles, with a maximum of 54,100 vehicles. 20 of these weeks had average weekday traffic volumes lower than 45,000 vehicles per day.

FIGURE 1 – Average Weekday Traffic Volumes by Week on I-564 south of Admiral Taussig Blvd, 2003 - 2005



Note: Columns shown in gray include holidays or the time period encompassing Operation Iraqi Freedom.

Data source: VDOT.
Station was out of service in January and February 2003.

Peak Hour Traffic Characteristics

This section examines existing peak hour traffic characteristics, including average delay and levels-of-service, at selected intersections in the vicinity of Naval Station Norfolk. To conduct this analysis, intersection turning movement counts were collected throughout the study area in 2005. These counts were taken one weekday at each intersection for two to three hours during both the morning and afternoon peak travel periods.

From these peak period turning movement counts, the peak travel hour was extracted and used for this analysis. For intersections along Hampton Boulevard, the morning peak hour was 6:00 am to 7:00 am (0600-0700), and the afternoon peak hour was 3:00 pm to 4:00 pm (1500-1600). For intersections to the east of Hampton Boulevard, the peak travel hours occurred slightly later both in the morning and the afternoon.

These peak hour intersection turning movement counts were then adjusted to account for variations in traffic due to a variety of reasons, including daily traffic volume variations as observed at the permanent count stations, traffic flow patterns that were affected by the temporary closures of Naval Station gates, and probable data collection inaccuracies.

Using the adjusted turning movement counts and current traffic signal timings and phasings, peak hour delays and levels-of-service were calculated using Synchro[3], a capacity analysis and traffic signal optimization program. Synchro uses Highway Capacity Manual[4] methods to calculate control delay (the delay resulting from slowing and stopping on the approaches of an intersection) and levels-of-service. Levels-of-service are letter grades that are assigned to traffic movements and intersections based on the amount of delay experienced by each driver (**Table 6**). Level-of-service A is considered the best operating condition with control delays of less than 10 seconds per vehicle at signalized intersections. Level-of-service F is

TABLE 6 – Description of Signalized Intersection Levels-of-Service

Level of Service (LOS)	Average Control Delay (sec/veh)	Description
A	$\leq$ 10.0	Progression is extremely favorable and most vehicles do not stop at all.
B	10.1 - 20.0	Progression is good, with more vehicles stopping than at LOS A.
C	20.1 - 35.0	Progression is fair, and individual cycle failures may begin to appear at this level.
D	35.1 - 55.0	Congestion becomes noticeable. Many vehicles stop and individual cycle failures become more prevalent.
E	55.1 - 80.0	Individual cycle failures are frequent.
F	> 80.0	Arriving traffic volumes exceed the capacity of the intersection. Significant cycle failures occur.

Source: Highway Capacity Manual 2000.

3 **Synchro**, Version 6.0, Trafficware Corporation.
4 **Highway Capacity Manual**, Transportation Research Board, 2000.

considered the worst operating condition with control delays of greater than 80 seconds per vehicle at signalized intersections. Levels-of-service A through D are considered to be acceptable operating conditions, while levels-of-service E and F are generally considered to be unacceptable operating conditions.

Table 7 shows the existing morning and afternoon peak hour delay and levels-of-service for selected intersections in the study area. **Map 5** on page 12 and **Map 6** on page 13 also show morning and afternoon peak hour levels-of-service for intersections along and in the vicinity of Hampton Boulevard.

During the morning peak hour, all of the intersections approaching Naval Station Norfolk currently operate at acceptable levels of service. The intersection of Little Creek Road and Granby Street has the highest delay among analyzed intersections with a level-of-service D.

During the afternoon peak hour, two of the analyzed intersections currently operate under unacceptable conditions: Hampton Boulevard at Admiral Taussig Boulevard and Little Creek Road at Granby Street. Another intersection, Hampton Boulevard at B Avenue/Seabee Avenue, operates at LOS D. All of the remaining analyzed intersections operate at levels-of-service C or better.

More detailed turning movement counts, average delay and levels-of-service for each intersection are included in **Appendix A**.

TABLE 7 – Average Delay and Levels-of-Service during the AM and PM Peak Hour at Intersections in the Vicinity of Naval Station Norfolk, 2005

Intersection	AM Peak Hour		PM Peak Hour	
	Average Delay (sec/veh)	LOS	Average Delay (sec/veh)	LOS
Admiral Taussig Blvd at Mall Dr	13.7	B	19.3	B
Admiral Taussig Blvd at Hammond Ave	34.1	C	6.4	A
Bainbridge Ave at Bellinger Blvd	9.7	A	34.2	C
Hampton Blvd at Admiral Taussig Blvd	0	A	57.3	E
Hampton Blvd at B Ave	14.0	B	38.8	D
Hampton Blvd at D Ave	0.6	A	N/A	
Hampton Blvd at Northgate Rd	0.4	A	4.6	A
Hampton Blvd at Greenbrier Ave	3.6	A	3.4	A
Hampton Blvd at Beechwood Ave	6.1	A	10.3	B
Hampton Blvd at Glendale Ave	8.8	A	5.4	A
Hampton Blvd at Helmick St	10.0	A	5.3	A
Hampton Blvd at Baker St	1.8	A	13.8	B
Hampton Blvd at Staff College	5.2	A	3.4	A
Hampton Blvd at Terminal Blvd	27.9	C	33.4	C
Hampton Blvd at Little Creek Rd	28.3	C	26.5	C
International Terminal Blvd at Meredith St	2.2	A	19.2	B
International Terminal Blvd at Diven St	29.6	C	32.9	C
Little Creek Rd at Diven St	5.9	A	12.4	B
Little Creek Rd at Granby St	47.1	D	59.5	E

Note: D Avenue in the vicinity of Gate 6 is closed during the PM Peak Hour.


MAP 5
Intersection Levels-of-Service
AM Peak Hour
LEGEND
Study Area
Interstate Roadway
Arterial Roadway
Other Roadway
Railroad
Naval Base Gates
Intersection Level-of-Service – AM Peak Hour
0 0.1 0.2 Miles
Base map source: VDOT.
N
GATE 1
GATE 2
GATE 3A
GATE 3
GATE 5
GATE 6
ADM TAUSSIG BLVD
HAMPTON BLVD
MALL DR
HAMMOND AVE
SEABEE AVE
564
NAVAL STATION NORFOLK
B AVE
D AVE
GREENBRIER AVE
BEECHWOOD AVE
GLENDALE AVE
HELMICK ST
BAKER ST
NORFOLK INTERNATIONAL TERMINALS
ARMED FORCES STAFF COLLEGE
MEREDITH ST
INTERNATIONAL TERMINAL BLVD
DIVEN ST
LITTLE CREEK RD
Little Creek Rd at Granby St


MAP 6
Intersection Levels-of-Service
PM Peak Hour
LEGEND
Study Area
Interstate Roadway
Arterial Roadway
Other Roadway
Railroad
Naval Base Gates
Intersection Level-of-Service – PM Peak Hour
0
0.1
0.2
Miles
Base map source: VDOT.
N
GATE 1
GATE 2
GATE 3A
GATE 3
GATE 5
GATE 6
ADM TAUSSIG BLVD
HAMPTON BLVD
MALL DR
HAMMOND AVE
SEABEE AVE
564
NAVAL STATION NORFOLK
B AVE
D AVE
GREENBRIER AVE
BEECHWOOD AVE
GLENDALE AVE
HELMICK ST
BAKER ST
MEREDITH ST
ARMED FORCES STAFF COLLEGE
NORFOLK INTERNATIONAL TERMINALS
INTERNATIONAL TERMINAL BLVD
DIVEN ST
LITTLE CREEK RD
Little Creek Rd at Granby St

Accessing the Base

The needs of providing access to 60,000 active-duty military and 10,000 civilian personnel are balanced by the security needs of the world's largest Naval installation. Although traffic conditions are generally acceptable in the vicinity of Naval Station Norfolk, traffic flows are also affected by the security checks that are required to enter the base.

Nine gates provide access to the secure areas of Naval Station Norfolk. The locations of these gates (**Map 7** on page 15) are:

- Gates 1 & 2 – North and west of the intersection of Admiral Taussig Boulevard and Hampton Boulevard.
- Gates 3 & 3A – At the end of I-564.
- Gate 4 – At the end of Bay Avenue.
- Gates 5 & 6 - Southwestern portion of the base off of Hampton Boulevard.
- Gate 10 – West of the Willoughby neighborhood.
- Gate 22 – West of Granby Street north of I-564.

The Navy has recently renovated some of these gates to both enhance security and improve traffic flow entering the base. Renovations of Gate 3A were completed in July 2004, Gate 2 in December 2004, and Gate 5 in October 2005. Gate 6 renovations are pending based on additional funding.

The operation of these gates varies by time of day (**Table 8**). During the morning peak period, all 9 gates are open to inbound traffic with a total of 24 lanes. During this time only five of the nine gates are open to outbound traffic. During the afternoon peak period, five of the nine gates are open to inbound traffic and all of the gates except for Gate 6 are open to outbound traffic.

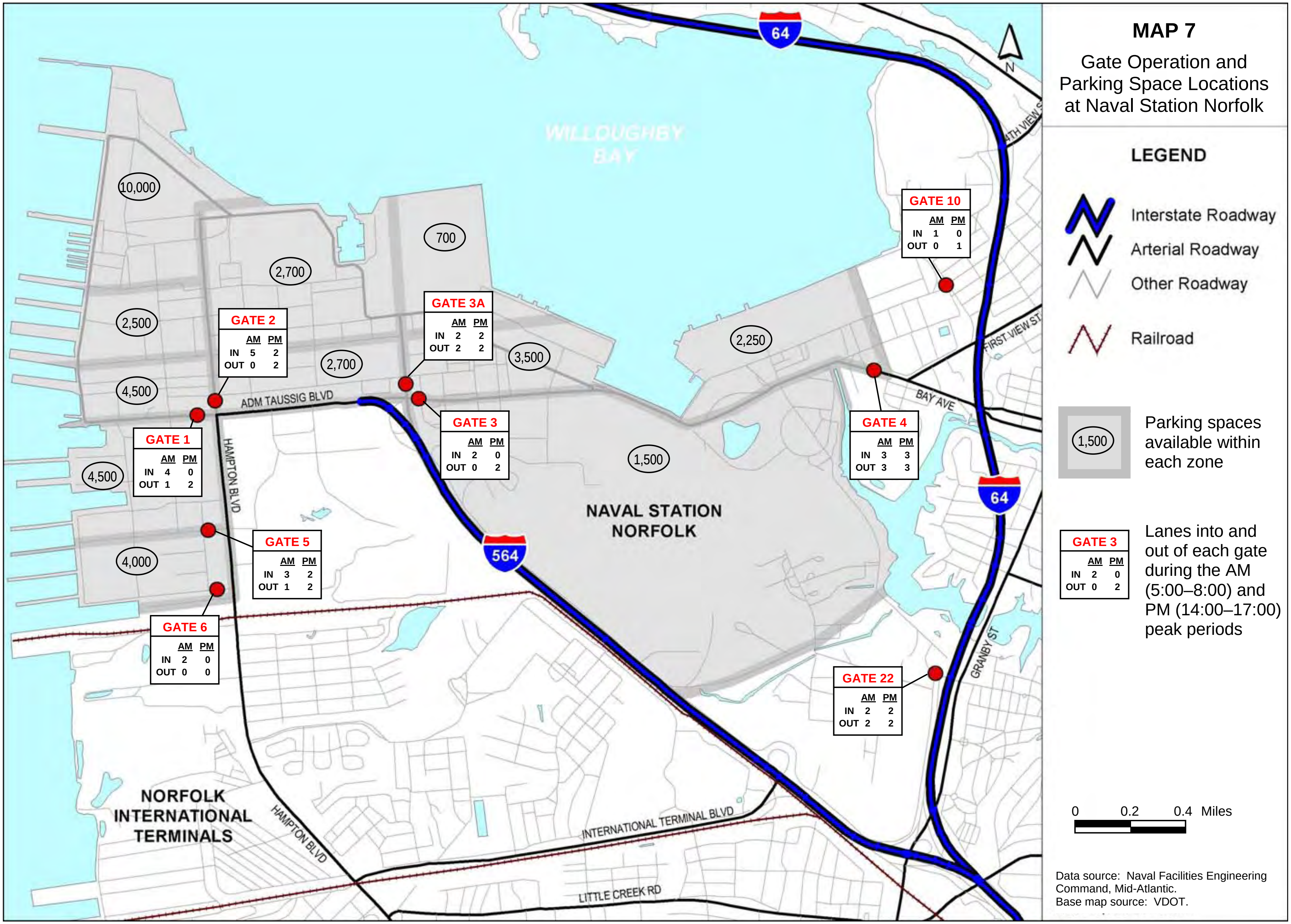
To determine the usage of each gate, the Naval Station Norfolk Commuter Study asked survey participants which gate they primarily used to access the base, regardless of time of day. Gates 3/3A had the highest usage of any of the gates with 22% of all traffic entering the base. Gates 2 and 4 also had a high level of usage at 20% and 19% of all entering traffic, respectively.

Gate usage can also be determined with the turning movement counts taken for this study. During the morning peak hour, the number of vehicles that entered the base via

TABLE 8 –Naval Station Norfolk Gate Usage and Availability During the Morning and Afternoon Peak Periods

Gate	Gate Location	AM Peak Period			PM Peak Period	
		Gate Usage (survey)	Inbound Lanes	Outbound Lanes	Inbound Lanes	Outbound Lanes
1	End of Admiral Taussig Blvd	10%	4	1	0	2
2	End of Hampton Blvd	20%	5	0	2	2
3	End of I-564	22%	2	0	0	2
3A	End of I-564		2	2	2	2
4	End of Bay Ave	19%	3	3	3	3
5	Hampton Blvd at B Ave	9%	3	1	2	2
6	Hampton Blvd at D Ave	4%	2	0	0	0
10	Willoughby neighborhood	6%	1	0	0	1
22	Granby St north of I-564	11%	2	2	2	2

Gate usage data source: Naval Station Norfolk Commuter Study.
Lane availability source: Naval Facilities Engineering Command, Mid-Atlantic.


