CHITTENDEN COUNTY REGIONAL PLANNING COMMISSION

I-89
BOLTON AND MILTON INTERCHANGES ASSESSMENT

FEBRUARY 2022

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

The Chittenden County Regional Planning Commission (CCRPC), as part of the ongoing I-89 2050 study to identify and prioritize regionally significant enhancements to the I-89 corridor within their jurisdiction, seeks to re-assess two interchange concepts in the Towns of Bolton and Milton that were developed in 1988 and 1987 respectively. This memorandum identifies items that would need to be addressed to meet the current geometric design standards set by AASHTO and VTrans, as well as to comply with the current environmental requirements of the National Environmental Protection Act (NEPA) and Vermont Act 250.

Chittenden County contains roughly 37 miles of Interstate 89 within its boundaries. The current configuration of the interstate route provides seven interchange options for motorists. Exit 11 in Richmond is the southernmost interchange within the RPC boundaries and Exit 17 in Colchester is the northernmost interchange. As part of the 2050 Chittenden County I-89 Study, which reviewed all aspects of Interstate 89 within the Chittenden County boundaries, all interchange concepts were revisited and assessed to determine the priority of new and/or modified interchanges. Two concepts one on the southern boundary of Chittenden County in Bolton and one on the northern boundary in Milton were revisited in this process. While these two concepts did not rank high in regional significance in the 2050 study, these concepts have garnered significant local support over the years which continues till today.

To address communities' concerns, the Chittenden County Regional Planning Commission is taking a fresh look at the previously developed concepts for a Bolton interchange between existing exits 10 and 11, and a Milton interchange between existing exits 17 and 18.

The Bolton interchange concept developed into a project in the 1980's and advanced to the conceptual design phase. A Draft Environmental Impact Statement (EIS) was produced, and public hearings held. A Supplemental Draft EIS was then produced. Increasing vocal opposition and questions about the planning process for the Bolton Interchange Conceptual plans led the Governor to cancel the project at that point and no subsequent Final EIS was produced.

Draft Environmental Impact Statement (EIS):

https://studiesandreports.ccrpcvt.org/wp-content/uploads/2022/01/BoltonInterchangeDEIS_1990.pdf

Supplemental Draft EIS:

https://studiesandreports.ccrpcvt.org/wp-content/uploads/2022/01/I_89_US_2_Interchange_Study_Bolton_Supplement_To_DEIS_1994.pdf

As part of a 1987 Chittenden County Regional Commission study several new interchanges and modifications to existing interchanges were reviewed and analyzed by Storch Engineers. An interchange between existing Exits 17 and 18 was proposed in Milton. Several alternatives were reviewed and considered to improve mobility, increase safety and minimize environmental impacts. The concept that the study settled on was a hybrid of two separate alternatives. The concept has resurfaced informally over the years; however, no official follow-up studies were conducted and the NEPA process was not initiated.

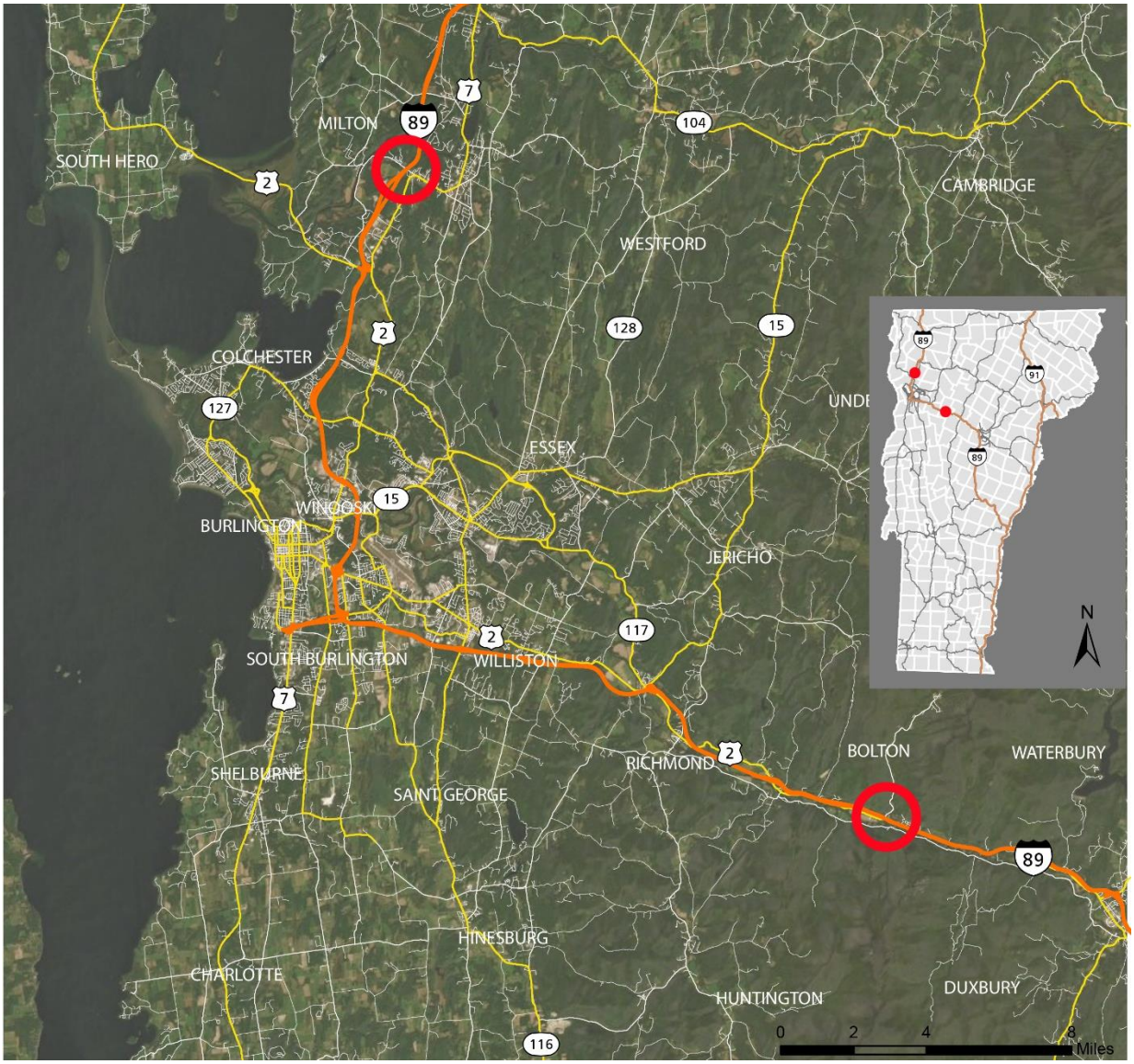
1987 Chittenden County Regional Commission study:

https://studiesandreports.ccrpcvt.org/wp-content/uploads/2017/01/i89_interchange_feasibility_1987.pdf

The following analysis will review both sites separately in the areas of Geometrics and Environmental characteristics. As several decades have passed since the concepts were developed, numerous design standards and environmental requirements have changed. The assessment will provide a roadmap for any proposal seeking to move either the Bolton or the Milton interchange forward.

The red circles on the following figure show the location of the proposed interchanges in Bolton and Milton.

Figure 1 - Location Map for Bolton-Milton Interchanges



2 METHODOLOGY

2.1 GEOMETRIC DESIGN STANDARDS

The following design standards were used to review the geometric design of each of the two interchanges:

- AASHTO A Policy on Geometric Design of Highways and Streets 7th Edition dated 2018
- Vermont State Design Standards dated October 22, 1997

The Vermont Design Standards refer to AASHTO for the geometric criteria governing the design of freeways. Therefore, the AASHTO design were used to evaluate the interchange ramps at both Bolton and Milton interchanges while the Vermont Design Standards were used to evaluate the relocated section of US Route 2 (classified as a minor arterial) at the Bolton Interchange.

Separate geometric design standard tables were developed for the ramps and for the relocated section of US Route 2 at the Bolton interchange. These design standards are summarized in Table 1.

