2 Existing Conditions

2.1 Introduction

This chapter describes the existing, or baseline conditions, within the study area. Existing transportation infrastructure, traffic flow characteristics and traffic-operating conditions, as well as environmental and socioeconomic resources, are described. Information on the natural and cultural resources was obtained from file reviews, agency consultations, geographic information system (GIS) database retrieval, and a windshield-level field-reconnaissance effort. It is this affected environment that the impacts of the various study alternatives are evaluated against in Chapter 5.

2.2 Existing Facilities

This section describes the study area's transportation system including the roadway network, public transportation system, and available bicycle facilities. **Table 2.2-1** summarizes the existing geometric roadway features in the study area including travel way and shoulder width, posted speed, minimum curve radius, maximum grade and the merge and diverge taper rate for vehicles entering and exiting I-293.

2.2.1 Roadways

I-293 Mainline

The project study area consists of a 3.5-mile section of I-293 beginning north of Exit 5 (Granite Street) and ending approximately 1.5-miles north of Exit 7 (Front Street). This section of I-293 consists of an urban, four-lane, median divided limited access highway. Beginning at the newly reconstructed Exit 5 interchange, the corridor winds between the Merrimack River on the east and the historic Millyard on the west, before intersecting with Exits 6 and 7, which were constructed in the late 1950s. The posted speed is 50 miles per hour thru Exit 7, and 65 mph north of Exit 7.

For the purpose of this description, the I-293 corridor was divided into three separate roadway segments that include a Mainline Segment, an Exit 6 Segment and an Exit 7 Segment. The Mainline segment includes the southerly 0.8-mile section of the I-293 study area. The Exit 6 Segment includes the Exit 6 interchange and a 0.8-mile section of I-293. The Exit 7 Segment includes the Exit 7 interchange and a 1.9-mile section of I-293 north of the Exit 6 Segment.

The 0.8-mile Mainline Segment begins just north of Exit 5 and follows the existing I-293 corridor between the Millyard buildings on the west and the Merrimack River on the east, passing under the West Bridge Street Bridge before ending just south of Exit 6. The existing reverse curves in this section (minimum radius for the 55 mph design) in combination with traffic entering and exiting just north at Exit 6 create congestion and unsafe vehicle operations. Poor sight lines further complicate traffic operations in this area. The sight line for motorists traveling in the northbound passing lane who may need to slow or stop to avoid a rear-end crash, for example, is obscured in some instances by a vehicle in the southbound passing lane. In addition, the sight line for northbound traffic decelerating and exiting at Exit 6 is poor due to the highway's curvature and vegetation on the riverbank, especially during the weekday evening peak hours when traffic from the off-ramp queues back onto the I-293 mainline.

Table 2.2-1 Existing Geometric Roadway Features

Roadway	Travel Way Width (Feet)	Min Shoulder Width (Outside/Inside) (Feet)	Posted Speed (MPH)	Min Curve Radius (Feet)	Max. Vertical Grade (Percent)	Merge Diverge Taper Rate	Comments
Mainline							
South of Exit 6	12/2 lanes	8/2	50	950	2.7%		
Exit 6 to Exit 7	12/2 lanes	10/2	55	2,875	2.8%		
North of Exit 7	12/2 lanes	8/12	65	2,875	1.9%		
Exit 6 Ramps							
NB Off	16/1 lane	2/2	30	954	6.0%	12:1 Decel	
NB On	16/1 lane	2/2	not posted	225	3.5%	15:1 Accel	260 ft merge taper
SB Off	16/1 lane	2/2	not posted	150	4.9%	Parallel Decel Lane	300' +/- weave
SB On	16/1 lane	2/2	not posted	418	7.3%	Parallel Accel Lane	area between On and Off ramps
SB On - Slip	16/1 lane	2/2	not posted	150	1.0%	17:1 Accel	475 ft merge taper
Exit 7 Ramps							
NB On	16/1 lane	2/2	30	1,432	3.6%	12:1 Decel	
SB On	16-20/1 lane	2/2	not posted	636	0.8%	27:1 Accel	
Front St	12/2 lanes	2/2	30	250	5.7%		
Eddy Rd	12/2 lanes	2/2		350	6.7%		
Amoskeag St	12/2-3 lanes	2/2	30	250	3.7%		
Goffstown Rd	12/2 lanes	2/2	30	325	6.0%		
Dunbarton Rd	12/2 lanes	2/2	30	330	7.2%		

Information compiled from existing as-built plans and GIS data

Exit 6 Segment

Exit 6 serves as a major connection to Downtown Manchester across the Amoskeag Bridge on the east, as well as a primary link to the residential areas of Goffstown and Dunbarton to the west. The layout of the interchange ramps is substandard and does not meet today's design criteria.

The existing northbound on-ramp taper (260-feet) for merging traffic is substandard. Northbound ramp traffic entering must rapidly accelerate to mainline speed often using the shoulder to merge with through traffic. This merge is further exacerbated by the heavy volume of traffic using the outer lane to exit at the Exit 7 northbound off-ramp. Occasionally the on-ramp vehicles come to a complete stop before merging while looking for a safe gap within the through traffic stream.

The Amoskeag Circle flows in a counter-clockwise direction connecting the local roadway network with I-293. The merge configuration where the northbound off-ramp traffic yields to the northbound Eddy Road traffic, in the vicinity of the LaQuinta Inn and Suites, often slows the northbound off-ramp traffic creating a stopped queue along the northbound mainline shoulder (noted earlier in the Mainline Segment discussion). The northbound weaving section created between the Eddy Road/northbound off-ramp intersection and the Amoskeag Street traffic signals further compromises safe and efficient traffic operations.

Currently, the southbound on-ramp and off-ramp are configured such that traffic must weave when entering or exiting the highway. The existing weaving geometry is substandard by today's design criteria, which hinders traffic operations and safety. Exiting southbound traffic often decelerates in the through traffic lane to exit onto the 25 mph ramp. The southbound off-ramp is short, resulting in the exiting traffic often queuing back into the weaving section with the southbound on-ramp traffic. The southbound on-ramp is steep and traffic often stops while looking for a gap to safely merge into the mainline through traffic. The congestion within this weave section of I-293, especially in the morning peak hour, often affects the safe operations of through traffic. To avoid this conflict, the mainline through traffic often shifts to the median lane.

To the south, the short southbound on-ramp from Eddy Road is operationally similar to the northbound on-ramp. The ramp acceleration area for traffic merging into the southbound mainline is substandard. The on-ramp traffic must accelerate rapidly often using the shoulder to merge with through traffic. The southbound on-ramp merges with I-293 on the outside of a sharp curve creating additional conflict between the through traffic and the entering ramp traffic.

Exit 7 Segment

Approximately 0.4-miles north of Exit 6, the Exit 7 partial interchange supports connectivity for motorists traveling to and from the south on I-293 with a southbound on-ramp and northbound off-ramp only. I-293 northbound speed limit changes from 50 mph to 65 mph north of the northbound off-ramp near Manchester Community College. The I-293 southbound speed limit changes from 65 mph to 50 mph near the merge area for the southbound on-ramp.

The northbound off-ramp is substandard by today's standards including the deceleration area for exiting traffic and the intersection layout with Front Street. Left-turning traffic from the northbound off-ramp onto Front Street often creates queues backing onto I-293 during peak hour conditions resulting in a potentially unsafe operating condition. To avoid the left-turn backup, many motorists who are destined toward Dunbarton Road will instead turn right onto Front Street and right onto Stark Lane to access Front Street where the left-turn is less congested. In addition to the northbound off-ramp congestion during peak periods, traffic turning left into Manchester Community College queues on Front Street, slowing and stopping northbound through traffic on Front Street.

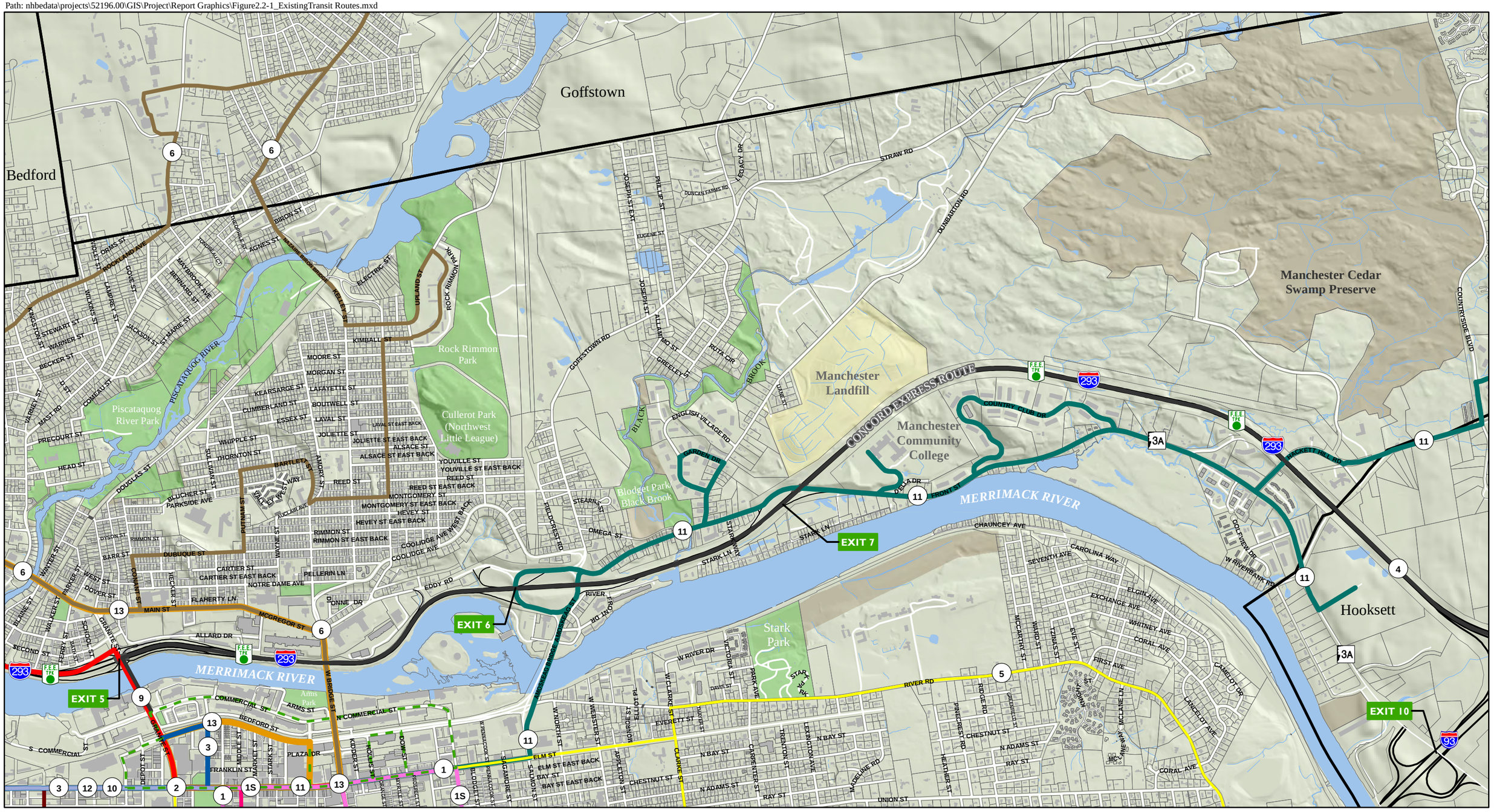
The intersection of Front Street and the southbound on-ramp is confusing and unexpected where the southbound motorist on Front Street does not fully realize that they have the right-of-way when entering onto I-293. Northbound traffic on Front Street has a combination slip-lane onto the southbound on-ramp and a through lane stop condition. The merge area with I-293 for the southbound on-ramp is also substandard, occasionally forcing motorists to stop and look for a gap in traffic before merging onto the highway.

2.2.2 Public Transportation

The Manchester Transit Authority (MTA) (http://www.mtabus.org) provides public transportation within the study area. MTA provides 13 regular bus routes through the city, including a free downtown circulator, known as the Green DASH (Downtown Area Shuttle). In general, service is hourly, with more frequent service along corridors served by multiple routes. The Green DASH runs every 10 minutes during peak periods and every 20 minutes the rest of the day. The study area's existing transit routes are shown in **Figure 2.2-1**.

The MTA system converges downtown at Veterans Park with one line departing from the nearby Manchester Transportation Center on Canal Street. Service is generally limited to the City of Manchester, with a few lines extending into the neighboring towns of Bedford, Goffstown, Hooksett and Londonderry. Two express lines run to Concord and Nashua. Bedford contributed funding to the MTA until 2010, and service coverage was significantly

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\Figure2.2-1_ExistingTransit Routes.mxd



Legend

- Assessor's Tax Parcels
- Building
- Surface Water
- Stream
- City Park Land
- Conservation/Public Land
- Bridge
- Town/City Boundary

Manchester Transit Authority Routes

- Route 1 - Healthcare Shuttle/East Side Plaza
- Route 2 - Hanover St/East Side Plaza
- Route 3 - Brown Ave/Airport Industrial Area*
- Route 4 - Concord Express*
- Route 5 - River Road/SNHU
- Route 6 - Bremer St/Mast Road
- Route 9 - Nashua Express
- Route 10 - Valley St/Weston Rd/Mall of NH
- Route 11 - Front Street/Hackett Hill Road
- Route 12 - South Beech St/Mall of NH
- Route 13 - Bedford Grove Plaza/Second St
- GREEN DASH - Downtown Area Shuttle*

Note: * Weekday service only.
All other routes include Saturday service.

0 1,500 3,000 Feet

Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.2-1
Existing Transit Routes

Manchester, NH

New Hampshire DOT Department of Transportation

reduced within the town the following year. As of 2009, 97 percent of Manchester residents lived within 0.25-mile of an MTA bus line.

In addition to the 13 public transit routes, the MTA operates:

- "StepSaver" a program that provides assistance to individuals with disabilities who are unable to use the regular fixed route bus service.
- "Shopper Shuttle" a program that operates three days a week to three local grocery stores.
- School buses for the Manchester School District.

The Manchester Transportation Center is owned by the City of Manchester and operated by Boston Express. The terminal is located at 119 Canal Street off I-293 Exit 5. Scheduled service at this terminal is provided by Boston Express, Concord Coach Lines, Greyhound Bus Lines and Peter Pan Bus Lines.

- Boston Express provides service between Concord to the north and Londonderry, Salem, Nashua, and Tyngsborough (MA) to the south with continuing service to Logan Airport and Boston South Station.
- Concord Coach Lines provides service to the south at Londonderry, Salem, Logan Airport, and Boston South Station. Concord Coach Lines provides service as far north as Littleton and Gorham.
- Greyhound Bus Lines provides two daily round trips between Boston and Montreal stopping in Manchester.
- Peter Pan Bus Lines provides one daily round trip between Concord and Foxwoods (CT) stopping in Manchester.

2.2.3 Bicycle Facilities

The NHDOT has designated bicycle routes throughout the state as shown on seven Regional Bicycle maps available online at: http://www.nh.gov/dot/programs/bikeped/index.htm. The study area falls within the Merrimack Valley Region that generally offers rolling terrain with heavy traffic within urban areas. Within the study area, the following have been designated as bicycle routes:

- Dunbarton Road east of Straw Road in Goffstown continuing onto Front Street to Goffstown Road, just west of the Amoskeag Traffic Circle.
- Straw Road from Dunbarton Road continuing onto Goffstown Road to Coolidge Avenue, just west of the Amoskeag Traffic Circle.
- Coolidge Avenue between Goffstown Road and West Bridge Street.
- Kelly Street between Goffstown and Coolidge Avenue.
- Bridge Street from Coolidge Avenue through Downtown Manchester to I-93;
- Elm Street from Bridge Street to Queen City Avenue.
- Canal Street from Bridge Street continuing along River Road, West Clark Street, and Union Street beyond I-93 in Hooksett.

2.3 Traffic Flow

This section presents the existing traffic volume demands and other traffic flow characteristics on I-293 such as travel speeds, vehicle crash data, and operational levels of service (LOS). Also presented is a brief description of the regional travel demand model that was used to assist with traffic forecasting and the evaluation of study alternatives.

2.3.1 Traffic Volumes

To determine the existing traffic volume demands and flow patterns in the study area, a traffic volume count program was conducted in April 2012. The 2012 counts were supplemented with other count data available from the NHDOT. Weekday morning and weekday evening peak period manual turning movement counts were conducted at Exit 6, Exit 7, and other major intersections surrounding the I-293 study area. Multi-day automatic traffic recorder counts were also conducted along key local roadways that provide access to and from Exits 6 and 7.

Review of the hourly traffic volumes for a typical weekday (June 2012) on I-293 northbound and southbound, as depicted in **Exhibits 2.3-1 and 2.3-2** respectively, reveals typical commuter route characteristics. The graphs show distinct weekday morning and evening commuter activity. The highest recorded northbound traffic volume occurs during the weekday morning peak hours, while the highest recorded southbound volume occurs during the weekday evening peak hours.

