

4 Alternatives Development

4.1 Introduction

Having identified the existing and potential future capacity and safety deficiencies and having solicited input from the public and the Technical Advisory Committee on defining the study area problems, issues and constraints, and potential solutions, a range of alternatives were developed. This chapter describes the range of alternatives aimed at addressing the safety and mobility needs of the study corridor. The alternatives include the No Build alternative, Transportation Demand Management (TDM), Transportation System Management (TSM), and a range of long-term mainline and interchange Build alternatives.

4.2 No Build

The No Build alternative reflects the perpetuation of the existing transportation infrastructure within the study area. Therefore, the No Build alternative does not consider any physical alteration to the existing transportation system. However, the alternative does include the same level of traffic growth out to the future design year of 2035 as each of the Build alternatives. The No Build serves as a benchmark to compare the benefits and impacts of the Build alternatives.

4.3 Transportation Demand Management

Transportation Demand Management (TDM) encompasses a wide range of strategies designed to change personal travel behavior. The result is a reduction in demand for automobile use and in the need to construct additional roadway capacity. This is accomplished through measures that reduce the number and length of drive-alone trips or move trips out of the peak roadway congestion times. TDM measures focus on incentives (or disincentives) to drivers who drive alone that will encourage them to change their travel behavior to ride-share or use other modes of travel.

Given the commitment of local communities and the NHDOT to a multimodal approach to meeting the area's transportation needs in favor of solely relying on the continued construction of new and wider roadways, TDM actions are presented in this Study as not an either /or alternative but rather actions that could be implemented regardless of other physical modifications to the transportation system. Following are some examples of TDM measures:

- **Alternative Work Schedules:** This measure allows employees to utilize flex time, compressed work weeks, staggered work hours, and telecommuting. Flex time and staggered work hours have the effect of shifting some trips outside of peak congestion periods; compressed work weeks and telecommuting have the effect of eliminating some work trips.
- **Carpool/Vanpool Programs:** In this type of program, a transportation coordinator works with employees to create carpools and vanpools. Employers can provide preferential parking for carpool vehicles.
- **Secure Bicycle Facilities and Associated Amenities:** The provision for secure bicycle-parking facilities and on-site showers and lockers promotes cycling to work.
- **Financial Incentives and Parking Costs:** These types of measures may call for higher parking fees for single-occupancy vehicles, reduced parking fees for carpools and vanpools, transit subsidies (e.g., free or employer-subsidized monthly passes), and other financial incentives.
- **Site Walk Access Improvements:** This measure examines the difference in walking time associated with travel to and from the workplace as a result of work site access changes. Walking time includes the time to walk from a parking lot or bus stop to an employee's actual work site. Walk access time can be affected by policies such as preferential parking for carpools and vanpools or through improvements to the work site or area that renders access to public transit easier.

The NHDOT's website (<http://www.nh.gov/dot/traveler/index.htm>) provides access to healthy, economical, and eco-friendly alternatives to commuting in a single-occupant automobile. The site provides a wealth of information on carpooling, park and rides locations, trip planning, ridesharing services, and real-time information of construction activities and traffic delays. It also provides educational information on bicycle and pedestrian news, events, and safety as well as providing bicycle maps.

In addition to these existing TDM programs that are currently available to area commuters through the NHDOT website, the City of Manchester and the Towns of Goffstown and Hooksett can provide incentives to encourage employer-based programs through local land-use ordinances and regulations. For example, the towns could implement a traffic-impact fee system that would allow each municipality to assess private development projects an impact fee based on the number of vehicle trips that would be generated by the development. The incentive comes from applying credits to the fee for the developer's commitment to various levels of TDM actions.

Aside from impact fees, municipal site plan regulations should encourage pedestrian and bicyclist mobility through site design (i.e., sidewalks, multiuse paths and trails, and limiting convenient parking) and by providing amenities such as bicycle storage, locker rooms, and shower facilities in buildings. Property owners and employers should be encouraged to promote ridesharing and the use of public transportation, through postings of maps and other information on internal employee bulletin boards and company websites. Employers could also provide employees with subsidized public-transportation passes.

There are currently a number of public transportation initiatives under study or being considered that could reduce the future demand of single-occupant vehicles within the study area.

The Manchester Transit Authority recently began running bus service between Concord and the Manchester-Boston Regional Airport. This service is being implemented for an initial one-year period while the Southern New Hampshire Planning Commission (SNHPC) and the Central New Hampshire Planning Commission (CNHPC) conduct a ridership demand study.

The New Hampshire Rail Transit Authority is pursuing the implementation of passenger rail service on the New Hampshire Main Line (Capitol Corridor) extending from North Station in Boston, MA to Concord, NH including station stops in downtown Manchester and the Manchester-Boston Regional Airport. This service is being pursued as the first phase of a Boston to Montreal rail service. It is anticipated that such a project would be sponsored and funded by the State of New Hampshire. Additionally, the NHDOT has secured federal funding that would allow New Hampshire to comprehensively study the feasibility, costs, and benefits of expanding passenger rail service.

There is a wide-range of TDM strategies and actions that have the potential to reduce vehicular travel demand. These actions will be further developed and evaluated in more detail under Part B of the study (Environmental Documentation).

4.4 Transportation System Management

Transportation System Management (TSM) strategies are generally low cost, easy to implement actions aimed at optimizing the performance of the existing transportation system. Some examples of TSM actions include traffic signal coordination, access management, and incident management.

Based on feedback from the public NHDOT forces cut back growth along the east side of I-293, south of the Exit 6 northbound off-ramp. This low cost and easy to implement action had an immediate effect of improving driver sight lines as motorists approach the interchange. In addition, the NHDOT is evaluating opportunities to install dynamic message boards along I-293 aimed at alerting southbound motorists of peak period congestion at the Exit 6 ramps. Other actions being considered include increasing the storage capacity of the Exit 6 northbound off-ramp by widening the ramp to provide two-lanes, with possible traffic signal enhancements at Amoskeag Street.



