PRELIMINARY ENGINEERING TECHNICAL REPORT
APPENDIX A
DESIGN CRITERIA

Design Criteria

Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
FHWA	Federal Highway Administration
USDOT	US Department of Transportation
VTrans	Vermont Agency of Transportation
VSS	Vermont State Standards

Introduction

The Geometric Design Standards presented herein are the initial and draft standards for use on this project, and will be expanded as needed during the preliminary engineering phase. These standards include both Critical Design Elements of primary importance to the FHWA and VTrans and General Design Elements representing common design values, policies and practices. Every reasonable effort will be made to meet the Critical Design Element standards as Geometric Design Exceptions are required in instances where the Critical Design Element criteria cannot be met.

General Geometric Design Standards

The Geometric Design Standards presented here are consistent with the most recent versions of design polices of VTrans, AASHTO, and the FHWA. These policies are stated in the following publications:

- VTrans Vermont State Standards for the Design of Transportation Construction Reconstruction and Rehabilitation on Freeways, Roads, and Streets.
- VTrans Traffic Control Design Guideline.
- VTrans Level of Service Policy.
- VTrans Vermont Pedestrian and Bicycle Facility Planning and Design Manual.
- VTrans The Vermont Stormwater Management Manual
- VTrans Vermont Agency of Transportation Hydraulics Manual
- AASHTO A Policy on Geometric Design of Highways and Streets, 2004.
- AASHTO Roadside Design Guide,
- FHWA Roundabouts: An Informational Guide,2000.
- FHWA Flexibility in Highway Design, 1997.

The Geometric Design Standards presented below are organized by the EIS alternatives which follow either the Vermont Route 2A or CIRC A/B corridors. All of the alternatives under consideration would classify as Arterials, Principal Arterial, Arterial Highways or Collector Roads with the principal difference consisting of variations in design speed and control of access.

Vermont Route 2A Corridor Alternatives

Vermont Route 2A is a principal arterial within the project limits, design standards which apply to alternatives along this corridor include the Vermont State Standards (VSS), AASHTO *A Policy on*

Geometric Design of Highways and Streets 2004 (AASHTO) criteria where they are not in conflict with the VSS, and the Vermont Level of Service Policy (LOSP) which allows design for a lower level of service in areas where negative impacts would outweigh the benefits of maintaining the desirable level of service.

Table 1 Geometric Design Standards

Vermont Route 2A Corridor Alternatives

Critical Design Element	Proposed Condition	Reference
Design Speed	35 – 45 mph	VSS Section 3.3
Minimum Stopping Sight Distance	325-400 ft	AASHTO Exhibit 7.1, VSS Table 3.1
Maximum Grades	7%	VSS Table 3.6
Minimum Horizontal Alignment Radius	2,220	AASHTO Exhibit 3-27
Vertical Alignment K Value Crest	80 – 120	VSS Table 3.1
Vertical Alignment K Value Sag	70 – 90	VSS Table 3.1
Normal Cross Slope	2%	VSS Section 3.12
Maximum Super-elevation	4%	VSS Section 3.13
Lane Width	11-12 ft	VSS Section 3.5
Shoulder Width Right	4 ft	VSS Table 3.8
Shoulder Width Left	4 ft	VSS Table 3.8
Bridge Shoulder Width Right	4 ft	VSS Section 3.7
Bridge Shoulder Width Left	4 ft	VSS Section 3.7
Vertical Clearance	16 ft	VSS Section 3.8
Horizontal Clearance – Clear Zone	16 ft	VSS Table 3.4
General Design Element	**Proposed Condition**	**Reference**
Backslopes & Foreslopes		VSS Table 3.4
Bikeways		Standard A-78, 79, & 80
Bus Turnouts		TBI
Curbs		Standard C-1
Level of Service	C	AASHTO 470 LOSP, VSS Section 3.2
Minimum Corner Sight Distance	495 ft	VSS Table 3.2

CIRC A/B Corridor Limited Access Alternatives

The CIRC A/B corridor is an arterial highway with full access control and the purpose of carrying through traffic and providing no direct access to abutting properties. Design standards which apply to alternatives along this corridor are found within AASHTO Chapter 7 Rural and Urban Arterials and Chapter 8 Freeways. The VSS Section 3.0 Principal Arterials provides overriding criteria and Section 2.0 Freeways supplements AASHTO criteria with Special Design Guidelines.