Table 1 - Geometric Design Standards

Horizontal Geometry				
Design Standard	**Value**	**Resource**	**Comments**	**Page**
I-89				
Design Speed (mph)	70	2018 AASHTO	Section 8.2.1. Design Speed.	638
Superelevation Emax	6%	2018 AASHTO	Table 3-9. Minimum Radii for Design Superelevation Rates, Design Speeds, and emax = 6%	241
Lane Widths (ft)	12	2018 AASHTO	Section 8.2.4. Traveled Way and Shoulders	639
Shoulder Widths (ft)				
Left	4 to 8	2018 AASHTO	Section 8.2.4. Traveled Way and Shoulders	639
Right	12	2018 AASHTO	Section 8.2.4. Traveled Way and Shoulders	639
Ramps				
Min Design Speed (mph)	25-35	2018 AASHTO	Table 10-1. Guide values for ramp design speed as related to Highway Design Speed	967
Superelevation eMax	8.0%	2018 AASHTO	Table 3-10. Minimum Radii for Design Superelevation Rates, Design Speeds, and emax = 8%	243
Length of Spiral Curve (ft)	88 to 103	2018 AASHTO	Table 3-21. Tangent Runout Length for Spiral Curve Transition Design	278
Intersection Edge of Pavement Radius (ft)	50		Based on Design Vehicle	
Centerline Radius (ft)	134 to 314	2018 AASHTO	Table 3-7. Minimum Radius Using Limiting Values	232
Max Compound Curvature Ratio	2:1	2018 AASHTO	Section 3.3.8.12	288
Lane Widths (ft)	12	2018 AASHTO	Section 10.9.6	983
Total Traveled Way Width (ft)	Varies	2018 AASHTO	Table 3-27	307
Length of Accel Lane (ft)	Varies	2018 AASHTO	Table 10-4	994
Length of Decel Lane (ft)	Varies	2018 AASHTO	Table 10-6	1000
Shoulder Widths (ft)				
Left	2 to 4	2018 AASHTO	10.9.6.3.2. Shoulder Widths and Lateral Offset. The left and right shoulder widths may be reversed if needed to provide additional sight distance.	983
Right	6 to 10	2018 AASHTO	10.9.6.3.2. Shoulder Widths and Lateral Offset. The left and right shoulder widths may be reversed if needed to provide additional sight distance.	983

Horizontal Geometry				
Design Standard	**Value**	**Resource**	**Comments**	**Page**
US Rte 2 (Minor Arterial)				
Design Speed (mph)	35-55	Vermont State Design Standards - October 22, 1997	3.3 Design Speed	33
Superelevation eMax	8.0%	Vermont State Design Standards - October 22, 1997	Section 3.13 Superelevation	39
Centerline Radius (ft)	758	2018 AASHTO	Table 3-7. Minimum Radius Using Limiting Values of e and f (design speed of 50mph)	232
Min Length for Horizontal Curves (ft)	525-825	2018 AASHTO	3.3.13 General Controls for Horizontal Alignment	318
Max Compound Curvature Ratio	1.5:1	2018 AASHTO	Section 3.3.8.12	
Min Lane Width (ft)	11	Vermont State Design Standards - October 22, 1997	Table 4.3 Minimum Width of Lanes and Shoulders ADT of 0-1500 and design speed of 50mph	35
Min Shoulder Widths (ft)				
Left	4	Vermont State Design Standards - October 22, 1997	see above	35
Right	4	Vermont State Design Standards - October 22, 1997	see above	35

Vertical Geometry				
Design Standard	**Value**	**Resource**	**Comments**	**Page**
I-89				
Max Grade	4% (max)	2018 AASHTO	Table 8-1 Maximum Grades for Freeways at Design Speed of 50mph.	641
Vertical Curve - Crest	247	2018 AASHTO	Table 3-35. Design Controls for Crest Vertical Curves based on SSD	368
Vertical Curve - Sag	181	2018 AASHTO	Table 3-37. Design Controls for Sag Vertical Curves	374
Vertical Clearance (ft)	16	2018 AASHTO	Section 8.2.9. Vertical Clearance. Provide at least 16' of vertical clearance over entire roadway width.	641
Stopping Sight Distance (ft)	Varies	2018 AASHTO	Table 3-1 or 3-2. Depends on vertical grade	202 & 204
Ramps				
Max Grade	3-7%	2018 AASHTO	Table 10-2. Design Speed varies from 30mph to 55mph. Ramp Design Speed 25-30mph = 5-7% grade 45mph or greater = 3-5% grade	972
Vertical Curve - Crest	19 to 29	2018 AASHTO	Table 3-35. Design Controls for Crest Vertical Curves based on SSD	368
Vertical Curve - Sag	37 to 49	2018 AASHTO	Table 3-37. Design Controls for Sag Vertical Curves	374
Stopping Sight Distance (ft)	Varies	2018 AASHTO	Table 3-1 or 3-2. Depends on vertical grade	202 & 204
US Rte 2 (Minor Arterial)				
Max Grade	5%	Vermont State Design Standa	Table 4.5. Based on Rolling Terrain and 50mph	38
Vertical Curve - Crest	110-160	Vermont State Design Standa	Table 4-1. Values are for design speed of 50mph	33
Vertical Curve - Sag	90-110	Vermont State Design Standa	Table 4-1. Values are for design speed of 50mph	33
Min Vertical Clearance (ft)	14	Vermont State Design Standa	Section 4.8 - Vertical Clearance. Provide at least 14' of vertical clearance over entire roadway width.	37
Stopping Sight Distance (ft)	450 to 550	Vermont State Design Standa	Table 4-1. Values are for design speed of 50mph	33

3 BOLTON INTERCHANGE ANALYSIS

3.1 GEOMETRIC ANALYSIS

3.1.1 *MATERIAL PROVIDED BY CCRPC*

The geometric review performed by WSP is based on the interchange plans prepared by Vollmer Associates in 1988. CCRPC provided these plans to WSP in PDF format (99 sheets). These plans provide a good level of detail that allowed WSP to review most of the horizontal and vertical design elements.

3.1.2 *GEOMETRIC ANALYSIS*

The proposed interchange is connecting existing I-89 to US Route 2. Since the alignment of Route 2 is diagonally crossing I-89, this interchange is split among two locations: The ramps connecting to I-89 SB are located north of Bolton Valley Access Rd while the ramps connecting to I-89 NB are located south of Bolton Valley Access Rd. An approximate length of 3100 LF of US Route 2 is relocated on the east side of I-89 to provide room for the proposed northbound ramps.

Five different alignments were evaluated in this geometric analysis: the southbound off-ramp (ramp S1), the southbound on-ramp (ramp S2), the northbound off-ramp (ramp N2), the northbound on-ramp (ramp N1) and the relocated section of US Route 2 along I-89 NB.

The relocated section of US Route 2 is classified as minor arterial per the VTrans Functional Classification map published at the following location. This map was approved by FHWA in December 2020.

https://vtransmaps.vermont.gov/Maps/Publications/Maps/FunctionalClassMaps/RuralFunclStatewide_2020.pdf

The results of the geometric analysis are summarized in Table 2 below. Design elements that meet current geometric standards are color coded in green and the ones that do not meet geometric standards are color coded in red.

Table 2 - Bolton Interchange Geometric Analysis

Item	Design Criteria	Ramp N1	Ramp N2	US RTE 2 (@NB Interchange)	Ramp S1	Ramp S2
Horizontal Geometry (Ramp)						
Design Speed (mph)	25-35	35	35	n/a	35	35
Superelevation Emax	8.0%	8.0%	8.0%	n/a	8.0%	8.0%
Length of Spiral Curve (ft)	88 to 103	400	400	n/a	400	400
Intersection Edge of Pavement Radius (ft)	50	50	50	n/a	50	50
Centerline Radius (ft)	134 to 314	180 to 350	180 to 350	n/a	180 to 350	196.3 to 350
Max Compound Curvature Ratio	2:1	0.5	1.9	n/a	1.9	0.6
Lane Widths (ft)	12	16	16	n/a	16	16
Shoulder Widths (ft)						
Left	2 to 4	4	4	n/a	4	4
Right	6 to 10	4	4	n/a	4	4
Total Traveled Way Width (ft)	23	24	24	n/a	24	24
Length of Accel Lane (ft)	Varies	1543	n/a	n/a	n/a	1543
Length of Decel Lane (ft)	Varies	n/a	613	n/a	613	n/a
Length of Ramp (ft)	n/a	1894.33	964.33	n/a	980.23	1911.11
Vertical Geometry (Ramp)						
Max Grade	3-7%	-3.0%	-2.7%	n/a	-6.0%	6.0%
Vertical Curve - Crest	19 to 29	300'	300'	n/a	150'	130'
Vertical Curve - Sag	37 to 49	120'	150'	n/a	140'	140'
Stopping Sight Distance (ft)	Varies	473	436	n/a	375	440
Horizontal Geometry (Rte 2)						
Design Speed	50	n/a	n/a	50	n/a	n/a
Superelevation eMax	8.0%	n/a	n/a	6.1%	n/a	n/a
Centerline Radius (ft)	758	n/a	n/a	n/a	n/a	n/a
Min Length for Horizontal Curves (ft)	525-825	n/a	n/a	750	n/a	n/a
Max Compound Curvature Ratio	1.5:1	n/a	n/a	n/a	n/a	n/a
Lane Widths (ft)	11	n/a	n/a	12	n/a	n/a
Shoulder Widths (ft)						
Left	4	n/a	n/a	8	n/a	n/a
Right	4	n/a	n/a	8	n/a	n/a
Vertical Geometry (Rte 2)						
Max Grade	5%	n/a	n/a	6.1%	n/a	n/a
Vertical Curve - Crest	110-160	n/a	n/a	600	n/a	n/a
Vertical Curve - Sag	90-110	n/a	n/a	400	n/a	n/a
Stopping Sight Distance (ft)	450 to 550	n/a	n/a	475	n/a	n/a

The analysis shows that the length of horizontal curves 1 and 3 for Route 2 are non-compliant based on a design speed of 50mph. As stated in AASHTO 2018, the minimum length for horizontal curves on main highways should be 15 times the design speed, which is equivalent to a minimum length of 750 ft at 50mph. Curve 1 has a length of 604.07 ft whereas Curve 3 is 523.09 ft long. Curve 2 is compliant as this has a length of 1208.14 ft.