4.5 Long-Term Build Alternatives

The first step toward the development of conceptual alternatives to address the safety and mobility needs was to establish, on a macro-scale level, the environmental, socio-economic, cultural, topographical and basic engineering constraints for the study area. Available information from various resources, was collected. Base mapping of the study area was prepared depicting the existing infrastructure, permanent features, water bodies, as well as existing topography. Available resource information such as wetlands, surface and groundwater, floodplains, historic resources, archeological resources, hazardous material sites, and property and ROW boundary lines were added to the mapping.

Initial design criteria, that would serve toward the development of a range of viable alternatives, were established for new roadways, as well as existing highways and local streets that would be reconstructed. The combination of resource information, physical and topographical constraints, and initial design criteria formed a basis for the brainstorming of potential alternatives. The applicable regulations, guides, policies and references that would provide the foundation for developing the conceptual studies were also established early in the development process.

The primary references include:

- A Policy on Geometric Design of Highways and Streets, AASHTO, “Green Book”
- New Hampshire Department of Transportation Highway Design Manual Volumes 1 and 2
- Roadside Design Guide AASHTO 4th edition 2011
- Roundabouts and Informational Guide NCHRP Report 672, 2012

Design criteria established for the purpose of developing horizontal and vertical roadway geometry are presented in the following table:

Table 4.5-1 Design Criteria

Roadway Section	Design Speed (mph)	Lane Width (feet)	Right Shoulder Width (feet)	Left Shoulder Width (feet)	Grade (Percent max.) ⁴	Min. Horiz. Curve Radius (feet)	Cross-slope (percent maximum)	Stopping Sight Distance (level roadway feet)
I-293 Mainline ¹	55	12	10 ³	10 ³	3	960	8	495
I-293 Mainline	70	12	10 ³	10 ³	3	1810	8	730
Interchange Ramps	30 to 50	12 to 16	2 to 10	2	6	231 & 833	6	200 to 425
Front Street /NH 3A	30 to 40	11 to 12	4 to 5	4 to 5	4	250 & 533	4	200 to 305
Eddy Road	30 to 35	11 to 12	4 to 5	4 to 5	6	250 & 371	4	200 to 250
Amoskeag Street	30 to 35	11 to 12	4 to 5	4 to 5	4	250 & 371	4	200 to 250
Goffstown Road @ Exit 6	30	11 to 12	4 to 5	4 to 5	6	250	4	200
Exit 7 New Connector ²	30 to 40	12	4 to 10	4 to 10	6	250 & 533	4	200 to 305
Exit 7 New Connector	40	12	4 to 10	4 to 10	6	444	8	305
Dunbarton Road	40	12	4	4	6	444	8	305
Dunbarton Road Connector	30	12	4	4	6	250	4	200

Structures Height – 16'-6" over major roadways and 14'-6" over minor roadways; Minimum grade = 1 percent

¹ Between I-293 Exit 5 and Exit 6

² Vicinity of interchange or intersection with Front Street

³ 12 feet with barrier or guard rail; 4 feet w/ 2 lanes

⁴ Minimum grade = 0.5 percent

The 3.5 mile study section of I-293 was divided into three roadway segments where improvement strategies to address the safety and capacity needs could be developed and then easily compared. These study area segments described below include a Mainline Segment, an Exit 6 Segment and an Exit 7 Segment.

- I-293 Mainline Segment consists of a traffic evaluation that will retain the existing four lanes along the entire 3.5-mile I-293 study corridor together with interchange upgrades and alternatives that consider widening and reconstructing the southerly 0.8-mile section of the I-293 study area;

- Exit 6 Segment considers new interchange alternatives along with the widening of a 0.8-mile section of the I-293 mainline at Exit 6;
- Exit 7 Segment includes two options that either reconstruct the existing Exit 7 partial interchange at Front Street to a fully directional interchange or relocate and construct a new Exit 7 interchange to the north. Both options involve widening I-293 approximately 1.3-miles or 1.9-miles, respectively.

4.5.1 Mainline Alternatives

The Mainline Segment involves three alternatives. Alternative 1 involves a traffic evaluation that will retain the existing four lanes along the entire 3.5-mile I-293 study corridor, together with interchange upgrades to improve safety and traffic operations. Alternative 2 and Alternative 3 involve the southerly section of the study corridor and are approximately 0.8 miles in length. These two alternatives begin just north of the Granite Street Exit 5 interchange and follow the existing I-293 corridor between the Historic Millyard District on the west and the Merrimack River on the east. The segment passes under the West Bridge Street Bridge before ending just south of Exit 6.

The Exit 6 I-293 Segment lies between the Mainline just south of Exit 6 and ending approximately 0.1 mile north of the I-293 bridge over Black Brook. The Exit 6 Segment considers interchange alternatives 4, 5, 5A, 6 and 7.

The Exit 7 I-293 Segment covers a 1.9-mile section of the study corridor beginning just north of the I-293 bridge over Black Brook and includes five alternatives. Alternative 8 involves reconstructing Exit 7 at its current location while Alternatives 9A, 9B, 10A and 10B will eliminate the existing interchange and construct a new fully directional interchange just north of Manchester Community College. Alternatives 10A and 10B include extending the Dunbarton Road connector across Black Brook to the Goffstown Road/Straw Road intersection.

For the Mainline Segment, both Alternative 2 and Alternative 3 evaluate a 0.8-mile section of the I-293 Mainline Segment beginning just north of Exit 5 and ending just south of existing Exit 6. Both alternatives look at widening and reconstructing I-293 from a four-lane divided highway, approximately 90 feet of total pavement width, to a modern six-lane divided highway, approximately 122 feet of total width. The existing alignment is severely constrained as it winds itself between the Merrimack River on the east, the historic district of the Millyard on the west. The large pier foundations carrying West Bridge Street over I-293 and the Merrimack River are an additional constraint.

Alternative 2 examines shifting the widening primarily to the east toward the Merrimack River to minimize impacts to the historic properties on the west. Alternative 3 shifts the widening to the west into the historic Millyard properties to minimize impacts to the Merrimack River. The northerly ends of the Mainline Segment for both Alternatives 2 and 3 are similar with the widening shifting to the west to avoid the Merrimack River.

Alternative 1

Alternative 1 considers maintaining the existing four travel lanes (two lanes per direction) along the entire 3.5 mile I-293 study corridor together with interchange upgrades to improve safety and traffic operations. Effectively, the alternative considers whether the anticipated future design year traffic volume demand can be accommodated within the existing carrying capacity of the I-293 mainline.