Exhibit 2.3-1 – Hourly Volumes
I-293 Northbound between Exits 5 and 6

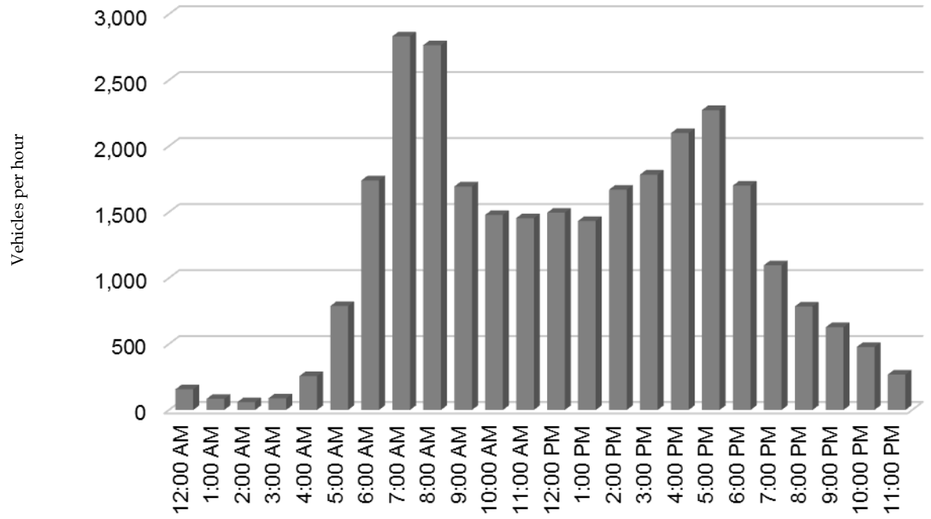
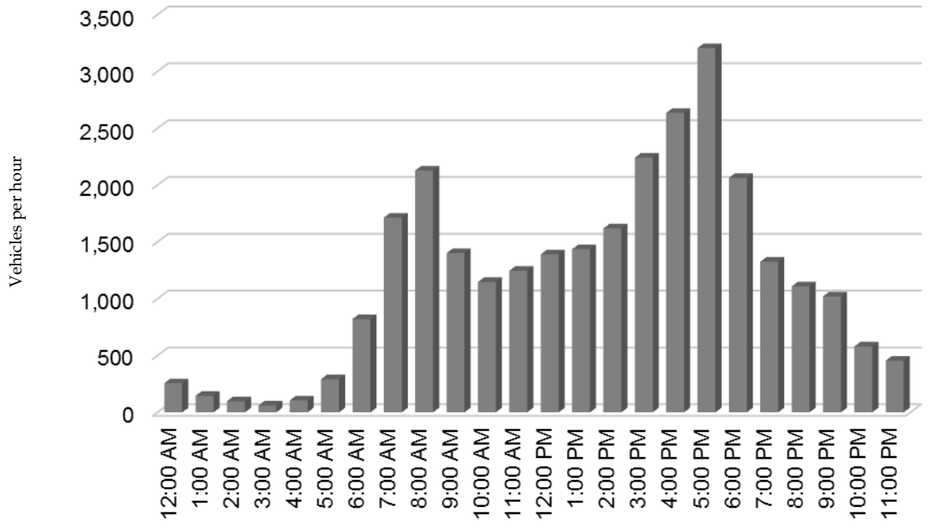
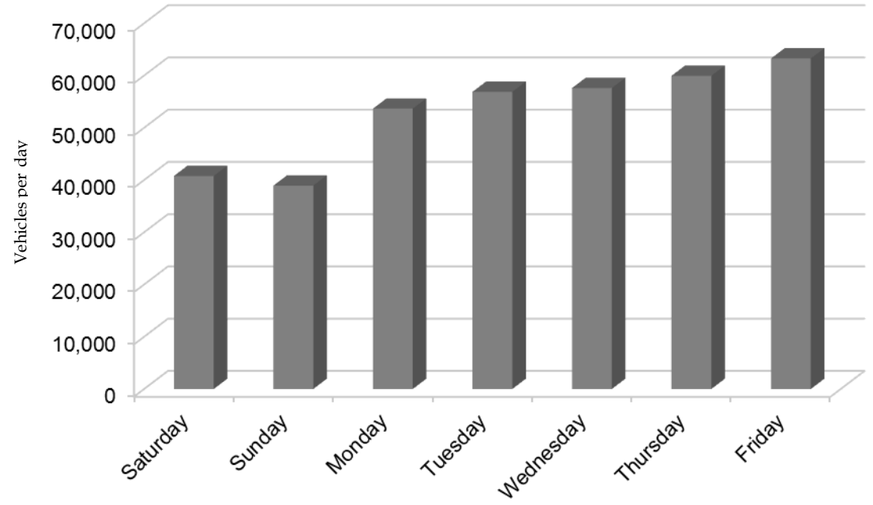


Exhibit 2.3-2 – Hourly Volumes
I-293 Southbound between Exits 5 and 6



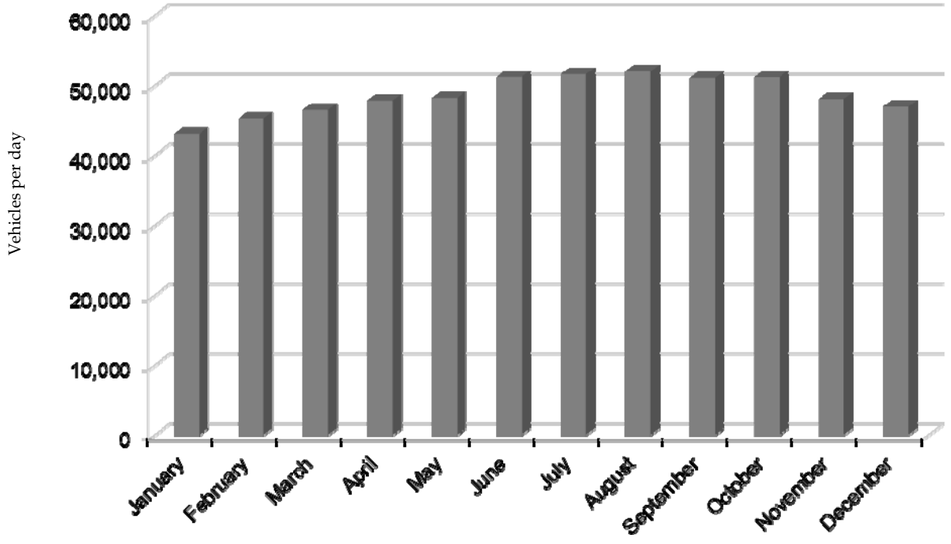
Examination of the daily traffic volumes (**Exhibit 2.3-3**) during June 2012 revealed only moderate variation during the weekdays with the highest daily volume occurring on Friday. The weekday volumes range from approximately 53,700 vehicles per day (vpd) to 63,300 vpd. The weekend daily volumes are lower with the Saturday and Sunday daily volumes recorded at approximately 40,800 vpd and 38,900 vpd, respectively.

Exhibit 2.3-3 – Daily Volumes
I-293 Both Directions between Exits 5 and 6



In addition to the hourly and daily traffic volume trends, a review of monthly traffic volumes (**Exhibit 2.3-4**) show that the highest volume months occur from early summer (June) through mid-fall (October).

Exhibit 2.3-4 – Seasonal Volumes
I-293 Both Directions between Exit 5 and 6



Design Hour Volume (DHV)

The unit of measure used to evaluate and design roadway facilities is an hourly traffic volume measured in vehicles per hour (vph). However, because hourly traffic volumes can vary during the course of a day, and throughout the year, it is necessary to select an appropriate design hour volume (DHV) condition. The hourly traffic volume used for the purpose of design should not be exceeded very often or by very much. However, it should not be so high that the traffic volume would rarely be high enough to make full use of the facility. It is wasteful to design a facility based on the maximum peak hour traffic of the design year, yet the use of the average hourly traffic may result in an inadequate design. Therefore, the procedure typically used to evaluate traffic volume demands on a roadway system, as described in *A Policy on Geometric Design of Highways and Streets,*[1] is to establish a 30th-highest hour volume, or DHV, as the future design condition. Given the economic considerations involved in the planning and design of roadway facilities, the DHV design criterion is selected because the 30th-highest hour volume generally reflects a "point of diminishing return" in that a substantial increase in capacity would only accommodate few periods of higher traffic volumes.

[1]American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, Sixth Edition, Washington, DC, 2011.

A review of historical count data at the NHDOT count station on I-293 between Exits 5 and 6 (Station #02285002) revealed that increasing the June peak hour traffic counts on I-293 by four percent best approximates the DHV condition. Specifically, the K-Factor (12.41 percent), which is the percent of traffic of the Average Annual Daily Traffic (AADT) that occurs during the 30th highest hour at this location, was applied to the estimated 2012 AADT (26,675) to establish the DHV (3,310) on I-293 northbound during the weekday evening peak hour. A four percent adjustment was also applied to the slightly lower weekday morning peak period on I-293. **Figures 2.3-1 and 2.3-2** show the 2012 DHV on I-293.

Seasonal Adjustment

The manual turning movement counts collected in April 2012 were seasonally adjusted to represent a peak month condition. Historical count data at numerous nearby NHDOT permanent count stations (I-293 in Manchester between Exits 5 and 6, F.E. Everett Turnpike at the Bedford Tolls, I-93 at the Hooksett Tolls, I-93 in Manchester between Exits 9 and 10, and NH Route 3A in Bow south of Robinson Road) revealed that peak month conditions are approximately five percent higher than the April conditions. Therefore, a five percent increase was applied to the April 2012 intersection counts to represent a peak month condition. **Figures 2.3-1** and **2.3-2** show the seasonally adjusted 2012 weekday morning and weekday evening peak hour volumes.

Limited Origin-Destination License Plate Survey

An origin-destination study was conducted on May 7, 2013 approaching the Exit 6 interchange to identify the destination of vehicles traveling eastbound on Goffstown Road and southbound on Front Street. Partial license plate numbers were recorded between 7:30 AM and 8:30 AM to identify the weekday morning peak hour distributions. The destinations for these vehicles were identified as I-293 southbound, Eddy Road (traveling southbound), I-293 northbound, and Amoskeag Street. Over 1,300 vehicles were recorded originating on Goffstown Road and Front Street with 89% (1,232 vehicles) of the vehicle destinations captured during the weekday morning peak hour. The results of the observations are summarized in **Table 2.3-1.**

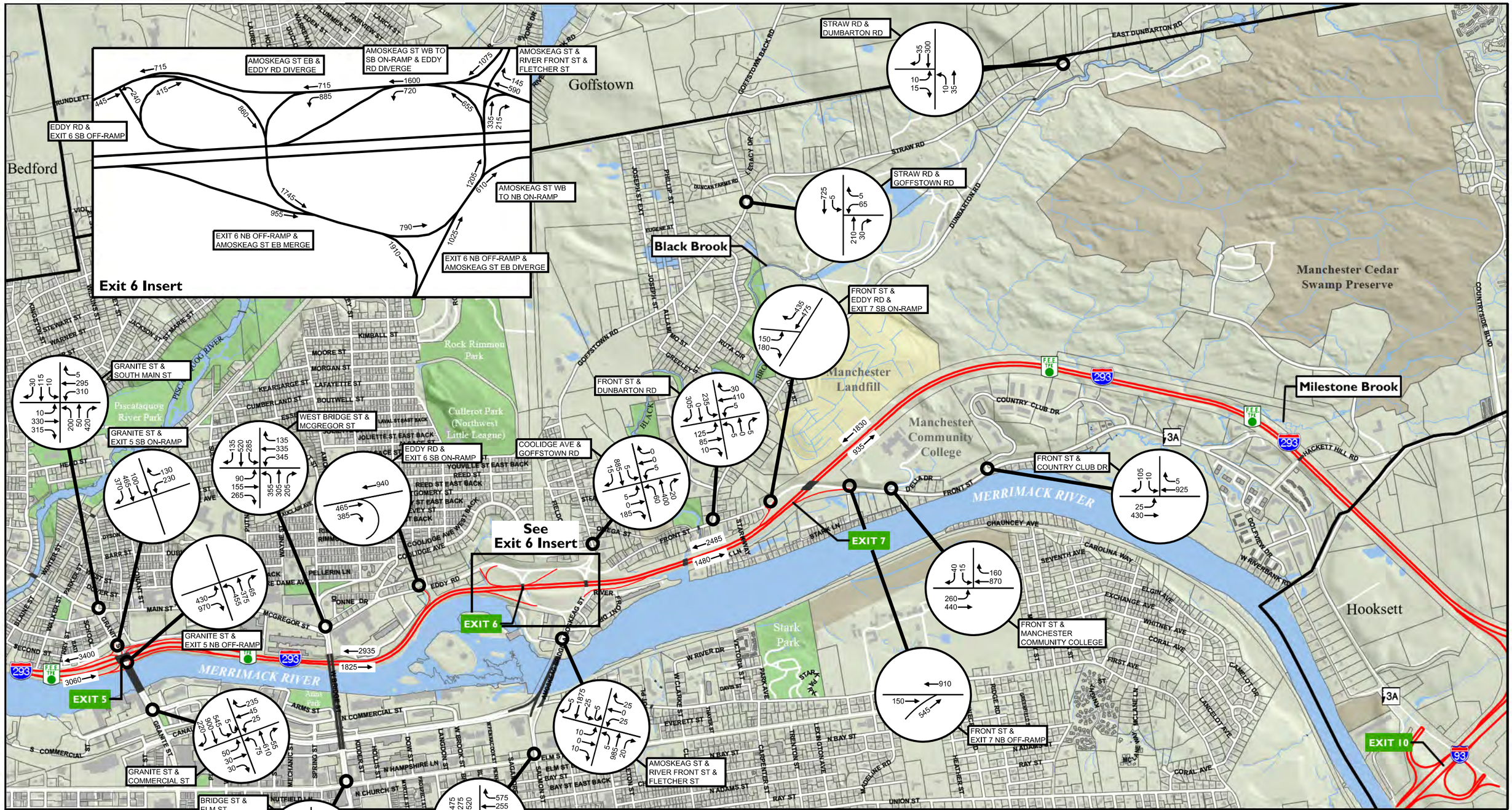
Table 2.3-1 Origin-Destination Survey Summary

Approach to Exit 6	I-293 North	I-293 South	Amoskeag St East	Eddy Rd South
Goffstown Rd Eastbound	19 %	21%	26%	14%
Front St Southbound	11%	12%	29%	27%

2.3.2 Regional Travel Demand Model

Southern New Hampshire Planning Commission (SNHPC) maintains a regional transportation daily model which utilizes the TP+/Viper travel demand modeling software package and 2010 Census data. The model is used to help understand traffic demand in the future based on land use growth and planned roadway projects. The base model contains

\\nh-bed\projects\52196.00\cad\ts\52196-TrafficNetworks.dgn



Vanasse Hangen Brustlin, Inc.

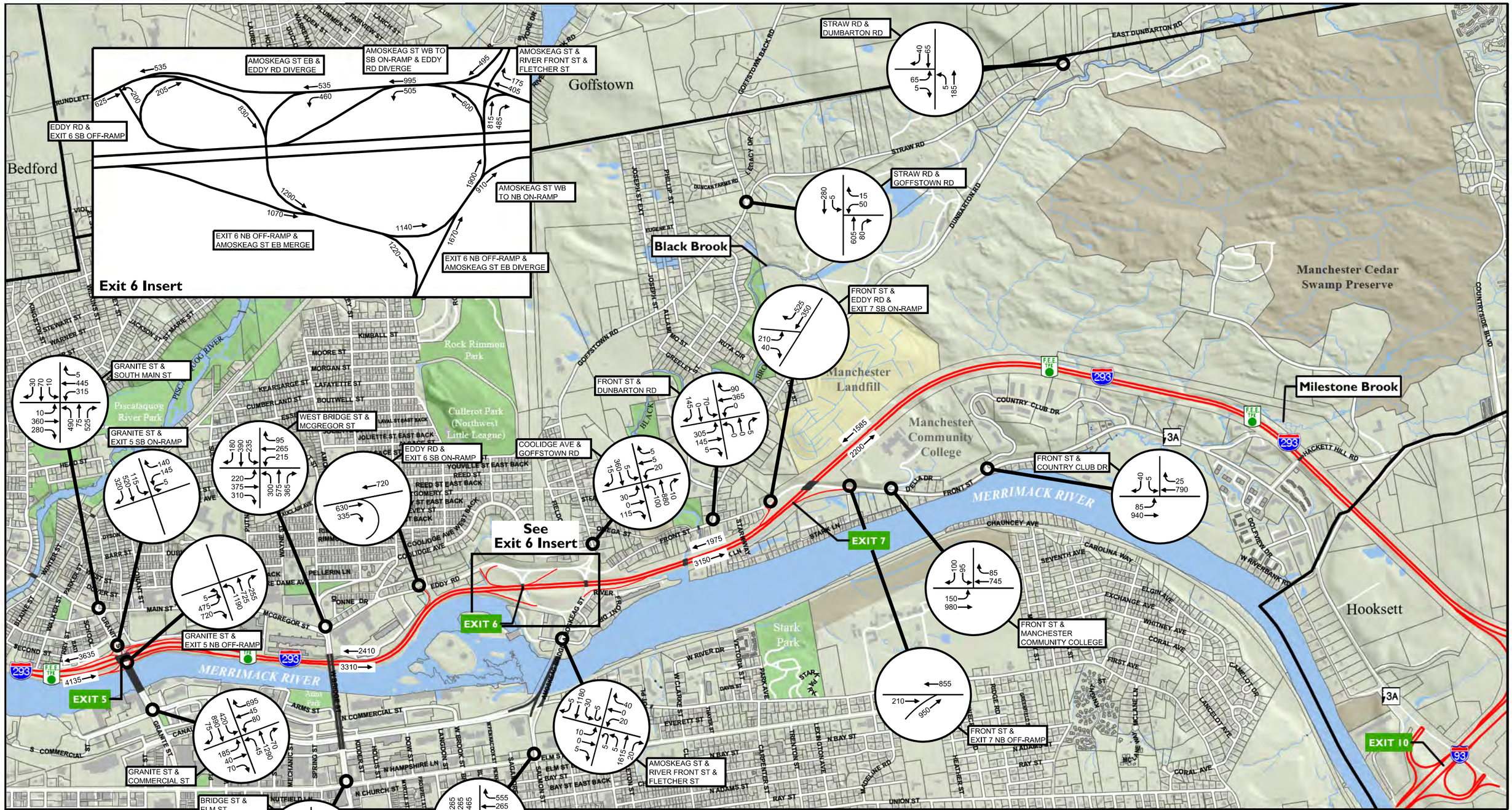
Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.3-1
2012 Existing Weekday Morning Peak Hour Traffic Volumes

Manchester, NH

New Hampshire DOT Department of Transportation

\\nh-bed\projects\52196.00\cad\ts\52196-TrafficNetworks.dgn



VHB Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.3-2
2012 Existing Weekday Evening Peak Hour Traffic Volumes

Manchester, NH

New Hampshire DOT Department of Transportation

290 internal traffic analysis zones (TAZs) and 67 external stations. Internal TAZs are geographic units that contain land use information (population, households, and employment) while external TAZs represent vehicle traffic that enters and exits the model area from outside the region. The traffic forecasting procedure generally follows the standard four-step process described below:

- Trip Generation: Determines the quantity of trips generated by each TAZ based on the land use contained in it.
- Trip Distribution: Determines the origin and destination patterns of trips generated at each TAZ.
- Modal Split: Determines what modes the trips are going to use to travel to their destinations.
- Traffic Assignment: Determines which routes the trips are going to take to their destination.

