

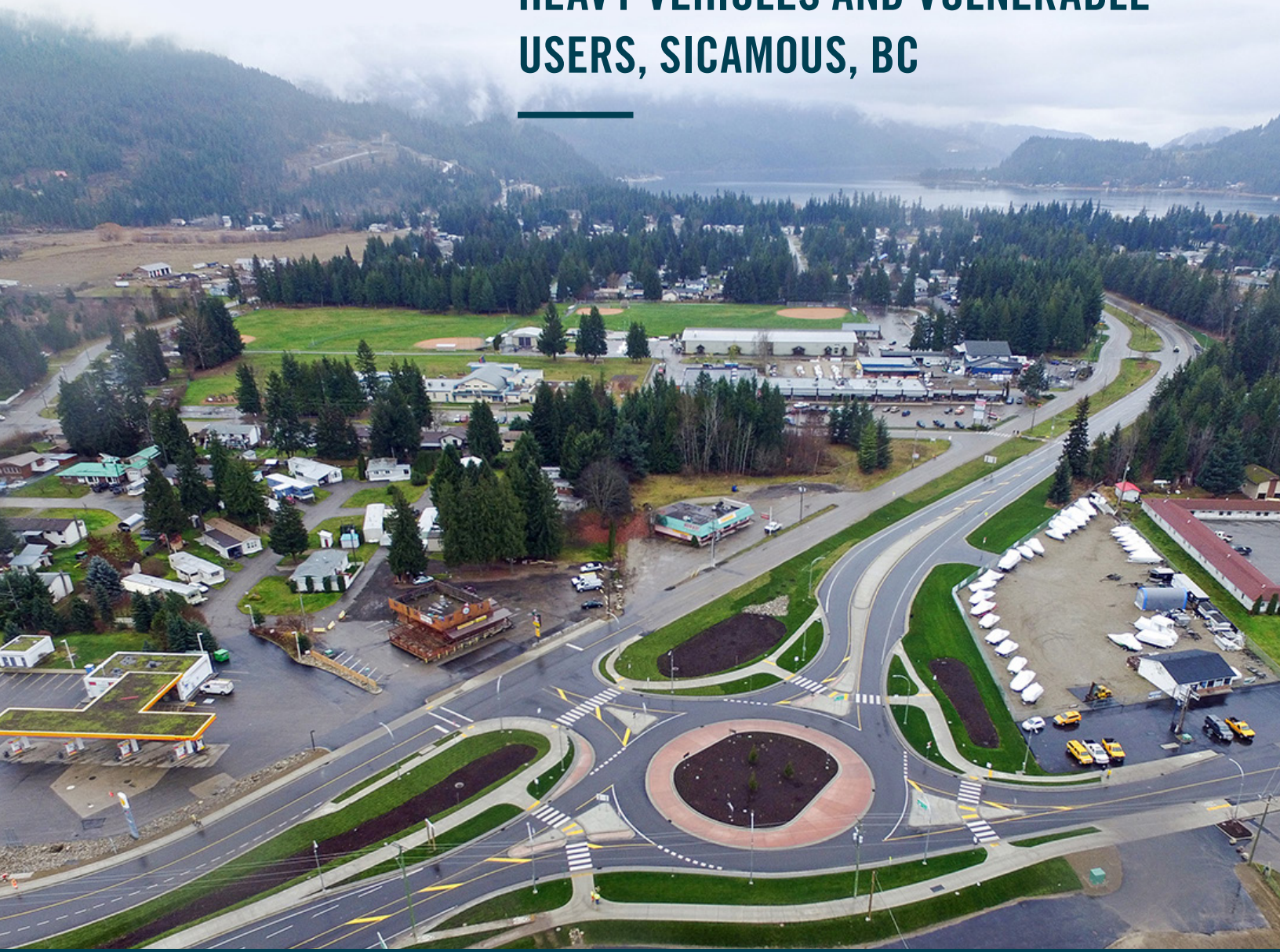


McElhanney

TAC TECHNICAL EXCELLENCE AWARDS | FEBRUARY 21, 2018

NOMINATION FOR 2018 ROAD SAFETY ENGINEERING AWARD

IMPROVED ROUNDABOUT SAFETY FOR HEAVY VEHICLES AND VULNERABLE USERS, SICAMOUS, BC



CATEGORY Projects

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PREPARED FOR Transportation Association of Canada