Table 2 Geometric Design Standards
CIRC A/B Limited Access Corridor Alternatives

Critical Design Element	Proposed Condition	Reference
Design Speed	50 mph	AASHTO 503 VSS 3.3
Minimum Stopping Sight Distance	400 - 475 ft	AASHTO Exhibit 7.1 VSS Table 3.1
Maximum Grades	5%	VSS Table 3.5
Minimum Horizontal Alignment Radius	3,120	AASHTO Exhibit 3-27
Vertical Alignment K Value Crest	110 – 160	VSS Table 3.1
Vertical Alignment K Value Sag	90 - 110	VSS Table 3.1
Normal Cross Slope	2%	VSS Section 3.12
Maximum Super-elevation	8%	VSS Section 3.13
Lane Width	12 ft	AASHTO 448 VSS 3.6
Shoulder Width Right	8 ft	AASHTO 448 VSS 3.6
Shoulder Width Left	4 ft	AASHTO 448 VSS 3.6
Bridge Shoulder Width Right	8 ft	VSS Section 3.7
Bridge Shoulder Width Left	4 ft	VSS Section 3.7
Guard Rail Clearance	2 ft	VSS Table 3.3
Vertical Clearance	16 ft	VSS Section 3.8hg
Horizontal Clearance – Clear Zone	24 ft	VSS Table 3.4
General Design Element	**Proposed Condition**	**Reference**
Backslopes & Foreslopes		
Bikeways		
Climbing Lanes		
Level of Service	C	AASHTO 504, VSS 3.2
Minimum Corner Sight Distance	550 ft	VSS Table 3.2
Signals		

CIRC A/B Corridor Boulevard Alternatives

The CIRC A/B Boulevard alternative would be designed as a principal arterial with at-grade intersections. Design standards which apply to this alternative are found within the VSS and AASHTO Chapter 7 Rural and Urban Arterials. These standards are the same as those applied to the VT Route 2A Corridor Alternatives.

CIRC A Street

The CIRC A Street alternative would be designed as a Collector Road with at-grade intersections. Design standards which apply to this alternative are found within the VSS Chapter 5 Collector Roads and Streets and AASHTO Chapter 6 Collector Roads and Streets.

Table 3 Geometric Design Standards
CIRC A Street Alternatives

Critical Design Element	Proposed Condition	Reference
Design Speed	30 mph	VSS 5.3
Minimum Stopping Sight Distance	200 ft	VSS Table 5.1
Maximum Grades	7 - 9%	VSS Table 5.6 & 5.7
Minimum Horizontal Alignment Radius	380	AASHTO
Vertical Alignment K Value Crest	30	VSS Table 5.1
Vertical Alignment K Value Sag	40	VSS Table 5.1
Normal Cross Slope	2%	VSS Section 5.12
Maximum Super-elevation	8%	VSS Section 5.13
Lane Width	11-12 ft	VSS Section 5.5 Table 5.3
Shoulder Width Right	3 ft	VSS Table 5.3
Shoulder Width Left	3 ft	VSS Table 5.3
Bridge Shoulder Width Right	3 ft	VSS Section 5.7
Bridge Shoulder Width Left	3 ft	VSS Section 5.7
Vertical Clearance	14 ft	VSS Section 5.8
Horizontal Clearance – Clear Zone	16 ft	VSS Table 5.5
General Design Element	**Proposed Condition**	**Reference**
Backslopes & Foreslopes		
Bikeways		
Level of Service	D	AASHTO 504 VSS 3.2
Minimum Corner Sight Distance	330 ft	VSS Table 5.2
Signals		

Roundabouts

Roundabouts are components of several of the Vermont Route 2A alternatives. Design criteria for roundabouts are contained within the US Department of Transportation Federal Highway Administration Publication FHWA-RD-00-067 *Roundabouts: An Informational Guide.* Additional criteria are contained in guidelines from the states of New York and Maryland. A number of general criteria will be of primary consideration for several locations along Vermont 2A, these include the diameter, number of lanes, entry speed, and number of legs. This information is summarized in Exhibit 1-7 of the aforementioned guides and is presented in part below as Table 4.