The roadway network assumed in the regional model includes the principal roadway street system as defined by NHDOT. It is not necessary to include all the local streets in the region. Within the model, a road segment is called a "link" and the intersection of two or more streets is called a "node". Each link is defined by characteristics such as length, average free flow speed, number of lanes, capacity, and one-way or two-way traffic flow.

Before the model can be used to forecast traffic for a horizon year, it must first be able to reasonably represent base year travel activity in the region. This involves modifying the model parameters until actual base year traffic is replicated.

For the purpose of this study, and to better understand the traffic patterns and flows in the study area, a number of TAZs were further broken down or detailed. Four TAZs in the study area were broken down into a total of 15 TAZs. The land use associated with each TAZ was assigned to these new TAZs based on 2010 Census data, as well as the SNHPC's employment database.

To check the model's calibration along I-293, and surrounding roadway network, the traffic model output was compared to actual daily traffic volume counts at 51 locations. These locations included all of the links on I-293 in the study area, ramp volumes at Exits 4 through 7, and roadways on either side of I-293. Once the model was calibrated, it was run using 2035 land use and roadway assumptions. The annual daily growth rate was then calculated for each of the 51 calibration check points. This annual growth rate provides the basis for forecasting future year 2035 traffic volumes for this study. It is important to note that the regional model is a daily model and was not directly used to establish future year peak hour volumes used for analysis purposes. In addition to establishing the growth rate for future traffic volumes, the regional model was instrumental in understanding the potential traffic volume "shifts" (diversions) that may occur under the various alternatives considered in the study.

2.3.3 Travel Speeds

The NHDOT conducted an automatic traffic recorder (ATR) count along I-293 between Exit 5 and Exit 6 north of the West Bridge Street Overpass to record volume and speed along the highway from June 2, 2012 through June 8, 2012. The data was recorded separately for each travel lane. For the purpose of presenting this information, the traditionally slower right-hand travel lane is referred to as the travel lane and the traditionally faster left-hand travel lane, is referred to as the passing lane. The count data revealed that the average hourly speed along I-293 (between Exits 5 and 6) during a typical weekday was 63 mph for the southbound travel lane and 60 mph for the northbound travel lane. The average hourly speed in the southbound and northbound passing lanes was recorded to be slightly higher at 66 mph. The average hourly speeds on I-293 fluctuate over the course of a typical weekday between 57 and 66 mph in the travel lanes and between 60 and 70 mph in the passing lanes. The highest hourly average speeds were recorded during the day at 6:00 AM (just prior to the weekday morning peak hour) and at 6:00 PM (just after the weekday evening peak hour). The lowest hourly average speeds were recorded during the overnight hours (8:00 PM through 3:00 AM). The travel speeds are summarized in **Table 2.3-2**.

Table 2.3-2 Travel Speed Summary

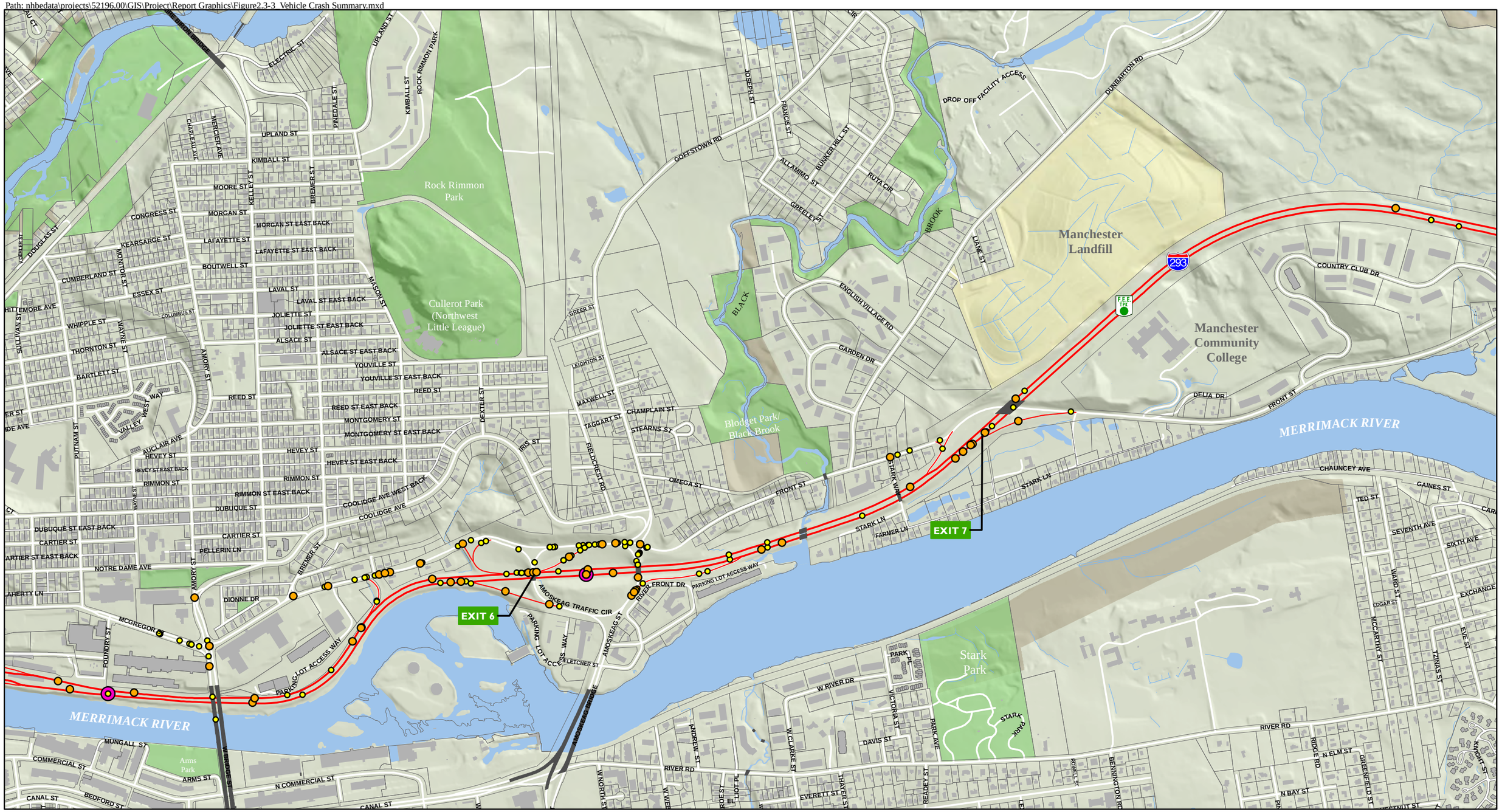
	I-293 (Exit 5-6) Weekday Travel Speeds			
	Southbound		Northbound	
Condition	Travel Lane	Passing Lane	Travel Lane	Passing Lane
Average Hourly Speed (mph)	63	66	60	66
Minimum Hourly Speed (mph)	58	59	57	60
Maximum Hourly Speed (mph)	66	70	63	69

2.3.4 Vehicle Crash Evaluation

NHDOT vehicle crash data was compiled for I-293 within the study area and the surrounding roadway network for the most recent three-year period available (2009 – 2011). As shown in **Figure 2.3-3**, a total of 246 crashes were reported within the study area during this three-year period. Of the total 246 crashes, 73 (30 percent) occurred on I-293, 67 (27 percent) occurred on the Exit 6 and 7 ramps, and the remaining 106 occurred along the adjacent study area roadways.

Ramp junctions and major intersections are generally the highest crash locations. Specifically, the Exit 6 ramps along the Amoskeag Traffic Circle experience the highest number of crashes, and the highest crash rates, within the study area. The crash data for Exit 6 indicates that the physical deficiencies described in Section 2.2.1 appear to be contributing toward the frequency of occurrences in this area. High numbers of crashes were also reported along Amoskeag Street between the Merrimack River and Front Street, along Eddy Road at the Exit 6 southbound on and off-ramps, on I-293 at Exit 7, and between Exits 5 and 6 along the "S-Curve". **Table 2.3-3** summarizes the number of crashes and crash rates along I-293 and the Exit 6 and 7 ramps within the study area.

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\Figure2.3-3_Vehicle Crash Summary.mxd



Legend

- Assessor's Tax Parcels
- Building
- Surface Water
- Stream
- City Park Land
- Conservation/Public Land
- Bridge
- Town/City Boundary
- Crash Location - No Injuries Reported (179 Crashes)
- Crash Location - Injuries Reported (65 Crashes)
- Crash Location - Fatality Reported (2 Crashes)

VHB Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.3-3
I-293 Crash Summary (2009-2011)

Manchester, NH

New Hampshire DOT Department of Transportation

In 2009 two fatal crashes were reported within the study area on I-293 northbound; one crash just north of the Exit 5 on-ramp merge and the other between the Exit 6 off and on-ramps. Of the 246 reported crashes 65 (26 percent) resulted in personal injuries while the remaining 179 crashes (73 percent) reported no injuries (property damage only).

Table 2.3-3 I-293 Crash Summary (2009 - 2011)

	Crashes (2009 - 2011)		2012 Traffic Volume		Length	Crash Rate
	Total	Average	Peak Hour	Daily	(miles)	(MVMT)
FEET (I293) Northbound Freeway Segments						
Exit 5 On Ramp - Exit 6 Off Ramp	6	2.0	3,310	26,672	0.89	0.23
Exit 6 Off Ramp - Exit 6 On Ramp	11	3.7	2,240	18,050	0.52	1.07
Exit 6 On Ramp - Exit 7 Off Ramp	9	3.0	3,150	25,383	0.48	0.67
North of Exit 7 Off Ramp	8	2.7	2,200	17,728	1.00	0.41
Total Segment	34	11.3	2,707	21,812	2.89	0.49
FEET (I293) Northbound Ramp Segments						
Exit 6 Off Ramp	7	2.3	1,070	8,622	0.17	4.36
Exit 6 On Ramp	8	2.7	910	7,333	0.21	4.74
Exit 7 Off Ramp	6	2.0	950	7,655	0.18	3.98
Total Segment	21	7.0	971	7,828	0.56	4.38
FEET (I293) Southbound Freeway Segments						
North of Exit 7 On Ramp	3	1.0	1,830	14,939	1.00	0.18
Exit 7 On Ramp - Exit 6 On Ramp	14	4.7	2,485	20,286	0.71	0.89
Exit 6 On Ramp - Exit 6 Off Ramp (weave)	5	1.7	3,205	26,163	0.08	2.18
Exit 6 Off Ramp - Exit 6 On Ramp	3	1.0	2,550	20,816	0.25	0.53
Exit 6 On Ramp - Exit 5 Off Ramp	14	4.7	2,935	23,959	0.68	0.78
Total Segment	39	13.0	2,384	19,460	2.72	0.67
FEET (I293) Southbound Ramp Segments						
Exit 7 On Ramp	2	0.7	655	5,347	0.12	2.85
Exit 6 On Ramp (north)	29	9.7	720	5,878	0.10	45.06
Exit 6 Off Ramp	11	3.7	655	5,347	0.14	13.42
Exit 6 On Ramp (south)	4	1.3	385	3,143	0.07	16.60
Total Segment	46	15.3	626	5,112	0.43	19.11
Total Freeway	73	24.3	5,091	41,272	5.61	0.29
Total Ramps	67	22.3	1,598	12,939	0.99	4.78
Total Freeway & Ramps	140	46.7	6,688	54,211	6.60	0.36

Crash Rates are expressed in crashes per million vehicle miles traveled (MVMT).

Daily volume is estimated based on a K-Factor from the NHDOT count station on FEET (I-293) between Exit 5-6:

- NB K-Factor (PM Peak Hour) = 12.41%
- SB K-Factor (AM Peak Hour) = 12.25%

2.3.5 Field Observations

In addition to conducting traffic volume counts, measuring travel speeds, researching vehicle crash data, and conducting operational analyses, general field observations were made. These field observations consisted of driving and walking the study area in an effort to gain a better understanding of how the I-293 mainline, entrance and exit ramps, and side streets function and what deficiencies currently exist. The following are some of the observations that were noted.

- Reverse curves along I-293 mainline, south of Exit 6, combined with proximity of interchange ramps, and high travel speeds creates conflicts, congestion, and safety issues.
- Vehicles queue back onto the I-293 mainline from the Exit 6 northbound off-ramp. Mainline curvature combined with vegetation and snow banks restrict sight lines creating potentially hazardous conditions.
- The short acceleration lane at the Exit 6 auxiliary southbound on-ramp from Eddy Road in conjunction with a mainline reverse curve compromises safety at this merge condition, especially during peak hours when there are few gaps in the mainline flow to accept ramp traffic.
- Substandard horizontal and vertical geometry at the Exit 6 southbound on and off-ramp weave section forces peak hour on-ramp motorists to stop at ramp nose and wait for gaps in the mainline traffic stream. This condition causes mainline motorists to slow to avoid conflicts. On-ramp traffic attempts to accelerate from a stop condition.
- Motorists aggressively change lanes along the mainline to avoid delays and slowdowns caused by motorists entering and exiting the highway.
- The short acceleration lane at the Exit 6 northbound on-ramp forces motorists to merge with mainline traffic prematurely. During high volume periods, motorists entering the highway are often forced to stop to wait for a gap in the mainline flow.
- At-grade braided ramps at the Amoskeag Traffic Circle cannot adequately accommodate high volume weaving movements, resulting in congestion and delay.
- Motorists exit from the Exit 7 northbound off-ramp onto Front Street at high speeds through a short merge area with limited sight lines. Motorists destined to the west use Stark Lane as a turnaround to reverse direction. Traffic operations are further complicated by queuing on Front Street associated with Stark Lane and the driveway to Manchester Community College.
- Motorists approaching the Exit 7 southbound on-ramp from Front Street northbound must stop to determine if southbound Front Street traffic is continuing on Front Street or traveling through the intersection to the on-ramp. Once on the on-ramp, motorists are frequently forced to enter the highway from a stop condition. The short acceleration length is further complicated by the high volume of trucks entering the highway from Front Street southbound.

2.3.6 Traffic Operations

Measuring the volume of traffic in the study area indicates the importance of I-293 to the regional transportation system but does not necessarily indicate the quality of traffic flow. To assess the quality of traffic flow along the corridor, capacity analyses were conducted to determine how well the roadway facilities serve the traffic demands placed on them. The traffic performance measures and the evaluation criteria used in the operational analyses are based on the methodology presented in the *2000 Highway Capacity Manual*.[2]

A primary result of capacity analysis is the assignment of level of service (LOS), which is a qualitative measure describing operational conditions. LOS generally describes these conditions in terms of such factors as speed and travel time, density or freedom to maneuver, traffic interruptions, comfort, and convenience, thereby providing an index to quality of traffic flow. Six levels of service are defined that range in letter designation from LOS A to LOS F, with LOS A representing the best operating condition and LOS F representing the worst. LOS C describes a stable flow condition and is considered desirable for design hour traffic flow. LOS D is generally considered acceptable, particularly when the cost and impacts of making the additional improvements needed to achieve LOS C are deemed unjustifiable. LOS E reflects a capacity condition, but under certain circumstances may be considered acceptable, such as in urban areas or where there's a desire to encourage multi-modal use and discourage single-occupant vehicles.

Results of the 2012 existing conditions operational analyses, which were conducted for the key freeway, ramp merge, ramp diverge, and ramp weave segments throughout the study area, as well as signalized and unsignalized intersections that control traffic operations at nearby major intersections are summarized in **Tables 2.3-4** (freeway and ramps), **2.3-5** (signalized), and **2.3-6** (unsignalized).