MAP 7
Gate Operation and Parking Space Locations at Naval Station Norfolk
LEGEND
Interstate Roadway
Arterial Roadway
Other Roadway
Railroad
1,500
Parking spaces available within each zone
GATE 3
AM PM
IN 2 0
OUT 0 2
Lanes into and out of each gate during the AM (5:00–8:00) and PM (14:00–17:00) peak periods
0 0.2 0.4 Miles
Data source: Naval Facilities Engineering Command, Mid-Atlantic.
Base map source: VDOT.
WILLOUGHBY BAY
NAVAL STATION NORFOLK
NORFOLK INTERNATIONAL TERMINALS
ADM TAUSSIG BLVD
HAMPTON BLVD
INTERNATIONAL TERMINAL BLVD
LITTLE CREEK RD
BAY AVE
GRANBY ST
FIRST VIEW ST
64
564
10,000
2,500
4,500
4,500
4,000
2,700
2,700
700
3,500
2,250
1,500
GATE 1
AM PM
IN 4 0
OUT 1 2
GATE 2
AM PM
IN 5 2
OUT 0 2
GATE 3A
AM PM
IN 2 2
OUT 2 2
GATE 3
AM PM
IN 2 0
OUT 0 2
GATE 4
AM PM
IN 3 3
OUT 3 3
GATE 5
AM PM
IN 3 2
OUT 1 2
GATE 6
AM PM
IN 2 0
OUT 0 0
GATE 10
AM PM
IN 1 0
OUT 0 1
GATE 22
AM PM
IN 2 2
OUT 2 2

selected gates was:

- Gate 1 – 1,058 vehicles
- Gate 2 – 1,058 vehicles
- Gate 3/3A – 1,779 vehicles
- Gate 5 – 1,041 vehicles
- Gate 6 - 417 vehicles

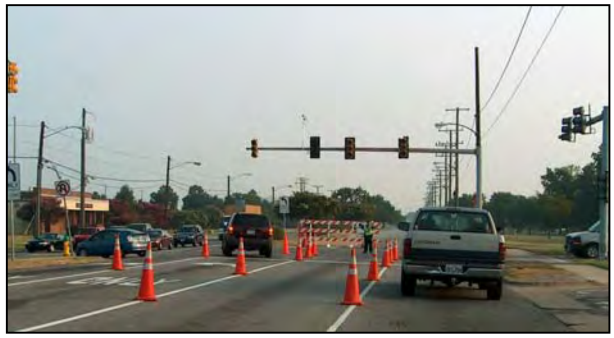
There is some discrepancy between the results of the commuter survey and the turning movement counts. Although both methods seem to indicate that Gates 3 and 3A are the most heavily used gates to enter the base, the turning movement counts seem to indicate more usage of Gate 1 and less usage of Gate 2 than the surveys did.

Using a combination of the commuter surveys, turning movement counts, and current gate operation, the current traffic density entering each gate during the morning peak hour is estimated to be:

- Gate 1 – 265 vehicles per hour per lane (vphpl)
- Gate 2 – 220 vphpl
- Gate 3/3A – 450 vphpl
- Gate 4 – 560 vphpl
- Gate 5 – 350 vphpl
- Gate 6 – 210 vphpl
- Gate 10 – 540 vphpl
- Gate 22 - 480 vphpl

The capacity of these gates varies greatly based on the security level. According to the Naval Station Norfolk Commuter Study, gates can process up to 700 vehicles per hour per lane during normal security conditions. During heightened security conditions, the capacity is reduced in half to 350 vehicles per hour per lane. At the traffic densities listed above, no gates have a current demand higher than 700 vehicles per hour per lane. Gate 3/3A, Gate 4, Gate 10, and Gate 22 currently have a demand higher than 350 vehicles per hour per lane.

In addition to managing traffic at the gates, the Navy also operates a traffic



PICTURE 1 - Temporary traffic control maintained by Naval Station Police at Hampton Boulevard and B Avenue (Gate 5).

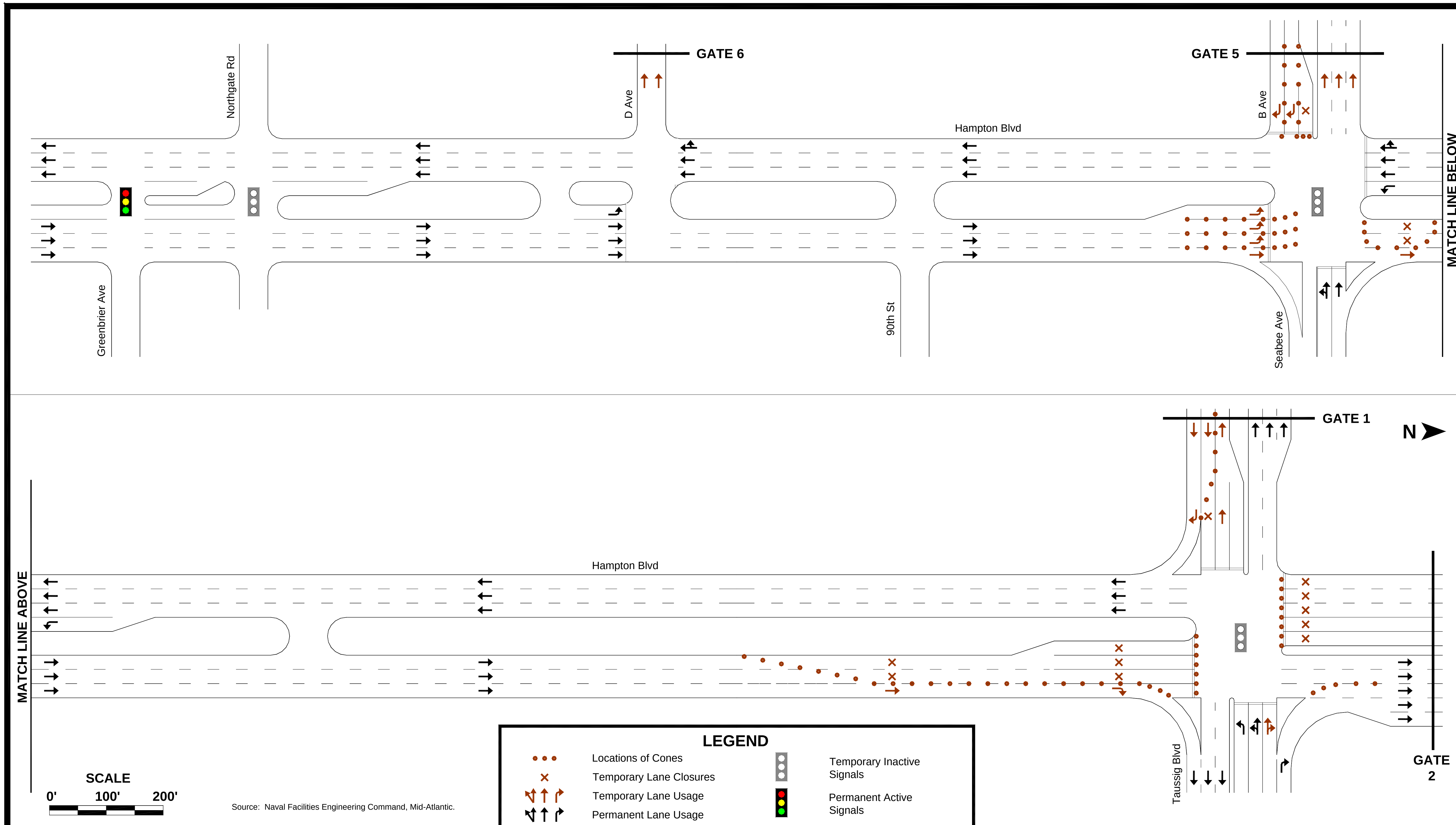
management plan for Hampton Boulevard between 5 am and 8 am (0500-0800). The current plan, which is detailed in **Figure 2** on page 17, does the following:

- Restricts northbound Hampton Boulevard traffic to right turns only at Admiral Taussig Boulevard. Access to Gates 1 and 2 is not permitted from Hampton Boulevard.
- Creates three left turn lanes and one through lane on northbound Hampton Boulevard at B Avenue.
- Prohibits traffic from exiting the base at Gate 2.
- Restricts traffic exiting the base at Gates 1 and 5 to make a right turn onto southbound Hampton Boulevard.
- Creates an additional right turn lane from westbound Admiral Taussig Blvd into Gate 2.

To implement this traffic management plan, Naval Station Police currently set up and remove traffic control devices along Hampton Boulevard each weekday morning. This process, while improving traffic flow into the gates, requires a significant amount of manpower to implement.

The traffic management plan has been altered at times, largely to accommodate gate renovations at the Naval Station and decrease the amount of manpower required. No similar traffic management plan is in place at other times of the day, although a traffic cop currently directs traffic at Admiral Taussig Blvd and Hampton Blvd during the afternoon peak.

FIGURE 2 – Hampton Boulevard Traffic Management During the Morning Peak Travel Period



Travel Time/Speed Data

Travel time and speed data is collected every five years by HRPDC along major roadways throughout the region. This data collection was most recently completed in 2000 and 2005.

For this study, three travel time runs were collected along major roadways in each direction during both the morning and afternoon peak travel periods. Travel time and speed data from these runs was collected using a GPS-equipped probe vehicle. Travel speeds from these three runs were then averaged, and these average speeds are included in **Table 9**.

In the study area, most of the average travel speeds during the morning peak travel period decreased between 2000 and 2005. However, travel speeds on the two primary roadways that access Naval Station Norfolk increased significantly. Between 2000 and 2005, the average travel speed increased 4.5 miles per hour on northbound Hampton Boulevard between Little Creek Road and Admiral Taussig Boulevard. On northwestbound I-564/Admiral Taussig Boulevard, the average travel speed increased 8.4 miles per hour between 2000 and 2005.

During the afternoon peak travel period, most of the travel speeds in the study area increased between 2000 and 2005. Average travel speeds on southeastbound I-564 leaving the Naval Station increased by 1.7 miles per hour during this time period. Travel speeds on southbound Hampton Boulevard, however, decreased by 9.2 miles per hour between 2000 and 2005.

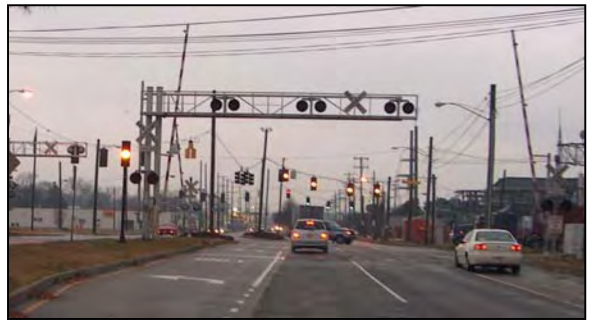
TABLE 9 – Average Travel Speeds in the Vicinity of Naval Station Norfolk, 2000 - 2005

		AM Peak Hour			PM Peak Hour		
Facility	**Dir**	**2000**	**2005**	**Change, 2000-2005**	**2000**	**2005**	**Change, 2000-2005**
Bay Ave/Ocean Ave from First View St to Granby St	EB	21.5	19.7	-1.8	17.7	21.5	3.8
	WB	24.8	24.1	-0.7	23.3	23.4	0.1
Bayview Blvd from Granby St to Tidewater Dr	EB	20.3	18.1	-2.2	15.2	17.3	2.1
	WB	21.1	18.9	-2.2	16.3	25.1	8.8
Granby St from Little Creek Rd to Tidewater Dr	NB	24.5	27.0	2.5	29.5	30.5	1.0
	SB	28.5	23.9	-4.6	21.3	23.4	2.1
Hampton Blvd from Little Creek Rd to Taussig Blvd	NB	21.6	26.1	4.5	21.9	26.0	4.1
	SB	23.6	22.5	-1.1	27.1	17.9	-9.2
International Terminal Blvd from Hampton Blvd to I-564	EB	37.3	39.4	2.1	19.2	37.3	18.1
	WB	27.4	15.7	-11.7	32.3	30.0	-2.3
Interstate 64 from 15th View St to I-564	EB	55.0	54.5	-0.5	55.0	36.1	-18.9
	WB	55.0	55.0	0.0	55.0	35.5	-19.5
I-564/Taussig Blvd from Hampton Blvd to I-64	NWB	16.7	25.1	8.4	44.1	38.9	-5.2
	SEB	42.0	41.7	-0.3	43.2	44.9	1.7
Little Creek Rd from Hampton Blvd to Tidewater Dr	EB	24.0	23.6	-0.4	18.4	22.2	3.8
	WB	13.7	26.2	12.5	20.9	21.4	0.5
Tidewater Dr from Little Creek Rd to Ocean View Ave	NB	29.6	35.1	5.5	28.9	25.6	-3.3
	SB	31.4	30.4	-1.0	34.4	35.7	1.3

All speeds are listed in miles per hour.
Data source: HRPDC.

Rail Crossings

There are two rail crossings along Hampton Boulevard in the study area. One crossing is located just north of Northgate Road and the other is located within the intersection of International Terminal Boulevard. Of particular concern to people accessing Naval Station Norfolk is the delay caused by slow moving trains using these crossings to enter and exit Norfolk International Terminals (NIT). With limited space inside NIT, train operators often perform switchback maneuvers across Hampton Boulevard to get rail cars into or out of the port.



PICTURE 2 – The northern of two rail crossings of Hampton Blvd into Norfolk International Terminals.

To interfere as little as possible with peak travel periods, trains are prohibited from using these Hampton Boulevard crossings four periods each weekday. Those times are from 6:45 to 8:15 am, 11:45 am to 12:15 pm, 12:45 to 1:15 pm, and 3:00 to 5:30 pm.

There were a total of 1,176 preemptions of the traffic signal at Hampton Boulevard and International Terminal Boulevard for train crossings between August and October of 2006, an average of 13 preemptions each day. There were another 748 preemptions of the Northgate Road signal during the three-month period, an average of 8 preemptions each day. 179 preemptions (15%) at International Terminal Boulevard and 163 preemptions (22%) at Northgate Road had durations of greater than five minutes.

Despite the peak hour restrictions, there were 216 preemptions during restricted times at the International Terminal Boulevard crossing and 184 preemptions during restricted times at the Northgate Road crossing from August to October of 2006. 27 of these preemptions exceeded 5 minutes.

Two crashes occurred between trains and vehicles at the International Terminal Boulevard railroad crossing between 1996 and 2005. Neither crash involved any fatalities or injuries.

TABLE 10 – Railroad Crossing Preemptions along Hampton Boulevard, August-October 2006

	Hampton Blvd at International Terminal Blvd	Hampton Blvd at Northgate Rd
Total preemptions (Aug-Oct 2006)	1176	748
Preemptions per Month	392	249
Total duration of preemptions	49 hours	53 hours
Total duration of preemptions per month	16.3 hours	17.7 hours
Average duration per preemption (min)	2.5 minutes	4.3 minutes
% of time signal is preempted	2.2%	2.4%
Total preemptions that exceeded 5 minutes	179	163
% of preemptions that exceeded 5 minutes	15.2%	21.8%
Total preemptions between 6:45 - 8:15 am	33	15
Total preemptions between 11:45 am - 12:15 pm	4	25
Total preemptions between 12:45 - 1:15 pm	10	36
Total preemptions between 3:00 - 5:30 pm	169	108
Total preemptions during restricted times	216	184
% of preemptions during restricted times	18.4%	24.6%
Total preemptions exceeding 5 minutes during restricted times	19	8

Data source: City of Norfolk.