Table 4 Critical Design Elements

Roundabouts

Critical Design Element	Urban Single Lane	Urban Double Lane	Rural Single Lane	Rural Double Lane
General				
Maximum Entry Speed	20 mph (30 mph)	25 mph (30 mph)	25 mph (30 mph)	30 mph (30 mph)
Entering Lanes/Approach	1	2	1	2
Inscribed Circle Diameter	100 - 130 ft	150 - 180 ft	115 - 130 ft	180 - 200 ft
Typical ADT on 4-leg Roundabout (veh/day)	20,000 vpd	20,000+ vpd	20,000 vpd	20,000 + vpd

Maximum Circulating + Entry Vol.	1800 vph	2400 – 3400 vph	1800 vph	2400 – 3400 vph
Typical Design Vehicle	[WB-50]	[WB-50]	[WB-67]	[WB-67]
Grade	-4.0 to 4.0%	-4.0 to 4.0%	-4.0 to 4.0%	-4.0 to 4.0%
Stopping Sight Distance (Based on maximum entry speed)	115 ft	155 ft	155 ft	200 ft
Intersection Sight Distance (Based on conflicting approach speed)	190 ft	240 ft	240 ft	290 ft
Length of Splitter Island	50 ft	50 ft	200 ft	200 ft
Entry				
Effective Flare Length	80 ft min. (12.5 – 100 m, 30 m preferred) [100 – 300 ft]	80 ft min. (12.5 – 100 m, 30 m preferred) [100 – 300 ft]	130 ft min. (12.5 – 100 m, 30 m preferred) [100 – 300 ft]	130 ft min. (12.5 – 100 m, 30 m preferred) [100 – 300 ft]
Minimum Entry Width	(3.0 m) [11 ft per lane]	(3.0 m) [11 ft per lane]	(3.0 m) [11 ft per lane]	(3.0 m) [11 ft per lane]
Maximum Entry Width	4.3 to 4.9 m typ. (10.5 m) [15 ft per lane]	(15.0 m) [15 ft per lane]	4.3 to 4.9 m typ. (10.5 m) [15 ft per lane]	(15.0 m) [15 ft per lane]
Entry Radius	33 – 98 ft (10 – 100 m, 20 m preferred) [50 ft min.]	50 – 230 ft (10 – 100 m, 20 m preferred) [100 ft min]	33 – 98 ft, successive curves recommended (10 – 100 m, 20 m preferred) [50 ft min.])	50 – 230 ft, successive curves recommended (10 – 100 m, 20 m preferred) [100 ft min]
Entry Angle	(20 – 60°, 30 – 40° desirable) [20 – 60°, 30 – 40° desirable]	(20 – 60°, 30 – 40° desirable) [20 – 60°, 30 – 40° desirable]	(20 – 60°, 30 – 40° desirable) [20 – 60°, 30 – 40° desirable]	(20 – 60°, 30 – 40° desirable) [20 – 60°, 30 – 40° desirable]
Maximum Entry Superelevation	(5.0%)	(5.0%)	(5.0%)	(5.0%)
Circulating Roadway				
Circulating Roadway Cross Slope	2% (0.5 – 2.5%) [2% max.]	2% (0.5 – 2.5%) [2% max.]	2% (0.5 – 2.5%) [2% max.]	2% (0.5 – 2.5%) [2% max.]
Truck Apron Cross Slope	3 – 4% (2%)	3 – 4% (2%)	3 – 4% (2%)	3 – 4% (2%)
Circulating Roadway Width	1.0 – 1.2 times max. entry width	1.0 – 1.2 times max. entry width	1.0 – 1.2 times max. entry width	1.0 – 1.2 times max. entry width
Central Island Slope	(2%) [6:1]	(2%) [6:1]	(2%) [6:1]	(2%) [6:1]
Exit				
Minimum Exit Radius	50 ft (20 – 100 m, 20 m preferred)	Not Provided (20 – 100 m, 40 m preferred)	50 ft (20 – 100 m, 20 m preferred)	Not Provided (20 – 100 m, 40 m preferred)
Pedestrian Access				
Crosswalk Location from Yield Line	1 car length (7.5 m) [1 – 3 car lengths]	1 – 3 car lengths (7.5 – 22.5 m) [1 – 3 car lengths]	1 car length (7.5 m) [1 – 3 car lengths]	1 – 3 car lengths (7.5 – 22.5 m) [1 – 3 car lengths]
Sidewalks Setback	5.0 ft [6.0 ft]	5.0 ft [6.0 ft]	5.0 ft [6.0 ft]	5.0 ft [6.0 ft]
Minimum Splitter Island Width at Crosswalk	1.8 m	1.8 m	1.8 m	1.8 m
Splitter Island Length	50 ft min.	50 ft min.	50 ft min.	50 ft min.

xx – FHWA Roundabouts: An Informational Guide

(xx) – NYS Roundabouts: Interim Requirements and Guidance – provided only where different than FHWA.

[xx] – Maryland DOT Roundabout Design Guidelines 1994 – provided only where different than FHWA.

There are numerous other geometric design standards affecting capacity contained within Chapter 6 of the Roundabout Guide that come into play during detailed design.