Mainline (Freeway and Ramps)

As shown in **Table 2.3-4**, the results of the 2012 existing conditions analysis at the freeway and ramp junctions indicate that several freeway segments and ramp junctions are currently operating at LOS D. This occurs during the peak periods along I-293 southbound during the weekday morning and northbound during the weekday evening. The only facility shown to operate at LOS E is the Exit 6 southbound on and off-ramps weave during the weekday morning peak hour. However, it is important to note that the software used to evaluate the freeway segments and ramps does not have the ability to incorporate the effects associated with the overall roadway network, such as when the ramp intersections back-up onto I-293. Therefore, some of the reported levels of service are likely better than experienced in the field.

[2] *2000 Highway Capacity Manual, Special Report 209*, Transportation Research Board, Washington, DC.

Table 2.3-4. 2012 Existing Freeway and Ramp Analysis

Location	Facility	Peak Period	2012 LOS
I-293 Northbound Exit 5 to Exit 6	Freeway	AM	B
		PM	D
I-293 Northbound Exit 6	Off Ramp (diverge)	AM	B
		PM	D
I-293 Northbound Exit 6	On Ramp (merge)	AM	B
		PM	D
I-293 Northbound Exit 6 to Exit 7	Freeway	AM	B
		PM	D
I-293 Northbound Exit 7	Off Ramp (diverge)	AM	B
		PM	D
I-293 Northbound Exit 7 to I-93	Freeway	AM	A
		PM	C
I-293 Southbound I-93 to Exit 7	Freeway	AM	B
		PM	B
I-293 Southbound Exit 7	On Ramp (merge)	AM	C
		PM	B
I-293 Southbound Exit 7 to Exit 6	Freeway	AM	C
		PM	C
I-293 Southbound Exit 6	Weave	AM	E
		PM	C
I-293 Southbound Exit 6 at Eddy Rd	On Ramp (merge)	AM	D
		PM	C
I-293 Southbound Exit 6 to Exit 5	Freeway	AM	D
		PM	C

Signalized Intersections

As shown in **Table 2.3-5**, the results of the 2012 existing conditions operational analyses indicate that four of the nine signalized intersections examined in the study are operating at LOS D or E. Specifically, the intersection of Granite Street at Main Street is shown to operate at LOS D during both the weekday morning and evening peak hours. The intersection of Granite Street at Commercial Street is shown to operate at LOS D during the weekday morning and LOS E during the weekday evening with a volume-to-capacity ratio (v/c) of 0.94 (94 percent of capacity). The intersection of McGregor Street and Bridge Street is shown to operate at LOS E during the weekday morning with a v/c of 0.90 and LOS D during the weekday evening. The intersection of Salmon Street at Elm Street is shown to operate at LOS C during the weekday morning and LOS D during the weekday evening with a v/c of 0.89. All other signalized intersections are shown to operate at a LOS C or better.

Table 2.3-5 2012 Existing Signalized Intersection Analysis

Location	Peak Period	2012 Existing v/c*	2012 Existing Delay**	2012 Existing LOS***
Granite Street at	AM	0.78	35	D
Main Street	PM	0.84	40	D
Granite Street at	AM	0.80	26	C
I-293 Exit 5	PM	0.87	31	C
Granite Street at	AM	0.73	39	D
Commercial Street	PM	0.94	73	E
McGregor Street at	AM	0.90	60	E
Bridge Street/Amory St	PM	0.75	41	D
Bridge Street at	AM	0.53	29	C
Elm Street	PM	0.64	32	C
Amoskeag Street at	AM	0.65	6	A
Goffstown Rd/Front St	PM	0.74	10	B
Amoskeag Street Traffic Circle	AM	0.66	14	B
(I-293 Northbound Approach)	PM	0.94	33	C
Amoskeag Street at	AM	0.74	10	A
River Front Dr/Fletcher St	PM	0.68	9	A
Salmon Street at	AM	0.81	29	C
Elm Street	PM	0.89	41	D

* Volume to capacity ratio.

** Delay in seconds per vehicle.

*** Level of service.

Unsignalized Intersections

Results of the 2012 existing conditions analyses for the unsignalized intersections (**Table 2.3-6**) reveal that the majority of side-street movements along the primary local roadways operate at poor levels of service (i.e., LOS E and F). Most notably, vehicles exiting from side streets onto Eddy Road, Goffstown Road, and Front Street experience long delays during peak-hour conditions. It is important to note that LOS E and F results for vehicles exiting from a side street do not necessarily mean that traffic operations are unacceptable or that improvements should be required at a particular location. Longer delays during peak hour conditions are common for minor streets and driveways intersecting major roadways. In situations where the existing lane geometry and traffic control devices at an intersection are optimal, and the intersection volume demands or crash rates do not meet the warrant criteria for the installation of a traffic signal, then LOS E or F can be considered acceptable.

Table 2.3-6. 2012 Existing Unsignalized Intersection Analysis

Location / Movement	AM Peak Hour Demand*	AM Peak Hour Delay**	AM Peak Hour LOS***	PM Peak Hour Demand	PM Peak Hour Delay	PM Peak Hour LOS
Exit 6 Southbound Off-Ramp at Eddy Road						
Exit 6 Southbound Off-Left	240	#	F	200	#	F
Exit 6 Southbound Off-Right	415	47	E	205	20	C
Exit 6 Northbound Off-Ramp at Amoskeag						
Exit 6 Northbound Off Ramp	955	#	F	1070	#	F
Amoskeag Westbound Slip Lane at Eddy Road						
Amoskeag Westbound Slip Lane	655	#	F	600	#	F
Goffstown Road at Coolidge Ave						
Goffstown Road Eastbound	905	0	A	380	0	A
Goffstown Road Westbound	480	2	A	990	3	A
Coolidge Ave Northbound	190	110	F	145	#	F
Business Drive Southbound	5	#	F	30	#	F
Front Street at Dunbarton Rd						
Dunbarton Road Eastbound	540	#	F	215	#	F
Retail Drive Westbound	10	79	F	5	9	A
Front Street Northbound	220	6	A	455	9	A
Front Street at Exit 7 SB On-Ramp						
Front Street Northbound	330	103	F	250	32	D
Front Street at Exit 7 NB Off-Ramp						
I-293 Exit 7 NB Off-Ramp Approach	545	40	E	950	#	F
Front Street at Manchester Community College						
Community College Exit	55	#	F	195	#	F
Front Street at Country Club Drive						
Country Club Dr Exit	115	32	D	45	29	D
Front Street Northbound	455	1	A	1025	4	A
Goffstown Road at Straw Road						
Straw Road Southbound	70	25	D	65	32	D
Dunbarton Road at Straw Road						
Straw Road Northbound	25	11	B	70	11	B

* Demand in vehicles per hour.

** Delay in seconds per vehicle. # Delay greater than 3 minutes.

*** Level of service.

2.4 Environmental Resources

This section describes the environmental resources in the study area. The existing-conditions inventory was compiled using various sources, as discussed herein. Environmental resources inventoried include wetlands; surface water; groundwater; floodplains; farmlands; rare, threatened, or endangered species; wildlife habitat; and potential soil and groundwater contaminated sites.

2.4.1 Wetlands

The US Fish & Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping, National Resources Conservation Service (NRCS) hydric-soils mapping, and 2010 aerial-photography-interpreted wetlands provided by the City of Manchester were reviewed to determine the potential location of wetlands within the study area. Environmental scientists verified potential wetlands by completing a windshield-level field-reconnaissance effort in October 2012. If the field-reconnaissance confirmed the presence of a wetland, wetland identification codes were assigned, wetland classification codes were assigned, brief notes regarding each wetland were recorded, and representative photos were taken. Wetlands were classified using the USFWS Methodology, "*Classification of Wetlands and Deepwater Habitats*, Cowardin et al, 1979".

Forty-three wetland/stream resources were observed in the study area. The field-reconnaissance effort does not constitute a wetland boundary determination. Field delineation of wetland boundaries during the NEPA/design phase may result in a greater number of wetlands as well as modifications to the size and shape of the wetland areas. Wetlands associated with Black Brook and those in the floodplain of the Merrimack River have the potential for greater overall functional values than many of the more disturbed wetlands in the study area. Many of the wetlands in the forested area to the north of the Manchester Landfill are potential vernal pools. **Figure 2.4-1** graphically displays the wetland resources.

I-293 Mainline (South of Exit 6)

Together, the photo-interpreted wetlands data provided by the City of Manchester and NWI mapping indicated two palustrine wetlands located in the study area. The windshield survey identified one additional wetland and refined the boundary of an additional wetland. The east side of the study area is bordered by the Merrimack River. Top-of-bank mapping for the Merrimack River was not delineated for this phase of the study, but was estimated based on aerial photography.

Two small wetlands are located on the west side of I-293, in the vicinity of the Eddy Road southbound on-ramp. The first wetland (Wetland 1) is located north of the former Coca-Cola bottling facility, adjacent to a parking lot. Wetland 1 is an isolated scrub-shrub wetland surrounded by invasive species. Silky dogwood and sensitive fern were observed as well as scattered litter throughout the wetland. The second wetland (Wetland 2) is an intermittent stream system with a submerged headwall at the inlet near Eddy Road. The stream outlets under I-293 and discharges to the Merrimack River. The two wetlands do not appear to be hydrologically connected.

The third wetland (Wetland 3) is forested wetland located immediately west of Eddy Road across from a commercial landscaping business. There was no visible surface outlet to Wetland 4 (located approximately 50 feet to the north) at the time of the field-reconnaissance, but the two wetlands are likely connected via a groundwater seep or high water connection.

Exit 6

Eight wetlands are located within the Exit 6 study area. Four of the eight wetlands were previously identified in the City of Manchester's aerial mapping. These wetlands consist of emergent, forested, scrub/shrub, and open-water habitat. Given the proximity of these wetlands to the existing I-293 and the surrounding developed area, many of these wetlands have been disturbed and are surrounded by invasive species such as Phragmites, Japanese knotweed, bittersweet, and others.

Wetlands 4 and 5 are located on the southern end of the Exit 6 study area in vicinity of the Exit 6 southbound off ramp. Wetland 4 is located on the west side of Eddy Road across from an existing gas station. A two to three foot wide sinuous intermittent stream channel flows through the wetland that outlets under Eddy Road to Wetland 5. The upland edge closest to Eddy Road is dominated by invasives such as bittersweet, Japanese knotweed, and burning bush. Wetland 4 is likely connected to Wetland 3 (located upslope of Wetland 4 and discussed in the previous section.)

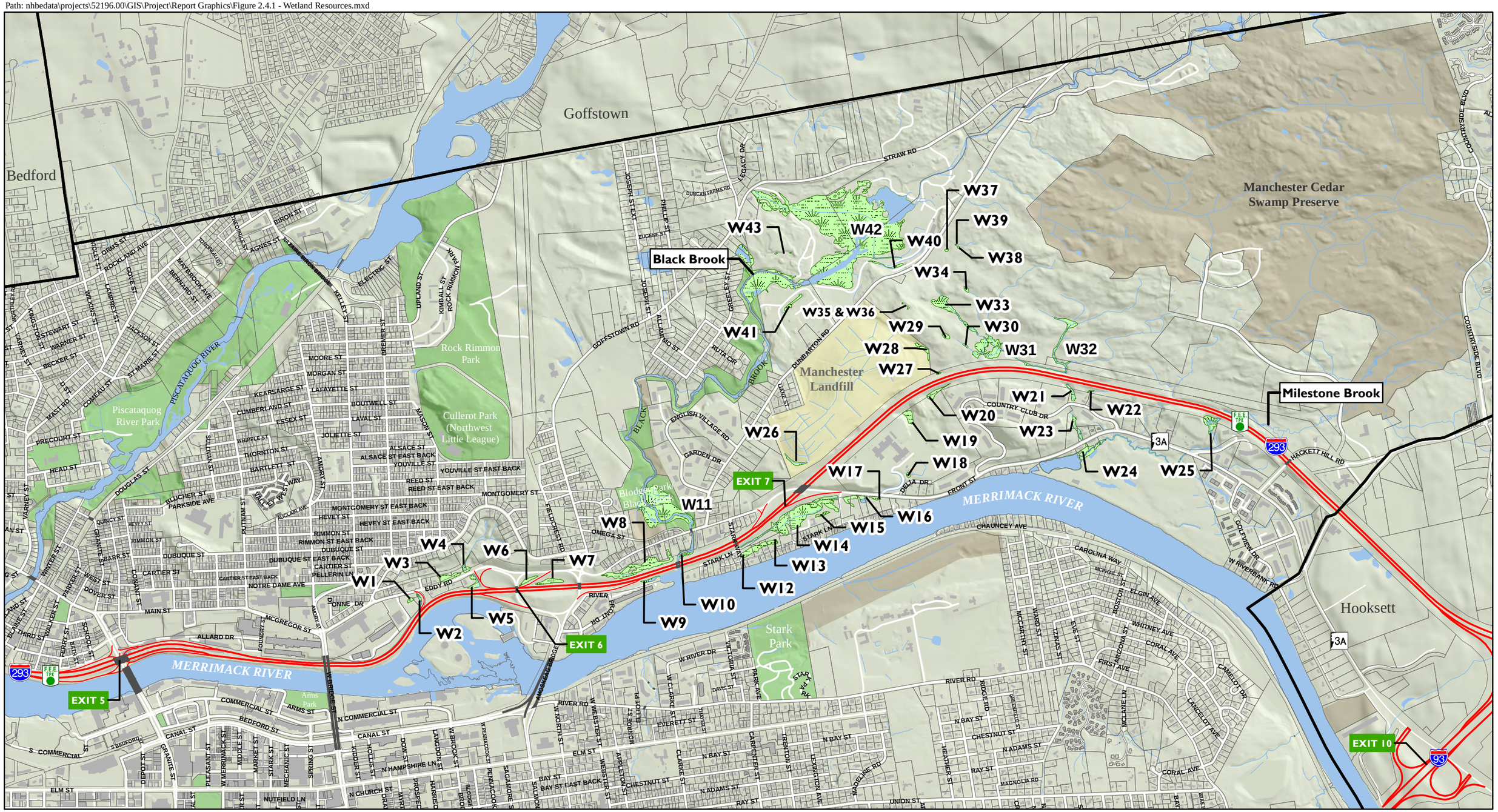
Wetland 5 is a scrub/shrub wetland with an intermittent stream channel flowing through it. The wetland system receives flow from three catch basins associated with the southbound off-ramp. A narrow stand of red maple saplings and equisetum are located adjacent to the intermittent stream channel. The shrub portion of the wetland is surrounded by a dense stand of knotweed, with trash and other debris scattered about the wetland.

Wetlands 6 and 7, which are both emergent systems, are located north and south of the Exit 6 southbound on-ramp. These wetlands are likely to be determined non-jurisdictional drainage areas associated with the construction of I-293. Wetland 6 is a cattail wetland, while Wetland 7 is dominated by Phragmites. Wetland 7 is located on the slope south of the Exit 6 southbound on-ramp. Both wetlands are connected to a series of catch basins and drainage pipes that connect to a larger drainage network which outlets to the Merrimack River in the vicinity of the Exit 6 northbound off-ramp.

The northern boundary of the Exit 6 study area extends approximately 400 feet north of Black Brook. In addition to Black Brook and the Merrimack River, four palustrine wetlands were identified (Wetlands 8-11) in this area. Wetland 11, with its scrub-shrub habitat, is one of the larger wetlands in the study area, and is located along Black Brook in Blodget Park (located off of Front Street). Much of Wetland 11 is located in the former impoundment on Black Brook that was removed several years ago. Wetland 10 is a small forested wetland located on the north side of the bank, just west of the I-293/Black Brook crossing.

Wetland 8 is located south of the Black Brook crossing and Front Street. Wetland 8 is classified as forested/emergent wetland primarily dominated by red maple. The southern end of the wetland is dominated by a solid stand of Phragmites. The western edge of the wetland is bordered by residential development along Front Street and is surrounded by Japanese knotweed. There was no obvious outlet observed in the field, but there is likely a culvert outlet under I-293.

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\Figure 2.4.1 - Wetland Resources.mxd



Legend

- Assessor's Tax Parcels
- Building
- Surface Water
- Stream
- City Park Land
- Conservation/Public Land
- Bridge
- VHB Verified Wetland

0 1,500 3,000 Feet

Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exits 6-7 Planning Study

Figure 2.4-1
Wetland & Surface Water Resources

Manchester, NH

New Hampshire DOT Department of Transportation

Wetland 9 is a small forested wetland along the cul-de-sac at the end of Riverfront Drive and includes many invasive species such as knotweed, bittersweet and others. Standing dead trees in the wetland were observed during the field visit.

Exit 7

Overall, thirty-two wetlands were identified in the Exit 7 study area. NRCS identified two types of hydric soils in this area: Chatfield-Hollis-Rock outcrop complex and Greenwood mucky peat. Many (n=13) of these wetlands (Wetlands 27-39) are located north of Manchester Landfill in undeveloped land associated with the western edge of Hackett Hill. A utility right-of-way traverses this area as well, where one of the larger wetlands (Wetland 33) is located. Wetlands 30 thru 34 are connected by a series of intermittent streams flowing northeasterly to a culvert at Wetland 32, which drains under I-293. Wetland 31 is another large and diverse wetland with potential vernal pool indicators in some pockets of standing water. The other wetlands in this area consist mostly of small isolated forested wetlands and intermittent stream channels.

