Summary Report

Modified Improvement Plan for the Sagamore Rotary

Grade Separated Interchange With Modern Roundabout Intersections

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1. INTRODUCTION

This report summarizes an alternative improvement plan, utilizing the MASS Highway’s grade separated interchange concept and configuration to replace the existing Sagamore Rotary at the Route 6 / Route 3 intersection.

This summary report proposes an alternate plan that reflects a modified version of the MASS Highway’s preferred alternative plan that utilizes a grade separated Route 3 for north-south traffic movements but replaces the signalized ramp terminal intersections with modern roundabout intersections.

The modified plan with modern roundabout intersections offer improved safety, traffic flow and geometric flexibility for the connecting roadways. This geometric flexibility allows this alternative plan to considerably reduce the negative impact on residential property, business access, local roadway connectivity and environmental concerns as compared to those associated with the MASS Highway’s preferred alternative.

The proposed alternative improvement plan utilizes many of the key design components and all of the required engineering criteria from the MASS Highway’s preferred alternative including:

- Grade separating Route 3 traffic with on-off ramp access from Scenic Highway and State Road (Route 6).

- Compliance with engineering requirements:
  - Vertical clearance
  - Vertical profile constraints associated with the Cape Cod Canal Bridge
  - Acceleration and deceleration distances required for on/off ramps

- Shifting the SB Route 3 traffic into one lane prior to the on-ramp merge and Bridge structure. This is required for good performance with the long-range traffic flows under both scenarios.

The findings of this summary report and accompanying CADD drawings are based on the short and long-range traffic volumes, engineering criteria and constraints as determined and reported in the Route 3 / Route 6 Sagamore Rotary Grade Separation Environmental Assessment (EA) and Draft Environmental Impact Report (EIR) dated June 2, 2003 prepared by the MASS Highway Department (volumes 1-3).

This alternative plan and analysis was completed under the supervision of a recognized expert (Barry Crown) in the field of roundabout design with 30 of experience in the U.K. and U.S.

The MASS Highway department should be commended for their efforts to find a solution for what is a very challenging location.
2. MODERN ROUNDABOUTS

Modern roundabout are superficially similar to rotaries and their important differences are not immediately obvious. As modern roundabouts are new to the USA few have experienced their benefits. With their bad experience of traffic circles it is easy to understand why engineers, decision makers, public agencies and the general public alike find it difficult to understand that a smaller modern roundabout operates very differently to Rotaries and that they have higher capacity and lower crash rates.

However, many communities in the U.S. have now implemented roundabouts with great success.

Rotaries Versus Roundabouts

The Sagamore Rotary was designed in the 1940’s. Many Rotaries were built in this time frame on the east coast. Rotaries worked well with low traffic volumes, but congestion, crashes and driver discomfort increased sharply at high traffic volumes. The inherent design defects to Rotaries are their large diameter, high speed entries, high speed weaving and lack of consistent signing and good pavement markings that produce an inconsistent and confusing message to drivers (lack of positive driver guidance). The Sagamore Rotary exemplifies the above problems. Below is a photo of a 200’ diameter roundabout replacement of a 600’ rotary in Ulster New York.

| Figure 1: Ulster New York: Courtesy of N.Y. State DOT |
Modern roundabout design is based on extensive research and engineering experience derived over the last 35 years primarily in the UK where very dense traffic conditions are prevalent. Properly designed high capacity roundabouts have proven themselves to perform extremely well throughout the US. There are good examples as widespread as California, Colorado, Florida, Michigan, Maryland, New York, Utah and many others. Below is a photo from the State of NY DOT of a recently opened modern roundabout that replaces an old rotary. Below is a photo of a recently opened modern roundabout in NY State that replaces an old rotary. The large diameter rotary shown in the photo above was performing very poorly (like the Sagamore rotary) whereas the new ~200’ diameter modern roundabout is providing very safe and efficient traffic movement for approximately two years now.

Despite their considerable success many in the US remain unconvinced about the benefits of roundabouts. However, as the above list indicates, they offer significant advantages over more conventional intersections when used in appropriate situations and when they are properly designed.

One main advantage of modern roundabouts is their considerable geometric flexibility. This enables the efficient connection of difficult roadway alignments. This geometric flexibility is possible due to the slow approach, entering and exit speeds inherent in properly designed modern roundabouts. Conventional signalized intersections do not have such geometric flexibility as higher vehicles speed requires larger centerline radii.

Although modern roundabout are relatively new to the US (about 300 have been built in the last 7 years) they are rapidly gaining acceptance. Modern roundabouts are a new ‘intersection control device’ that are worth considering as an alternative to conventional signalized intersection control. Alternative choice depends on the merits of each specific case. Modern Roundabout interchanges are becoming increasingly popular.

**Other Communities Experiences**

The Vail Valley in Colorado installed the first modern roundabout interchange in 1995 at the Main Vail Exit with I-25. Like all roundabout proposals this project faced tremendous resistance from the community. Figure 2 at right shows the interchange design recommended to the community as a solution to their traffic problems. Resistance was strong and understandable. The entire lively-hood of Vail itself is reliant upon tourist traffic coming into town from I-70. The project was a divisive issue within the community. What the people against the project did not know is that roundabouts have been tried and tested for over two decades in other countries. For example the UK spent over $10M refining analysis.
techniques to ensure proper design and operations.

Moreover, the designer of the Vail’s project had spent considerable time and effort learning how to properly design roundabouts.

Many were in favor of the roundabout plan as it promised to solve the horrendous traffic problems they faced each winter and summer peak seasons as shown in Figure 3 and it would fit well into the context and character of the small community.