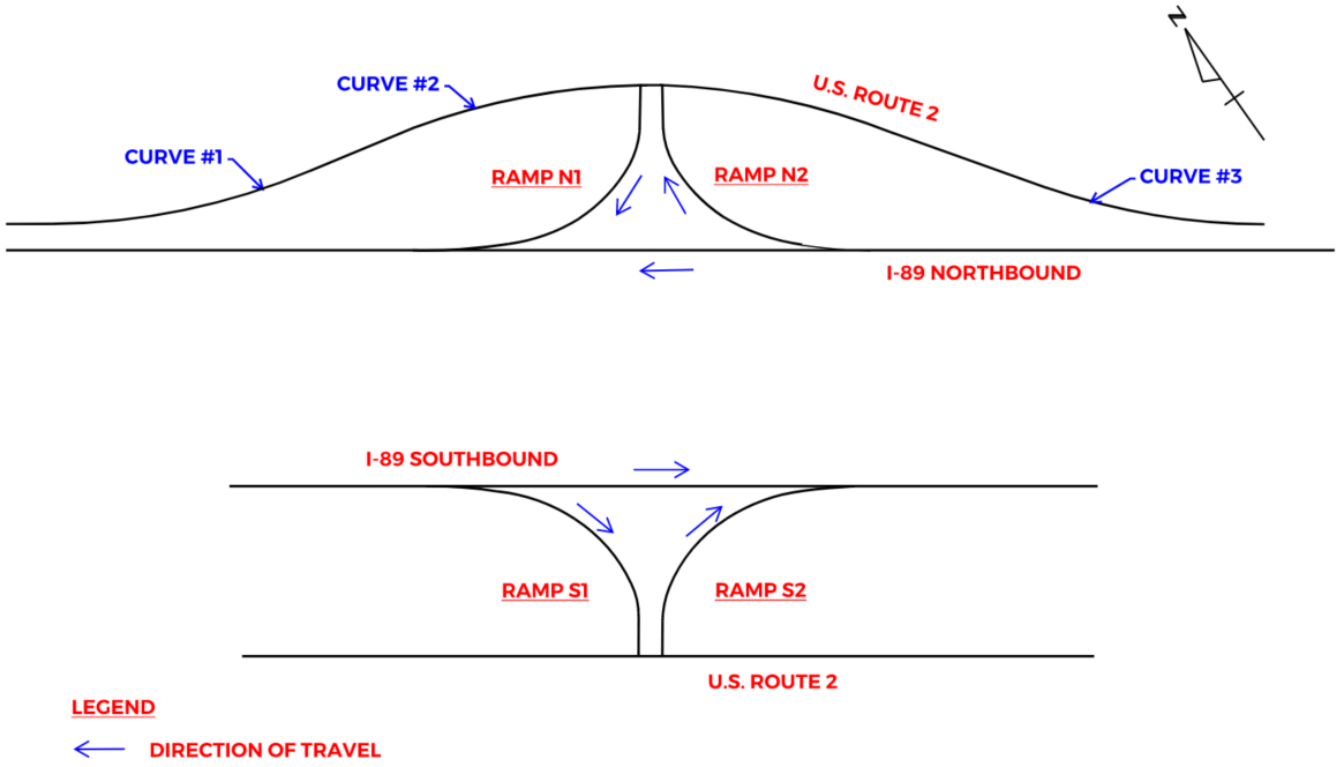
In addition, the Vermont State Standards specify that within 750 ft of a stop sign the length of curves may be designed up to 15mph below the stated design speed without design exception. From the current plans, it is unclear whether stop signs are planned on Route 2 at the ramps intersection. However, even if stops signs were provided, the length of curves 1 and 3 would still need to be extended since these curves are located more than 750 ft away from the ramps intersection.

Another non-compliant aspect of design is the maximum vertical grade of Route 2 as per Vermont State Design Standards. The classification of roadway falls under a Minor Arterial at 50mph, therefore the maximum rolling grade shall be 5%. Plans show that Route 2 has been designed to have a 6.1% vertical grade, therefore exceeding design standard.

All other design elements meet the current design standards specified by 2018 AASHTO and the Vermont State Design Standards.

The figure below shows a sketch of the Bolton Interchange. For more detailed plans of this interchange, refer to Appendix A.

Figure 2 - Bolton Interchange Sketch



3.2 ENVIRONMENTAL PERMITTING ANALYSIS

3.2.1 *NEPA REVIEW*

WSP reviewed the Supplemental Draft Environmental Impact Statement (DEIS) dated September 1994 to identify items that would need to be updated or re-assessed to adhere to current NEPA regulations. The Supplemental DEIS identified the existing conditions for the year 1993, and two build scenarios for the years 2000 and 2020. Accordingly, the following technical areas as described in the 1994 Supplemental DEIS would require re-assessment or, if not addressed, would have to be examined to determine if they are currently relevant.

- The Purpose and Need would have to be revisited to determine if the same needs or problems are present that the project would address or solve.
- Alternatives would have to be revisited based on any revisions to the purpose and need, as well to account for changes that make design options or technologies feasible and practical that were not previously contemplated.
- The affected environmental (existing conditions) and analysis of environmental consequences, (direct, indirect and cumulative impacts) to all resources would have to be updated to address changed conditions on the ground since 1994, changes since 1994 to federal and state laws and/or regulations protecting particular resources, and the outcome of court cases since 1994 that have addressed interpretations of the laws and regulations. These include, but are not limited to the following resources/impact areas:
    - Land Use;
    - Social Impacts;
    - Relocation Impacts;
    - Economic Impacts;
    - Farmland;
    - Pedestrians/ Bicyclists/ Recreation;
    - Air Quality;
    - Noise;
    - Water Resources/Quality;
    - Wetlands and Waterways;
    - Floodplains;
    - Seton 4(f) Resources;
    - Threatened and Endangered Species;
    - Historic and Archeological Resources;
    - Hazardous Waste Sites;
    - Visual Resources; and
    - Environmental Justice.