The field-reconnaissance also confirmed fourteen wetlands (Wetlands 12-25) east of I-293, between the highway and the Merrimack River. Six (6) of these wetlands (Wetlands 12-17) are located in the vicinity of the existing Exit 7 northbound off-ramp and along Front Street. Wetland 14 is the largest wetland in this area and is primarily an emergent wetland system. The radio towers and fences associated with the WGIR radio station are in this wetland. Many invasive species are growing around Wetland 14 along Stark Lake, but mainly purple loosestrife was noted within the wetland itself. Other wetlands in this area consist of smaller emergent cattail and open wetlands, but have been altered by construction activities along Stark Lane and Front Street.

Wetlands 18 thru 25 are located north of the Manchester Community college driveway and south of Milestone Brook. Many of these wetlands consist of forested habitat with intermittent and perennial streams flowing through them. Several of these wetlands are connected to each other (Wetlands 21-25), but are also connected by culverts to upstream wetlands (Wetlands 31-33) on the west side of I-293 in the Hackett Hill Area. These wetlands have seen some disturbance from the apartments/condos on Country Club Drive, but remain fairly intact with upland buffers.

A group of four wetlands (Wetlands 40-43) are located in the area between Dunbarton Road and Goffstown Road. Wetland 42, the largest wetland within the study area, is located along both sides of Black Brook, but the majority of this palustrine system is located on the west side of the brook. Wetland 42 is primarily a scrub-shrub wetland with various areas of open water with many important wetland functions and values observed during the field-reconnaissance. Additionally, multiple New Hampshire Natural Heritage Bureau (NHNHB) database records for rare, threatened, or endangered species have been observed in or within close proximity to Wetland 42.

2.4.2 Surface Waters

The Merrimack River, Black Brook, and Milestone Brook represent the three primary surface water bodies in the study area (Figure 2.4-1). The Merrimack River is the second largest river in New England with a total length of 116 miles and a watershed of 5,010 square miles, before it empties into the Atlantic Ocean near Newburyport, Massachusetts. The river flows through the City of Manchester along the easterly edge of the study area and adjacent to I-293. The river provided much of the water power used to operate the historic textile mill complex located along the river banks in Downtown Manchester. Today, the river is still used to supply hydroelectric power through the nearby Amoskeag Dam. The Amoskeag Dam is located near Exit 6 off of I-293 on the east side of the river. Below the dam, the river is free flowing with relatively swift currents for several miles.

Black Brook and Milestone Brook are tributaries to the Merrimack River that drain from the west with their watersheds primarily located in the communities of Manchester, Dunbarton and Goffstown. Black Brook flows beneath Front Street and I-293 and enters the Merrimack River just north of Exit 6. Milestone Brook flows beneath I-293 about 0.25-mile south of the Hackett Hill Road underpass.

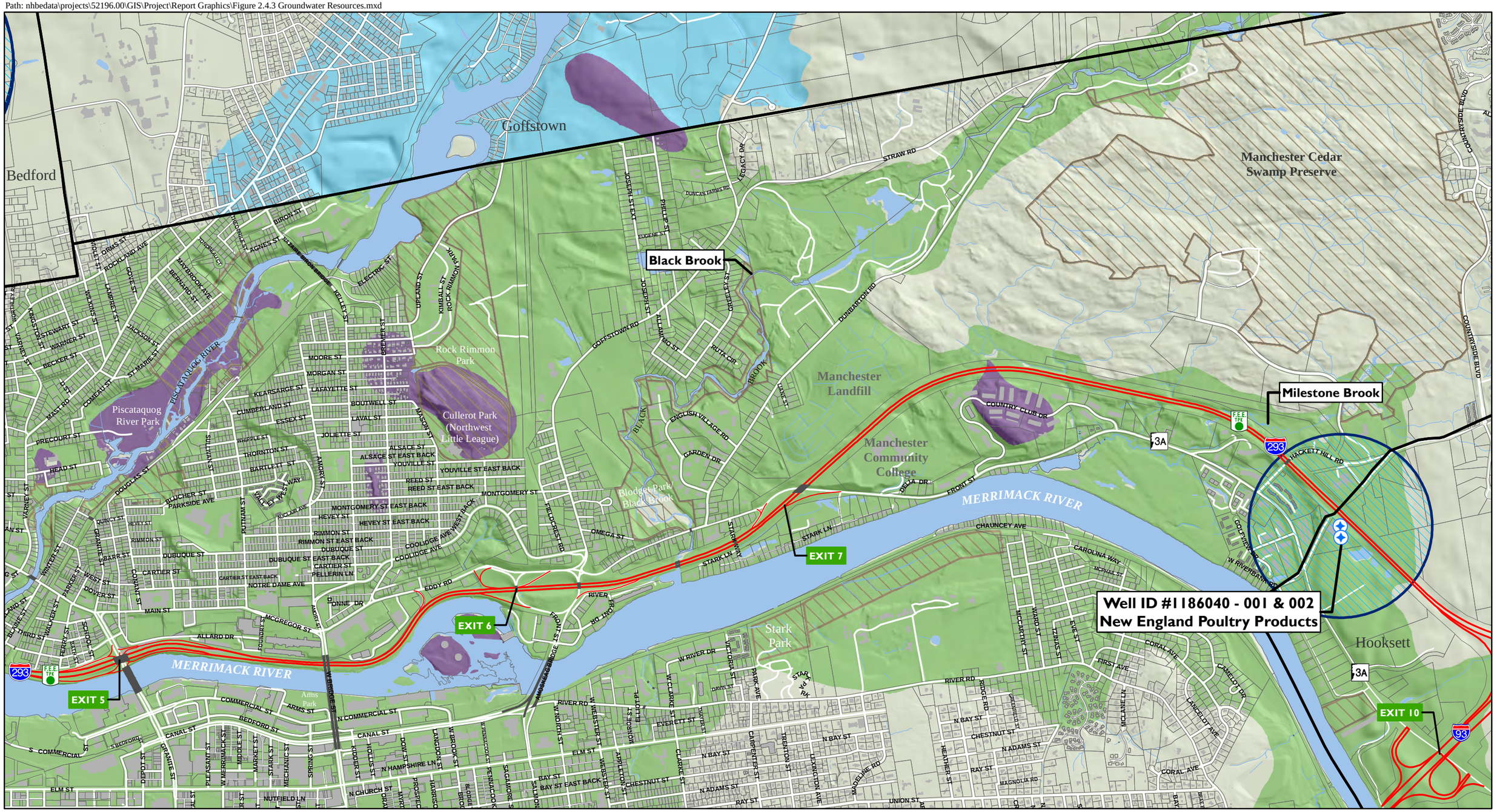
According to the New Hampshire Department of Environmental Services' (NHDES) 2012 303(d) list of impaired water bodies, the three water bodies have known water quality impairments indicating that the existing water quality is not sufficient to fully support all designated uses. For the Merrimack River, the primary water quality concern relates to elevated levels of *E. coli* bacteria, which can pose a potential human health risk for primary (i.e., swimming) and secondary (i.e., boating) recreational uses of the river. NHDES indicates that the elevated bacteria levels were detected within the impoundment behind the Amoskeag Dam and the potential source relates to releases of combined sewer overflows during wet weather events. The City of Manchester has developed a long-term capital improvement to minimize the number and frequency combined sewer overflow events in the future. Additionally, the Merrimack River is considered to be marginally impaired relative to supporting aquatic life due to previously detected elevated levels of aluminum, low pH and low dissolved oxygen saturation levels. The potential sources for these impairments are listed as unknown (NHDES 305(b)/303(d) list, 2010).

Black Brook and Milestone Brook are listed as impaired primarily due to previously detected elevated levels of iron and mercury, which could adversely affect aquatic life. The potential sources are listed as unknown. NHDES has indicated a target date of 2019 to complete a Total Maximum Daily Load (TMDL) study to address these water quality impairments of these brooks.

2.4.3 Groundwater Resources

Information on groundwater resources (**Figure 2.4-2**) in the form of aquifers mapped by the US Geological Survey, was retrieved from the NHGRANIT GIS database. The majority of the study area is underlain by a Stratified-drift Undifferentiated aquifer.

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\Figure 2.4.3 Groundwater Resources.mxd



Legend

- Assessor's Tax Parcels
- Building
- Surface Water
- Stream
- Conservation/Public Land
- Bridge
- Town/City Boundary
- Public Water Supply
- Well Head Protection Area

USGS Aquifer Boundaries

- Glacial Lake Bottom Deposits
- Stratified-drift
- Till
- Non Aquifer Area

Note: The entire City of Manchester is located in the Source Water Protection Area (SWPA).

0 1,500 3,000 Feet

Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.4-2
Groundwater Resources

Manchester, NH

New Hampshire DOT Department of Transportation

GIS data from NHDES were retrieved to determine whether the study area is located within a designated Well Head Protection Area (WHPA) or Source Water Protection Area (SWPA), or if there are any mapped public or private wells in the vicinity. This research revealed no WHPA within the study area and, according to the NHDES database, the only monitoring wells in the area are those associated with the landfill. Two non-transient, non-community wells associated with New England Poultry Product Inc., were identified just north of the study area. The entire City of Manchester is located in a SWPA watershed of the Pennichuck Water Works drinking water intake located in Nashua, NH.

2.4.4 Floodplains

All federal projects potentially impacting floodplains require an evaluation under Executive Order 11988, Floodplain Management (May 24, 1977). The regulation that sets forth the policy and procedures of this order is entitled Floodplain Management and Protection of Wetlands (44 CFR §9), which is under the authority of the Federal Emergency Management Agency (FEMA).

Information on the Regulatory Floodway and 100-year floodplain within the study area was obtained by reviewing the FEMA Digital Flood Insurance Rate Map (FIRM) mapping for Hillsborough County (Community Panels 33011C0236D, 33011C0238D, 33011C0376D). See **Figure 2.4-3**. The FIRM information also provides users with automated flood-risk data that can be used to locate Special Flood Hazard Areas (SFHA); the risk zones are depicted on a community's hardcopy FIRM maps. The FIRM mapping identifies three areas of floodplain resources associated with the Merrimack River, Black Brook, and Milestone Brook. FEMA mapping identifies both Regulatory Floodway and 100-year floodplain for the Merrimack River. Only 100-year floodplain has been identified for Black Brook and Milestone Brook and is identified as SFHA Zone A, indicating that no hydraulic analyses or base flood elevations have been established for either brook.

It is important to note that the flood insurance hydraulic analysis for this portion of the Merrimack River was completed in the 1970s, which means that the flood elevations could potentially change in this area under a revised analysis. As the design moves forward theses flows should be reevaluated with updated gage data from USGS and the Amoskeag Dam.

2.4.5 Farmland

Information on Important Farmland Soils as defined by the Farmland Protection Policy Act (FPPA) was retrieved from the NRCS Web Soil Survey for Hillsborough County. The Web Soil Survey contains current digital mapping and soil-unit attribute information on Prime Farmland, Statewide Important Farmland soils, and Farmland of local importance. In addition to the data provided by the NRCS, aerial photography was used to determine the presence or absence of active farmlands in the study area. NRCS farmland soils are shown in **Figure 2.4-4**.

Prime Farmlands

The NRCS database identified a small pocket of prime farmland soil within the overall study area. The prime farmland soil is on a parcel of land owned by Manchester Community College. The soil is classified as Agawam fine sandy loam and is primarily forested with a small portion located in an open area maintained by the College.

NRCS also mapped two pockets of Prime Farmland if drained. These areas are located in the wetland complex just east of the existing Exit 7 northbound off-ramp and much of the land associated with the Intervale Country Club.

Farmland of Statewide Importance

NRCS mapped three small pockets of Farmland Soil of Statewide Importance located in Manchester Cedar Swamp preserve of Hackett Hill.

Farmland of Local Importance

Farmland Soil of Local Importance can be found in northern stretches of the study area, north of Manchester Community College. The first area is located east of Front Street along the Merrimack River, in the vicinity of the Intervale Country Club. The soil in this area is classified as Suncook loamy fine sand. The majority of this area occurs in areas of residential development. The only non-developed areas occur on the grounds of the Intervale Country Club.

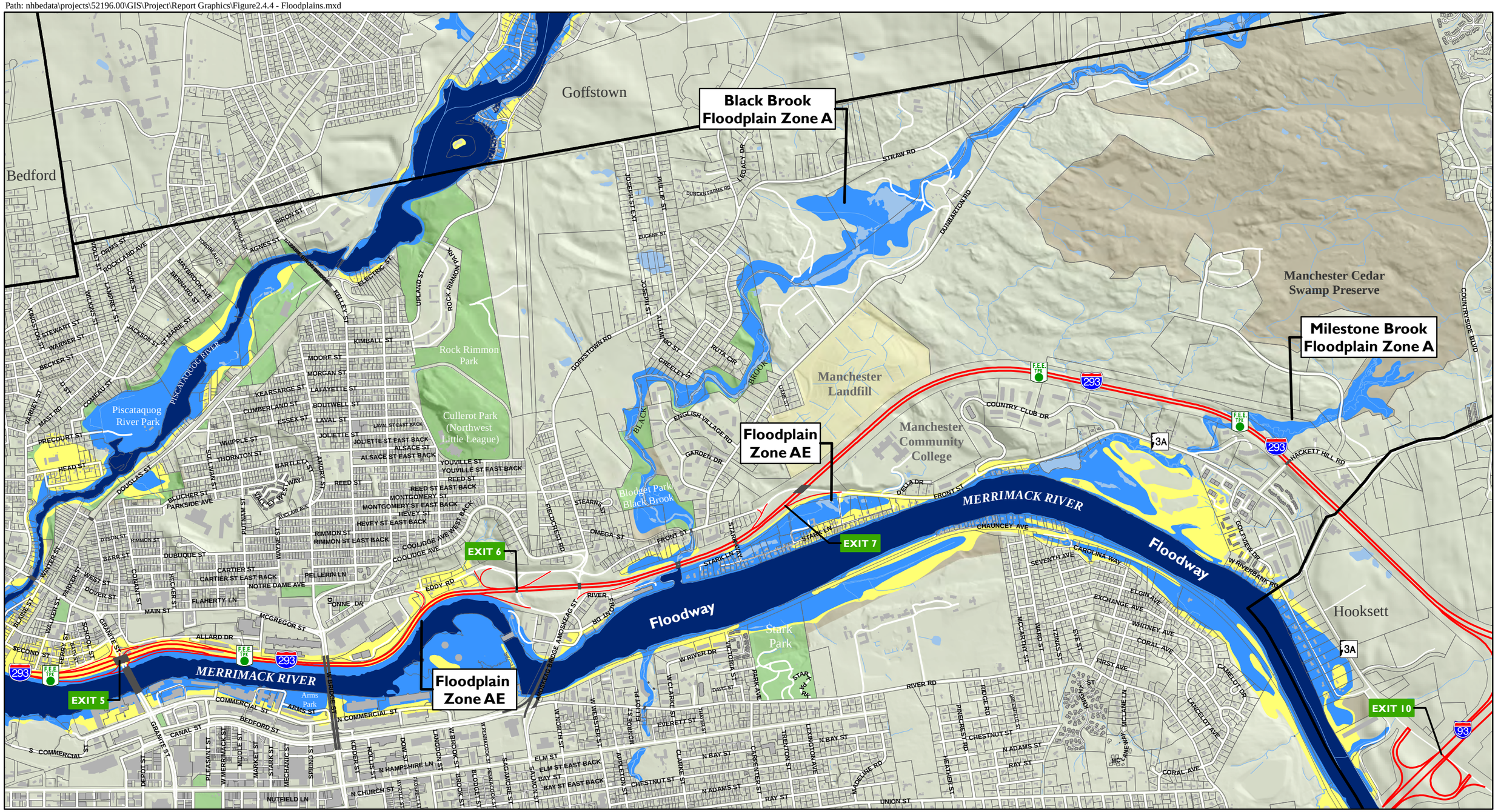
A larger pocket of Farmland Soil of Local Importance is located north of the Manchester Landfill between the Public Service of New Hampshire right-of-way (ROW) and the Washington Park Apartment complex. Soil in this area is classified as Windsor loamy sand and Deerfield loamy fine sand. A large portion of mapped Farmland Soil of Local Importance in this area has been disturbed, as I-293 bisects the area, and the area to the east has been developed by the Washington Park Apartment complex.

Soils mapped by the NRCS as Prime Farmland or Farmland of Local Importance in the study area consist primarily of industrial, retail, residential development, forested upland, and wetland habitats. Some areas designated by the NRCS as farmland based on soil type include waterway and vegetated wetlands and do not necessarily reflect those areas conducive to agricultural production. However, a Farmland Conversion Impact Rating may need to be prepared for review by the NRCS for compliance with the Farmland Protection Policy Act (FPPA). This is not expected to be a substantial issue for the advancement of transportation solutions in the future.

2.4.6 Rare, Threatened, or Endangered Species

Letters were sent both to the US Fish & Wildlife (USFWS) and the New Hampshire Natural Heritage Bureau (NHNHB) asking whether there were any records of rare species within the study area. A response from NHNHB was received on June 28, 2012 and from USFWS on June 20, 2012 (**See Appendix**).

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\Figure2.4.4 - Floodplains.mxd



Legend

- Assessor's Tax Parcels
- Building
- Surface Water
- Stream
- City Park Land
- Conservation/Public Land
- Bridge
- Town/City Boundary

FEMA DFIRM Mapping

- 100-yr Floodplain
- 500-yr Floodplain
- Floodway

0 1,500 3,000 Feet

Vanasse Hangen Brustlin, Inc.