After it was constructed as shown in Figure 4 it was a non-event as it operated as promised.

The nearby diamond interchange at West Vail was re-constructed with roundabouts very quickly to satisfy public demand to solve the congestion at that location.

Figure 5 at right is a photo of the ramp terminal at the West Vail diamond interchange in the Vail Valley.
3. PROBLEMS AND OBJECTIVES

The Sagamore Rotary has high traffic volumes during the existing peak summer weekends. Delays and queues are very large, especially on Friday evening, Sunday evenings and Saturday afternoons.

The current safety record of the existing Sagamore Rotary is poor at 3.6 crashes / MEV\(^1\).

The projected peak summer traffic patterns for Friday evenings, Sunday evenings and Saturday afternoons are significantly higher than non-summer traffic volumes.

Accommodating these high traffic volumes will be constrained by the bridge over the Cape Cod Canal and by the existing roadway alignment. Additional constraint arises from the need to maintain businesses access and minimize impact to local residential property.

The large traffic volumes together with the existing physical constraints create a particularly challenging design problem. The MASS Highway’s preferred plan strives to achieve a balance given these competing variables. However, they have not had high capacity modern roundabouts as a tool to achieve the desired objectives.

The objective is to design a plan that provides safe, efficient regional traffic flow and good local road connectivity while minimizing residential and business impact. It would also provide the best balance between competing objectives.

4. THE PROPOSAL

The 2026 traffic volumes in the EA provided the basis for the design of the alternative diamond interchange improvement plan utilizing modern roundabouts. The evaluation includes the peak hours on Friday evening, Sunday evening and Saturday afternoons.

Traffic Performance

Replacing the rotary with an at-grade modern roundabout would solve the existing problems and provide an excellent levels-of-service (LOS). However, it would not provide sufficient capacity for the 2026 traffic volumes.

The long-term solution at this location requires grade separation to accommodate the high traffic volumes on the north/south and east/west corridors.

The proposed grade separation is shown on the accompanying conceptual CADD drawing showing the roundabout alternative plan. The roundabout intersections provide LOS A with the 2026 traffic flows.

\(^1\) Environmental Assessment Document for the Sagamore Rotary Project prepared By Mass DOT
Safety

The proposed roundabouts and the connecting roadways will provide a safer roadway system than the current MASS Highway preferred alternative for all traffic modes. This is accomplished with the use of roundabout intersections versus signal intersections. Studies show all crashes to be lower and injury crashes in particular to be significantly reduced with roundabout intersections as compared to signal controlled intersections.2

Vertical Profile

The MASS Highway EA report identified that the grade separation of Route 3 traffic and Scenic Highway (Route 6) must maintain a minimum clearance height of 6 meters. The proposed Bridge structure is located at a sufficient distance from the existing Cape Cod Canal Bridge to maintain a smooth roadway profile for north and south bound Route 3 traffic and maintain the 6 meters of clearance. The proposed bridge location also provides the required acceleration and deceleration distances for the on/off ramps.

Calculations for the on and off ramps used a design speed of 80 km/hr (50 mph) based on a posted speed limit of 45 mph on the bridge. Distances are adjusted to take into account the profiles grades of 3-6% for both the on and off ramps.

Deceleration Distance

Northbound off ramp deceleration distances are in accordance with AASHTO 2001. These are 130m for a stop condition and adjusted to 175.5m for the 5-6% off ramp profile. The proposed design provides 190m.

The access shown for the Texaco and Friendly’s Restaurant satisfies minimum 20mph non-stop exiting requirements of AASHTO for the off-ramp.

Acceleration Distance (EB Scenic to SB Route 3)

Based on a calculated initial speed of 42 km/hr (26 mph) and the 80 km/hr (50mph) bridge design speed, AASHTO requires an acceleration distance of 170 meters (5-6%). The proposed design provides 170 meters.

As noted earlier this proposed alternative also requires that SB Route 3 traffic be merged into the left lane prior to the Cape Cod Bridge. This is necessary because the very large on-ramp traffic volumes are about equal to the southbound traffic volumes on Route 3.

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2 Insurance Institute for Highway Safety Study of 24 Intersections in the US converted to Modern Roundabouts, 2000
The large on ramp traffic does not have to merge, but enter the empty right lane unopposed. This avoids entry conflict where the on ram meets Route 3 and achieves balanced lane use and subsequent smooth traffic flow over the bridge.

5. SUMMARY

The proposed alternative is not significantly different from the MASS Highway’s existing preferred alternative as this alternative utilizes many similar features. The goals and objectives are identical as are the constraints and conditions. This is a challenging situation and the MASS Highway Department should be commended for the amount of analysis it has completed for this project. Moreover, it is understood that evaluation of this modified version of MASS Highway’s plan represents further expenditure of scarce resources. However, given the similarities in these two plans the time and expenditure of resources will be minimized to consider this alternate plan.

The roundabout alternative as shown in the accompanying CADD drawing when compared to the existing MASS Highway preferred alternative achieves:

- Greater traffic safety and operational performance
- Improves business access
- Increased local and regional traffic flow
- Lower residential and environmental impacts

Modern roundabouts are a new type of intersection in the U.S. and they face natural and understandable resistance from local agencies, decision makers and the public alike. Their superficial similarities to old rotaries makes them that much more difficult to implement in areas that presently experiencing poorly operating old rotaries like the Sagamore Rotary.

Modern roundabouts are based on 35 years of traffic and transportation engineering science in the UK and other countries. This engineering science and experience is what separates roundabouts from old rotaries and allows them to operate correctly and to drive easily.