Safety Data

Crash data was analyzed for major roadways in the study area using the crash severity method. In this method, each crash is categorized based on whether the crash had a fatality (fatality crashes), had at least one injury but no fatalities (injury crashes), or had no injuries or fatalities (property damage only crashes). Each of these three crash severity categories is then weighted by a factor to provide equivalence to property damage crashes. The factors are:

- Property Damage Only Crashes: 1
- Injury Crashes: 3
- Fatality Crashes: 12

These factors are incorporated into the equation for calculating annual Equivalent Property Damage Only (EPDO) crashes:

Annual EPDO =

12 x (Fatality Crashes per year) +
3 x (Injury Crashes per year) +
Property Damage Only Crashes per year

For each roadway segment in the study area, EPDO crash rates are calculated to analyze and compare roadway safety. Using EPDO crash rates accounts not only for the severity of crashes but also the amount of travel and therefore the amount of exposure to crashes on each roadway segment. EPDO crash rates are calculated using the equation below:

EPDO Crash Rate =

$$\frac{1{,}000{,}000 \times \text{Annual EPDO}}{365 \times \text{Average Daily Traffic} \times \text{Segment Length}}$$

Table 11 on page 20 shows the current and historical EPDO crash rates for major roadways in the study area, as well as the primary driver actions that led to crashes. **Map 8** on page 21 also shows the annual number of crashes and EPDO crash rates for major roadways and intersections within the study area.

Little Creek Road between Hampton Boulevard and Tidewater Drive had the highest EPDO crash rates in the study area. This is likely due to the many access management deficiencies on this roadway, including many residential and commercial driveways as well as limited raised medians. Hampton Boulevard between Admiral Taussig Boulevard and International Terminal Boulevard had the third highest EPDO crash rate in the study area. A large number of commercial driveways also contribute to this high rate.

Both Little Creek Road and Hampton Boulevard experienced increases in EPDO crash rates over the last few years. The EPDO crash rate on Hampton Boulevard increased 24% between 1998-2000 and 2002-2004. Of the 24 roadway segments in the study area analyzed for this study, 18 experienced an increase in EPDO crash rates between 1998-2000 and 2002-2004.

For both Little Creek Road and Hampton Boulevard, as well as most of the other roadways in the study area, the primary driver actions that led to each crash were the same: drivers not having the right-of-way, drivers following too closely, and drivers being distracted. On the Interstates in the study area, speeding was also one of the primary crash causes.

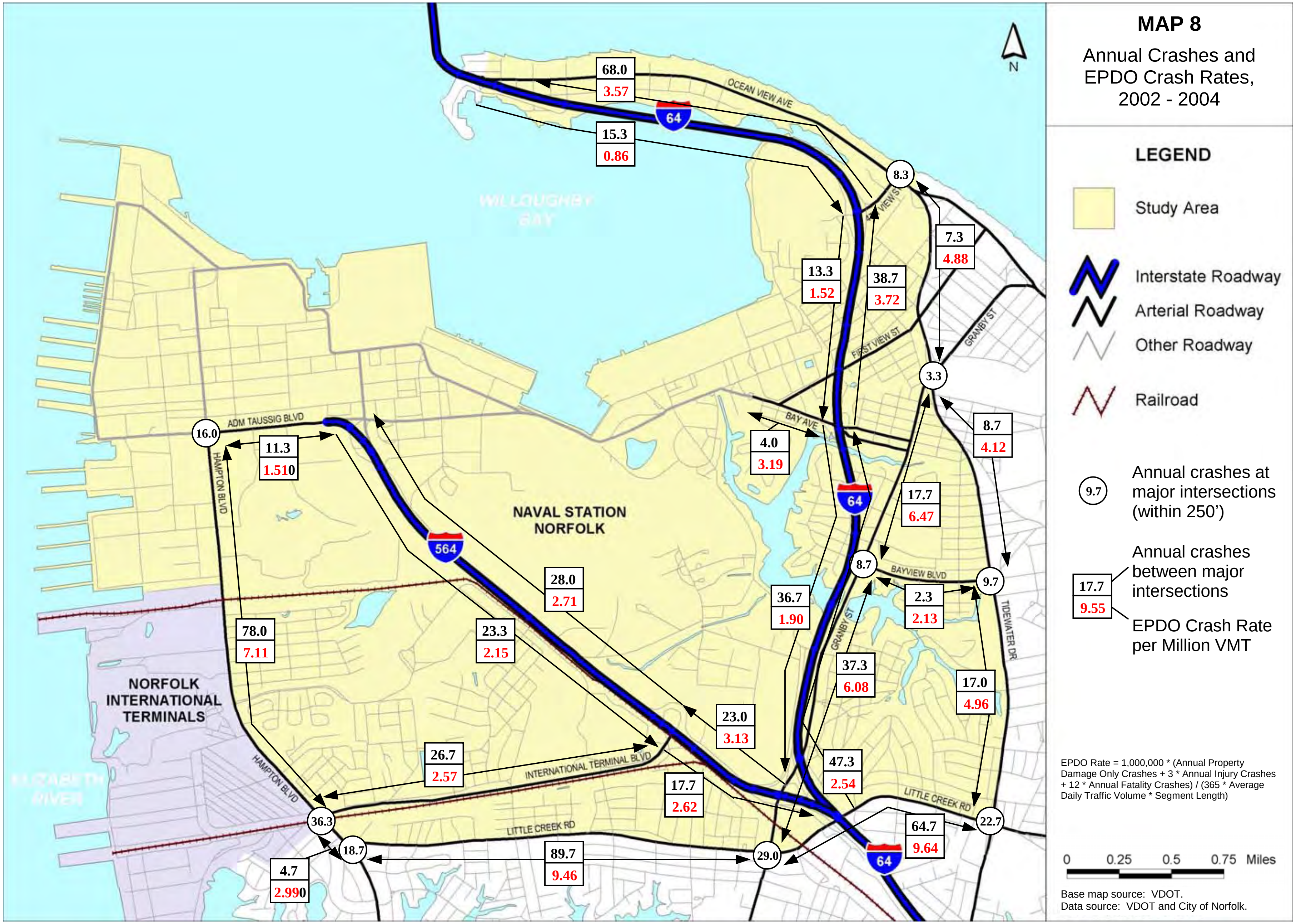
Due to a spike in fatalities nationwide, the Navy has recently taken steps to reduce traffic crash fatalities, both on and off base. These steps include mandatory seat belt use and drunken driving education sessions. The Navy is also considering investigating all traffic crash fatalities involving sailors, regardless of whether they occurred on or off base.

TABLE 11 – Roadway Segments in the Study Area with the Highest EPDO Crash Rates, 1998 - 2000 and 2002 - 2004

Facility	Total Crashes			EPDO Rate per Million VMT			Primary Driver Actions, 2002-2004
	1998-2000	2002-2004	Change	1998-2000	2002-2004	% Change	
Little Creek Rd between Granby St and Tidewater Dr	164	194	+30	9.18	9.64	+5%	Did not have right-of-way (29%), Following too closely (27%), driver distraction (10%)
Little Creek Rd between Hampton Blvd and Granby St	258	269	+11	9.15	9.46	+3%	Following too closely (35%), did not have right-of-way (27%), driver distraction (11%)
Hampton Blvd between Terminal Blvd and Taussig Blvd	237	234	-3	5.76	7.11	+24%	Did not have right-of-way (27%), following too closely (24%), driver distraction (13%)
Granby St between Bayview Blvd and Tidewater Dr	44	53	+9	6.23	6.47	+4%	Did not have right-of-way (36%), driver distraction (13%), disregarded traffic signal (10%)
Granby St between Little Creek Rd and Bayview Blvd	85	112	+27	5.55	6.08	+10%	Did not have right-of-way (30%), following too closely (26%), driver distraction (11%)
Tidewater Dr between Little Creek Rd and Bayview Blvd	57	51	-6	5.50	4.96	-10%	Did not have right-of-way (37%), following too closely (20%), driver distraction (12%)
Tidewater Dr between Granby St and Fourth View	18	22	+4	5.83	4.88	-16%	Did not have right-of-way (53%), other actions (18%), following too closely (6%)
Tidewater Dr between Bayview Blvd and Granby St	31	26	-5	3.85	4.12	+7%	Did not have right-of-way (29%), following too closely (11%), improper turns from wrong lane (7%)
Bay Ave between Naval Base and I-64	22	21	-1	2.42	3.19	+32%	Did not have right-of-way (33%), driver distraction (14%), improper turning (10%)
Hampton Blvd between Terminal Blvd and Little Creek Rd	8	14	+6	1.03	2.99	+190%	Did not have right-of-way (63%), following too closely (25%), improper turning (12%)
International Terminal Blvd between Hampton Blvd and I-564	80	80	0	2.77	2.57	-7%	Following too closely (31%), did not have right-of-way (15%), driver distraction (14%)
Fourth View between I-64 and Ocean View Ave	2	5	+3	1.08	2.48	+130%	Did not have right-of-way (50%), disregarded traffic control device (50%)
Bayview Blvd between Granby St and Tidewater Dr	7	7	0	2.66	2.13	-20%	Hit-and-run (29%), following too closely (14%), driver distraction (14%)
Taussig Blvd between Hampton Blvd and I-564	24	21	-3	1.25	1.51	+21%	Following too closely (71%), did not have right-of-way (8%), driver distraction (8%)

Facility	Total Crashes			EPDO Rate per Million VMT			Primary Driver Actions, 2002-2004
	1998-2000	2002-2004	Change	1998-2000	2002-2004	% Change	
I-64 WB between Bay Ave and Fourth View	89	116	+27	3.11	3.72	+20%	Following too closely (72%), Exceeded speed limit/safe speed (13%), Driver distracted (4%)
I-64 WB between Fourth View and 15th View	195	204	+9	3.89	3.57	-8%	Following too closely (70%), Exceeded speed limit/safe speed (10%), Driver distracted (4%)
I-564 WB between I-64 and Terminal Blvd	47	69	+22	2.06	3.13	+52%	Following too closely (36%), Exceeded speed limit/safe speed (16%), Cutting in (13%)
I-564 WB between Terminal Blvd and Taussig Blvd	105	84	-21	3.92	2.71	-31%	Following too closely (46%), Exceeded speed limit/safe speed (18%), Driver distracted (10%)
I-564 EB between Terminal Blvd and I-64	41	53	+12	2.44	2.62	+7%	Following too closely (28%), Exceeded speed limit/safe speed (13%), Driver distracted (9%)
I-64 WB between I-564 and Bay Ave	80	142	+62	1.63	2.54	+56%	Following too closely (39%), Exceeded speed limit/safe speed (17%), Fail to maintain control (9%)
I-564 EB between Taussig Blvd and Terminal Blvd	32	70	+38	1.07	2.15	+100%	Exceeded speed limit/safe speed (29%), Following too closely (29%), Fail to maintain control (10%)
I-64 EB between Bay Ave and I-564	81	110	+29	1.55	1.90	+23%	Following too closely (35%), Exceeded speed limit/safe speed (27%), Driver distracted (9%)
I-64 EB between Fourth View and Bay Ave	13	40	+27	0.45	1.52	+237%	Following too closely (35%), Exceeded speed limit/safe speed (20%), Fail to maintain control (15%)
I-64 EB between 15th View and Fourth View	34	46	+12	0.66	0.86	+29%	Following too closely (35%), Driver distracted (22%), Exceeded speed limit/safe speed (15%)

Data sources: VDOT and City of Norfolk.



HAMPTON ROADS PLANNING DISTRICT COMMISSION

TRANSIT/TRANSPORTATION DEMAND MANAGEMENT

Being one of the largest employers in the region, transit services and alternate means of transportation are essential for providing access to Naval Station Norfolk. This section details transit services to and around Naval Station Norfolk operated by Hampton Roads Transit (HRT), as well as transportation demand management (TDM) strategies offered by Traffix.

Transit Routes and Ridership

Six transit routes provide direct service to Naval Station Norfolk. These routes (shown on **Map 9** on page 23) are:

- Route 2 – Downtown Norfolk via Hampton Boulevard
- Route 3 – Downtown Norfolk via Ocean View
- Route 15 – Greenbrier Mall and Military Circle area
- Route 19 – Silverleaf Park and Ride in Virginia Beach (Express service)
- Route 22 – Greenbrier Mall and Indian River Park and Ride (Express service)
- Route 63 – Downtown Hampton (Express service)

Transit routes serving Naval Station Norfolk had a total monthly ridership of 178,000 passengers in 2005, but ridership varied greatly on these six routes. Route 15 carried nearly 90,000 passengers monthly in 2005, while Route 63 carried only 600 passengers per month.

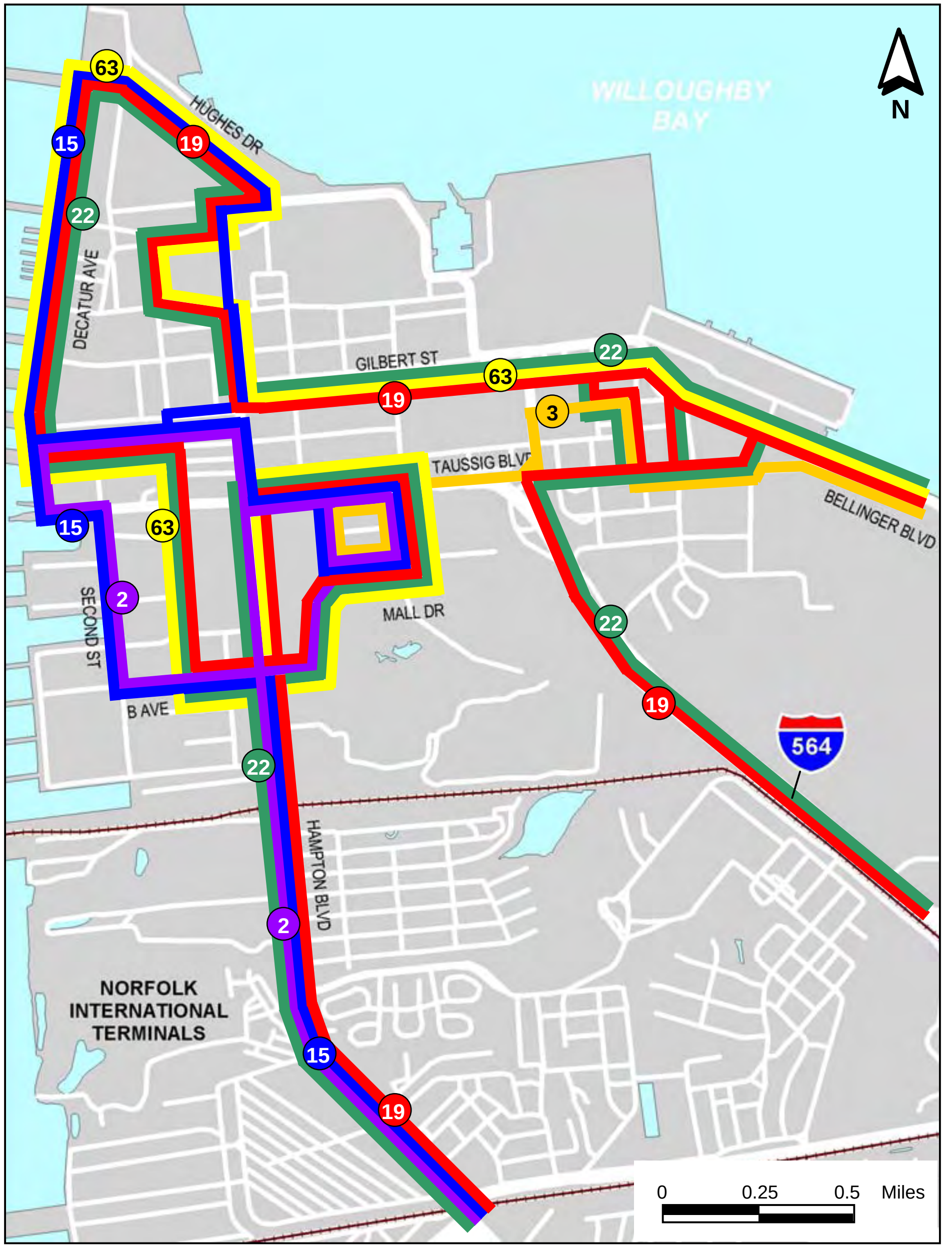
A free shuttle service operated by HRT began operation at Naval Station Norfolk on May 22, 2006. The shuttle service is comprised of two routes that only serve areas within the Naval Station (**Map 10** on page 24). Route 76 provides access to western portions of the base, including the Elizabeth River piers and the Naval Exchange. Route 77 provides access to the eastern portion of the Naval Station, including the hangar areas. The shuttle buses operate with headways of 15 to 20 minutes, and transfers between the two routes are available along Gilbert Street. Funding for the shuttle service is in place for three years from regional congestion relief funds.