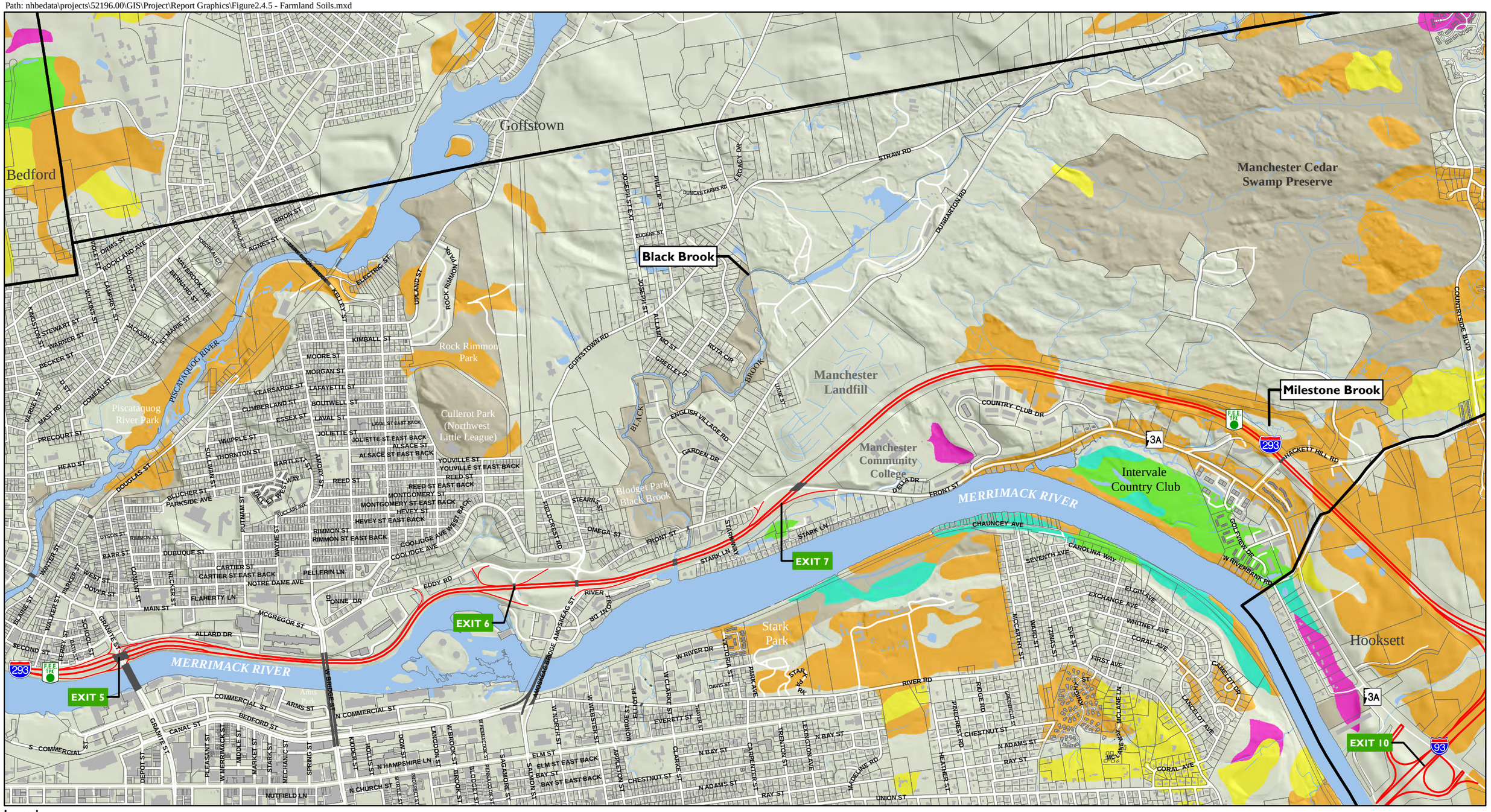
Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.4-3
FEMA Floodplain Mapping

Manchester, NH

New Hampshire DOT Department of Transportation

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\Figure2.4.5 - Farmland Soils.mxd



Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.4-4
NRCS Farmland Soils

Manchester, NH

New Hampshire DOT Department of Transportation

The NHNHB database search turned up 26 database records of rare species and exemplary natural communities within the vicinity of the study area. Specifically, three Invertebrate Species, four Vertebrate Species, twelve 12 Plant Species, and six Natural Communities (**See Table 2.4-1**). NHNHB defines "vicinity" by applying a 1-mile buffer to an applicant's study area to identify potential populations. Of the 26 database records only 10 records are within a distance that could potentially be impacted by the project. For protection purposes, the NHNHB data sharing regulations prevent the rare species information to be displayed in any reports, unless at a scale of 1:100K or larger. This scale limitation in relationship to the study area does not allow for a graphic to be presented in this report at a reasonable scale.

Table 2.4-1 Rare, Threatened or Endangered Species

Species	State Status	Federal Status
Invertebrate Species		
Brook Floater (*Alasmidonta varicosa*)	Endangered	--
Persius Dusky Wing (*Erynnis persius persius*)	Endangered	--
Pine Barrens Zanclognatha Moth (*Zanclognatha martha*)	Species of Concern	--
Vertebrate Species		
Grasshopper Sparrow (*Ammodramus savannarum*)	Threatened	--
Perigrine Falcon (*Falco peregrinus anatum*)	Threatened	--
Pied-billed Grebe (*Podilymbus podiceps*)	Threatened	--
Redfin Pickerel (*Esox americanus americanus*)	Species of Concern	--
Plant Species		
Clasping milkweed (*Asclepias amplexicaulis*)	Threatened	--
Clustered sedge (*Carex cumulata*)	Threatened	--
Downy False Foxglove (Aureolaria virginica)	Endangered	--
Golden Heather (*Hudsonia ericoides*)	Endangered	--
Licorice goldenrod (*Solidago odora*)	Endangered	--
Lion's-foot rattlesnake root (*Nabalus serpentarius*)	Endangered	--
Long-spined sandbur (*Cenchrus longispinus*)	Endangered	--
Lopsided rush (*Juncus secundus*)*	Endangered	--
Narrow-leaved white-topped-aster *(Sericocarpus linifolius*)	Endangered	--
Sesile-fruited Arrowhead (*Sagitttaria rigida*)	Endangered	--
Smooth slender crabgrass (*Digitaria filiformis varlaeviglumis*)	Endangered	--
Wild Lupine (*Lupinus perennis*)	Threatened	--
Wright's spikesedge (*Eleocharis diandra*)	Endangered	--
Natural Communities		
Acidid riverbank outcrop		
Appalachian oak - pine rocky ridge		
Atlantic white cedar - giant rhododendron swamp		
Coastal conifer peat swamp system		
High-gradient rocky riverbank system		
Rich red oak rocky woods		

The letter from the USFWS concluded that there are presently no federally-listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the US Fish and Wildlife in the study area. Preparation of a Biological Assessment or further consultation with that agency under Section 7 of the Endangered Species Act is not anticipated.

2.4.7 Wildlife Habitat

The NH Fish and Game Department (NHFG) is responsible for managing and protecting resident wildlife species. NHFG has promulgated rules (FIS Chapter 1000) for the protection and management of these species. These rules pertain almost entirely to the exploitation of the species and not to the habitats. The rules set seasons, bag limits, and legal means for the take of game, fish, and furbearing species.

The USFWS is responsible for managing and protecting migratory wildlife species. Except for threatened and endangered species and their associated "critical habitats," federal protection of wildlife on private property is confined to regulations regarding the exploitation of species and does not extend to wildlife habitat. Both wildlife species and wildlife habitats are generally protected on Federal lands, including National Wildlife Refuges, National Parks and Monuments, and National Forests, none which are present in the study area.

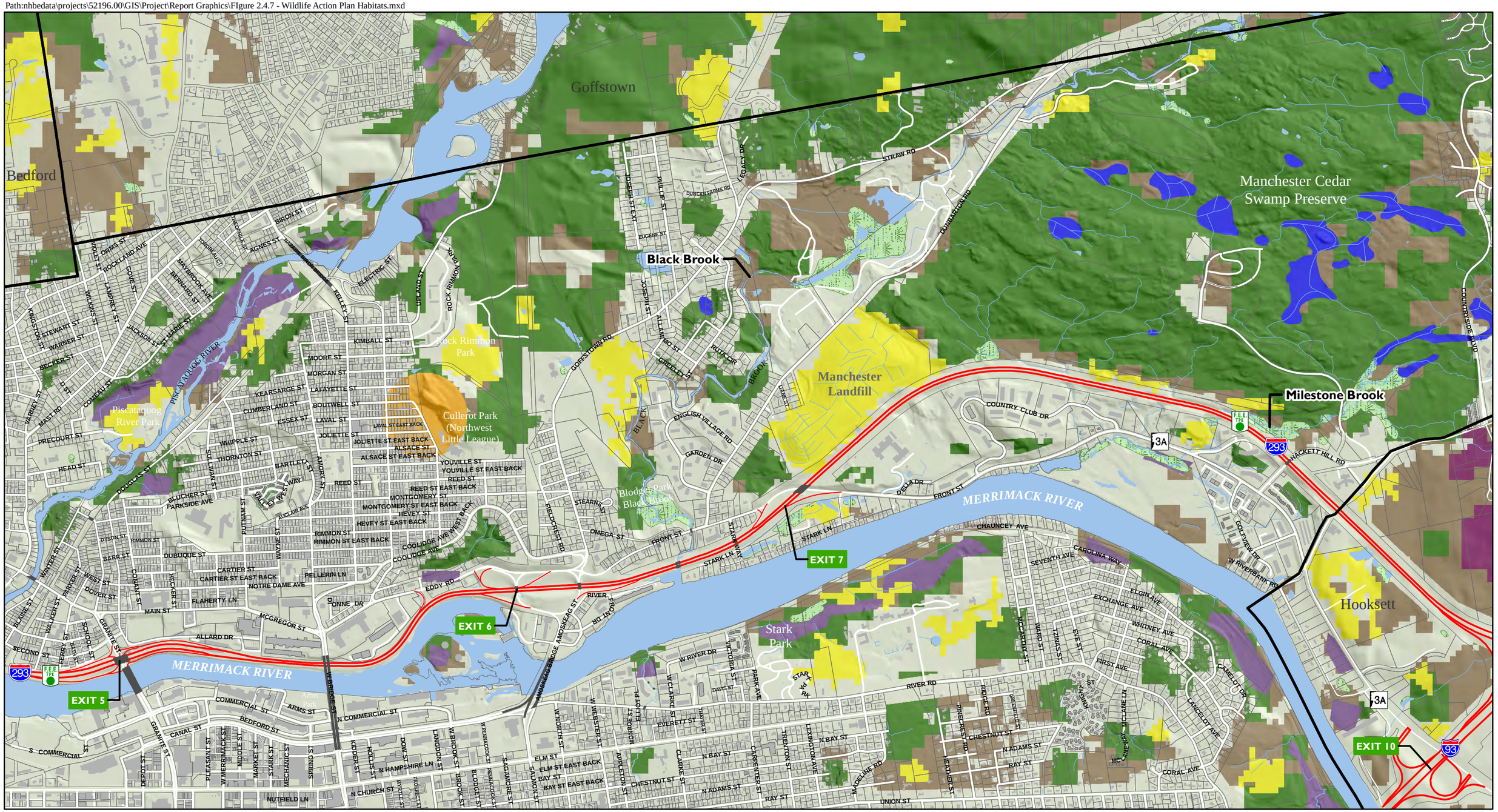
The southern half of the study area is located within an urbanized area with dense development, which generally does not support substantial wildlife populations or contain important habitat. However, the Merrimack River, Black Brook, and the undeveloped land associated with the western edge of Hackett Hill and the Manchester Cedar Swamp Preserve are recognized wildlife corridors at both the state and regional levels.

A habitat map and ranked habitat map for the study area were compiled using digital GIS data from the NH Wildlife Action Plan (NHWAP, NH Fish and Game Department, 2010). See **Figure 2.4-5**. Habitat types found to exist within the project study corridor include:

- Appalachian-Oak-Pine Forest
- Floodplain Forest
- Grasslands
- Hemlock-Hardwood-Pine Forest
- Marsh and Shrub Wetlands
- Peatlands

The NHFG analyzed the habitat areas and developed a statewide three-tiered ranking scheme to identify the highest quality habitat in the state. **See Figure 2.4-6**. The Merrimack River, Hackett Hill, and the former Manchester Landfill are located within areas listed by the NHWAP as areas of "Highest Ranked Wildlife Habitat by Ecological Condition."

Path:nhbedata\projects\52196.00\GIS\Project\Report Graphics\FIgure 2.4.7 - Wildlife Action Plan Habitats.mxd



Legend

- Assessor's Tax Parcels
- Building
- Surface Water
- Stream
- Bridge
- Town/City Boundary

New Hampshire Fish & Game Wildlife Action Plan Habitats

- Hemlock-Hardwood-Pine Habitat
- Appalachian Oak-Pine Habitat
- Floodplain Forest
- Marsh/Wet Meadow/Shrub Swamp Habitat
- Grasslands
- Peatland Complex
- Pitch Pine Habitat
- Rocky Ridge & Talus Slope Habitat
- Area not considered to be priority habitat

0 1,500 3,000 Feet

Vanasse Hangen Brustlin, Inc.

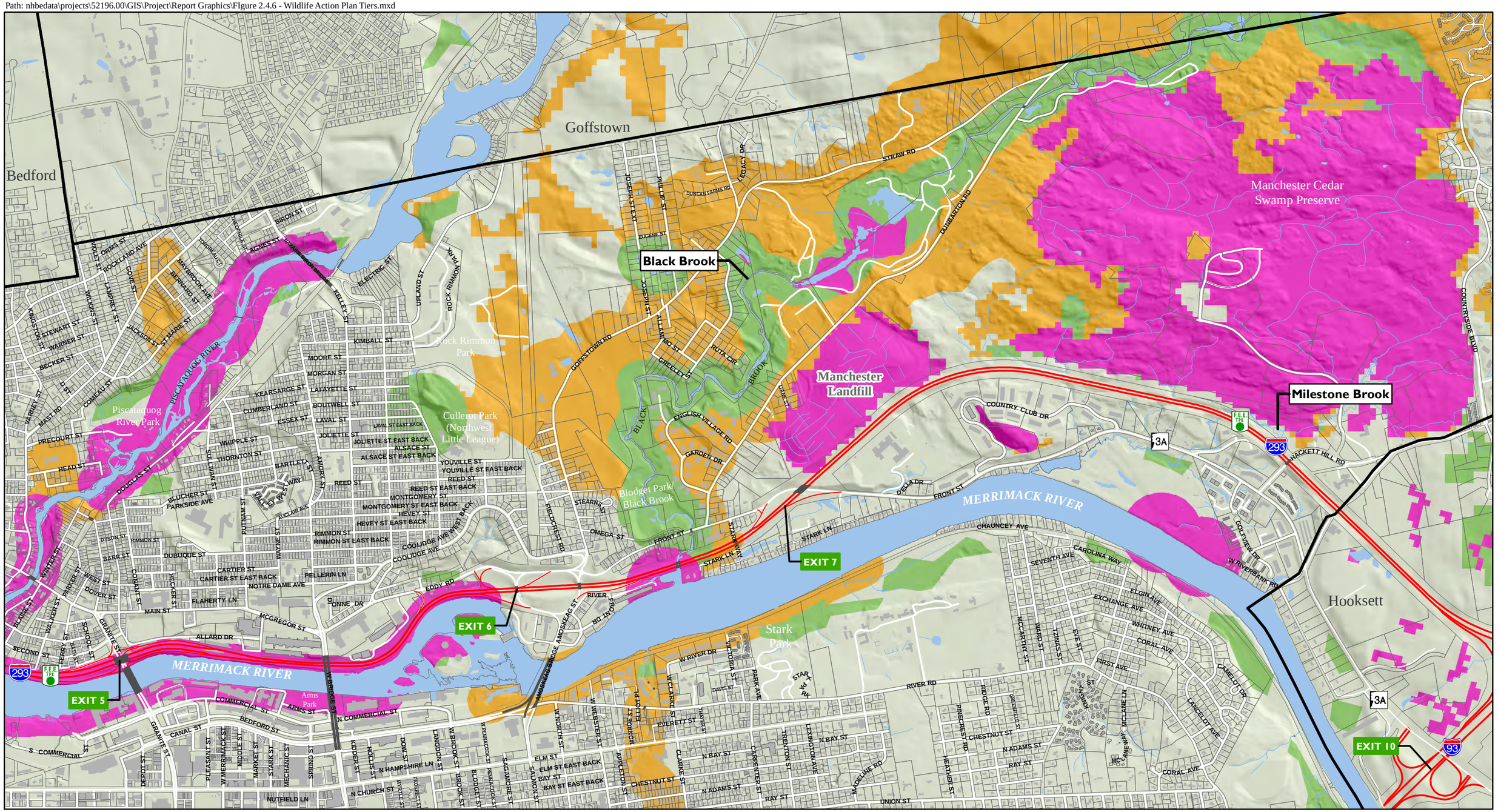
Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.4-5
NHFG Wildlife Action Plan Habitats

Manchester, NH

New Hampshire DOT Department of Transportation

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\FIgure 2.4.6 - Wildlife Action Plan Tiers.mxd



Legend

- Assessor's Tax Parcels
- Building
- Surface Water
- Stream
- Bridge
- Town/City Boundary

Ranked Habitat Tiers

- Tier 1 - Top Ranked Habitat in the State
- Tier 1 - Top Ranked Habitat in Biological Region
- Tier 3 - Supporting Landscape
- Area not considered to be priority habitat

0 1,500 3,000 Feet

Vanasse Hangen Brustlin, Inc.