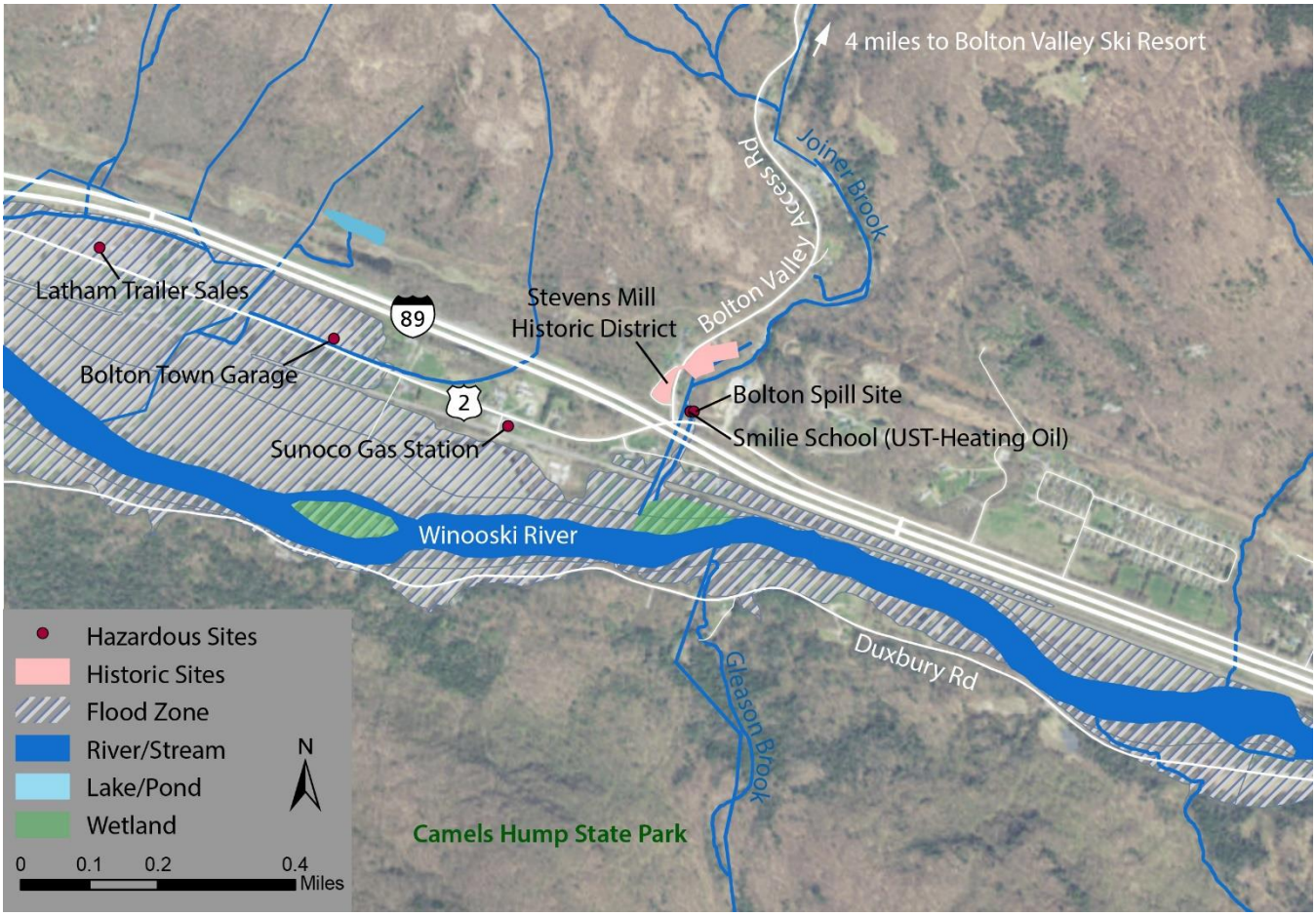
The following supplemental assessments cited in the Supplemental DEIS would also require re-assessment or revision:

- Cost-Benefit Analysis;
- Land Development Capacity Analysis; and

- Fiscal Impact Analysis.

The figure below shows the environmental resources present in the vicinity of the Bolton Interchange.

Figure 3 - Bolton Interchange Environmental Resources



3.2.2 *POTENTIAL PROJECT ROADBLOCKS*

Based on our review of the Supplemental DEIS and project documents, we have identified several potential project roadblocks. Due to the age of the Supplemental DEIS, very little would be salvageable and the EIS would likely have to be revised and re-assessed in its entirety to reflect new existing conditions, and to comply with changes to federal and state regulations, court decisions that affect the way the regulations are interpreted, and changes such as species added or removed from protection under the Federal Endangered Species Act. Vermont regulations would have to be adhered to as well such as Act 250 Statute (10 V.S.A. Chapter 151), which provides a public, quasi-judicial process for reviewing and managing the environmental, social, and fiscal consequences of major subdivisions and developments in Vermont. The project would also be required to initiate a new public involvement

process for comments on the revised environmental review and to provide another opportunity for NEPA scoping, given the likely revisions to the purpose and need and potential for changes to the alternatives analysis and conclusions.

To initiate Act 250 review, consultation is required with the local District Environmental Commission, who upon request will issue a Jurisdictional Opinion (JO) to determine whether a proposed project is subject to Act 250. If applicable, the project is then assessed for compliance against 10 criteria. For transportation projects the following criteria are likely to be applicable: Criterion 1: Air & Water Pollution, Criterion 5: Transportation, Criterion 8: Aesthetics, Historic Sites, and Rare and Irreplaceable Natural Areas, Criterion 8(A): Wildlife Habitat and Endangered Species, and Criterion 10: Town and Regional Plans. Pursuant to Act 250, the burden of proof of compliance under Criteria 1 through 4, and 9 and 10 is on the applicant, while the burden is on the opponent under Criteria 5 through 8, and 9A. The local District Environmental Commission will review the supporting information, and upon satisfactory completion will issue the requested land use permit and findings of fact, conclusions of law and order.
The Bolton Supplemental DEIS states Act 250 compliance would be required in the future. A search of the Act 250 Database determined there is an existing Bolton Interchange project (4C0776); however, no materials associated with the project are available. If any materials were prepared for Act 250 compliance, they would have likely been based on the Supplemental DEIS and would therefore require revision and re-assessment. Information supporting compliance with each of the applicable criterion defined by Act 250 would need to be developed prior to issuance of the land use permit. Notably, as discussed previously, the project area is within an area of high sensitivity for archeological resources and sufficient information would have to be provided for the District Commission to determine compliance with Criterion 8: Aesthetics, Historic Sites, and Rare and Irreplaceable Natural Areas.

Separately, the Supplemental DEIS made the argument that because much of the surrounding area did not provide municipal sewer and water, the project would be less likely to spur development. Based on advances in building technology and development trends, we do not believe that would be a viable rationale going forward. Residential development that could be causally linked to the project would be required to be considered in the assessment and would likely exacerbate concerns that were identified during the public involvement process of the DEIS, potentially furthering opposition to the project.
Lastly, as identified in the Supplemental DEIS as an “unresolved issue” the project area is within an area of high sensitivity for archeological resources because of its location in the Winooski River corridor, which was utilized as a Native American travel route; this condition remains today.

3.2.3 *GIS DATA NEEDS*

WSP has reviewed the Proposed Improvement Plan or the Town of Bolton, County of Chittenden for the Interstate Route 89 (FAI) and US Route 2 (FAS) Interchange (1988) prepared by Vollmer Associates. Given that the plans are over 30 years old and both roadway and non-roadway typography has changed, a comprehensive GIS data collection effort is needed.

The following is a list of GIS data needs that should be collected and assessed to begin a re-evaluation and/or redesign of proposed improvements at this location. WSP expects that much of this information can be found on the Vermont Open Geodata Portal.

- Transportation Network Data
  - Roadway Centerlines/Edges, including
    - Speed Limit
    - AADT
    - Lane Width
    - Grade
    - Curvature
  - Sidewalks
  - Bicycle Infrastructure
  - Trails
  - Transit Data
    - Rail Lines/Stops
    - Bus Lines/Stops
  - Bridges/Culverts
  - Crash Data
  - Signage
  - Emergency Routes
  - Pavement Condition
  - Guardrails
  - Park and Ride Locations
- Environmental Data
  - Wetlands
  - Hydrography
  - Soil Type
  - Flood Zones
  - Priority Habitats
  - Open Space (Private/Municipal/Federal)
  - Hazardous Waste Sites
  - Easements
  - Water Protection Areas
- Civil/Miscellaneous
  - Parcels
  - Utilities (including water, electric, sewer, etc.)
  - Land Use (Current and Future)
  - Zoning
  - Contours/Elevation
  - Municipal Boundaries
  - Historic Districts/Structures
  - State/Municipal Owned Property

A Survey of the entire study area should be conducted to create new base mapping, including Route I-89 Northbound, Southbound and adjacent Route 2.

4 MILTON INTERCHANGE ANALYSIS

4.1 GEOMETRIC ANALYSIS

4.1.1 *MATERIAL PROVIDED BY CCRPC*

The geometric review performed by WSP is based on the Interchange Feasibility Study prepared by Storch Engineers in 1987 provided by CCRPC to WSP. This study includes three interchange locations on I-89, one of which is Milton. At the Milton location, three different design alternatives (A, B and C) are discussed in the study. The preferred alternative is a combination of the northbound ramps from Alternative C and the southbound ramps from Alternative B.

The plans provided for this preferred alternative include a limited level of detail. Therefore, the geometric design analysis for this interchange is less detailed than for the Bolton interchange.

4.1.2 *GEOMETRIC ANALYSIS*

The proposed interchange connects I-89 to West Milton Rd (referred to as Mayo Rd in the 1987 Interchange Feasibility Study) and US Route 7. The SB ramps are both located in the southwestern corner of the interchange and connect to Mayo Rd while the NB ramps are both located in the southeastern corner of the interchange and connect to US Route 7.