Transportation Demand Management

The purpose of transportation demand management (TDM) is to reduce traffic congestion by encouraging ridesharing, transit usage, and spreading out peak period traffic. In Hampton Roads, the Traffix program implements these TDM strategies. Traffix offers a wide variety of programs, including carpooling and commuter matching, guaranteed ride programs, vanpooling and van leasing, and telecommuting assistance. Subsidies are available for qualified employees of Naval Station Norfolk that use these TDM alternatives.

Traffix also conducts Transportation Needs Assessment Studies for specific areas to help in the development and coordination of TDM programs. Traffix completed a Transportation Needs Assessment Study for Naval Station Norfolk in 2001. The purpose of the study was to identify transportation and transportation awareness deficiencies, measure changes in the awareness of the Traffix program, identify the current mode split of Naval Station Norfolk commuters, and the identify the awareness and attractiveness of transportation alternatives.

Currently, Traffix maintains a full-time outreach program with Naval Station Norfolk. One staff person from Traffix is assigned to the Naval Base to promote TDM alternatives. Additionally, a pilot program called NuRide, which provides rewards for ridesharing that can be redeemed at various merchants, is being promoted at the base.



MAP 9 – Transit Routes Providing Direct Service to Naval Station Norfolk

Route #	Transit Route Name	Other Areas Served	Average Monthly Route Ridership, 2005
2	Naval Station Norfolk/Hampton Blvd Route	Downtown Norfolk Old Dominion University	27,238
3	Downtown Norfolk/Naval Station Norfolk Route	Downtown Norfolk	53,717
15	Naval Station Norfolk/Robert Hall Blvd Route	Greenbrier Mall Military Circle Area	88,851
19	Naval Station Norfolk/Silverleaf Route (EXPRESS)	Silverleaf Park and Ride Lot (Virginia Beach)	4,276
22	Naval Station Norfolk/Greenbrier - Indian River P&R Lot Route (EXPRESS)	Greenbrier Mall Indian River Park and Ride	3,269
63	Hampton Transportation Center/Naval Station Norfolk (EXPRESS)	Downtown Hampton	627

Note: Monthly route ridership includes all riders on the entire length of the route, regardless of whether the riders embarked or disembarked at Naval Station Norfolk.

Data source: Hampton Roads Transit.

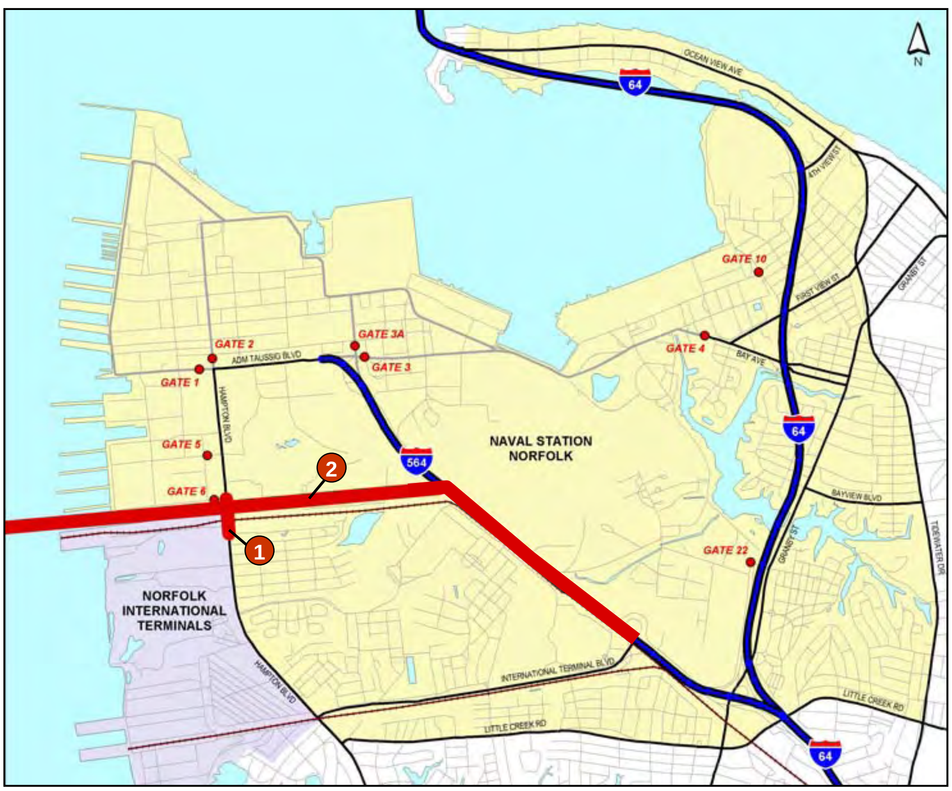

MAP 10
Naval Station Norfolk Area Traffic Management Study
Naval Base Shuttle Routes
LEGEND
76
Naval Station Norfolk Shuttle Route Number
Data source: Hampton Roads Transit.
N
WILLOUGHBY BAY
HUGHES DR
DECATUR AVE
76
76
76
77
77
GILBERT ST
TAUSSIG BLVD
TOW WAY DR
BELLINGER BLVD
5th AVE
MALL DR
SECOND ST
B AVE
HAMPTON BLVD
564
0 0.2 0.4 Miles

PLANNED PROJECTS

Two major projects to improve traffic flow and safety are planned for the study area (**Map 11**). The first project is a railroad overpass for Hampton Boulevard between Greenbrier Avenue and D Avenue. This grade separation project will remove conflicts between Hampton Boulevard traffic and trains entering or exiting the northern section of Norfolk International Terminals. Construction on this project was expected to begin in 2007, but will be delayed due to funding constraints. Traffic on Hampton Boulevard is not expected to be significantly affected during the construction of this project.

The other project is Segments I & VI of the Hampton Roads Third Crossing project. If completed, this project would provide a four-lane limited-access freeway and two multimodal lanes from I-564 across the Elizabeth River and the Hampton Roads harbor to I-664. Portions of I-564 would also be widened as part of this project. This would provide better access to the Naval Station and Norfolk International Terminals from the west and decrease traffic volumes on Hampton Boulevard. Although this project is included in the region's current long-range transportation plan[5], it is not included in the draft 2030 Regional Transportation Plan due to a lack of funding.

MAP 11 – Planned and Programmed Projects in the Vicinity of Naval Station Norfolk



Projects

1. Hampton Blvd railroad overpass in the vicinity of Greenbrier Ave
2. Segments I & VI of the Hampton Roads Third Crossing project

0 0.25 0.5 0.75 Miles

Source: Hampton Roads 2026 Regional Transportation Plan.

Base map source: VDOT.

5 HRPDC, "Hampton Roads 2026 Regional Transportation Plan", June 2004.

FUTURE VOLUMES

Due to variations in staffing levels and operations at NAS Norfolk, it is difficult to predict future traffic volumes in the vicinity of Naval Station Norfolk. Employment at Naval Station Norfolk is expected to increase by 2,800 people in the next few years as a result of the 2005 Base Realignment and Closure process (BRAC), which would increase traffic volumes in the short-term. Although no future BRAC processes are currently scheduled, any BRAC processes that do occur could greatly affect employment levels at Naval Station Norfolk as well as the volume of traffic in the vicinity of the base.

Table 12 shows the existing and projected 2026 traffic volumes for roadways in the study area. Most traffic volume changes in the study area are related to changes in traffic flow due to the Third Crossing project. This project would introduce new traffic to this area, as well as provide new access to the southern section of Naval Station Norfolk and the northern section of Norfolk International Terminals.

However, as was stated in the previous section of this report, this project is not included in the draft 2030 Regional Transportation Plan due to a lack of funding. If the Third Crossing is not constructed, it is projected that traffic volumes will not significantly change on roadways in the study area to the west of I-64.

TABLE 12 – Existing and Future Weekday Traffic Volumes Near Naval Station Norfolk

		Average Weekday Volumes		
Facility	**Location**	**Most Recent Volume**	**Count Year**	**Projected 2026 Volumes**
Admiral Taussig Blvd	Hampton Blvd and I-564	33,595	2003	24,000
Bay Ave	First View St and I-64	17,199	2003	13,000
Bayview Blvd	Granby St and Tidewater Dr	9,146	2003	9,000
First View St	Bay Ave and Tidewater Dr	10,712	2003	N/A
Fourth View St	I-64 and Ocean View Ave	13,806	2003	24,000
Granby St	Little Creek Rd and I-564	27,824	2003	28,000
Granby St	I-64 and Bayview Blvd	20,998	2003	23,000
Granby St	Bayview Blvd and Bay Ave	15,767	2003	15,000
Hampton Blvd	Adm. Taussig Blvd and Future Intermodal Connector	25,809	2003	44,000
Hampton Blvd	Future Intermodal Connector and International Terminal Blvd	25,809	2003	38,000
Hampton Blvd	International Terminal Blvd and Little Creek Rd	37,387	2003	44,000
I-564	Adm. Taussig Blvd and Future Intermodal Connector	49,368	2005	31,000
I-564	Future Intermodal Connector and International Terminal Blvd	49,368	2005	45,000
I-564	International Terminal Blvd and I-64	66,116	2003	61,000
I-64	15th View St and 4th View St	93,712	2003	104,000
I-64	4th View St and Bay Ave	88,062	2003	90,000
I-64	Bay Ave and I-564	98,260	2003	100,000
International Terminal Blvd	Hampton Blvd and I-564	29,760	2005	25,000
Little Creek Rd	Hampton Blvd and Diven St	16,136	2003	25,000
Little Creek Rd	Diven St and Granby St	23,930	2003	25,000
Little Creek Rd	Granby St and I-64	38,860	2003	37,000
Ocean View Ave	15th View St and 4th View St	8,210	2003	N/A
Third Crossing (E-W Connector)	Portsmouth CL and Second St	N/A		29,300
Third Crossing (Intermodal Connector)	Second St and Hampton Blvd	N/A		29,300
Third Crossing (Intermodal Connector)	Hampton Blvd and I-564	N/A		21,000
Tidewater Dr	Little Creek Rd and Bayview Blvd	15,461	2003	19,000
Tidewater Dr	Bayview Blvd and Granby St	11,404	2003	15,000
Tidewater Dr	Granby St and First View St	6,723	2003	10,000

Data Sources: VDOT, HRPDC.

ALTERNATIVE ANALYSIS

After analyzing the existing conditions and consulting with staff from the Navy and the City of Norfolk, the primary transportation concerns in the study area in no particular order are:

- Delay at the two rail crossings along Hampton Boulevard, particularly during restricted times
- Safety (per the national emphasis the Navy is placing on this)
- Congested intersections
- Manpower used to implement traffic management plans each morning
- Gate management and utilization
- The high number of commuters using single occupant vehicles to access the base.

Each of these topics is addressed at length separately in this section.

Delay at Rail Crossings

As was detailed in the Traffic Characteristics portion of this report, delays due to trains at the two rail crossings on Hampton Boulevard are problematic. Between August and October of 2006, the traffic signal at Hampton Boulevard and International Terminal Boulevard was preempted an average of 392 times each month with an average duration of 2.5 minutes. During this time period, the traffic signal at Hampton Boulevard and Northgate Road was preempted an average of 249 times each month with an average duration of 4.3 minutes. Preemptions that occur during the four prohibited periods each day are also a problem. With train volumes expected to increase at Norfolk International Terminals, the number of blockages will likely increase in the future.

These delays caused by trains entering and exiting Norfolk International Terminals will largely be addressed by two projects. The first project is a grade separation of the

PICTURE 3 – Trains block the intersection of Hampton Blvd and International Terminal Blvd nearly 400 times each month.
Image source: Virginia Geographic Information Network.

railroad crossing at Hampton Boulevard and Northgate Road. When complete, trains will enter the northern section of NIT via an overpass of Hampton Boulevard, removing all delays. Construction on this project was expected to begin in 2007 although that will be delayed due to funding constraints.

The other project is the Norfolk International Terminals Central Rail project. According to the port's consultant, this project will significantly increase the rail capacity at NIT by adding 11,000 feet of rail and several rail switching areas in the center of the complex. This project, which will reduce delays from trains crossing Hampton Boulevard at International Terminal Boulevard, is expected to begin construction in 2007.

The Virginia Port Authority also includes other rail projects in the Norfolk International Terminals 2040 Master Plan, although funding for these projects is not currently allocated. Among these projects is a rail connection between the northern and southern sections of NIT.

In the meantime, some of the delays due to these blockages could be alleviated by adjusting the timings of signals along Hampton Boulevard after each train crossing. Giving more green time to Hampton Boulevard immediately after each train crossing could help dissipate the congestion on Hampton Boulevard more quickly.