Alternative 2

The Alternative 2 (**Figure 4.5-1**) widening essentially holds the existing westerly edge of the I-293 pavement as it curves around the American Cotton Duck historic property. This design control shifts the widening improvements easterly toward the Merrimack River. The proposed highway widening for Alternative 2 involves establishing horizontal and vertical alignments that:

- Minimize any reconstruction of the Exit 5 area, which was designed to accommodate a future widening of six lanes.
- Minimize impacts to the historical properties along the west side of I-293 between the Exit 5 southbound off-ramp and the West Bridge Street bridge by constructing a retaining wall/barrier separating the I-293 southbound traffic from the historic properties.
- Avoid impacts to the West Bridge Street bridge piers that are close to the I-293 corridor by use of a highway barrier.
- Avoid impacts to the historic American Cotton Duck property by maintaining the existing edge of pavement along I-293 and widening primarily to the east. The easterly widening and alignment shift would allow the American Cotton Duck property to maintain its current commercial operations and parking layout.
- Minimize impacts to the Merrimack River and its associated 100-year floodplain by utilizing a combination of steepened stone slopes and retaining walls. In areas where the river could be substantially impacted by the widening, cantilever retaining walls (approximately 1,500 to 2,000 feet) would be employed, to mitigate impacts. As a result a portion of I-293 is extended over the river.

Alternative 3

Alternative 3 (**Figure 4.5-2**) tries to minimize/avoid all impacts along the Merrimack River and its 100-year flood plain while minimizing/avoiding impacts to the American Cotton Duck historic property. The proposed highway layout for Alternative 3 is similar in some respects to Alternative 2, and involves establishing horizontal and vertical alignments that:

- Minimize any reconstruction of the Exit 5 area, which was designed to accommodate a future widening of six lanes.
- Minimize impacts to the historical properties along the west side of I-293 between the Exit 5 southbound off-ramp and the Bridge Street overpass by constructing a retaining wall/barrier separating the I-293 southbound traffic from the historic properties.
- Avoid impacts to the West Bridge Street bridge piers that are close to the I-293 corridor, by use of a highway barrier.

- Avoid impacts to the historic American Cotton Duck property. Alternative 3 would shift the I-293 widening primarily to the west such that the new highway would be approximately 10 feet from the American Cotton Duck building’s walkway. The parking and commercial operations that currently exist along the east side of the American Cotton Duck building would no longer be feasible.
- Minimize impacts to the Merrimack River and its associated 100-year floodplain by utilizing a combination of steepened stone slopes and retaining walls.

4.5.2 Exit 6 Interchange Alternatives

A range of interchange ideas were evaluated for their feasibility and practicality in addressing the deficiencies of the Exit 6 topside-traffic circle. The congestion and weaving conflict points were eliminated in order to meet the Exit 6 capacity demands.

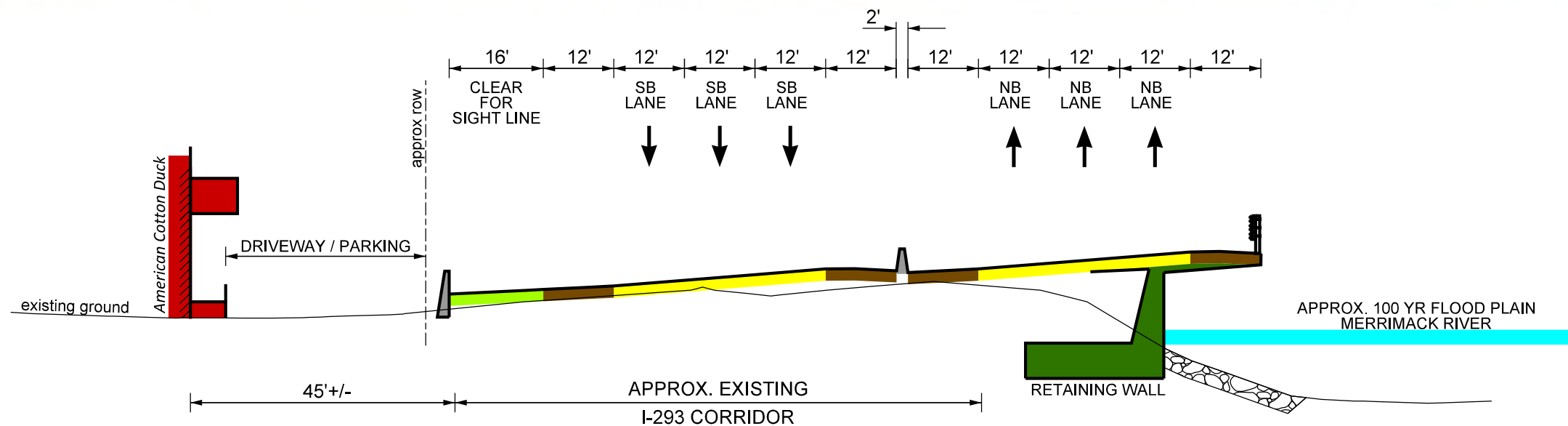
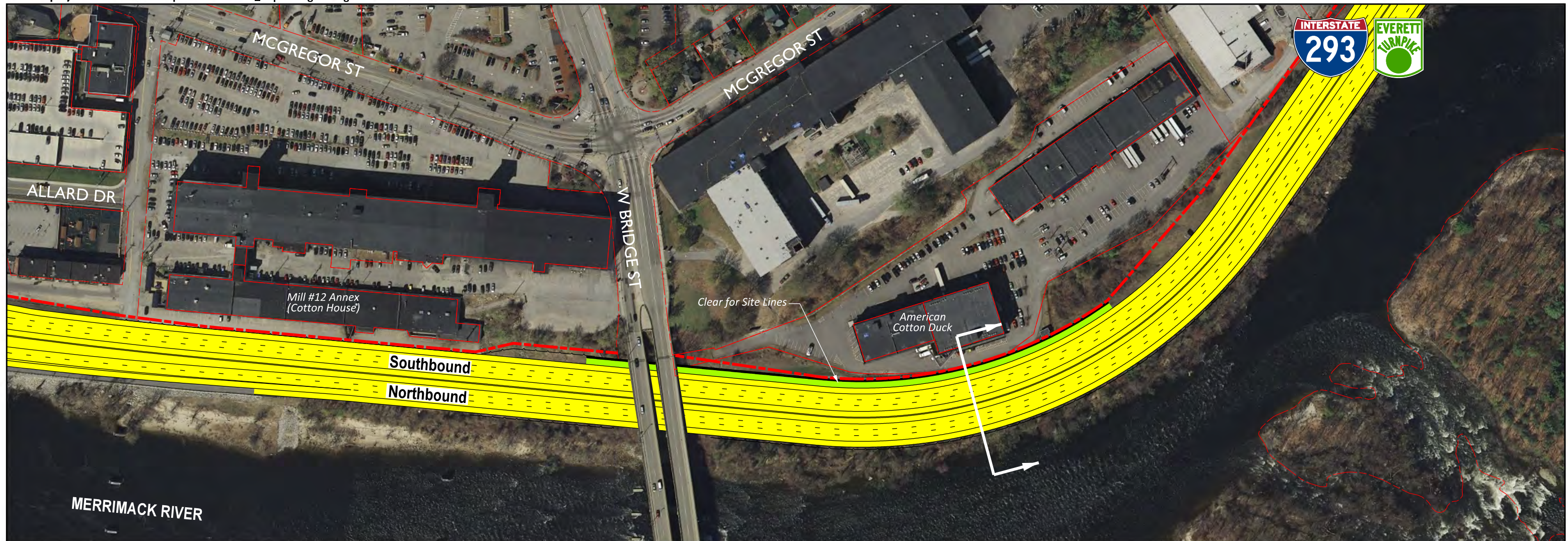
The development process for a new interchange at Exit 6 considered constructible design layouts that would minimize and/or eliminate impacts to:

- Commercial properties, residential properties, and driveways that currently exist adjacent to Exit 6.
- The existing Amoskeag Bridge over the Merrimack River.
- The Merrimack River and 100-year floodplain.
- Existing transmission lines crossing I-293.
- Existing wetland areas adjacent to Black Brook.
- Historic Resources

Each concept was first evaluated from an engineering feasibility and traffic operations perspective to aid in establishing the basic number of lanes, intersection layout, and the feasibility of construction. If the interchange concept looked feasible, the engineering and design was further advanced and a more detailed traffic operations analysis was completed.

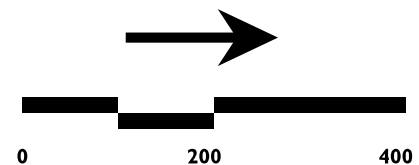
Each alternative for Exit 6 includes a 0.8-mile section of the I-293 mainline, beginning approximately 0.4 miles south of the existing Goffstown Road/Amoskeag Street overpass at Exit 6, and extending 0.8 miles ending just north of the I-293 Black Brook bridge. To accommodate the footprint for each of the new interchange alternatives, in conjunction with the widening and reconstruction of I-293 from four lanes to six lanes, the proposed I-293 mainline centerline shifts westerly approximately 30 feet. The westerly centerline shift allows for development of a wider I-293, offers opportunities to maintain traffic during construction, and provides for a range of reasonable interchange layouts while minimizing impacts to businesses and residences and the Merrimack River.

In addition, early in the conceptual development phase, the preliminary traffic operational analyses suggested two possible mainline design alternatives. The alternatives manage the heavy southbound mainline traffic through Exit 6 in combination with accommodating the heavy southbound ramp traffic. The first layout maintains mainline lane continuity by carrying the three mainline southbound lanes through the interchange area and adding an



LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal



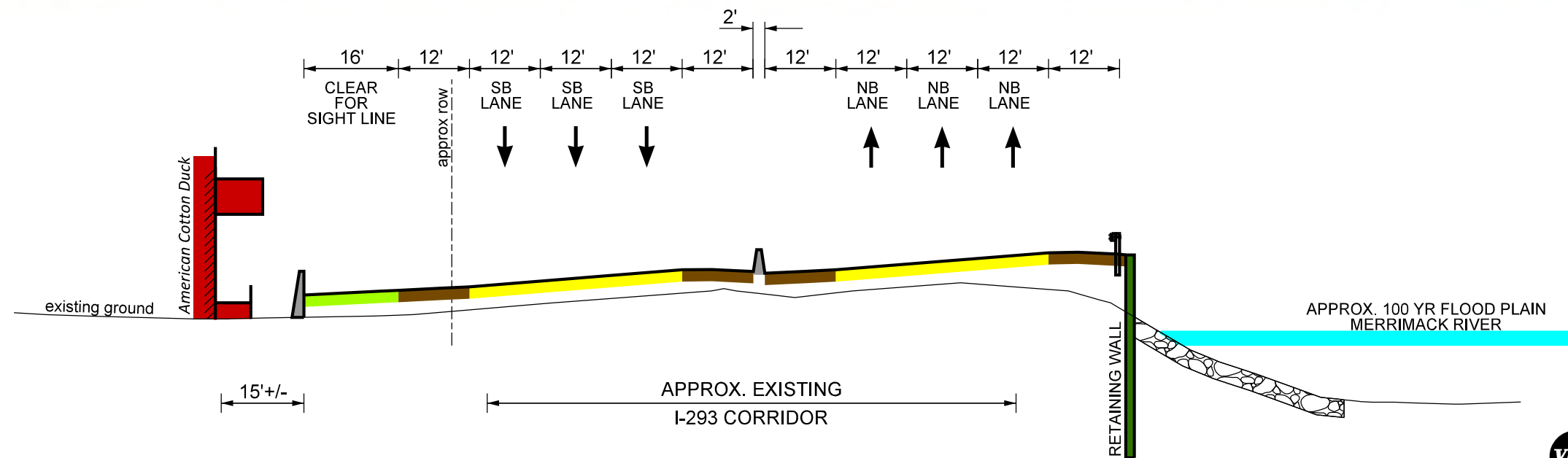
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Figure 4.5-1
Alternative 2
FEET Widen to the East

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New Hampshire
DOT
Department of Transportation



LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal

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Figure 4.5-2
Alternative 3
FEET Widen to the West

Manchester, NH



auxiliary lane, or fourth lane, where the southbound on-ramp merges with I-293. The fourth lane would extend approximately 0.8 mile to the south to Exit 5.