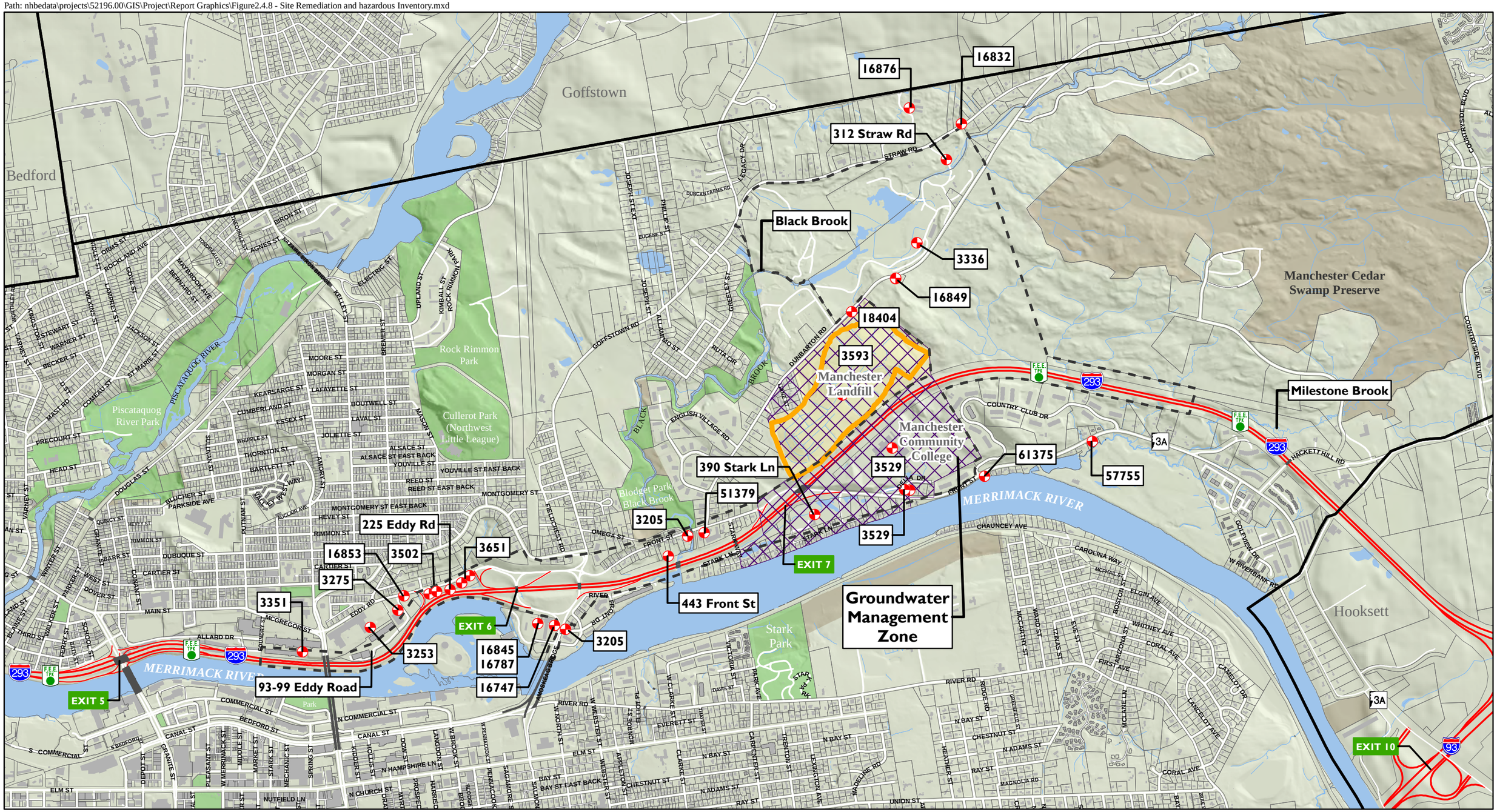
Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.4-6
NHFG Wildlife Action Plan Habitat Tiers

Manchester, NH

New Hampshire DOT Department of Transportation

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\Figure2.4.8 - Site Remediation and hazardous Inventory.mxd



Legend

- OHM Project Study Area
- Assessor's Tax Parcels
- Building
- Surface Water
- Stream
- City Park Land
- Conservation/Public Land
- Bridge
- Town/City Boundary
- Potential OHM Locations (Labeled by NHDES Master ID or Street Address)
- Landfill
- Landfill Groundwater Management Zone

0 1,500 3,000 Feet

Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.4-7
Potential OHM Locations

Manchester, NH

New Hampshire DOT Department of Transportation

Additionally Black Brook and its associated watershed is identified as "Highest Ranked Habitat in Biological Region."

2.4.8 Hazardous Material

VHB conducted a review of available databases to determine properties with oil and/or hazardous materials (OHM) concerns within anticipated work in the study area. Environmental Data Resources, Inc. (EDR) provided VHB with a database report summarizing government and state records available within a one-mile radius of the study area. **Table 2.4-2** summarizes the report findings. VHB also conducted a review of the NHDES One Stop Database available online. The GIS tool was used to generate a list of properties of concern located within or in close proximity to the study area.

Table 2.4-2 Properties with Oil and/or Hazardous Materials

Database	Number of Locations
NPL sites	0
CERCLIS sites	0
CERCLIS NFRAP sites	1
RCRA TSD	0
RCRS CORRACTs	0
RCRA Generators	20
State Hazardous Waste sites	24
NH Spills	2
NH Institutional Control	5
Facility Index System (FINDS)	42
NH Solid Waste/Landfill	2
Registered USTs	52
NH LUST	34
NH AIRS	4
FIFRA/TSCA Tracking System	1
Emergency Response	0
NH AST	6
Federal Land use	0
NH Brownfields	5

Properties determined to have the potential to impact the study are detailed in **Table 2.4-3**. Remaining properties are not expected to be an issue within the study area based on proximity to the site, regulatory status, nature of contamination, and/or inferred groundwater flow direction.

NHDES One Stop Database Findings

Several sites were noted that may have the potential to impact site environmental media and include active gas stations, electrical substations, industrial manufacturers, a closed landfill, and active NHDES remediation sites (**Figure 2.4-7 and Table 2.4-3**). Of particular note are the following active NHDES cases:

- 194/195 McGregor Street (NHDES Master ID 3351). A plume of chlorinated solvents in groundwater exists within the study area at this location. The contaminant concentrations are in excess of the Ambient Groundwater Quality Standards (AGQS), and a Groundwater Management Permit (GMP) has been assigned to the site. Groundwater at the site is located at depths ranging from 0.04 to 15.67 feet below the tops of well casings. Indoor air concentrations of contaminants measured in a nearby building have been detected above commercial screening levels.
- A gasoline filling station at 495 Front Street (NHDES Master ID 3488). The property abuts the study area directly to the west and is the location of a former release of gasoline. A GMP is in place at the property, and select petroleum constituents have been measured in groundwater in excess of AGQS. Groundwater at the site is located at depths ranging from approximately 10 to 18 feet below the tops of well casings.
- The Manchester Municipal Landfill located at 625 Dunbarton Road (NHDES Master ID 3593). Groundwater at this property has been impacted by landfill leachate, which is in direct contact with the groundwater. Metals and volatile organic compounds are the primary contaminants at the remediation site, which is managed under a GMP. The Groundwater Management Zone (GMZ) extends from an area south of Dunbarton Road in a northeast direction to the Merrimack River, crossing I-293.
- A gasoline station located at 245 Eddy Road (NHDES Master ID 3651). A gasoline release at the property has impacted groundwater, which ranges from approximately 7 to 10 feet below the tops of well casings. The property is located within the study area.

VHB conducted a field reconnaissance of the study area on September 27, 2012. It should be noted that the interiors of site structures were not observed. Properties noted as a concern during the field reconnaissance are detailed in **Table 2.4-4**. Although many of these properties are also listed on **Table 2.4-3,** there were five (5) additional locations identified, where material use and/or storage practices may have the potential for OHM concern.

Table 2.4-3 Properties Determined to have Potential Impacts

Master ID	Site Name	Address		Distance Relative to Study Area
3205	Gas Station	49 Amoskeag St	"Regulatory Action Completed - DES File Closed" Active USTs	Within Study Area
3237	Residential Site	26 Delia Dr	"Regulatory Action Completed - DES File Closed" No Active USTs	150 Feet East
3253	Industrial Site	345 McGregor St	"Regulatory Action Completed - DES File Closed"	200 Feet West
3275	Bottling Facility	99 Eddy Rd	"Regulatory Action Completed - DES File Closed" No Active USTs	Within Study Area
3336	Industrial Site	888 Dunbarton Rd	"Regulatory Action Completed - DES File Closed"	Within Study Area
3351	Industrial/Commercial Site	194/195 McGregor St	Active NHDES Site No Active USTs	Within Project Area
3502	Gas Station	210 Eddy Rd (also known as 157 Eddy Rd)	UIC Registered 2007 "Regulatory Action Completed - DES File Closed"	Within Study Area
3529	Manchester Community College	1066 Front St	Active USTs	Within Study Area
51379	Auto Repair	575-599 Front Street	N/A	Abuts to West
3488	Gas Station	495(493) Front Street	Active NHDES Site Active USTs	Abuts to West
3593	Manchester Municipal Landfill	625 (or 513) Dunbarton Rd	Active NHDES Site	Within Study Area
3651	Gas Station	245 Eddy Rd	Active NHDES Site Active USTs	Within Study Area
16747	Hotel	21 Front St	"Regulatory Action Completed - DES File Closed"	Abuts to East
16787	Electrical Substation	6 Fletcher St	"Regulatory Action Completed - DES File Closed"	Abuts to East
16832	Residential Site	245 Straw Rd	"Regulatory Action Completed - DES File Closed"	Abuts to West
16845	Amoskeag Hydro Station	W. Salmon St	"Regulatory Action Completed - DES File Closed"	Abuts Site to East
16849	Electrical Substation	833 Dunbarton Rd	Active AST	Within Study Area
16853	Electrical Substation	149 Eddy St	Active AST	Abuts to West
16876	Sendashi Pet Resort/Kennel	355 Straw Rd	UIC Registered 1998	500 Feet West
57755	Residential Site	1625 Front St	"Regulatory Action Completed - DES File Closed"	750 Feet East
61375	Sullivan Property	1164 Front St	Unknown	Abuts to the East

Table 2.4-4 Properties of Concern at Time of Field Review

Address	Property Use	Concern Observed on Property	Listed on Table 2.4-3?	Distance Relative to Study Area
6 Fletcher Street	Electrical Substation	Large pad-mounted transformers likely contain OHM	Yes	Abuts to East
26 Delia Drive	Residential	One 55-gallon drum and 5-gallon buckets stored next to shed	Yes	150 Feet East
49 Amoskeag Street	Gas Station	Petroleum handling and storage	Yes	Within Study Area
93-99 Eddy Road	Industrial Buildings with Commercial Tenants	May have historic uses of concern/Transformers	Yes (Partial)	Within Study Area
149 Eddy Road	Electrical Substation	Large pad-mounted transformers likely contain OHM	Yes	Abuts to West
194-195 McGregor Street	Industrial Buildings with Commercial Tenants	May have historic uses of concern	Yes	Within Study Area
210 Eddy Road	Gas Station	Petroleum handling and storage	Yes	Within Study Area
225 Eddy Road	Landscape Supply	Fill material with unknown origin	No	Within Study Area
245 Eddy Road	Gas Station	Petroleum handling and storage	Yes	Within Study Area
245 Straw Road	Residential	55-gallon drum stored outside garage	Yes	Abuts to West
312 Straw Road	Residential/Construction Storage	At least three 55-gallon drums stored outside	No	Within Study Area
345 McGregor Street	Industrial Buildings with Commercial Tenants	May have historic uses of concern	Yes	200 Feet West
390 Stark Lane	Communications Towers	Possible storage of oils on Site	No	Abuts to East
443 Front Street	Residential/Construction?	Storage of materials at rear of lot	No	Abuts to West
495(493) Front Street	Gas Station and Auto Repair	OHM handling and storage	Yes	Abuts to West
575-599 Front Street	Auto Repair	OHM handling and storage	Yes	Abuts to West
833 Dunbarton Road	Electrical Substation	Large pad-mounted transformers likely contain OHM	Yes	Within Study Area
888 Dunbarton Road	Aggregate Industries	Large piles of fill material and AST noted on Site, industrial use	Yes	Within Study Area
625 Dunbarton Road	Manchester Landfill/Gas Extraction Facility	Transfer station and closed landfill	Yes	Within Study Area
Intersection of Stark Lane and Front Street	Monitoring Wells	Reason for wells unknown	No	Abuts to East

2.5 Cultural and Community Resources

2.5.1 Historic/Archaeological

VHB conducted a cultural resources survey within the study area, consisting of two components. The first component was the identification of previously recorded properties, compiled at the New Hampshire Division of Historical Resources (NHDHR) and the City of Manchester. The second component consisted of a windshield survey of properties located within the areas potentially affected by the project and those that may have indirect visual effects. VHB cultural resource staff performed a site file search at NHDHR for recorded above-ground properties on July 20, 2012, to gather information on previously documented resources in the study area. Generally speaking, the site file search was limited to properties located within 0.25-mile radius of the I-293 corridor from Exit 5 to approximately one mile north of existing Exit 7. Additionally, the site file search was expanded to include the project corridor between Front Street, in the vicinity of the Manchester Community college, and Goffstown Road (**See Figure 5.2-1**). Furthermore, the search was limited to properties located on the west side of the Merrimack River.

One National Register-listed district and one National Register-certified district are located within the study area vicinity. There are seven individually recorded properties located within the study area vicinity. Of these seven recorded properties one property is listed in the National Register, one property is listed in the State Register, one property was determined individually eligible for the National Register by NHDHR, two properties have been determined eligible by NHDHR as part of a district (McGregorville/Notre Dame district), one property was determined not eligible for the National Register, and for one property a National Register nomination form was prepared but the property was never formally listed. In addition, two project area forms on file at NHDHR cover areas located in the vicinity of the study area. The results of the site file search are summarized in **Table 2.5-1** and depicted on **Figure 2.5-1**. (See **Appendix** for a complete listing of above-ground resources as identified in the NHDHR Request for Project Review.)

The City of Manchester maintains GIS information for historic above-ground resources located within the city limits, including National Register districts and locally-designated districts subject to specific zoning regulations, individual National Register-listed properties, properties determined eligible for the National Register, and local historic sites. The City's GIS information was merged with the results of the NHDHR site file search for a complete picture of all properties located within the study area.

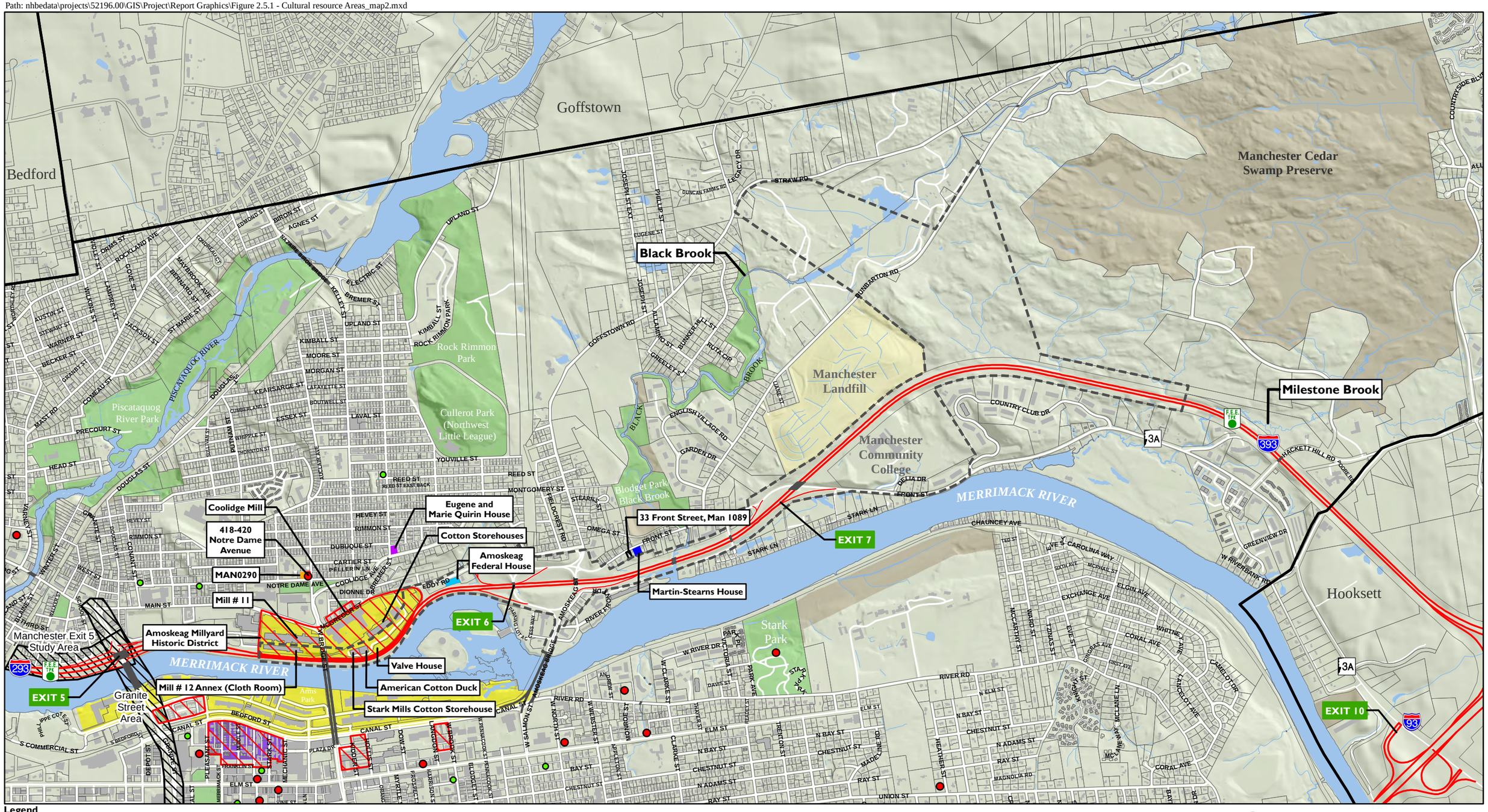
In addition to the results of the site file research, VHB cultural resource staff, in consultation with NHDHR, anticipates that at least one local historic district and several historic properties could be identified along Front Street, between Goffstown Road and Exit 7. None of these properties have been previously inventoried. NHDHR staff recommend a Project Area Form be completed for the study area once an Area of Potential Effect (APE) can be established. Working with NHDHR, VHB developed a draft APE boundary for the current study area, which should be re-evaluated in the next phase of the project.