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REALIZED OR ANTICIPATED BENEFITS

1.1 Project Introduction

The British Columbia Ministry of Transportation and Infrastructure (BC MoTI) recognizes Highway 97A in the Okanagan Valley as an important transportation corridor connecting rural communities and urban centers, as well as serving as the goods gateway to the US market for the northern half of the province. The Okanagan Valley Corridor program of improvements to safety and reliability included the Highway 97A / Main Street Roundabout upgrade in Sicamous, largely known as a resort town on Shuswap Lake, 140 km east of Kamloops. McElhanney Consulting Services Ltd. (McElhanney) was retained by BC MoTI for the preliminary and detailed design of this \$5.7M project that provided significant improvements to facilities for pedestrians and cyclists, improved access to the community and local businesses, and included several design features to accommodate oversize permit vehicles. The roundabout was officially opened for traffic by Minister of Transportation and Infrastructure Todd Stone in November 2016.



WINNER OF THE 2017 MoTI
DEPUTY MINISTER'S AWARD
OF EXCELLENCE FOR DESIGN.

1.2 Magnitude of Project's Safety Impact

This project replaced a geometrically substandard multi-leg intersection on Highway 97A in Sicamous, BC with a 4-leg modern roundabout. The original, multi-leg, 45-degree skewed intersection configuration was confusing and so geometrically insufficient that local users avoided the intersection and dubbed it “the Octopus.” There were no facilities for cyclists or pedestrians, and students of the adjacent high school crossed the highway irregularly.

The community of Sicamous has a high proportion of seniors. It is also a base for numerous houseboat rental companies on Shuswap Lake, requiring seasonal hauling of houseboats through the intersection. A key plan (see **Figures 1** in Appendix) a show the community and several key locations.

The new design provides several unique features for heavy vehicles, especially oversize permit vehicles, which helped the Province of BC gain trucking industry acceptance of roundabouts on numbered highways. The project includes safe and effective pedestrian and cyclist integration; rain gardens with native, drought-resistant plantings; and a community-based public art installation.

Sources of Safety Improvements

The pre-project intersection (see **Figure 1**) had no provisions for pedestrians or cyclists despite the adjacent school and included several extremely substandard geometric components (e.g., stop bars that would require vehicle storage to impede a through movement). The intersection location was in close proximity to the intersection of Highway 97A and Highway 1, and traffic queues occasionally backed into the intersection during summer peak operation. Traffic volumes are 9000 SADT with about 2% of heavy, articulated vehicles. The percentage of heavy vehicles is expected to rise, and

several local businesses require oversize vehicles to traverse the intersection. The adjacent frontage road system constrained the achievable geometry.

The challenge of this design was to safely incorporate features for pedestrians, cyclists, and seniors and other vulnerable users, and also accommodate heavy and oversize vehicles. This was achieved with a roundabout design that encourages active transportation, and improves safety and mobility for all vehicles, including heavy trucks. Several features, described further in section 2.1, reduce the potential for roll-over or load shifting. Careful use of consistent colours, materials, and textures help users to differentiate areas for use by standard vehicles, trucks, pedestrians, and oversize vehicles, and contribute to safe use by each group.

The design reduced conflict nodes from 61 for the pre-project intersection to 16, illustrated in **Figures 2 and 3**. This suggests that opportunities for collision are reduced to about 25% when compared to the original intersection and indicates a less confusing and safer facility for drivers. A collision prediction analysis predicts 0.8 fewer collisions/year than would occur with the original configuration. While this is not a high figure, it should be noted that the location was not collision prone, quite probably because local residents had been consciously avoiding using the intersection. Accordingly, the actual safety improvements may be greater, especially as traffic increases in the future and when pedestrians and cyclists are included in the analysis.

The roundabout was designed as a 2-lane facility, but McElhanney's design called for a single lane to be constructed initially to gradually introduce it to the aging local community to increase safety and community acceptance. This approach has worked out well, and the second outer lane can be readily added when volumes warrant in the future, with minimal throw-away and reduced impacts to traffic for construction. This staging is shown in a schematic sketch in **Figure 4**.

Reliability of Safety Performance Results

The safety gains are expected to very reliable, given the well-documented safety improvements of a single-lane roundabout versus an unsignalized intersection. This is especially true when the intersection is highly skewed and includes unconventional geometry. A collision prediction analysis predicted a minimum 27% reduction due to this change.