The second design layout calls for the outer lane of the three mainline travel lanes to be dropped just south of the proposed Exit 6 off-ramp and extend only two southbound travel lanes through the interchange area. A third lane would then be added where the heavy volume of traffic from the southbound on-ramp merges with the mainline. The three lanes would be then carried southerly to Exit 5. In order to minimize the overall mainline footprint and inherent additional impacts associated with adding an auxiliary or fourth southbound lane between Exit 6 and Exit 5, the first layout was carried forward for all the alternatives at Exit 6.

For Exit 6, Alternatives 4, 5, 5A, 6 and 7 were considered feasible and are described below.

Alternative 4

Alternative 4 (**Figure 4.5-3**) evaluates a Single Point Urban Interchange, typically referred to as a SPUI. The proposed SPUI at Exit 6 is similar to one constructed at I-293/Exit 5 at Granite Street in 2008. However, unlike the Exit 5 SPUI where I-293 passes over the interchange, I-293 would pass below the Exit 6 SPUI interchange. The SPUI intersection would be controlled by a single traffic signal at the center of the interchange to direct traffic along Goffstown Road, as well as all turns to and from the highway ramps. The major advantages of a SPUI-type interchange are a more compact layout, requiring less ROW, and providing greater efficiency by allowing the left turns to operate concurrently through its one signal as opposed to the two signals of a traditional diamond interchange design.

Alternative 4 includes three (3) additional major design features that will work in concert to manage efficient traffic flow, while maintaining connectivity to all existing roadways at Exit 6. First, the Goffstown Road/Eddy Road/Front Street intersection will be reconfigured to allow Goffstown Road to bridge over Front Street/Eddy Road and connect directly to the SPUI bridge and Amoskeag Street. By separating this intersecting traffic, the conflicts and congestion adjacent to the SPUI interchange will be eliminated, allowing safer and more efficient traffic flow at the SPUI.

Second, a new connector road and overpass, near the existing Eddy Road and Amoskeag connector, will link Eddy Road and Front Street to Amoskeag Street. Traffic signal control will be required at Eddy Road and Amoskeag Street intersections. The third design element would retain the existing I-293 southbound on-ramp (right-turn traffic only) opposite the intersection of Eddy Road and Lorraine Street near McGregor Street. The ramp is being retained because the other southbound on-ramp located at Amoskeag Street is over 0.5 mile to the north. Rather than traveling this distance, motorists might choose to travel south along Eddy Road and McGregor Street to enter I-293 at Exit 5. Retaining the ramp is expected to minimize this potential impact to the local street system. The existing T-type Coolidge Avenue intersection to Goffstown Road and the four-way signalized intersection connecting River Front Drive and Fletcher Street to Amoskeag Street are also retained.

Alternative 4 includes construction of 0.5 mile of Eddy Road and Front Street; 0.25 mile of a new connector linking Eddy Road to Amoskeag Street, 0.2 mile of Goffstown Road and Coolidge Avenue, 0.2 mile of Amoskeag Street, 1.2 miles of interchange ramps, 0.8 mile of I-293, four bridges (SPUI over I-293; connector over I-293, Goffstown Road over Front Street/Eddy Road, and I-293 over Black Brook), 0.5 mile of retaining walls, and four signalized intersections.

Alternative 5

Alternative 5 (**Figure 4.5-4**) evaluates an Urban Diamond Interchange at Exit 6. Alternative 5 has two basic design features. The first will develop a new urban diamond interchange connecting Eddy Road to the west and Amoskeag Street to the east. The northbound and the southbound ramps will form two separately controlled signalized intersections. The interchange connector road will join Amoskeag Street at a T-type signalized intersection. The second element will include a new separate bridge structure over I-293 carrying two-way traffic, linking Goffstown Road and Amoskeag Street. The existing Front Street connection to Goffstown Road will be maintained with a T-type signalized intersection. The existing four-way signalized intersection connecting River Front Drive and Fletcher Street to Amoskeag Street will also be retained.

Alternative 5 includes construction of 0.5 mile of Eddy Road/Amoskeag Street connector, 0.25 mile of a new connector linking Eddy Road to Amoskeag Street, 0.2 mile of Goffstown Road and Coolidge Avenue, 0.2 mile of Amoskeag Street, 1.1 miles of interchange ramps, 0.8 mile of I-293, three bridges (Eddy Road/Amoskeag Street diamond interchange connector over I-293, Goffstown Road/Amoskeag Street over I-293, and I-293 over Black Brook), 0.2 mile of retaining walls, and five signalized intersections.

Alternative 5A

Alternative 5A (**Figure 4.5-5**) is an Offset Diamond Interchange. The layout for Alternative 5A will separate the Exit 6 northbound and southbound ramp connections from the local roadways. The northbound ramp connections will intersect Amoskeag Street while the southbound ramp connections will intersect Eddy Road. The ramp intersections are approximately 0.5 mile apart allowing for opportunities to introduce additional directional ramps while improving the traffic operations due to the intersection separation.

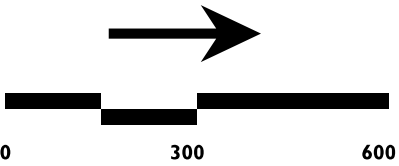
To the north, Goffstown Road and Amoskeag Street will be connected with a new bridge over I-293 carrying two-way traffic. The Coolidge Avenue connection to Goffstown Road will remain. Eddy Road will be modified to a two-way roadway intersecting Goffstown Road, opposite Front Street, at a signalized intersection.