Safety

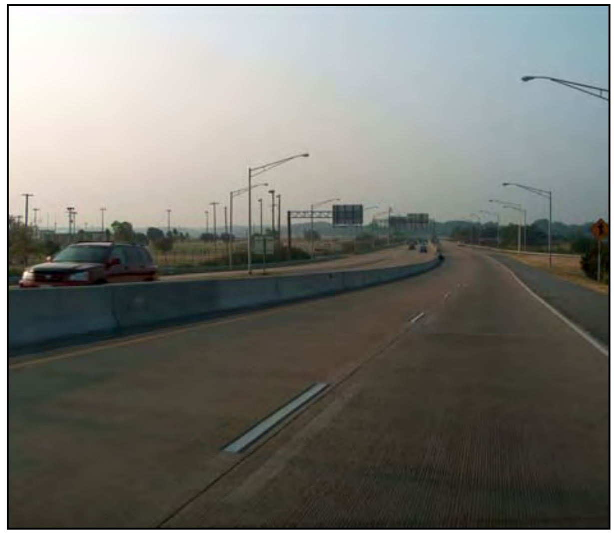
On the national level the Navy is addressing fatalities involving sailors both on and off base. Particularly concerning to the Navy are the number of fatalities that involved alcohol and/or speeding, as well as the number of fatal crashes that involved people not wearing safety belts. In order to reduce the number of fatalities involving sailors, the Navy has ordered mandatory sessions on drunken driving as well as seat belt usage.

Roadway safety is particularly a problem on the Interstates in the study area as well as on Little Creek Road and Hampton Boulevard. Among the safety concerns are speeding, driving under the influence of alcohol, following too closely, and roadway design deficiencies.

Speeding led to a high number of crashes on I-64 and I-564 in the study area. Speeding was the primary driver action preceding crashes in 10.5% of all crashes on the Interstate system in Hampton Roads in 2004. Most of the Interstate segments in the study area had a higher percentage of crashes where speeding was the primary driver action than the regional average. On eastbound I-564 between Admiral Taussig Blvd and Terminal Boulevard, speeding was a cause of a whopping 29% of all crashes between 2002 and 2004.

Various enforcement and engineering remedies have been found to reduce the prevailing speeds on a particular roadway. These speeding remedies[6] include:

- Additional enforcement efforts.
- Imposing higher penalties for speeding convictions, including additional disciplinary actions by the Navy.
- The use of traffic control devices, such as optical speed bars. These pavement markings, which are a series of transverse lines placed at decreasing intervals, have proven effective in Europe in reducing speeds and the severity of crashes due to speeding. VDOT is currently testing the effectiveness of optical speed bars on Route 460 in Isle of Wight County.
- The use of technology, including electronic speed trailers that notify drivers of their current speed. Studies have shown that using these signs reduce prevailing speeds 90% of the time, although prevailing speeds generally return to previous levels once the equipment is removed.
- Publicizing these speed-reduction efforts.



PICTURE 4 – Speeding and driving under the influence of alcohol are the causes of many crashes on I-564.

Driving while under the influence of alcohol is also a problem on I-564. On westbound I-564 between International Terminal Boulevard and Admiral Taussig Boulevard, 12.5% of all crashes involved alcohol in 2004. Although this is down from the 17.1% of all crashes that involved alcohol on this segment between 1998 and 2000, this rate is still well above the regionwide rate of 7.8% of all crashes involving alcohol in 2004.

There are two methods that reduce alcohol-related crashes: reducing excessive drinking

6 Most of the remedies included in this section of the report are from the National Cooperative Highway Research Program's (NCHRP) Report 500 series, which provides detailed safety data and strategies in 22 key emphasis areas.

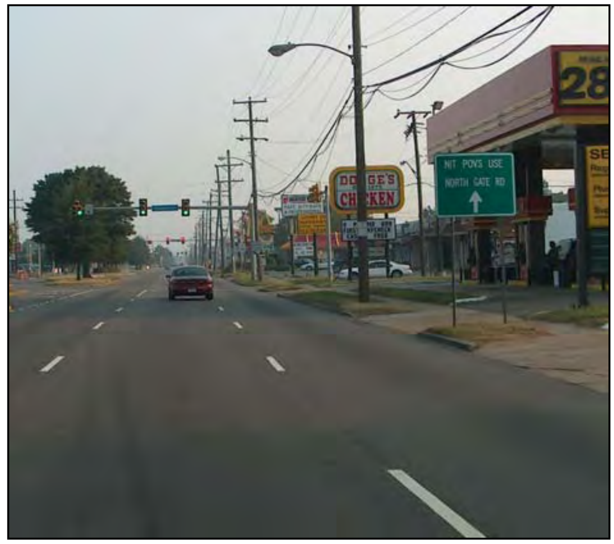
through policies and programs and deterring driving while under the influence of alcohol. Possible remedies include:

- Additional enforcement efforts, particularly on roadways with a high number of alcohol-related crashes such as I-564.
- Imposing higher penalties for DUI convictions, including additional disciplinary actions by the Navy.
- Additional education efforts, including mandatory sessions conducted by the Navy.
- Publicizing these enforcement efforts.

Another concern is the number of crashes that occur on westbound I-564 in the morning heading towards Naval Station Norfolk. Of the 60 crashes that occurred on westbound I-564 in 2004, 29 (48%) occurred between 5:00 and 7:00 am. Among these 29 crashes, 21 (72%) were due to following too closely. Methods of addressing these types of crashes include:

- Additional enforcement efforts.
- The use of technologies, including variable message signs warning drivers of the distance to upcoming congested areas. This is particularly important near the runway overpass where sight distance is limited by the horizontal and vertical curvature of the roadway.
- Improving traffic flow into the base, thereby reducing the amount of congestion that occurs on the roads approaching the base. This is addressed further in the Gate Management and Utilization section of this report.

The safety deficiencies on Little Creek Road are largely due to the design of the roadway. The travel lanes on Little Creek Road are narrow, an average of 11 feet wide rather than the recommended 12 feet. There are also many homes and businesses that line this section of Little Creek Road, with no restrictions to accessing these properties. There is also no median and no turn lanes on Little Creek Road between the major intersections at Hampton Boulevard and Granby Street.



PICTURE 5 – There are many entrances to businesses along Hampton Boulevard south of Naval Station Norfolk.

Hampton Boulevard, which has the third highest EPDO crash rate in the study area, also has many driveways to various businesses between Little Creek Road and Northgate Road (see Picture 5). Unlike Little Creek Road, access on Hampton Boulevard is restricted by a landscaped median.

Improving the access management deficiencies on Little Creek Road and Hampton Boulevard would be costly at this point. Restricting access to homes and businesses would be politically difficult, and adding turn lanes or a median would require significant funding for right-of-way and construction costs.

Congested Intersections

PICTURE 6 – A traffic cop currently directs traffic at the intersection of Admiral Taussig Bouleard and Hampton Boulevard during the afternoon peak period.

As was noted in the Peak Hour Traffic Characteristics section of this report, most of the signalized intersections in the study area currently operate at acceptable levels during the peak travel periods. All of the intersections currently operate at acceptable levels during the morning peak travel period. During the afternoon peak travel period, the only intersections in the study area that are congested are the intersections of Admiral Taussig Boulevard and Hampton Boulevard, and the intersection of Granby Street and Little Creek Road. Both of these intersections have average delays of slightly above 55 seconds per vehicle, which is the threshold between LOS D (which is considered acceptable operating conditions) and LOS E (which is considered unacceptable).

At the intersection of Hampton Boulevard and Admiral Taussig Boulevard, a traffic cop currently directs traffic during the afternoon peak period. The primary reason that this intersection operated at unacceptable levels without the traffic cop directing traffic is the delay experienced by drivers making the southbound left turn movement from Hampton Boulevard to Admiral Taussig Boulevard. By optimizing traffic signal timings and giving more green time to the southbound left turn movement, average delay can be reduced to about 45 seconds per vehicle without the traffic cop, which is an acceptable LOS D. In order to accomplish this, however, traffic detection equipment will be necessary on all approaches of the intersection to make the signal fully-actuated.

At the intersection of Granby Street and Little Creek Road, optimizing signal timings would not improve the operating conditions of the intersection during the afternoon peak period above LOS E. Changing lane usage at the intersection (for example, making the rightmost northbound lane a right turn only lane), while improving conditions during the afternoon peak travel period, would have adverse effect on operating conditions during the morning peak travel period. And while adding additional turn lanes at the intersection would improve the peak hour LOS to acceptable conditions, they are not likely to be cost-effective due to the lack of available right-of-way. Since traffic volumes are not expected to grow in the future at this intersection, and since the level-of-service is only four seconds over the LOS D threshold, the existing operating conditions at the intersection of Granby Street and Little Creek Road are tolerable.

Traffic Management Manpower

As was noted in the Accessing the Base section of this report, the Navy operates a traffic management plan for Hampton Boulevard each weekday morning. The purpose of the current traffic management plan (which is detailed on page 16) is to aid traffic flow from westbound I-564 into Gates 1 and 2. Traffic from northbound Hampton Boulevard is funneled into the secure areas of the base via Gates 5 and 6, with access to Gate 3/3A also available.

This traffic management plan has been effective in funneling vehicles into Gates 1 and 2, largely because there is a much higher volume of vehicles accessing the base via I-564 than Hampton Boulevard. During the morning peak hour, 2,000 vehicles approach Naval Station Norfolk via northbound Hampton Boulevard versus just over 3,800 vehicles approaching the base via westbound I-564.

Although this traffic management plan is effective, it requires a significant amount of manpower. Naval Station Police must set up and remove traffic control devices each weekday morning on Hampton Boulevard at B Avenue and at Admiral Taussig Boulevard, and personnel are also stationed at the intersection of Hampton Boulevard and B Avenue.

In the past year the leftmost lane on northbound Hampton Boulevard was converted to a left turn only lane at B Avenue, creating two permanent left turn lanes into Gate 5 for most of the day. Between 5:00 am and 8:00 am (0500-0800) there are three left turn lanes from northbound Hampton Boulevard into Gate 5.

An analysis was done to see whether the traffic control devices that are put in place to create a third left turn lane on northbound Hampton Blvd at B Avenue is necessary. This analysis was done using Synchro traffic optimization software. The following three alternatives were analyzed:

- <u>*Existing conditions*</u>. This alternative uses cones and police personnel to allow for three left turn lanes from northbound Hampton Boulevard into Gate 5 during the morning peak period. It also includes using cones to force traffic leaving Gate 5 to turn right onto southbound Hampton Boulevard.

Under the existing traffic management plan, the intersection of Hampton Boulevard and B Avenue easily operates at acceptable levels. The average delay during the morning peak hour at Hampton Boulevard and B Avenue is 14.0 seconds per vehicle, or LOS B.

- <u>*Partial active traffic management at the intersection*</u>. This alternative removes the cones and police personnel on northbound Hampton Boulevard, leaving two left turn lanes from northbound Hampton Boulevard into Gate 5. Cones, however, are still in place to force traffic leaving Gate 5 to turn right onto southbound Hampton Boulevard.

Under this alternative, the intersection would operate at the same level as it currently does with three northbound left turn lanes. The average delay at this intersection during the morning peak hour only increases 0.3 seconds per vehicle, up to 14.3 seconds per vehicle. This is due to providing a large amount of green time to the northbound left turn movement, which can be done since there is little opposing traffic on southbound Hampton Boulevard.

However, under this alternative the 95th percentile queueing length is 280 feet for the

TABLE 13 – Average Delay for Various Alternatives at Hampton Blvd and B Ave

Alternative	Average Delay (seconds per vehicle)
Existing Conditions (3 NBLT lanes)	14.0
Partial Active Traffic Management (2 NBLT lanes)	14.3
No Active Traffic Management (2 NBLT lanes)	16.4

northbound left turn movement during the morning peak hour, which is about 80 feet longer than the existing storage area in the leftmost turn lane. Additional storage area would need to be provided in the leftmost turn bay to handle this queue and make this a viable alternative.

- *No active traffic management at the intersection*. This alternative assumes all vehicles can make all movements at the intersection of Hampton Boulevard and B Avenue during the morning peak period, similar to the other 21 hours each weekday. Vehicles leaving Gate 5 would be able to turn left onto Hampton Boulevard or continue straight onto Seabee Avenue, although little demand is expected at this time of day for either of these movements.

Under this alternative, the intersection would operate at nearly the same level as it currently does. The average delay during the morning peak hour only increases up to 16.4 seconds per vehicle, which remains LOS B. However, similar to the previous alternative, the leftmost left turn bay would need to be extended to handle the 95th percentile queue length.

Based on these results, it appears that the traffic management plan implemented each weekday morning at Hampton Boulevard and B Avenue would not be necessary if the leftmost northbound left turn bay is extended.

At the intersection of Hampton Boulevard and Admiral Taussig Boulevard, the traffic management plan requires northbound Hampton Boulevard traffic to turn right onto eastbound Admiral Taussig Boulevard. This allows for uninterrupted flow from I-564 and westbound Admiral Taussig Boulevard into Gates 1 and 2. Without this traffic management plan, Hampton Boulevard traffic would be able to use Gates 1 and 2, leading to congested conditions at the intersection of Admiral Taussig Boulevard and Hampton Boulevard. More vehicles would also be processed at Gates 1 and 2, although these gates have extra capacity available.

The goals of any alternative should be:

- To maintain steady traffic flow into Naval Station Norfolk during the morning peak period while decreasing the amount of manpower required.

- To limit the amount of negative impacts on traffic flows at other times during the day.

- To limit the negative effects on safety and emergency access.

Four traffic management alternatives were examined to determine their relative strengths and weaknesses in meeting these goals. An alternative using the existing infrastructure without active traffic management was not considered since the traffic flow into Gates 1 and 2 would degrade to unacceptable levels. These four alternatives are:

- *Reconstruct the intersection*. This alternative would reconstruct northbound Hampton Boulevard so that traffic will be forced to turn right onto eastbound Admiral Taussig Boulevard at all times of the day. The biggest incentive to this would be that

FIGURE 3 – Reconstructed Intersection of Hampton Blvd at Admiral Taussig Blvd

Background image source: Virginia Geographic Information Network.