Table 2.5-1 Previously Recorded Above-ground Properties*

NH DHR Property Name/ Historic District Name	NH DHR Inventory #	National Register-listed, Eligible, or Not Eligible	Date of Determination (mm/dd/yy)	National Register Criteria of Significance (if applicable)
Amoskeag Millyard Historic District	N/A	Certified NR district	05/31/12	A, C, D; potentially B
333 Front Street	MAN1089	NR Not Eligible individually	11/08/95	N/A
Martin-Stearns House, 367 Front Street	MAN1088	NR Eligible individually	04/21/99	C
412 Notre Dame Avenue	MAN0292	Within potential Eligible district/ potentially Eligible individually (more information needed)	09/09/09	None noted, likely A and C for district
404 Notre Dame Avenue	MAN0290	Within potential NR Eligible district	06/24/09	None noted, likely A and C for district
Manchester Exit 5 Study Area	N/A for area, includes MAN0028, MAN0063, and MAN0029	Not Eligible as NR district, but contains portion of Amoskeag Millyard Historic District within boundaries	02/09/00	N/A
Granite Street Area	MAN0021-MAN0024	Not Eligible as NR district, but contains portion of Amoskeag Millyard Historic District within boundaries	03/28/01	N/A
418-420 Notre Dame Avenue	N/A	NR listed	10/31/96	A and C
Eugene and Marie Quirin House, 250 Coolidge Avenue	MAN1039	Potentially NR Eligible individually (more information needed)/ SR-listed	02/08/06	A and C; potentially B
Amoskeag Manufacturing Company Housing Districts	N/A	NR listed	09/23/82	None noted, likely A and C
Amoskeag Federal House, moved to 225 Eddy Road	N/A	NR form prepared but property is not listed	NR form prepared 05/20/74	None noted/ if Eligible, likely A and C

* Properties within 0.25-mile of study area.

Path: nhbedata\projects\52196.00\GIS\Project\Report Graphics\Figure 2.5.1 - Cultural resource Areas_map2.mxd



Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.5-1
Cultural Resource Areas

Manchester, NH

New Hampshire DOT Department of Transportation

Archaeological Resources

A site file search was conducted at the NHDHR offices on July 20 and July 23, 2012 to identify previously recorded archaeological sites and their associated forms, as well as completed archaeological study reports that could assist in the identification and understanding of archaeologically sensitive areas in the study area. (See Appendix.) A total of 45 sites have been recorded in the five-kilometer buffer, including prehistoric, historic, and multi-component sites. By far, the vast majority of the recorded sites (including prehistoric and historic) are located adjacent to, or within close proximity of the Merrimack River. It should be noted that the largely undeveloped area at the north end (Hackett Hill area) of the study area has no recorded archaeological sites in the vicinity. However, this should not be construed as an indication of a lack of archaeological potential; rather, this likely reflects the lack of investigation and survey of the area.

Previously Recorded Archaeological Sites

Amoskeag Falls

The Amoskeag Falls served as a main source of sustenance during the earliest settlement of the area and provided the impetus for the continuation of that development during the historic era when industrial advantages joined transportation benefits of commercial and residential development along the river. A concentration of approximately a dozen prehistoric and multi-component sites has been located in the immediate area of Amoskeag Falls. A number of these sites were originally noted in the 1930s and 1940s and surveyed in the late 1970s and 1980s by the New Hampshire Archaeological Society (NHAS) as part of the NH State Conservation and Rescue Archaeology Program (SCRAP). Although several of the sites had been discussed in publications of the archaeological community, by the time they were formally investigated during the late 20th century, most of these sites had been destroyed by development.

Other sites have been recorded more recently (1980s-present) as part of field school programs, cultural resource management project surveys, or independent investigations. These sites include three recommended by the surveyors as eligible for the National Register one site evaluated as potentially significant, and three sites recommended as not eligible. The sites recommended as eligible include the multi-component site 27-HB-362, the historic site 27-HB-377, and 27-HB-229, a prehistoric site. The form for 27-HB-362 notes that future data recovery from the site has the potential to fill gaps of understanding left by the destruction of other sites previously located near the Amoskeag Falls. A fourth site located in the Amoskeag Falls vicinity has been assessed as potentially significant. The prehistoric site 27-NH-413 was surveyed by the State Archaeologist quite recently, after an artifact find by a landowner. The form notes the "high research" potential of the site and the National Register eligibility evaluation section notes the site's eligibility under National Register Criterion D, which recognizes the site's potential to yield significant information in the future. However, the evaluation section leaves the National Register eligibility column (i.e., where the evaluator chooses between individually eligible, eligible in a district, not eligible, or more information needed) blank and there is no official DOE. Three additional historic sites located near the falls (27-HB-364, 27-HB-367 and 27-HB-368) were recommended not eligible for the National Register. Site 27-HB-364 was considered not eligible due to lack of integrity of the site, while excavations at 27-HB-367 are considered to have exhausted the recovery potential of the site.

(Clyde) "Berry Sites"

Nearly half of the recorded sites were surface collected by local historian Clyde F. Berry during the 1930s. The artifacts are kept at the NHAS and the 1980s and 1990s preparation of forms that are in the NHDHR files appears to be part of an effort to have these sites formally recorded at NHDHR, rather than as part of a systematic, comprehensive effort to update or assess the integrity of the sites. That being said, a few of the Berry sites have been investigated more recently, especially during the 1980s in affiliation with the NHAS and SCRAP. These recently-investigated sites are noted as likely destroyed based on reports of future development noted in the forms. Aside from the small number of recorded Berry sites that have been the subject of more recent surveys, no recent information about the Berry sites is available and their integrity has not been assessed. These sites are located throughout the five-kilometer radius, and include some of the Amoskeag Falls area sites.

Additional Significant Recorded Sites

One additional archaeological site has been determined eligible for the National Register by the NHDHR, in a Determination of Eligibility dated November 3, 1992. Site 27-HB-030 is located near the outer edge of the five-kilometer buffer, southwest of the study area. Although plowing has occurred at this prehistoric site, activity areas within the site are still distinguishable, suggesting the data potential for a site that may be associated with Middle Archaic and Woodland period occupations of the Amoskeag Falls region.

NHDHR indicated that the Amoskeag Falls area is one of the most important archaeological areas in the state – first evidence of pottery, a Native American cemetery, and deposits go down to two meters. NHDHR suggested the preparation of a Phase 1A report be completed as soon as possible to identify potential areas of sensitivity for archaeological resources. NHDHR also noted that during the Exit 5 (Granite Street) interchange improvements, a site was found underneath I-293, noting that sensitivity could be far-reaching for any additional roadway improvements.

2.5.2 Parklands and Recreation

Parklands and recreational areas are protected by various federal statutes that may apply to future phases of the Study if funding is provided by the FHWA.

Conservation Land

Based on a review of the most recent NHGRANIT Conservation/Public Lands database, two occurrences of existing conservation land are found within close proximity to the study area. Specifically, the Samuel Blodget Park and the Manchester Cedar Swamp Preserve are within close proximity.

- Blodget Park located off Front Street, is an approximately 60-acre park that has been protected by a permanent conservation easement by the City of Manchester. The

management status protects more than 50% of the area from conversion of natural cover, but subject to extractive uses of either a broad-scale low-moderate intensity type (such as timber harvest) or localized-scale high intensity type (e.g., mining).

- Manchester Cedar Swamp Preserve located off Hackett Hill Road is approximately 600 acres and held in easement by The Nature Conservancy. The property was acquired partially through the Land and Community Heritage Investment Program (LCHIP).

Section 6(f) LWCF

Properties that have been acquired or improved with LWCF funding are protected under Section 6(f) of the Land and Water Conservation Fund Act. No Section 6(f) properties are located in the study area.

Recreational Resources

Based on a preliminary field review, at least four recreational resources are within close proximity to the study area, which may qualify as park land or recreational area under Section 4(f) of the National Department of Transportation Act of 1996. These resources include Samuel Blodget Park, Lafayette-Simpson Park, Arms Park (Riverfront Park), and Martineau Park.

- Blodget Park (located off Front Street) provides nature trails and fishing opportunities along Black Brook.
- Lafayette-Simpson Park encompasses over 2 acres of land adjacent to Notre Dame Avenue. The park is bisected by Amory Street, spanning two tracts of land. The park is also home to several works of sculpture.
- Arms Park (Riverfront Park) is located on the east side of the Merrimack River, just south of West Bridge Street. The park contains a scenic walk by the river and is also part of the Heritage Trail.
- Martineau Park, a small triangle of land spanning less than 0.3 acre, lies between Montcalm Street and Dionne Drive on the west side of Manchester. This secluded park offers benches and a cobblestone walkway.

2.5.2 Noise

The FHWA[3] and NHDOT[4] have established noise policies to protect the public health and welfare from excessive vehicle traffic noise. Traffic noise can adversely affect human activities such as communication, sleep, work or recreation. Certain highway projects can exacerbate noise issues because of changing highway geometry, traffic volumes or traffic speed. While a full noise impact assessment is beyond the scope of this planning study, a preliminary review of existing noise conditions in the study area was conducted.

[3] *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, Federal Highway Administration's 23 CFR, 772.

[4] *Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I Highway Projects*, New Hampshire Department of Transportation, July 2011.

A first step in the evaluation of possible noise impacts involves identification of "sensitive receptors" - locations that have indoor or outdoor activities that might be sensitive to highway noise. These can include residences, schools, churches, hospitals and park lands. **Figure 2.5-2** depicts more than 400 receptor locations that were identified during field work and a review of assessing records completed by the Study Team, indicative of the densely populated character of the study area.

Most of the receptor locations (residences) fall into the FHWA's "Activity Category B," which has a noise abatement criterion of 66 decibels (dBA). Other land uses, such as commercial buildings (i.e., those that do not involve temporary overnight residence), are in FHWA "Activity Category C" which has a noise abatement criterion of 72 dBA.

A simplified sound level program was conducted to obtain a sampling of the existing sound levels in the study area. The noise monitoring was conducted at six receptor locations, typically residences, in July 2012. These noise measurements were collected in conformance with the FHWA noise monitoring guidelines[5]. Noise sources in the study area included vehicles on I-293 and vehicles on local roadways.

Figure 2.5-2 presents the location of the noise monitoring sites and **Table 2.5-2** presents results of the noise monitoring.

Table 2.5-2 Existing Sound Levels (dBA)

Monitoring Station	Location	Existing Sound Level	Noise Abatement Criteria (NAC)
M1	Stark Way	67.1[1]	66
M2	Coolidge Avenue	62.2	66
M3	Eddy Road	66.9[1]	66
M4	Washington Park	61.1	66
M5	Stark Lane	66.7[1]	66
M6	River Front Drive	52.3	66

Note: [1] The sound level approaches, is at, or exceeds the FHWA noise abatement criterion.

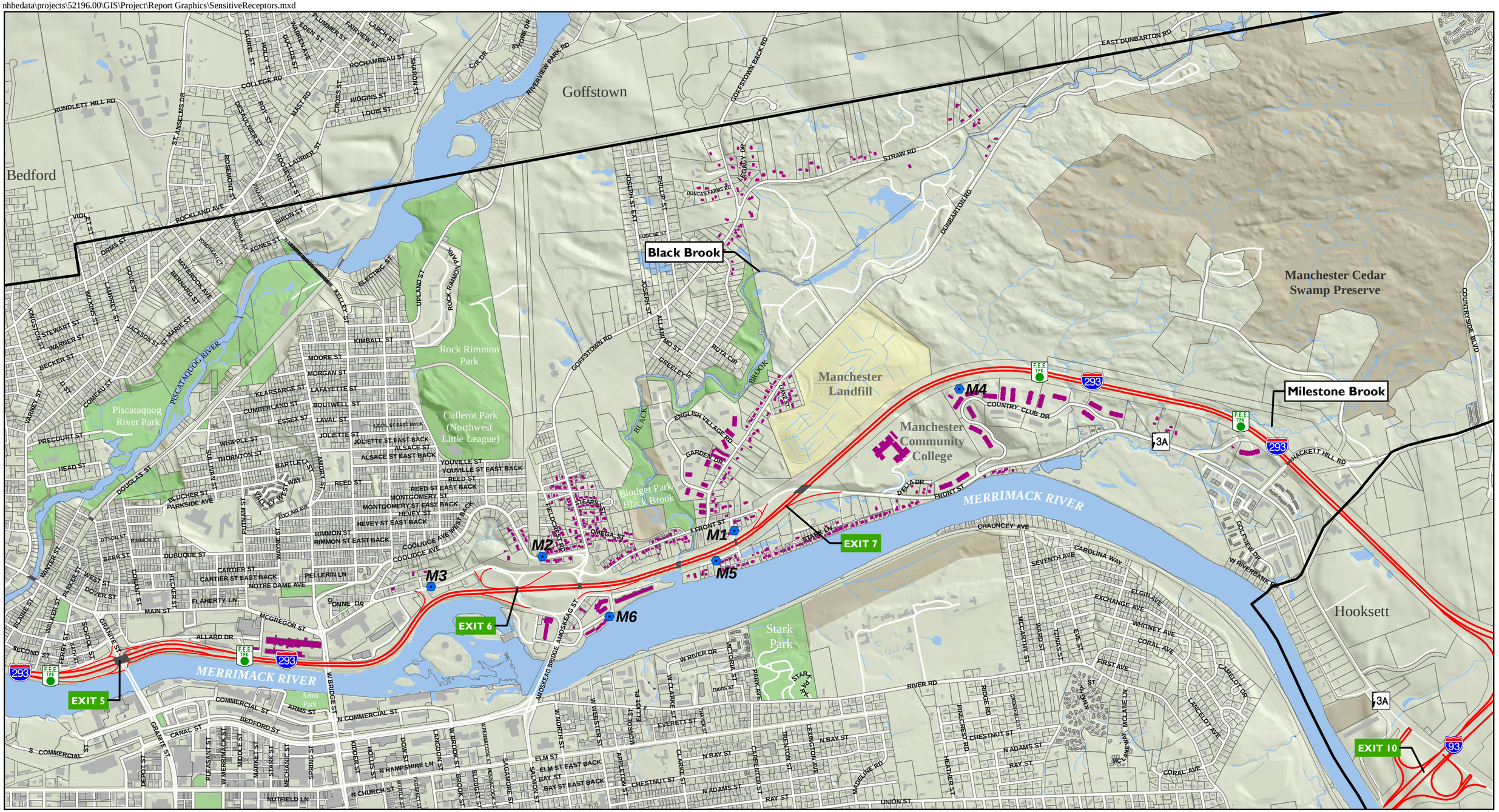
Note that half of the monitoring stations were found to have existing noise levels at or above the FHWA Noise abatement criterion. This confirms the concern expressed by many local residents, who indicate that the existing highway noise impacts the quality of life in local neighborhoods.

Further work on this issue will be conducted during the NEPA phase of the project. NHDOT and FHWA noise impact assessment procedures for Type I[6] projects will be used to predict existing and future highway noise levels, to determine project noise impacts, and to evaluate the feasibility of noise mitigation measures in the study area.

[5] *Measurement of Highway-Related Noise*, US Department of Transportation, Federal Highway Administration, FHWA-PD-96-046, May 1996.

[6] A Type I project is a highway project that results in the construction of a new highway or the physical alteration of an existing highway that substantially changes either the horizontal or vertical alignment or increases the number of through travel lanes.

nhbedata\projects\52196.00\GIS\Project\Report Graphics\SensitiveReceptors.mxd



VHB Vanasse Hangen Brustlin, Inc.

Manchester 16099
FEET/I-293, Exit 6-7 Planning Study

Figure 2.5-2
Noise Receptors

Manchester, NH

New Hampshire DOT Department of Transportation