Four different alignments were evaluated in this geometric analysis: the southbound off-ramp (ramp C), the southbound on-ramp (ramp D), the northbound off-ramp (ramp A) and the northbound on-ramp (ramp B). The new interchange design does not introduce any modifications to Mayo Rd or US Rote 7. Therefore, these two roadways are not included in this geometric design analysis.

The results of the geometric analysis are summarized in Table 3 below. Design elements that meet current geometric standards are color coded in green and the ones that do not meet geometric standards are color coded in red.

Table 3 - Milton Interchange Geometric Analysis

Item	Design Criteria	Ramp A	Ramp B	Ramp C	Ramp D
Horizontal Geometry					
Ramp Design Speed	25-35	55	55	30	50
Superelevation eMax	8%	unknown	unknown	unknown	unknown
Length of Spiral Curve	88 to 103	n/a	n/a	n/a	n/a
Intersection Edge of Pavement Radius (ft)	50	50	50	50	50
Radius of Ramp	134 to 314	1200	700	300	1000
Lane Widths (ft)	12	unknown	unknown	unknown	unknown
Shoulder Widths (ft)					
Left	2 to 4	unknown	unknown	unknown	unknown
Right	6 to 10	unknown	unknown	unknown	unknown
Total traveled way width (ft)	22	24	24	24	24
Length of Accel Lane (ft)	Varies	n/a	650	n/a	600
Length of Decel Lane (ft)	Varies	600	n/a	500	n/a
Length of Ramp (ft)	n/a	1850	200	850	1200
Vertical Geometry					
Max Grade - Ramp	3-7%	2.0%	-0.9%	2.0%	0.5%
Vertical Curve - Crest	19 to 29	450	n/a	200	300
Vertical Curve - Sag	37 to 49	n/a	n/a	n/a	n/a
Stopping Sight Distance	Varies	830	n/a	400	3600

The analysis shows that the acceleration length for Ramp B is non-compliant. We cannot determine the exact ramp speeds used in the design because the super-elevation values are not listed on the plans. However, based on the 700ft horizontal radius and an Emax of 8%, the maximum design speed of Ramp B is 45mph (per AASHTO Table 3-7).

Per AASHTO Table 10-4, the required acceleration length from 45mph to 70mph is 820 ft. As per Table 3 above, the available acceleration length is 650 ft which is non-compliant.

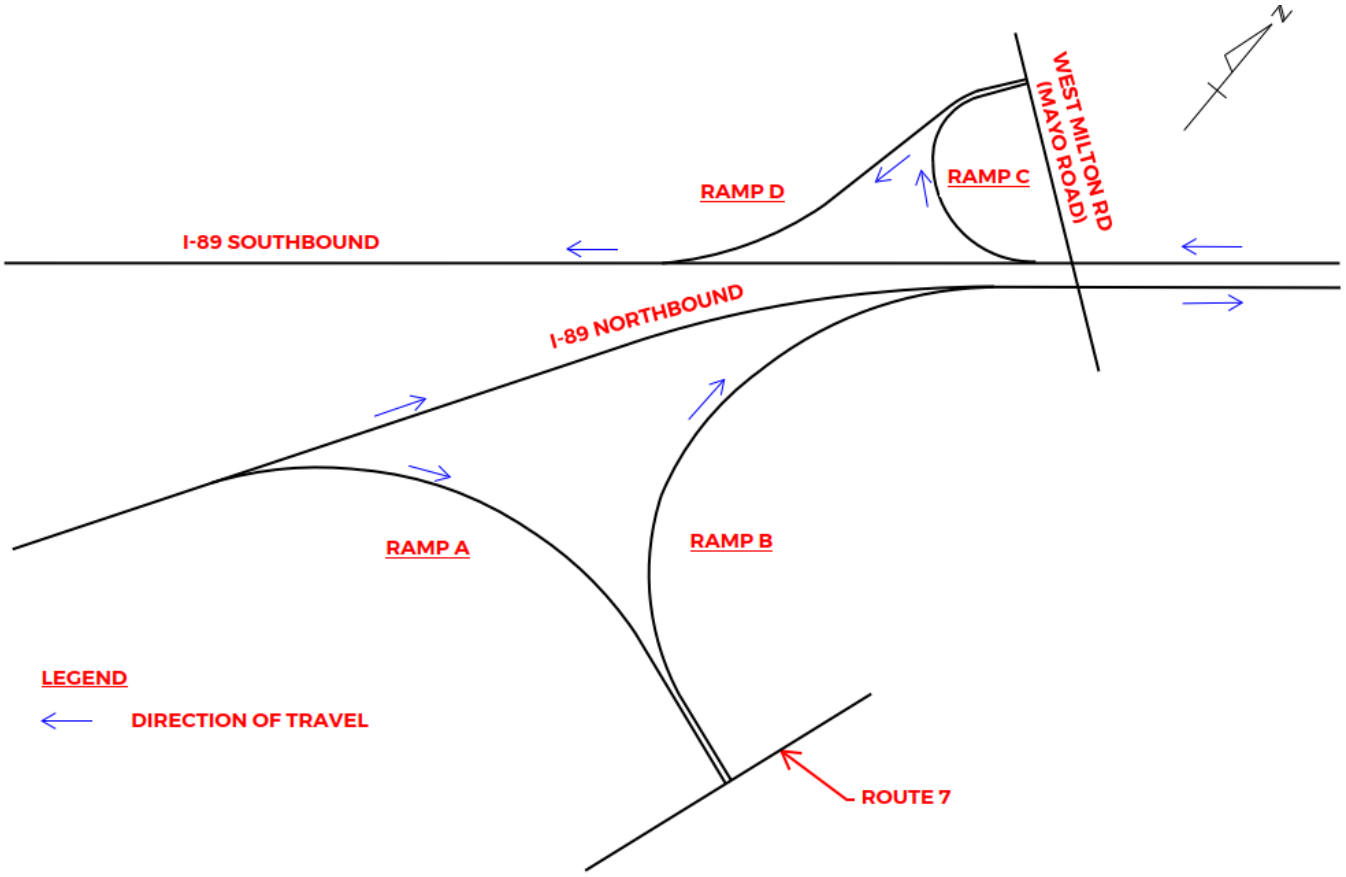
Similarly, the analysis shows that the deceleration length for Ramp C is non-compliant. Based on the 300ft horizontal radius and an Emax of 8%, the maximum design speed of Ramp C is 30mph (per AASHTO Table 3-7).

Per AASHTO Table 10-6, the required deceleration length from 70mph to 30mph is 520 ft. As per Table 3 above, the available acceleration length is 500 ft which is non-compliant.

All other design elements listed in the above table meet the current design standards specified by 2018 AASHTO and the Vermont State Design Standards. However, as previously mentioned the geometric analysis for this interchange is limited due to the conceptual level of the design included in the 1987 Interchange Feasibility Study.

The figure below shows a sketch of the Milton Interchange. For more detailed plans of this interchange, refer to Appendix B.