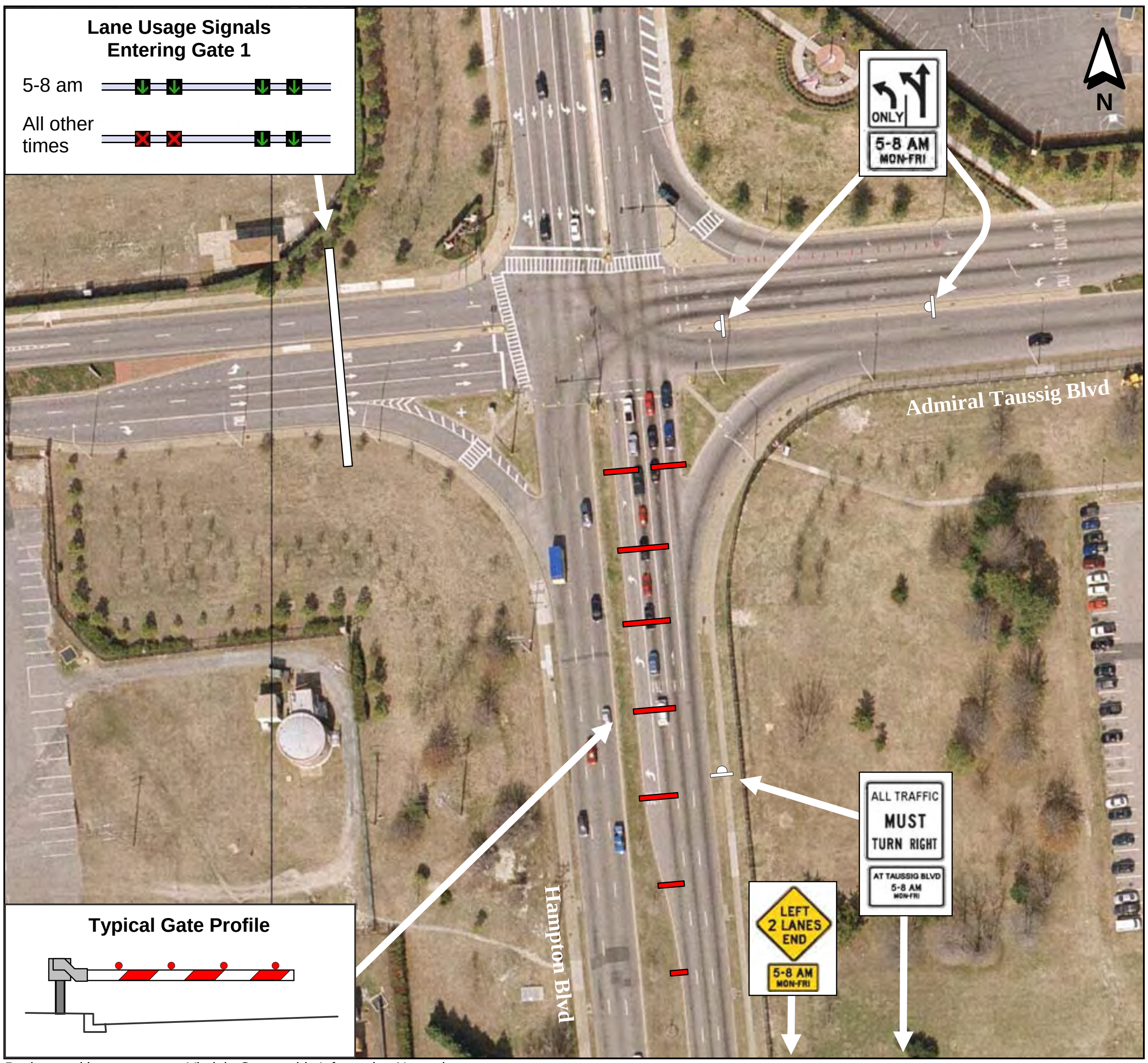
manpower would no longer be required each morning to regulate traffic flow at the intersection.

However, this will prohibit traffic from directly entering Gates 1 and 2 from Hampton Boulevard throughout the day, not only during the morning peak period. Traffic accessing northern sections of the base from Hampton Boulevard will have to enter Gate 5 and use Virginia Avenue on the base at all times. This would be inconvenient for many travelers and could cause congestion problems both at Gate 5 and on Virginia Avenue, particularly during the lunchtime period.

Construction costs for this alternative could also be high, depending on the design of the reconstructed intersection.

- *Install traffic management technologies.* This alternative (**Figure 4**) would install traffic management technologies to prohibit left turns and through movements during the morning peak period from northbound

FIGURE 4 – Traffic management gates, signals, and signage at Hampton Boulevard and Admiral Taussig Boulevard



Background image source: Virginia Geographic Information Network.

Hampton Boulevard at Admiral Taussig Boulevard. These technologies include crossing gates on northbound Hampton Boulevard and lane usage signals on westbound Admiral Taussig Boulevard to account for traffic entering Gate 1. Signs (either conventional or fiberoptic) would also be installed in the vicinity of the intersection to notify drivers that only right turns are permitted at Admiral Taussig Boulevard, as well as to let drivers know which lanes are available to enter Gates 1 and 2.

The strengths of this alternative are that it would eliminate the need for manpower to put out and pick up traffic cones each morning while allowing efficient traffic flow from I-564/Admiral Taussig Boulevard into Gates 1 and 2. The installation of gates and lane usage signals also will insure that traffic will adhere to only those movements that are permitted.

The biggest negative concerning this alternative is that a significant amount of infrastructure is required. This infrastructure not only includes the gates and lane usage signals but also the conduit necessary to allow the gates and signals to be operated from either a traffic management center or from Gate 1 or 2.

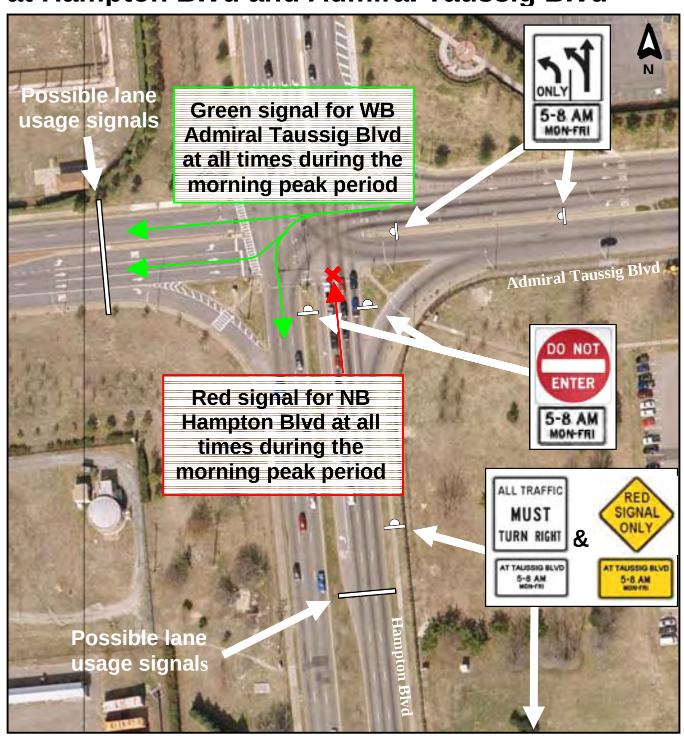
According to the ITS costs database produced by USDOT[7], capital costs for the traffic management gates would be expected to cost in the low $100,000s, and the cost for lane control signals would be expected to be about $75,000 - $100,000.

There would also be maintenance costs for such a system, including electricity, gate repair, bulb replacement, etc. According to the ITS costs database these maintenance costs would be in the $7,000 - $10,000 range annually.

- *<u>Signage and traffic signal operations</u>.* This alternative would attempt to maintain traffic flow into Gates 1 and 2 each morning without the extensive infrastructure that was included in the previous alternative. This would primarily be done through the use of signs as well as the operation of the signal at Admiral Taussig Boulevard and Hampton Boulevard. Currently the traffic signal at Admiral Taussig Boulevard and Hampton Boulevard is turned off during the morning peak period, and traffic on westbound Admiral Taussig Boulevard operates in free flow conditions through the intersection. In this alternative the traffic signal at Admiral Taussig Boulevard and Hampton Boulevard would remain in operation during the morning peak period, with westbound Admiral Taussig Boulevard receiving the green phase at all times and all other approaches receiving the red phase at all times throughout the morning peak period.

To accomplish this, signs would need to be installed on northbound Hampton Boulevard

FIGURE 5– Signage and traffic signal operations at Hampton Blvd and Admiral Taussig Blvd



Background image source: Virginia Geographic Information Network.

7 http://www.benefitcost.its.dot.gov

that clearly notify drivers of the operation of the traffic signal and that all drivers must turn right onto Admiral Taussig Boulevard. Lane usage signals may also be used on northbound Hampton Boulevard to notify drivers to move to the right and that they are not permitted to travel through the intersection with Admiral Taussig Boulevard. Installing lane usage signals, however, would greatly increase the infrastructure costs for this alternative.

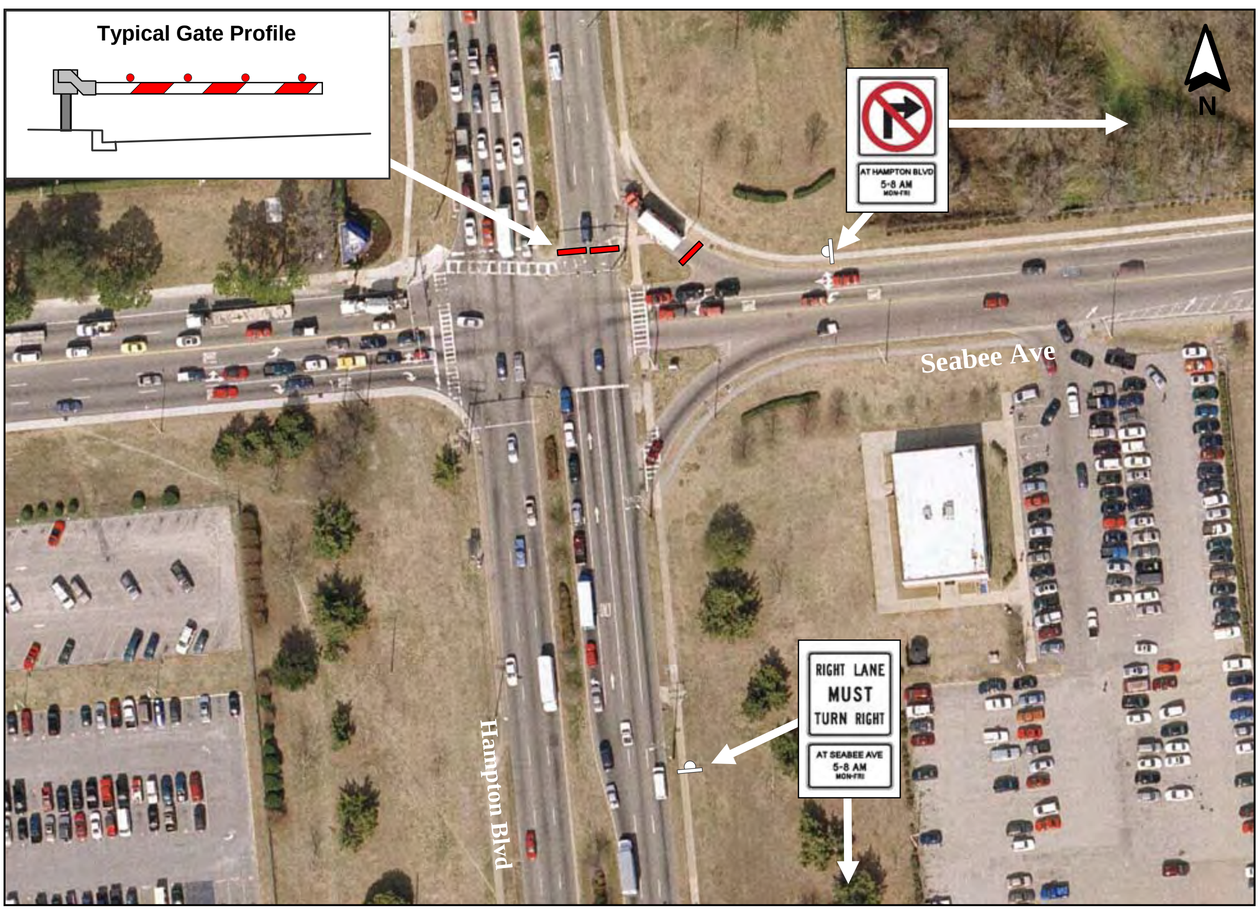
The primary advantage of this alternative is that it does not require the significant construction and maintenance costs that the previous alternative requires, particularly if lane usage signals are not used. Manpower would also not be required to put out and pick up traffic control devices each morning.

The biggest disadvantage of this alternative is the probability of violations occurring. Some drivers that do not pay attention to the signage approaching the intersection may be confused by this configuration. Without cones or gates in place, drivers on northbound Hampton Boulevard may also be tempted to proceed through the intersection in spite of the red phasing. These violators would compromise the safety of the intersection to some extent.

Coming up with signage that clearly conveys the correct message to drivers is also difficult since the Manual of Uniform Traffic Control Devices (MUTCD) has no such signage for a temporary all-red signal.

- *Close northbound Hampton Boulevard at Seabee Avenue*. This alternative is similar to the Install traffic management technologies alternative, but would prohibit vehicles on

FIGURE 6 – Traffic management gates and signage at Hampton Boulevard and Seabee Avenue



Background image source: Virginia Geographic Information Network.

northbound Hampton Boulevard north of B Avenue/Seabee Avenue. Drivers using northbound Hampton Boulevard would be required to turn into Gate 5 or onto eastbound Seabee Avenue during the morning peak period.

Under this alternative crossing gates would be installed on northbound Hampton Boulevard and signs (either conventional or fiberoptic) would be installed in the vicinity of Hampton Boulevard and Seabee Avenue. Lane usage signals still may need to be installed at the entrance to Gate 1.

The primary advantage of this alternative is that moving the gates to Seabee Avenue should require less infrastructure than having the gates near Admiral Taussig Boulevard. Manpower would also no longer be needed to put out and pick up traffic cones each morning. Local traffic should not be greatly affected since there are no public entrances on northbound Hampton Boulevard between Seabee Avenue and Admiral Taussig Boulevard.

With northbound Hampton Boulevard no longer being open for traffic north of Seabee Avenue, it is expected that over 800 vehicles would use eastbound Seabee Avenue east of Hampton Boulevard during the morning peak hour, up from the current volume of 466 vehicles. Although Seabee Avenue is a two-lane roadway, it should be able to handle this extra traffic since there are no signals and few access points on this stretch of roadway.

The primary disadvantage to this alternative is the high capital and operating costs for the infrastructure. Another disadvantage is that access to the medical clinic, which is located near the intersection of Admiral Taussig Boulevard and Hampton Boulevard, would be more difficult during these morning hours. Medical clinic users coming in passenger vehicles from Hampton Boulevard would need to follow a somewhat circuitous route to access the clinic, while ambulances that access the medical clinic from Hampton Boulevard will need to get around the gates during the morning peak period.

Gate Management and Utilization

Although many of the security gates at Naval Station Norfolk have been upgraded in recent years to allow for better security and traffic flow, the Navy is still concerned about traffic flow approaching and through the gates.