The existing four-way signalized intersection connecting River Front Drive and Fletcher Street to Amoskeag Street will be retained. The northbound off-ramp will intersect Amoskeag Street at a signalized intersection, while the northbound on-ramps will be directional, with the eastbound and westbound traffic from Goffstown Road and Amoskeag Street connecting directly to I-293. To the south at Eddy Road, the southbound off-ramp traffic will be free flow for vehicles exiting to Eddy Road northbound, while vehicles heading



LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal



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Figure 4.5-3
Alternative 4
Single Point Urban Interchange (SPUI)

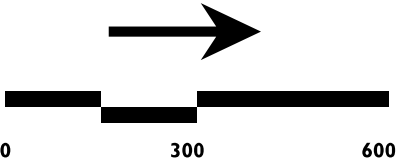
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LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal



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Figure 4.5-4
Alternative 5
Diamond Interchange

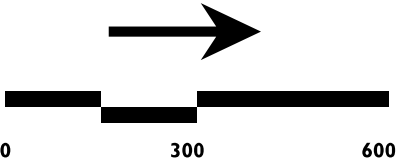
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LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal



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Figure 4.5-5
Alternative 5A
Off-Set Diamond Interchange

Manchester, NH



south on Eddy Road will turn left to Eddy Road at a signalized intersection. For Eddy Road southbound traffic entering I-293, a fly-over ramp will allow motorists to access I-293 directly by bridging over Eddy Road without passing through the signalized intersection. The northbound traffic on Eddy Road will also have direct access to I-293 by way of a short ramp that merges with the fly-over ramp without passing through a signalized intersection.

Alternative 5A includes construction of 0.5 mile of Eddy Road, 0.2 mile of Goffstown Road and Coolidge Avenue, 0.2 mile of Amoskeag Street, 1.4 miles of interchange ramps, 0.8 mile of I-293, three (3) bridges (Goffstown Road/ Amoskeag Street over I-293, the southbound on-ramp fly-over Eddy Road; and I-293 over Black Brook), 0.1 mile of retaining walls, and four signalized intersections.

Alternative 6

Alternative 6 (**Figure 4.5-6**) evaluates a Diverging Diamond Interchange (DDI), sometimes referred to as a Double Crossover Diamond. A DDI is a diamond interchange that more efficiently facilitates heavy left-turn movements. The ramp configuration is comparable to the traditional diamond, but the traffic on the roadway crossing over I-293 moves from the established right-side of the roadway and crosses over to the left-side of the road briefly between the signalized ramp intersections. Shifting the traffic from the right side to the left side eliminates any conflict with through traffic and allows all the left turning traffic to enter I-293 without the need to utilize a left-turn signal phase at the signalized ramp intersections. The principal benefits of a DDI are 1). The reduction in vehicle conflict points from thirty conflicts with a typical diamond interchange to 18 conflicts with a DDI and 2). Each of the two signalized ramp intersections for a DDI can be operated with a simple two-phase operation for improved efficiency.

Alternative 6 is similar to Alternative 5 and also has two basic design features. The first develops a new DDI connecting Eddy Road to the west and Amoskeag Street to the east with the northbound and the southbound ramps forming two separately controlled signalized intersections. The DDI interchange connector road will join Amoskeag Street at a T-type signalized intersection. The second element includes a new separate bridge structure over I-293 carrying two-way traffic and linking Goffstown Road and Amoskeag Street. The existing Front Street connection to Goffstown Road will be maintained with a T-type signalized intersection. The existing four-way signalized intersection connecting River Front Drive and Fletcher Street to Amoskeag Street will also be retained.

Alternative 6 includes construction of 0.5 mile of Eddy Road/ Amoskeag Street connector, 0.25 mile of a new connector linking Eddy Road to Amoskeag Street, 0.2 mile of Goffstown Road and Coolidge Avenue, 0.2 mile of Amoskeag Street, 1.2 miles interchange ramps, 0.8 mile of I-293, three bridges (Eddy Road/ Amoskeag Street DDI connector over I-293, Goffstown Road/ Amoskeag Street over I-293, and I-293 over Black Brook), 0.3 mile of retaining walls, and five signalized intersections.

Alternative 7

Alternative 7 (**Figure 4.5-7**) evaluates a traditional diamond interchange with the use of roundabouts instead of signals at the intersections with the northbound and southbound

ramps. Alternative 7 design features would include a new diamond interchange connecting Eddy Road to the west and Amoskeag Street to the east with the northbound and the southbound ramps. Because of the high volume of traffic, each of the ramp intersections with the Eddy Road/ Amoskeag connector will be controlled with a two-lane roundabout.

The roundabout interchange connector road will join Amoskeag Street at a T-type signalized intersection. The design would also include a new separate bridge structure over I-293 carrying two-way traffic and linking Goffstown Road and Amoskeag Street. The existing Front Street connection to Goffstown Road will be maintained with a T-type signalized intersection. The existing four-way signalized intersection connecting River Front Drive and Fletcher Street to Amoskeag Street would also be retained.

Alternative 7 includes construction of 0.5 mile of Eddy Road/ Amoskeag Street connector, 0.25 mile of a new connector linking Eddy Road to Amoskeag Street, 0.2 mile of Goffstown Road and Coolidge Avenue, 0.2 mile of Amoskeag Street, 1.2 miles of interchange ramps, 0.8 mile of I-293, three bridges (Eddy Road/ Amoskeag Street roundabout interchange connector over I-293, Goffstown Road/ Amoskeag Street over I-293, and I-293 over Black Brook), 0.2 mile of retaining walls, and three signalized intersections.

4.5.3 Exit 7 Interchange Alternatives

The primary deficiency for the Exit 7 Segment is that the existing interchange is a partial interchange, only supporting connectivity for motorists traveling to and from the south on I-293. There are no ramps to provide connectivity to the north. In addition to the interchange capacity deficiencies and other safety issues, the nearly 60-year old interchange has substandard merge, diverge and weave areas on I-293 that further exacerbate traffic operations. The existing ramp intersections with Front Street are both substandard and confusing to traffic entering and exiting. To address these issues, two options were evaluated for their feasibility and practicality that either reconstruct the existing partial interchange to a fully directional interchange or relocate Exit 7 and construct a new interchange further to the north.

Key components toward the development of these options include measures that will improve connectivity for northbound and southbound traffic and improve safety and mobility, while looking to minimize impacts to residences, businesses, and the environmental resources. Segment 7 includes five alternatives and will involve widening I-293 approximately 0.8 miles when reconstructing existing Exit 7 or 1.9 miles when relocating Exit 7 to the north.