Figure 4 - Milton Interchange Sketch



4.2 ENVIRONMENTAL PERMITTING ANALYSIS

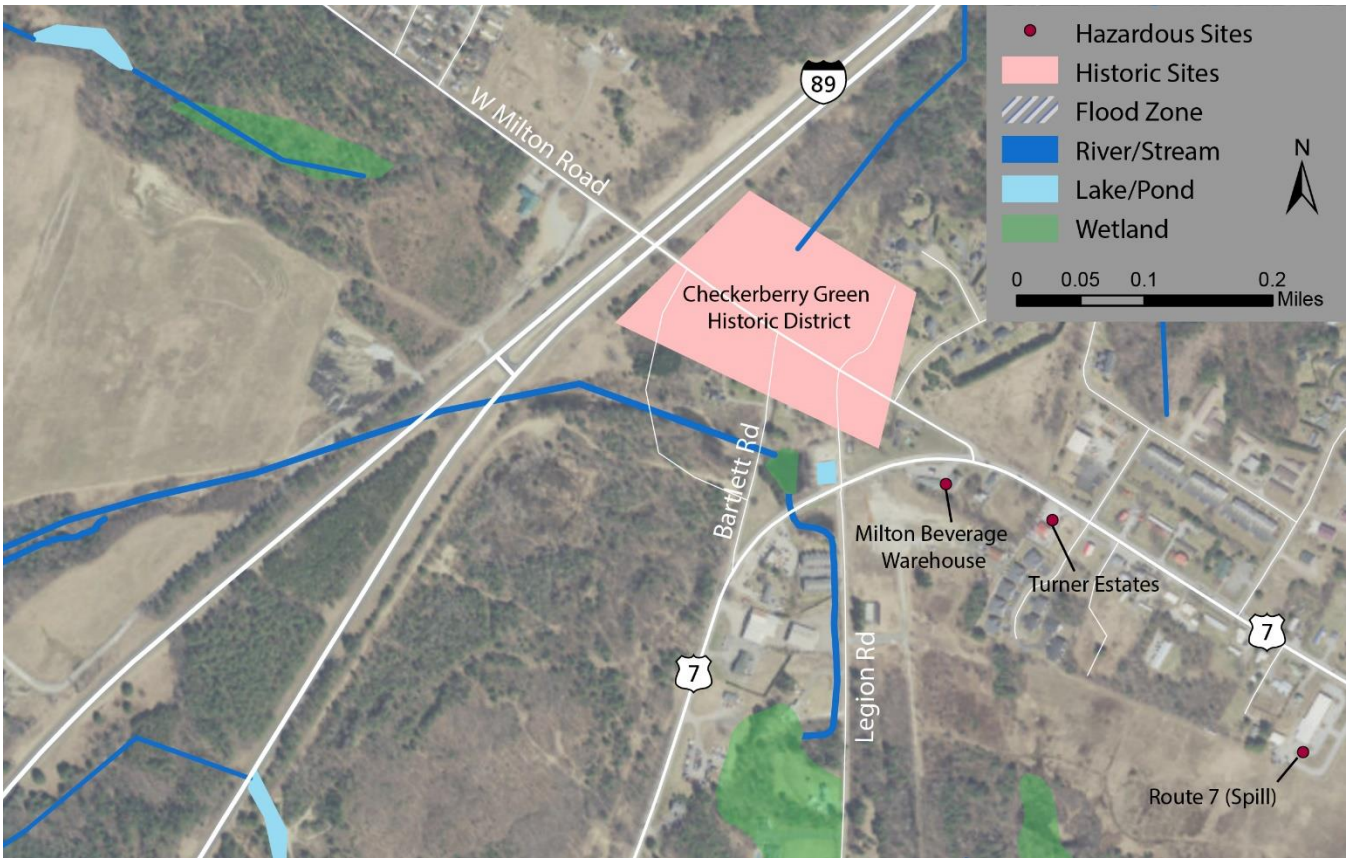
4.2.1 *NEPA REVIEW*

WSP reviewed the Interchange Feasibility Study dated July 1987 to identify items that would need to be updated. The Interchange Feasibility Study utilized methodologies from the 1985 Highway Capacity Manual, the 1984 American Association of State Highway and Transportation Officials (AASHTO) and identified the existing conditions for the year 1985 with a build year of 2010. Formal environmental review was never initiated for the Milton Interchange; therefore, assuming federal funding would be required for the project, assessment pursuant to the National Environmental Policy Act (NEPA) would be required and the Federal highway Administration (FHWA) would be the lead federal agency. FHWA would determine the appropriate level of assessment, or the NEPA "class of action." There are three possible classifications, a Categorical Exclusion, an Environmental Assessment (EA), and an

Environmental Impact Statement (EIS). Based on similar projects, it is likely that the Milton Interchange would be classified as either an EA or an EIS, depending upon whether it is expected that impacts from the project can be mitigated to below significant (EA) or not (EIS). The technical analysis and review process for an EA or an EIS for a given project are not that different and it is expected that the time frame for either an EA or an EIS would range from 18 months to three years, depending upon the nature of the impacts and potential for mitigation. Any analysis of the purpose and need and alternatives included in the 1987 Feasibility Study would have to be updated to comply with the requirements of NEPA, FHWA's current NEPA regulations and other state and federal requirements relative to analysis of impacts to natural and cultural resources.

The figure below shows the environmental resources present in the vicinity of the Milton Interchange.

Figure 5 - Milton Interchange Environmental Resources



4.2.2 *POTENTIAL PROJECT ROADBLOCKS*

Based on our review of the Interchange Feasibility Study and project documents, we have identified several potential project roadblocks. Due to the age of the Interchange Feasibility Study, very little of the study would be salvageable and the report would likely have to be revised and re-assessed in its entirety to reflect new existing conditions, to comply with changes to federal and state regulations, and

to adhere to the latest design guidelines. Vermont regulations would have to be adhered to as well such as Act 250 Statute (10 V.S.A. Chapter 151), which provides a public, quasi-judicial process for reviewing and managing the environmental, social, and fiscal consequences of major subdivisions and developments in Vermont.

The Interchange Feasibility Study found that due to the phased nature of the Catamount Industrial Park and the uncertainty of when it would be built out, the interchange could not be considered economically justifiable. The industrial park appears to have since been constructed, and a revised Cost-Benefit Analysis would have to account for this. However, if the industrial park does not perform in the same way the Interchange Feasibility Study anticipated, then the project could again be determined economically unjustifiable. Additionally, the Interchange Feasibility Study identified separate improvements to West Milton Road (Mayo Road) and U.S. Route 7 that would be necessary to justify the project. Unless these improvements have already been implemented or have been separately funded, the reliance on independent improvements to other roadways could undermine the purpose and need of the project. Furthermore, the discussion of additional improvements to other roadways could result in questions of segmentation, which could significantly expand the scope of the environmental review.

As described in the Interchange Feasibility Study, several alternatives to the project required the taking of residential property. Therefore, the preferred alternative was a configuration that would be near the Checkerberry Village, an eligible historic district on the National Register of Historic Places. Aside from the project's potential effects on historic resources, additional residential properties have been developed in the surrounding area since the preparation of the Interchange Feasibility Study. The presence of historic resources and sensitive receptors (i.e. residences) raise the likelihood that the project could result in potentially significant impacts and would likely warrant an EIS.

Formal environmental review was never initiated for the Milton Interchange, and a search of the Act 250 Database yielded no results. Similar to the Bolton Interchange, Act 250 compliance is anticipated to be required for the Milton Interchange and a JO would confirm applicability. Upon receipt of the JO, information supporting compliance with each of the applicable criterion defined by Act 250 would need to be developed prior to issuance of the land use permit. As discussed previously, the project would be near the Checkerberry Village, an eligible historic district on the National Register of Historic Places. Similar to the Bolton Interchange, Criterion 8: Aesthetics, Historic Sites, and Rare and Irreplaceable Natural Areas would be of particular importance.

4.2.3 *GIS DATA NEEDS*

As mentioned previously, WSP has reviewed the Interchange Feasibility Study dated July 1987 to determine relevant GIS data that would be required to accurately assess feasibility and conduct a re-evaluation and/or redesign of proposed improvements at this location. Given the age of the previous report, it is anticipated that all GIS mapping would need to be recreated with updated data to accurately reflect the existing conditions within the study area. This includes:

- Survey of the entire study area including Route I-89 Northbound, Southbound and adjacent roadways.

    - Of particular importance for updated survey would be any implemented improvements to West Milton Road (Mayo Road) or U.S. Route 7, as proposed in the original feasibility study.
- Transportation Network data, including:
    - Roadway Centerlines/Edges, ideally which includes:
        - Speed Limits
        - AADT and Traffic Generation
        - Lane Width
        - Grade
        - Curvature
    - Sidewalks (if applicable)
    - Bicycle Infrastructure (if applicable)
    - Trails (if applicable)
    - Transit Data
        - Rail Lines/Stops
        - Bus Lines/Stops
    - Bridges/Culverts
    - Crash Data
    - Signage
    - Emergency Routes
    - Pavement Condition
    - Guardrails
    - Park and Ride Locations
- Environmental data to determine potential impacts on natural resources including the following layers:
    - Wetlands
    - Hydrography
    - Soil Type
    - Flood Zones
    - Priority Habitats
    - Open Space (Private/Municipal/Federal)
    - Hazardous Waste Sites
    - Easements
    - Water Protection Areas
- Civil and other miscellaneous data pertaining to the area including:
    - Parcels
    - Utilities (including water, electric, sewer, etc.)
        - Particularly any new utilities or expanded service serving the Catamount Industrial Park
    - Land Use (Current and Future)
    - Zoning
    - Contours/Elevation
    - Municipal or other political boundaries
    - Historic Districts/Structures
    - State/Municipal Owned Property
    - Traffic Generators

5 RECOMMENDATIONS & CONCLUSIONS

This study provided a high-level assessment of previous work completed for the proposed interstate interchange concepts in the Towns of Bolton and Milton. While regional significance to the overall transportation network is difficult to prove, these proposed interchange concepts have garnered continued local interest and support. Should either concept resurface at the regional or state level, significant work will need to be done to move these concepts forward.