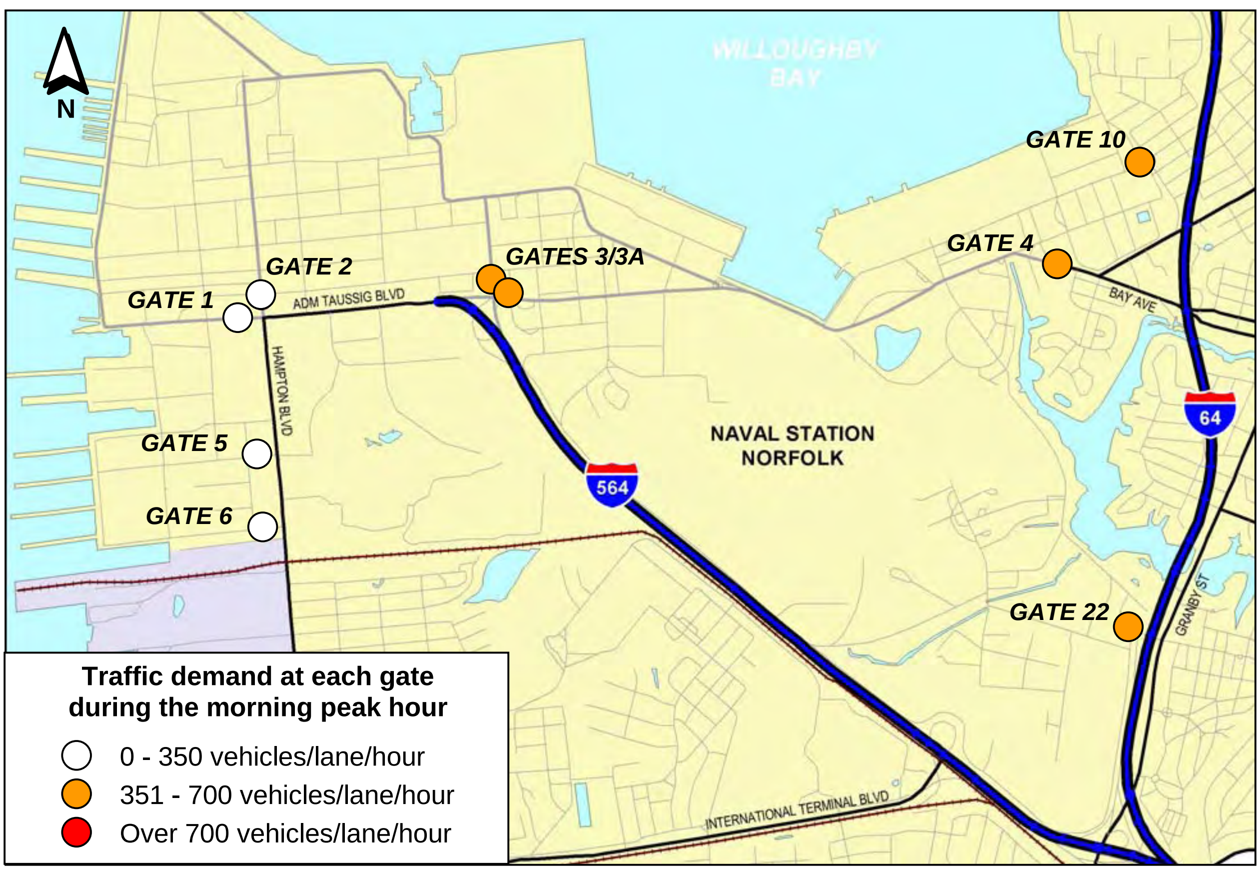
According to the Naval Station Norfolk Commuter Study, the security gates can process up to 700 vehicles per lane per hour during normal security conditions, or a processing rate of just over 5 seconds per vehicle. During heightened security conditions, however, gates can only process 350 vehicles per lane per hour, or a rate of just over 10 seconds per vehicle.

All of the gates currently have morning traffic demands that are below the gate capacity during the morning peak hour in normal security conditions. However, all of the gates to the east of Hampton Boulevard have traffic demands that are above the gate capacity in higher security conditions.

In order to better utilize the current gate arrangement, vehicles would need to be diverted from gates on the eastern side of the base to those four gates on the western side of the base. Diverting those users of the three gates closest to I-64 (Gates 4, 10, and 22) would be difficult since most of these users likely come from areas on the Peninsula and to the east of the base. For those commuters, the additional travel required to access the western gates would not make up for the time lost in queues at those three easternmost gates.

Some of the commuters that use Gates 3/3A, however, could potentially be diverted to Gates 1 and 2, particularly if they work on

MAP 12 – Traffic Demand at Naval Station Norfolk Gates During the Morning Peak Hour



Base map source: VDOT.

the northern or western portions of the base. This diversion likely already happens to some extent if travelers on I-564 see queues from Gates 3/3A that back up onto the interstate. In order to lower the demand at Gates 3/3A to the higher security capacity of 350 vehicles per lane per hour, a total of 400 vehicles would need to be diverted from Gates 3/3A to Gates 1 and 2 during the morning peak hour. Gates 1 and 2 can handle these extra vehicles since combined they can currently handle almost 1,000 more vehicles during the morning peak hour before reaching the 350 vehicles per lane per hour threshold.

One method to help divert traffic from Gates 3/3A to Gates 1 and 2 would involve the use of various ITS technologies. These technologies, which as an example could include localized highway advisory radio and variable message signs, would notify commuters of current delays at Gates 3/3A and of the lesser delays at Gates 1 and 2. In order to accurately portray the delay at Gates 3/3A, traffic cameras and/or roadway sensors would need to be installed to detect the length of the queue. Delay estimates would then need to be calculated based on the average time to process each vehicle at the gates based on the security condition and the length of the queue. These delay estimates could then be broadcast to commuters via these ITS technologies.

In order to test the effectiveness of ITS technologies, temporary message signs (Picture 7) could be used on westbound I-564. These portable message signs can be updated through wireless communications, either via manual entry at one of the gates or automatically through input received from roadway sensors. These signs can also be moved in order to test their effectiveness in various locations.

According to the USDOT ITS costs database, each permanent variable message sign would cost between $100,000 - $200,000. Portable variable message signs are much less expensive, at about $25,000

PICTURE 7 – Temporary Variable Message Signs could be used on northbound I-564 to alert commuters of the delay at Gates 3/3A.

each. Multiple passive acoustic sensors would be required at a cost of about $7,500 each and if CCTV cameras are used, they would cost about $30,000 each.

In spite of the shorter queues at Gates 1 and 2, many commuters would likely continue to use Gates 3/3A in spite of the information provided by ITS technologies. This is especially true if their destination is on the central or eastern portion of the base. For these commuters, only excessive delays would likely change the gate they choose to enter the base from.

In spite of high costs, constructing additional lanes through Gate 4 and Gates 3/3A should be considered as a means of lessening the delay at these higher-used gates. One additional lane into Gates 3/3A would lower the demand to the threshold of 350 vehicles/lane/hour, whereas two additional lanes would be needed at Gate 4 to get below the 350 vehicles/lane/hour threshold.

As part of the Third Crossing project, a new Gate 6 off of the Intermodal Connector portion of the project is planned. This would improve access from both I-564 and Hampton Boulevard to western sections of the base. However, although this project is included in the region's current long-range transportation plan, it is not included in the draft 2030 Regional Transportation Plan due to a lack of funding. It also would not improve traffic flow into NAS Norfolk's eastern gates.

High Number of Commuters Using Single Occupant Vehicles to Access the Base

As was stated in the Commuting Characteristics portion of this report, 95% of survey respondents to the Naval Station Norfolk Commuter Survey said that they commuted to the base via single occupant vehicles (SOVs). Only 3% of respondents said that they commuted via high occupancy vehicles (defined as those vehicles with two or more occupants), and 1% used public transportation. This number of workers commuting via single occupant vehicles is much higher than the regional average, which was 83% in 2005 according to the Census Bureau.

During the morning peak hour 8,600 vehicles enter the secure areas of the base. Using the 95% SOV value from the Naval Station Norfolk Commuter Survey and assuming a conservative value of 2.0 persons per high occupancy vehicle, this means that 8,460 of the 8,600 vehicles entering the base during the morning peak hour are SOVs.

If the number of people commuting to Naval Station Norfolk via SOVs decreased to 90% and the number of HOVs increased to 8%, 8,380 vehicles would enter the base during the morning peak hour, a decrease of 220 vehicles (2.6%). If this SOV level dropped to the regional average of 83% with an increase in HOVs to 13% of all commuters, 8,150 vehicles would enter the base during the morning peak hour, a decrease of 450 vehicles (5.2%). Although these numbers may not seem significant, 450 fewer vehicles entering Gate 3/3A during the morning peak hour would lower the demand at this gate below the gate's capacity during higher security conditions.

Transportation Demand Management (TDM) techniques are designed to decrease the number of vehicles using the road system by providing various alternatives to driving alone to work. These techniques include carpooling, vanpooling, using public transit, flexible work schedules, telecommuting, and value pricing. The following methods and programs are currently in place to encourage more people to use TDM techniques to access Naval Station Norfolk:

- *Express bus service*. Three routes serve Naval Station Norfolk with express service from near Town Center in Virginia Beach, Greenbrier Mall in Chesapeake, and Downtown Hampton. In 2005 these three routes combined to serve about 270 users daily.

- *Naval shuttle*. HRT provides a free shuttle service throughout Naval Station Norfolk that provides regular access to most areas of the base. This shuttle reduces the need for personal vehicles for intrabase travel.

- *Traffix.* The Traffix program promotes various TDM alternatives and leases vans for vanpooling. Traffix has a dedicated staff person that serves Naval Station Norfolk.

- *Commuting subsidies*. Those commuters that use public transit or vanpools are eligible for subsidies via the Commuter Check program. Employees are able to receive up to $110 each month from the Navy for commuting in vanpools or using public transit. 1,300 employees of Naval Station Norfolk are currently enrolled in this program according to Traffix, and to date over $500,000 worth of Commuter Checks have been sold for Naval Station Norfolk.

- *Carpooling incentives*. The NuRide program encourages carpooling by connecting carpoolers based on their route to work and providing incentives to registered participants. These incentives include gift cards for various restaurants, entertainment centers, and retailers. Traffix has staff dedicated to connect carpoolers with the NuRide program.

- *HOV network*. The Southside HOV network is designed to help HOV traffic travel from Virginia Beach and Chesapeake to

Naval Station Norfolk in the morning and away from the naval base in the afternoon. Although these TDM programs are all valuable, the number of commuters that access the base via single occupant vehicles indicates that people either do not know about these programs or that these programs either do not or can not provide enough incentives to change their normal commuting routines.

Some possible programs that could be put in place to increase the number of commuters using alternative methods of transportation include:

- *Commuting subsidies for carpoolers*. Carpoolers currently are not eligible to receive commuting subsidies similar to those using public transportation or vanpools. For many people, public transportation and vanpools may not be as convenient as carpools would be. This, however, would require amending the federal tax code to allow for this.

- *Indirect financial incentives*. This includes additional non-monetary incentives that can be provided by Naval Station Norfolk to registered carpoolers and those using vanpools or public transportation. These incentives could include extra vacation time or discounts at Naval Exchange. A company in California that provided one to two extra vacation days for those employees that used ridesharing alternatives saw the number of commuters that drove alone to work dropped 10%.

- *Parking incentives*. Providing preferential parking for registered carpools could be effective at Naval Station Norfolk, since the amount of available parking adjacent to the Elizabeth River waterfront is limited, particularly during those periods when a large number of ships are in port.

Many parking incentive programs exist throughout the United States. However, most of these programs are in central business districts or other locations where there is a fee for parking, and preferential parking for carpools provides both improved parking locations as well as discounted or free parking. These programs are difficult to apply to Naval Station Norfolk since parking is free at the base, and only used by people either employed by or doing business at Naval Station Norfolk.

- *Additional transit service*. Certain express bus routes, particular the one from the Silverleaf station in Virginia Beach, have shown success. Based on the trip ends map included in this report, additional locations for express bus service that are convenient to the Interstate system could also be successful. These locations could include the Hilltop and Lynnhaven areas of Virginia Beach and the Military Circle area of Norfolk.

As the regional light rail system expands from the starter line in Norfolk in future years, service to NAS Norfolk, as one of the region's largest employers, should also be considered.

- *Flexible work schedules*. Although this would be difficult to implement at a place such as NAS Norfolk, letting some employees have flexible work schedules may make it more convenient for them to use carpooling, ridesharing, or transit alternatives. Employees that can work four-day, ten-hour weekly schedules versus the conventional five-day, eight-hour weekly schedule would reduce the number of single occupant vehicles entering the base.

- *Teleworking*. This alternative would be difficult to implement for most positions at the base. Each employee that can telework from home, even for only one day each week, reduces the number of single occupant vehicles entering the base.

RECOMMENDATIONS

Based on the results of the Alternative Analysis section of this report, the following recommendations are made for each of the transportation concern areas:

- Delays at rail crossings – *Implement planned projects including the Hampton Boulevard underpass and NIT Central Rail project.*

The delays that occur at rail crossings along Hampton Boulevard will be addressed by the proposed Hampton Boulevard underpass at Northgate Road and the proposed NIT Central Rail project. Although these projects are currently scheduled to begin construction in 2007, the Hampton Boulevard underpass is likely to be delayed due to funding constraints.

- Safety concerns – *Implement additional engineering remedies and increase enforcement efforts*.

Additional engineering and enforcement efforts are needed to address the high number of crashes that are occurring on I-564 due to speeding, driving under the influence of alcohol, and those crashes that occur during the morning peak period.

- Congested intersections – *Implement changes in signal phasing and install additional vehicle detection equipment.*

The intersection of Admiral Taussig Boulevard and Hampton Boulevard can operate at acceptable congestion levels if additional green time for the southbound left turn movement is provided and vehicle detection equipment is installed for all approaches of the intersection.

- Traffic management manpower – *Extend the leftmost northbound left turn lane at Hampton Boulevard and B Avenue, and install gates (or similar devices) on northbound Hampton Boulevard to force traffic onto eastbound Admiral Taussig Boulevard during the morning peak period.*

Putting out cones each morning should not be necessary at the intersection of Hampton Boulevard and B Avenue if additional green time is provided to the northbound left turn movement from Hampton Boulevard into Gate 5, and if the leftmost northbound left turn bay is extended to handle the 95^{th} percentile queue.

Active traffic management is necessary at the intersection of Admiral Taussig Boulevard and Hampton Boulevard to maintain uninterrupted traffic flow from I-564 into Gates 1 and 2 each morning. The method that would best maintain this uninterrupted traffic flow without putting out cones each morning and without affecting traffic the rest of the day is to install gates (or similar devices) on northbound Hampton Boulevard that forces traffic to turn right onto eastbound Admiral Taussig Boulevard during the morning peak period. Construction and maintenance costs for this alternative are costly, although this project would likely be eligible for regional Congestion Mitigation and Air Quality (CMAQ) funding.

- Gate management and utilization – *Create a means of providing up-to-date information to commuters of the delays at the gates, especially Gates 3/3A.*

Shifting commuters from using the gates on the eastern portion of the base to the gates on the western portion of the base would be difficult due to the additional distance that would need to be traveled. Some of the traffic that uses Gates 3/3A could be shifted to Gates 1 and 2 if reliable and up-to-date information about the length of delays at Gates 3/3A can be provided.

- *<u>Reducing the number of commuters using single occupant vehicles</u> – Further market existing programs and consider instituting new incentive programs.*

To decrease the number of employees that commute to the base via single occupant vehicles, further marketing of existing transportation demand management techniques is necessary. Additional transportation demand management techniques could also be provided, such as commuting subsidies for carpoolers, indirect financial incentives, and parking incentives.