The severely reduced number of conflict nodes is a reliable indicator of a simplified geometry and reduced driver decision requirements, and another reliable indicator of increased safety to be expected for the new roundabout.

Many of the safety benefits expected from the roundabout are the result of the new facilities for pedestrians and cyclists. Considering that there was nothing other than paved shoulders previously, these new pathways, sidewalks, crosswalks, and refuge islands should reliably improve safety for these users.

The project also included several features to improve the safety for persons with poor vision, poor mobility, or other disabilities. These conform to ADA standards and are well-proven. They can reliably be expected to provide the anticipated safety benefits.

1.3 Sustainability

Economic Sustainability

The safety gains inherent in this roundabout will be sustained in the future, as the project is widely seen as not only an improvement to the safety and reliability of the highway, but also as a major commercial and aesthetic improvement to the community, and an enhancement for the local economy.

The construction period actually saw improved revenue for several adjacent businesses, due to having provided the Contractor with a reference detour design and other contract terms reflecting care to maintain local access. This commercial boost continued after the facility opened, with several businesses being redeveloped and expanded.

Local First Nations people gained employment as archeology monitors on-site, and labour and materials were sourced locally whenever possible.

The roundabout provides an improved entrance feature – complete with public art installations – for this tourism-dependent community, and the cycling and pedestrian elements promote the community vision for tourism and residential growth.

Social / Environmental Sustainability

This project is socially and environmentally sustainable in several ways. The team raised the circulatory roadway and central island to avoid extensive excavation, and thus minimized the likelihood of encountering historical artifacts, per a pre-agreement with the local First Nations.

By providing a reference detour and through the construction contract terms, there was minimal traffic delay and reduced vehicle emissions from idling vehicles; yet the detour still allowed local oversize vehicles to be accommodated during the construction phase.

The environment was respected by including drought-resistant, native plant landscaping, and incorporating rain gardens to refresh the groundwater with roadway runoff. This avoided discharge into Eagle River, and also reduced future requirements for maintenance.

The extensive active transportation elements reflect the community's desire for more non-motorized options, and increase the likelihood of both residents and tourists choosing an active mode of transportation. This will also support local efforts to encourage students to choose active modes to and from school.

Lastly, the community social bonds were strengthened by the project directly, as the District of Sicamous was a partner in the project with BC MOTI. The opportunity for a public art installation in the central island developed into a cooperative venture between the District of Sicamous, the Splatstin Indian Bands, and the Columbia Shuswap Regional District.

2.1 Project Innovations

This project had a high public profile, as it was only the second roundabout directly on a numbered route within British Columbia, and the trucking industry had expressed safety and operational concerns regarding the first facility .

The project team understood that community input and acceptance would be crucial for success. The team solicited specific requirements and concerns from local groups and individuals representing seniors, students, residents, and local businesses, including houseboat operators, and the BC Trucking Association.

The team developed several unique and innovative features in the design, including:

- A crowned circulatory roadway with reduced cross fall and drainage towards outer edge of central truck apron to reduce racking and potential for roll-over or load shifting,
- A custom truck aprons that delineate areas for various truck types,
- A roll-over approach median to accommodate extremely oversized vehicles operating under special permit in a counterflow direction, and
- Differing materials and colours to indicate areas for conventional vehicles, heavy vehicles, pedestrians, and cyclists.

Crowned Circulatory Roadway

There was a concern that circulatory roadways with cross fall draining towards the outside may contribute to roll-over accidents for heavy vehicles. This was coupled with another concern that very large vehicles with reduced clearance could have difficulties with grounding out.

To respond to these concerns, the design team reduced and reversed the cross fall for the inner circulatory lane (towards the outer edge of the truck apron) and planned for a crowned circulatory roadway when the outer lane would be constructed. This is illustrated in **Figure 5**.

By reducing the cross fall and introducing valleys and crowns across the potential width of travelled route for oversize vehicles, the cumulative difference of elevation is reduced and the potential for roll-overs and grounding out.

Custom Truck Aprons

While truck aprons are a standard feature in modern roundabouts, this design included “sequential designation of space” by using a combination of painted and physical islands. In this manner, passenger vehicles and light trucks operate within the paint lines; heavier vehicles may need to operate outside the paint lines but within pavement areas; larger trucks (WB20, etc.) will need to use the

coloured concrete central island apron; and very large permit vehicles will need to also use the coloured concrete aprons on the splitter islands. These truck aprons are shown in **Figure 6**.