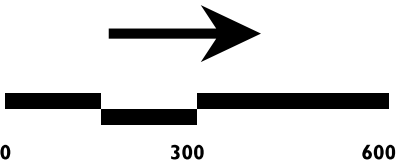
Alternative 8 involves reconstructing existing Exit 7 to a fully directional interchange at its current location while Alternatives 9A and 9B will relocate the interchange and construct a new fully directional interchange just north of Manchester Community College. Alternatives 10A and 10B are variations of Alternatives 9A and 9B in that they involve not only a new Exit 7 interchange, but include extending the Dunbarton Road connector in Manchester further to the west across Black Brook to Goffstown Road.

For Exit 7 Alternatives 8, 9A, 9B, 10A and 10 B were considered feasible and described below.



LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal



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Figure 4.5-6
Alternative 6
Diverging Diamond Interchange (DDI)

Manchester, NH





LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal

Alternative 8

Alternative 8 (**Figure 4.5-8**) evaluates the potential of constructing a new fully directional diamond interchange at the current Exit 7 location. The development of a new diamond interchange for at Exit 7 considered a constructible design layout that will minimize/eliminate impacts to:

- The Manchester Landfill area to the west.
- Any paved areas or buildings at the Manchester Community College.
- Existing wetland areas at Black Brook and Stark Lane.
- Impacts to Merrimack River, Black Brook, and the 100-year flood plain.
- Commercial and residential properties.

The interchange layout will widen Front Street to accommodate through/turning traffic at the signalized northbound and southbound ramp intersections with Front Street. Wider bridges will carry I-293 over Front Street, Stark Way and Black Brook. Retaining walls 10 to 25 feet high along the southbound off-ramp and six to 18 feet high along Black Brook will be constructed to minimize resource and property impacts. Alternative 8 includes construction of 0.4 mile of Front Street, 0.8 mile of interchange ramps, 1.3 miles of I-293, three bridges (I-293 over Front Street, I-293 over Stark Way, and I-293 over Black Brook), 0.7 mile of retaining walls, and two signalized intersections.

Alternatives 9A, 9B, 10A and 10B

Alternatives 9A and 9B (**Figure 4.5-9**) will relocate Exit 7 and construct a new fully directional interchange on I-293 just north of Manchester Community College and adjacent to the Manchester Landfill. Both alternatives avoid the Manchester Landfill by shifting the Interchange Connector Road alignment northerly while attempting to avoid the steep terrain and wetlands near the transmission line corridor. Both alternatives are similar with new connections to Front Street to the east and at Dunbarton Road to the west. The 1.0-mile long Interchange Connector Road passes under I-293. The northbound on and off-ramps and the southbound off-ramp will be in a diamond interchange configuration while the southbound on-ramp will be configured in a loop layout.

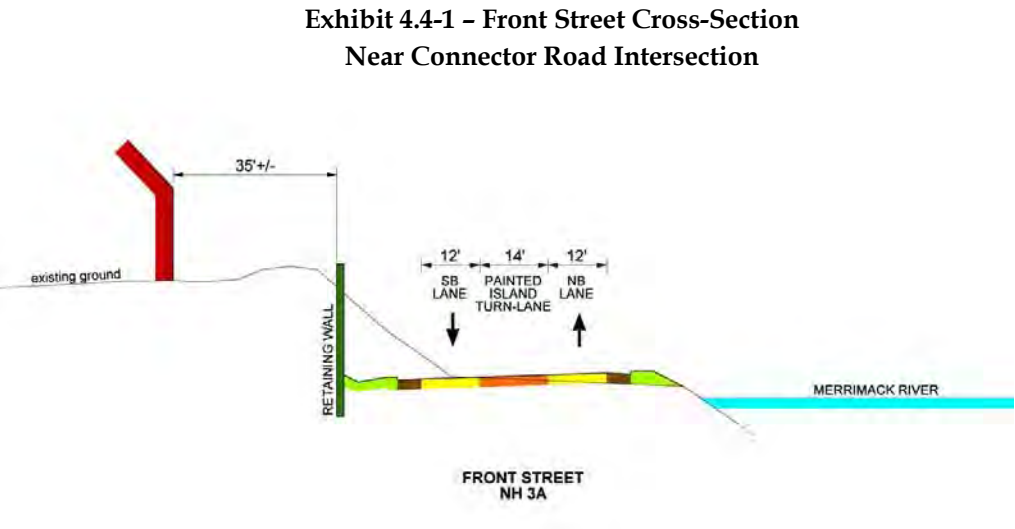
The primary difference between Alternative 9A and 9B is the location of the proposed Interchange Connector Road intersection with a widened and reconstructed Front Street. For Alternative 9A, the Interchange Connector Road intersects Front Street at the existing Country Club Drive intersection. Alternative 9B, the Interchange Connector Road intersects Front Street approximately 800 feet further to the south of Country Club Drive. New driveway access to the Interchange Connector Road will be provided for Country Club Drive and for Manchester Community College.

The development of a relocated interchange for Exit 7 considers a constructible design layout that will minimize/eliminate impacts to:

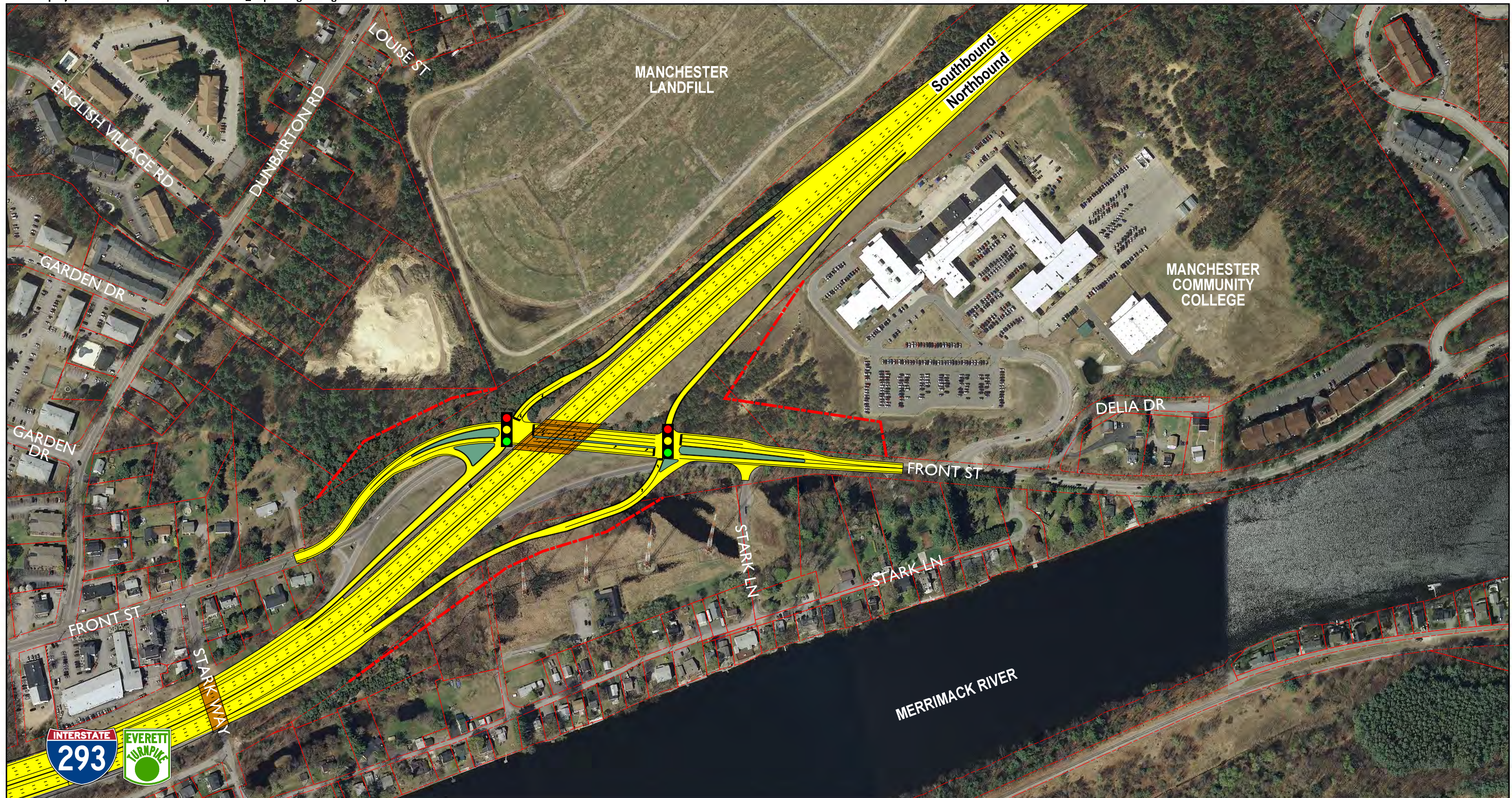
- The Manchester landfill area to the south.
- Residential properties along Front Street, Delia Drive and Country Club Lane.

- Paved areas or buildings at the Community College.
- Existing wetland areas.
- The Merrimack River and the 100-year flood plain.
- Black Brook and the 100-year flood plain (Alt 10A and 10B).
- Residential properties along Dunbarton Road, Straw Road, Goffstown Road (Alt 10A and 10B).

Alternatives 10A and 10B (**Figure 4.5-10**) are similar to Alternatives 9A and 9B, respectively with the primary difference being variations of the Dunbarton Road connection. For Alternatives 9A and 9B the highway improvement proposed are essentially the same and include, the widening of 0.25 mile of Front Street to accommodate turning traffic at the new Interchange Connector Road, construction of 1.0 mile of Interchange Connector Road, construction of 800 feet of intersection approach connecting the proposed Interchange Connector Road with Dunbarton Road, and the construction of 500 to 700-foot long drives from the Interchange Connector Road into the Community College and to Country Club Drive, respectively. Both Alternatives also include building six to twenty foot high retaining walls along Front Street to minimize impacts to adjacent residential properties, the construction of 0.8 mile of interchange ramps, reconstructing 1.8 miles of I-293, a new bridge carrying I-293 over the Interchange Connector Road, 0.2 mile of retaining walls, and four signalized intersections. A cross-section of Front Street depicting the retaining wall is shown in **Exhibit 4.4-1**.

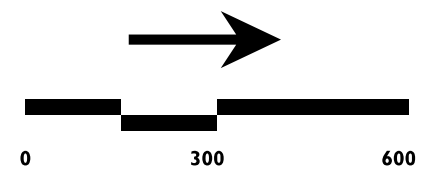


For Alternatives 10A and 10B, the 800-foot Dunbarton Road connection proposed for the 9A and 9B layout will be extended westerly as the Goffstown Connector Road bridging across Black Brook an additional 0.7 mile, linking the proposed Exit 7 Interchange Connector Road with the Goffstown Road/Straw Road intersection. The highway improvements proposed are similar to 9A and 9B with the difference being the 0.7-mile extension of the Dunbarton Connector includes a proposed Goffstown Connector Road to Goffstown Road/Straw Road intersection, the construction of a new bridge over Black Brook, and the 0.1-mile reconstruction of Straw Road. Note that the configuration and alignment of the Goffstown Connector Road will require more detailed evaluation under the National Environmental Policy Act (NEPA) phase of the project.



LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal



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Figure 4.5-8
Alternative 8
Diamond Interchange (Current Location)

Manchester, NH



Alternative 9A

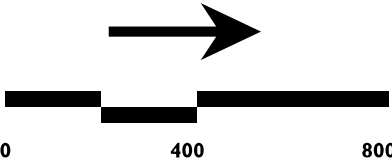


Alternative 9B



LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal



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Figure 4.5-9
Alternative 9A & Alternative 9B
Exit 7 - Relocated Interchange

Manchester, NH



Alternative 10A

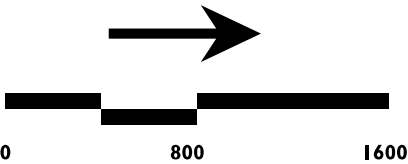


Alternative 10B



LEGEND

- Pavement
- Bridge
- Median / Grass Panel
- Existing ROW
- Proposed ROW
- Signal




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Figure 4.5-10
Alternative 10A & Alternative 10B
Exit 7 - Relocated Interchange (with connection to Goffstown Rd.)

Manchester, NH

**DOT**
Department of Transportation