APPENDIX A

Turning Movement Counts, Total Delay, and Levels-of-Service

AM and PM Peak Hour

Naval Station Norfolk Study Area

Total Intersection Peak Hour Volume, Average Delay, and Levels-of-Service

AM Peak Hour

Intersection		NBLT	NBTH	NBRT	NB Total	SBLT	SBTH	SBRT	SB Total	EBLT	EBTH	EBRT	EB Total	WBLT	WBTH	WBRT	WB Total	Intersection
Admiral Taussig Blvd at Mall Dr	Volume	-	-	-	-	-	-	-	-	-	319	62	381	377	2389	-	2766	3147
	Delay	-	-	-	-	-	-	-	-	-	12.7	4.1	11.3	45.8	8.9	-	13.9	13.7
	LOS	-	-	-	-	-	-	-	-	-	B	A	B	D	A	-	B	B
Admiral Taussig Blvd at Hammond Ave	Volume	467	-	87	554	-	-	-	-	-	319	-	319	-	2299	-	2299	3172
	Delay	114.2	-	0.0	96.2	-	-	-	-	-	7.7	-	7.7	-	22.2	-	22.2	34.1
	LOS	F	-	A	F	-	-	-	-	-	A	-	A	-	C	-	C	C
Bainbridge Ave at Bellinger Blvd	Volume	6	1265	268	1539	-	250	88	338	200	46	-	246	-	-	-	-	2123
	Delay	41.8	7.5	1.0	6.5	-	0.4		0.4	42.7		-	42.7	-	-	-	-	9.7
	LOS	D	A	A	A	-	A		A	D		-	D	-	-	-	-	A
Hampton Blvd at Admiral Taussig Blvd	Volume	0	0	381	381	-	-	-	-	-	-	140	140	273	1058	1058	2389	2910
	Delay	-	-	0.0	0.0	-	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	LOS	-	-	A	A	-	-	-	-	-	-	A	A	A	A	A	A	A
Hampton Blvd at B Ave	Volume	795	378	466	1639	65	148	200	413	-	-	149	149	54	46	3	103	2304
	Delay	15.3	6.2	3.7	9.9	58.6	15.7		22.4	-	-	0.1	0.1	56.6		29.0	55.7	14.0
	LOS	B	A	A	A	E	B		C	-	-	A	A	E		C	E	B
Hampton Blvd at Northgate Rd	Volume	28	2035	0	2063	4	335	5	344	7	2	28	37	0	0	2	2	2446
	Delay	8.3	0.0	-	0.1	20.2	0.0	0.0	0.2	12.5		12.5	12.5	-	-	9.5	9.5	0.4
	LOS	A	A	A	A	C	A	A	A	B		B	B	-	-	A	A	A
Hampton Blvd at Greenbrier Ave	Volume	-	1924	15	1939	30	333	-	363	-	-	-	-	30	-	111	141	2443
	Delay	-	1.8		1.8	48.3	1.5	-	5.4	-	-	-	-	23.6			23.6	3.6
	LOS	-	A		A	D	A	-	A	-	-	-	-	C			C	A
Hampton Blvd at Beechwood Ave	Volume	70	2051	11	2132	20	338	5	363	16	1	15	32	65	1	72	138	2665
	Delay	0.7	3.1		3.0	5.8	5.0		5.1	44.5		14.8	30.5	51.9			51.9	6.1
	LOS	A	A		A	A	A		A	D		B	C	D			D	A
Hampton Blvd at Glendale Ave	Volume	2	2198	9	2209	5	413	0	418	0	0	0	0	62	0	34	96	2723
	Delay	1.0	6.4		6.4	2.6	4.1		4.1	-	-	-	-	67.1			67.1	8.8
	LOS	A	A		A	A	A		A	-	-	-	-	E			E	A

Volumes are listed in vehicles during the peak hour.
Average delay is listed in seconds per vehicle.

Total Intersection Peak Hour Volume, Average Delay, and Levels-of-Service
AM Peak Hour

Intersection		NBLT	NBTH	NBRT	NB Total	SBLT	SBTH	SBRT	SB Total	EBLT	EBTH	EBRT	EB Total	WBLT	WBTH	WBRT	WB Total	Intersection
Hampton Blvd at Helmick St	Volume	9	2133	100	2242	83	391	1	475	1	0	3	4	101	0	243	344	3065
	Delay	0.4	3.3	0.1	3.1	25.0	2.6		6.5	32.8			32.8	54.0		59.3	57.7	10.0
	LOS	A	A	A	A	C	A		A	C			C	D		E	E	A
Hampton Blvd at Baker St	Volume	40	2209	3	2252	2	474	16	492	33	0	6	39	0	0	0	0	2783
	Delay	0.4	0.7		0.7	2.7			2.7	57.0		27.2	52.7	-	-	-	-	1.8
	LOS	A	A		A	A			A	E		C	D	-	-	-	-	A
Hampton Blvd at Staff College	Volume	-	2205	80	2285	18	454	8	480	23	0	10	33	23	0	26	49	2847
	Delay	-	4.8		4.8	8.4	1.5		1.7	42.7			42.7	53.3		17.8	34.5	5.2
	LOS	-	A		A	A	A		A	D			D	D		B	C	A
Hampton Blvd at Terminal Blvd	Volume	120	1600	315	2035	215	232	40	487	6	10	0	16	171	116	679	966	3504
	Delay	32.6	29.4	2.4	25.4	48.4	26.0	8.2	34.4	49.2	48.5	-	48.8	33.0		26.3	28.4	27.9
	LOS	C	C	A	C	D	C	A	C	D	D	-	D	C		C	C	C
Hampton Blvd at Little Creek Rd	Volume	1	1551	2	1554	60	362	1	423	18	6	4	28	264	6	466	736	2741
	Delay	25.4			25.4	35.8	0.7		5.7	53.1	50.0	27.0	48.7	41.7		48.3	45.9	28.3
	LOS	C			C	D	A		A	D	D	C	D	D		D	D	C
International Terminal Blvd at Meredith St	Volume	-	-	-	-	38	-	37	75	89	451	-	540	-	929	668	1597	2212
	Delay	-	-	-	-	53.4	-	13.4	33.6	3.9	0.6	-	1.1	-	0.9	0.8	0.8	2.2
	LOS	-	-	-	-	D	-	B	C	A	A	-	A	-	A	A	A	A
International Terminal Blvd at Diven St	Volume	220	100	60	380	50	10	7	67	9	450	30	489	30	1370	220	1620	2556
	Delay	56.7			56.7	51.4	36.4		47.7	46.3	16.3		16.9	57.0	26.0		26.6	29.6
	LOS	E			E	D	D		D	D	B		B	E	C		C	C
Little Creek Rd at Diven St	Volume	13	23	62	98	27	6	25	58	37	415	5	457	39	790	371	1200	1813
	Delay	21.3			21.3	42.2		13.6	29.9	2.9			2.9	4.1			4.1	5.9
	LOS	C			C	D		B	C	A			A	A			A	A
Little Creek Rd at Granby St	Volume	274	622	155	1051	48	913	327	1288	121	452	180	753	315	667	20	1002	4094
	Delay	65.9	28.8		38.5	53.9	43.3		43.7	60.9	42.7	11.6	38.2	118.3	41.7		65.8	47.1
	LOS	E	C		D	D	D		D	E	D	B	D	F	D		E	D

Volumes are listed in vehicles during the peak hour.
Average delay is listed in seconds per vehicle.

Total Intersection Peak Hour Volume, Average Delay, and Levels-of-Service
PM Peak Hour

Intersection		NBLT	NBTH	NBRT	NB Total	SBLT	SBTH	SBRT	SB Total	EBLT	EBTH	EBRT	EB Total	WBLT	WBTH	WBRT	WB Total	Intersection
Admiral Taussig Blvd at Mall Dr	Volume	-	-	-	-	-	-	-	-	-	1817	276	2093	385	563	-	948	3041
	Delay	-	-	-	-	-	-	-	-	-	11.1	0.2	9.6	96.5	2.4	-	40.6	19.3
	LOS	-	-	-	-	-	-	-	-	-	B	A	A	F	A	-	D	B
Admiral Taussig Blvd at Hammond Ave	Volume	200	-	771	971	-	-	-	-	-	1817	-	1817	-	743	-	743	3531
	Delay	54.2	-	0.0	11.2	-	-	-	-	-	4.4	-	4.4	-	2.9	-	2.9	6.4
	LOS	D	-	A	B	-	-	-	-	-	A	-	A	-	A	-	A	A
Bainbridge Ave at Bellinger Blvd	Volume	18	297	-	315	-	1398	225	1623	256	-	-	256	444	124	2	570	2194
	Delay	27.3	21.4	-	21.7	-	35.3		35.3	8.9	-	-	8.9	56.7	23.8	17.9	49.4	34.2
	LOS	C	C	-	C	-	D		D	A	-	-	A	E	B	B	D	C
Hampton Blvd at Admiral Taussig Blvd	Volume	2	147	591	740	774	535	10	1319	4	488	114	606	357	3	203	563	1909
	Delay	35.5	32.7	45.5	42.9	123.0	15.2		78.5	43.8	60.3	6.7	50.1	75.6		4.2	39.6	57.3
	LOS	D	C	D	D	F	B		E	D	E	A	D	E		A	D	E
Hampton Blvd at B Ave	Volume	146	406	269	821	61	985	35	1081	320	74	337	731	288	44	14	346	2979
	Delay	77.8	19.3	7.1	25.7	68.7	35.0		36.9	43.7		31.3	38.1	74.0		28.3	72.8	38.8
	LOS	E	B	A	C	E	D		D	D		C	D	E		C	E	D
Hampton Blvd at D Ave	Volume	Gate 6 closed during PM peak																
	Delay																	
	LOS																	
Hampton Blvd at Northgate Rd	Volume	39	877	10	926	16	1888	6	1910	25	1	51	77	15	0	5	20	2933
	Delay	13.2	1.3		1.8	1.4	3.2		3.2	52.1		40.9	44.6	40.8			40.8	4.6
	LOS	B	A		A	A	A		A	D		D	D	D			D	A
Hampton Blvd at Greenbrier Ave	Volume	-	884	74	958	19	1935	-	1954	-	-	-	-	25	-	42	67	2979
	Delay	-	4.9		4.9	65.9	1.0	-	1.7	-	-	-	-	28.0			28.0	3.4
	LOS	-	A		A	E	A	-	A	-	-	-	-	C			C	A
Hampton Blvd at Beechwood Ave	Volume	106	907	34	1047	29	1921	10	1960	20	5	94	119	37	13	31	81	3207
	Delay	30.4	6.9		9.3	2.1	7.0		6.9	46.6		36.2	38.4	43.2			43.2	10.3
	LOS	C	A		A	A	A		A	D		D	D	D			D	B
Hampton Blvd at Glendale Ave	Volume	19	1011	27	1057	74	1977	1	2052	7	2	21	30	50	0	29	79	3218
	Delay	4.9	5.4		5.4	2.1	2.9		2.8	45.3	18.7		24.7	50.6			50.6	5.4
	LOS	A	A		A	A	A		A	D	B		C	D			D	A

Volumes are listed in vehicles during the peak hour.
Average delay is listed in seconds per vehicle.

Total Intersection Peak Hour Volume, Average Delay, and Levels-of-Service

PM Peak Hour

Intersection		NBLT	NBTH	NBRT	NB Total	SBLT	SBTH	SBRT	SB Total	EBLT	EBTH	EBRT	EB Total	WBLT	WBTH	WBRT	WB Total	Intersection
Hampton Blvd at Helmick St	Volume	28	885	168	1081	169	1884	3	2056	2	0	8	10	158	0	170	328	3475
	Delay	6.6	1.9	0.8	1.8	3.7	1.4		1.6	25.0			25.0	58.6		20.7	39.0	5.3
	LOS	A	A	A	A	A	A		A	C			C	E		C	D	A
Hampton Blvd at Baker St	Volume	160	960	0	1120	0	1962	80	2042	121	0	77	198	0	0	0	0	3360
	Delay	42.8	1.5		7.4	14.6			14.6	60.3		10.4	40.8	-	-	-	-	13.8
	LOS	D	A		A	B			B	E		B	D	-	-	-	-	B
Hampton Blvd at Staff College	Volume	-	1067	22	1089	50	1977	12	2039	10	0	21	31	70	0	43	113	3272
	Delay	-	3.3		3.3	0.7	0.2		0.3	40.9			40.9	59.5		13.9	42.1	3.4
	LOS	-	A		A	A	A		A	D			D	E		B	D	A
Hampton Blvd at Terminal Blvd	Volume	57	659	426	1142	758	1296	14	2068	10	130	76	216	398	66	420	884	4310
	Delay	40.6	27.2	17.0	24.0	52.5	26.4	21.5	35.9	43.1	52.5	24.5	42.2	62.5		11.9	38.4	33.4
	LOS	D	C	B	C	D	C	C	D	D	D	C	D	E		B	D	C
Hampton Blvd at Little Creek Rd	Volume	2	930	519	1451	375	1386	9	1770	10	8	3	21	323	10	202	535	3777
	Delay	19.7			19.7	122.8	2.1		27.7	50.5	50.0	29.7	47.1	56.9		11.1	40.1	26.5
	LOS	B			B	F	A		C	D	D	C	D	E		B	D	C
International Terminal Blvd at Meredith St	Volume	-	-	-	-	500	-	142	642	77	1237	-	1314	-	742	53	795	2751
	Delay	-	-	-	-	50.0	-	7.5	40.6	5.2	14.6	-	14.0	-	9.3	0.1	8.7	19.2
	LOS	-	-	-	-	D	-	A	D	A	B	-	B	-	A	A	A	B
International Terminal Blvd at Diven St	Volume	80	20	50	150	200	50	20	270	50	1600	150	1800	30	700	80	810	3030
	Delay	49.2			49.2	55.2	43.9		52.3	65.5	35.8		36.6	56.1	15.1		16.7	32.9
	LOS	D			D	E	D		D	E	D		D	E	B		B	C
Little Creek Rd at Diven St	Volume	13	27	69	109	103	88	66	257	77	826	14	917	65	613	80	758	2041
	Delay	25.3			25.3	69.9		15.6	51.6	9.2			9.2	3.6			3.6	12.4
	LOS	C			C	E		B	D	A			A	A			A	B
Little Creek Rd at Granby St	Volume	298	697	293	1288	187	769	160	1116	202	701	150	1053	412	696	50	1158	4615
	Delay	65.6	48.3		52.3	56.0	50.8		51.6	53.9	47.0	13.9	43.6	176.2	36.9		86.4	59.5
	LOS	E	D		D	E	D		D	D	D	B	D	F	D		F	E

Volumes are listed in vehicles during the peak hour.
Average delay is listed in seconds per vehicle.