As both concepts entail significant changes to the surrounding transportation and environmental resources, they would likely require Environmental Impact Statements (EIS) to satisfy NEPA requirements. This documentation would require a thorough analysis of many factors. WSP recommends that a good first step to advance any new interchange concept in either Bolton or Milton would be a Planning and Environmental Linkages (PEL) study. While a PEL study does not go into the intense detail of an EIS, it does provide the region and the state with a great starting point for a new or revised concept and a thorough understanding of NEPA and other federal environmental requirements.

From a geometric standpoint, all new concepts will be required to meet existing federal and state standards for horizontal and vertical alignments, and roadway width levels. The geometric analysis that is provided in this report shows that most design elements are compliant with the current AASHTO and VTrans design standards. The non-standard elements include two acceleration/deceleration lengths for the Milton interchange and one vertical grade for the Bolton interchange. These elements will need to be revised in subsequent designs. All alternatives will need to address current stormwater and erosion control regulations. A new Milton interchange would require a new alternatives analysis complete with horizontal and vertical data.

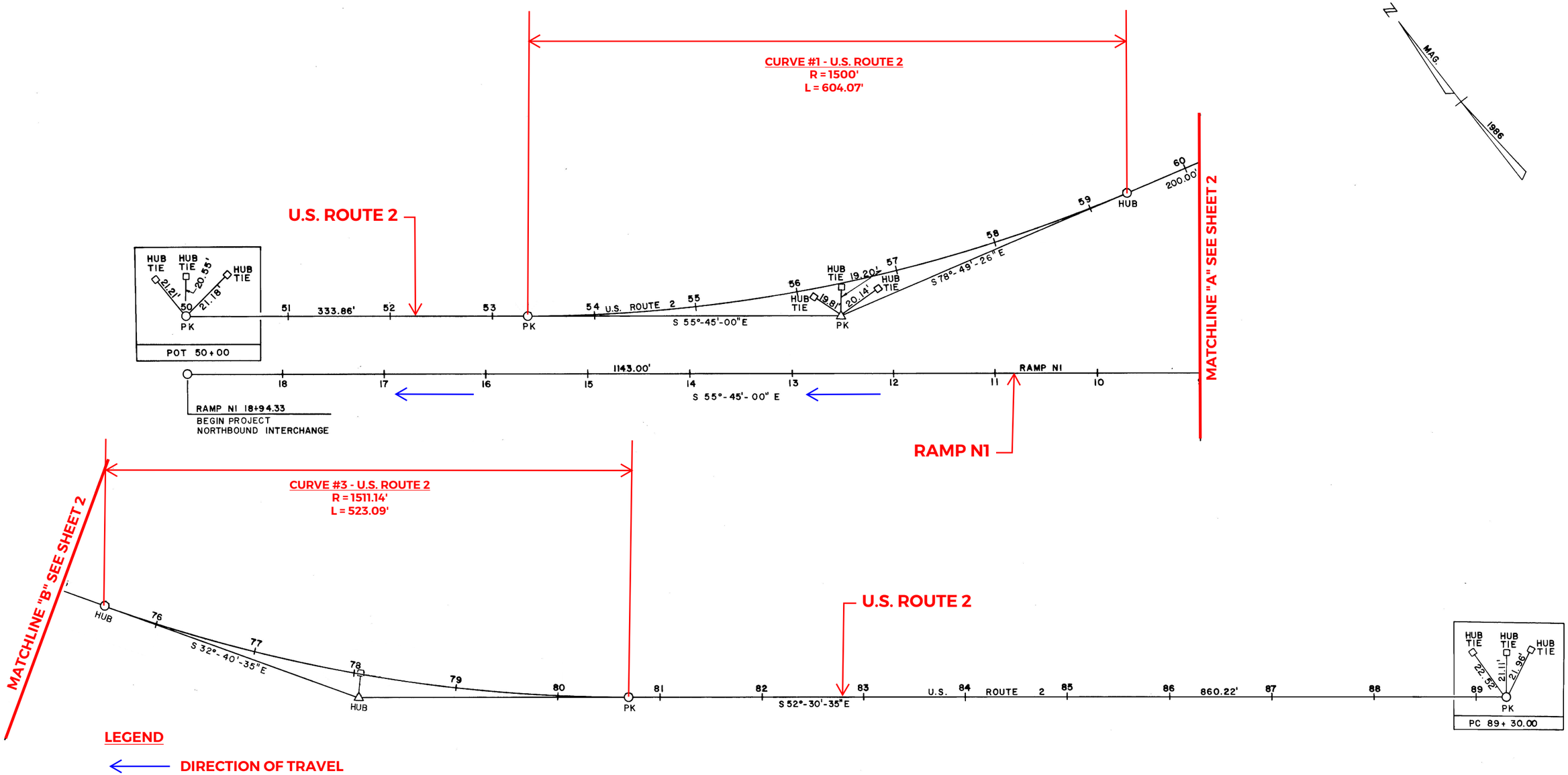
While there are no current efforts in existence to move either the Bolton or the Milton interchange forward, should the region or state decide to revitalize these efforts, the information provided in this report is a starting point for such an effort.

APPENDIX

A

BOLTON INTERCHANGE DESIGN PLANS

BOLTON INTERCHANGE PROPOSED PLAN
RAMPS N1, N2, S1, S2 & ROUTE 2



SHEET 1

CURVE #2 - U.S. ROUTE 2
R = 1500'
L = 1208.14'

N
MAG.
1986

HUB
S 78°-49'-26"E
S 32°-40'-35"E
U.S. ROUTE 2
61
62
63
64
65
66
67
68
69
70
71
72
73
74
200.00'
200.00'
1143.00'
254.23'
S 55°-45'-00"E
254.23'
213.00'
90°
90°
90°
25.00'
97.87'
97.87'
276.31'
276.31'
504.81'
N 34°-15'-00"E
N63°-40'-48"E
S09°-49'-12"W
N88°-29'-26"E
S23°-00'-34"E
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
N1
N2
RAMP
RAMP

CURVE #1 - RAMP N1
R = 180.0'
L = 80.0'

CURVE #3 - RAMP N2
R = 180.0'
L = 80.0'

CURVE #2 - RAMP N2
R = 350.0'
L = 170.0'

RAMP N2

RAMP N1

CURVE #2 - RAMP N1
R = 350.0'
L = 170.0'

CURVE #3 - (SPIRAL)
RAMP N1
L = 400.0'

CURVE #1 - (SPIRAL)
RAMP N2
L = 400.0'

HUB TIE
4.57'
3.99'
4.37'
5.13'
3.89'
5.18'
4.95'
3.81'
4.55'

ST 7+51.33
SPIRAL PI 14+84.38=
14+75.37
TS 12+13.00
POT 10+00

RAMP N2 10+00
END PROJECT
NORTHBOUND INTERCHANGE

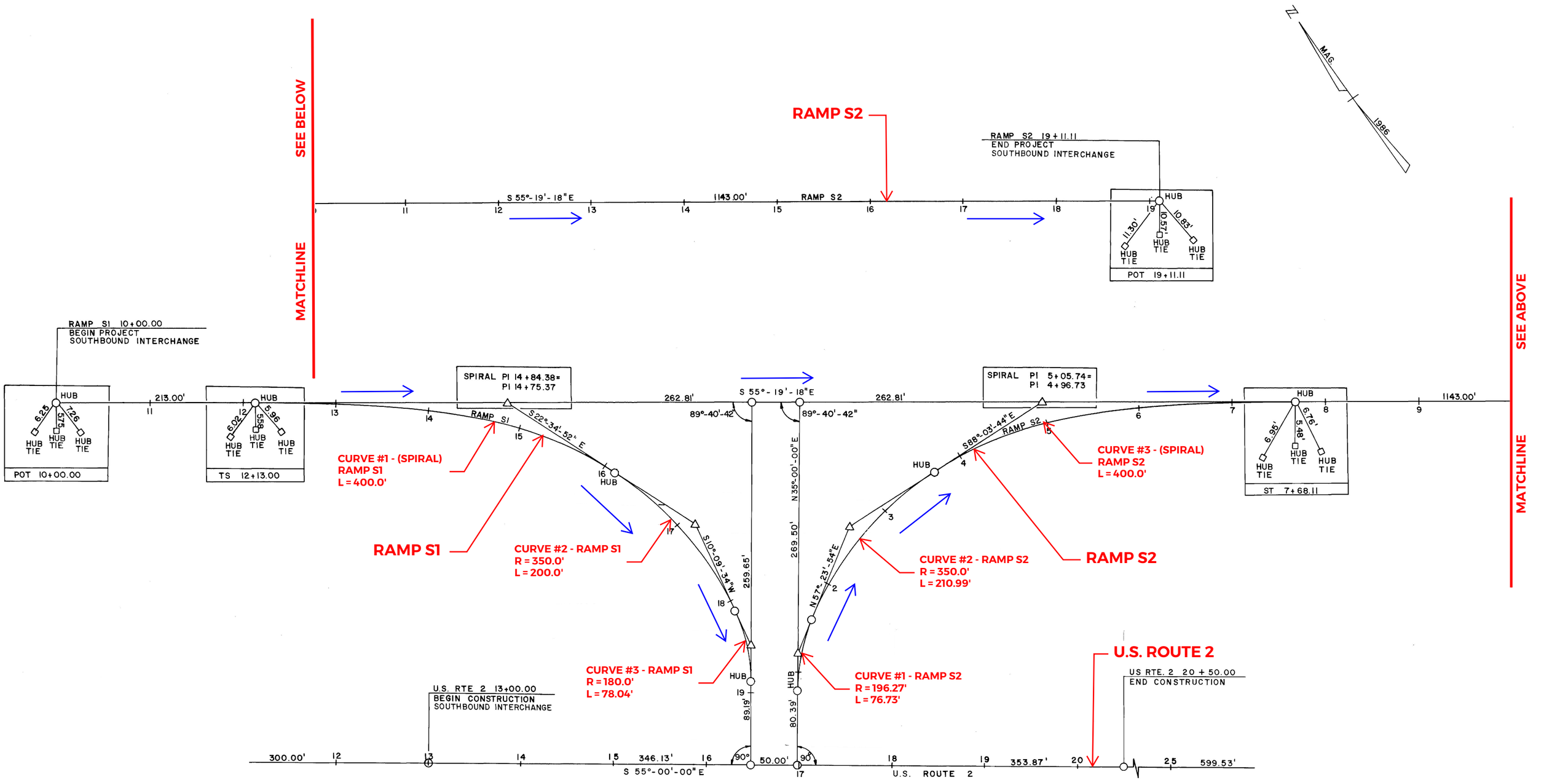
MATCHLINE "A" SEE SHEET 1

MATCHLINE "B" SEE SHEET 1

LEGEND

DIRECTION OF TRAVEL

SHEET 2


SEE BELOW
MATCHLINE
RAMP S2
RAMP S2 19+11.11
END PROJECT
SOUTHBOUND INTERCHANGE
S 55°-19'-18"E
1143.00'
RAMP S2
HUB
11.30'
10.57'
10.83'
HUB TIE
HUB TIE
HUB TIE
POT 19+11.11
N
MAG.
1986
SEE ABOVE
MATCHLINE
RAMP S1 10+00.00
BEGIN PROJECT
SOUTHBOUND INTERCHANGE
HUB
6.25'
7.26'
5.75'
HUB TIE
HUB TIE
HUB TIE
POT 10+00.00
213.00'
HUB
6.02'
5.96'
5.58'
HUB TIE
HUB TIE
HUB TIE
TS 12+13.00
SPIRAL PI 14+84.38=
PI 14+75.37
RAMP S1
S 22°-34'-52" E
CURVE #1 - (SPIRAL)
RAMP S1
L = 400.0'
RAMP S1
CURVE #2 - RAMP S1
R = 350.0'
L = 200.0'
S 10°-09'-34"W
259.65'
CURVE #3 - RAMP S1
R = 180.0'
L = 78.04'
HUB
89.19'
U.S. RTE 2 13+00.00
BEGIN CONSTRUCTION
SOUTHBOUND INTERCHANGE
300.00'
346.13'
S 55°-00'-00" E
90°
50.00'
90°
262.81'
S 55°-19'-18"E
262.81'
89°-40'-42"
89°-40'-42"
N 35°-00'-00"E
269.50'
80.39'
HUB
HUB
SPIRAL PI 5+05.74=
PI 4+96.73
S 88°-03'-44" E
RAMP S2
CURVE #3 - (SPIRAL)
RAMP S2
L = 400.0'
CURVE #2 - RAMP S2
R = 350.0'
L = 210.99'
N 57°-23'-54"E
RAMP S2
CURVE #1 - RAMP S2
R = 196.27'
L = 76.73'
HUB
HUB
6.95'
6.76'
5.48'
HUB TIE
HUB TIE
HUB TIE
ST 7+68.11
1143.00'
U.S. ROUTE 2
US RTE. 2 20+50.00
END CONSTRUCTION
353.87'
599.53'
U.S. ROUTE 2
U.S. ROUTE 2
LEGEND
DIRECTION OF TRAVEL

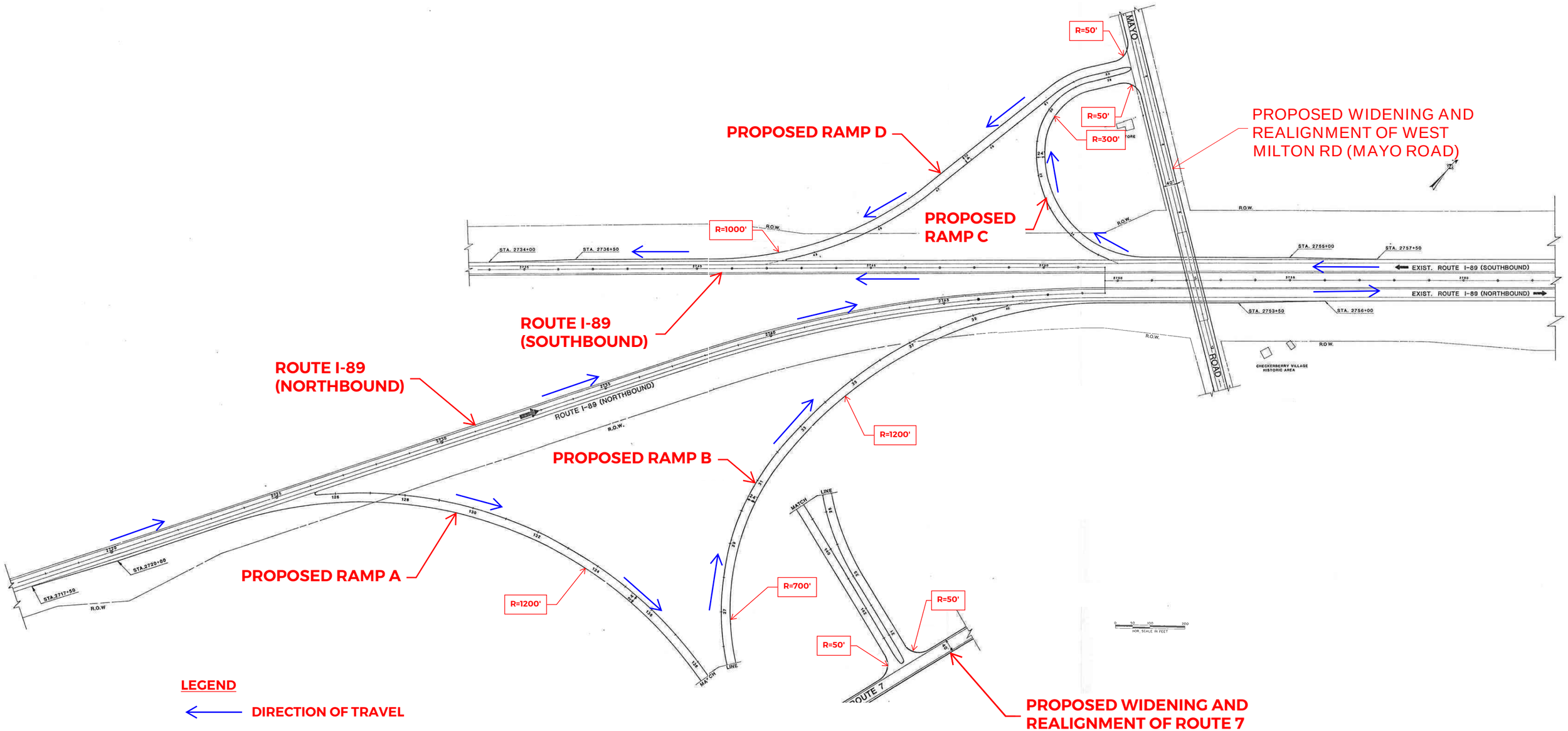
SHEET 3

APPENDIX

B

MILTON INTERCHANGE DESIGN PLANS

MILTON INTERCHANGE PROPOSED PLAN
RAMPS A, B, C & D



LEGEND

DIRECTION OF TRAVEL