Roll-over Approach Median

Extremely oversized vehicles operating under permits and with pilot vehicles, can traverse the roundabout in a counter-flow operation. The team used very low custom curbs, surrounding a roll-over median island on one approach to the roundabout, to accommodate these vehicles. The colour and materials for this median are consistent with the adjoining median preceding and following this section to avoid confusion by conventional traffic. This median is shown in see **Figure 7**.

Materials and Colour Use

A major challenge for this design was to balance the needs of heavy and oversized vehicles with the required safety improvements for pedestrians, cyclists, the disabled, seniors, and other vulnerable users. When reviewing several recently-constructed roundabouts, the team also recognized that in the interests of pleasing aesthetics and landscape design, conflicting messages were being provided to differing users. For instance, the colours, materials, and textures for truck aprons are often the same as those used in areas intended for pedestrian use (e.g., red-stamped brick design for both the central island apron and pedestrian refuge areas).

Similarly, there were several materials and colours for truck aprons. This variation, combined with drivers' recognition of similar items used in pedestrian areas, has led to confusion by truck drivers and they were occasionally reluctant to use the aprons.

The team discussed these issues with BC MoTI review staff and others to determine an acceptable designation of materials that would fulfil the design needs and aesthetic objectives while also contributing to a greater visual separation reflecting the intended use. The team also ensured that materials provided a high contrast at entrances to the travelled way to assist persons with poor vision. This was supplemented by tactile mats. An example of these material choices is shown in **Figures 7 and 8**.

2.2 Communication & Promotional Activities

This team used numerous communication options within a coordinated strategy to ensure that users and stakeholders could provide input for the design and were updated on the progress and the final project.

These events included presentations to the District of Sicamous council in public meetings, specific events for seniors' facilities and groups, and the adjacent school. The local newspaper was routinely briefed, and the BC MoTI website provided project updates during design and construction. The team created realistic video animations of several model vehicles tracking through the design (including custom vehicles representing specific houseboat trailers), as well as traffic modelling, to help stakeholders to better understand the design and what to expect (see **Figures 9-10**).

As the project neared completion, the team's outreach activities shifted towards education regarding use of a modern roundabout. Handouts were provided to seniors' groups and the school, and the BC MoTI website included links to a "how to use a roundabout" page. This education component was crucial to allowing the local users to be ready for the change and feel prepared and confident. By providing accurate and timely information, the BC MoTI avoided community concern becoming anxiety or discomfort, and this resulted in widespread community acceptance of both this specific roundabout and the concept of roundabouts.

TRANSFERABILITY TO OTHER CANADIAN COMMUNITIES AND ORGANIZATIONS

3.1 Benefits to the Transportation Community Across Canada

This project is an excellent example of a well-designed modern roundabout that fulfils divergent specific local requirements (such as providing safe active transportation facilities), within a project that also accommodates unique, oversized vehicles (houseboat trailers), all while improving local access, business, and tourism. This was accomplished on schedule, within budget, and with acceptable impacts during construction.

The success of this project is due to carefully defining the problem, listening to the stakeholders, and tailoring a design solution specifically for the location, even if that required some unconventional design and a greater than usual effort for stakeholder engagement. The lessons learned can be readily applied anywhere in Canada.

The benefit accrued is safe and efficient operation for all users of the facility, and a greater acceptance of roundabouts by communities, the trucking industry, and the general public.

3.2 Contributing to the National Road Safety Vision

Canada's Road Safety Strategy report, "Towards Zero: Ambitious Road Safety Targets and the Safe System Approach," includes the vision of being a world leader in road safety, with the safest roads in the world. The countries that perform the best have fatality rates of around 5-7 people killed per 100,000.

The Highway 97A / Main Street Roundabout project directly contributes to the realization of this vision by reducing the frequency and severity of future collisions at this junction and providing new, well-designed facilities for pedestrians and cyclists – especially students and seniors.

3.3 Likelihood of Other Jurisdictions Accepting & Implementing a Similar Project

This project was the result of a community-driven, adaptive design process, and the resultant innovative design has gained support from an aging community, students, and the trucking industry. It has helped to garner acceptance of roundabouts generally in British Columbia and the broader society. This success will enhance the opportunities for agencies to construct new roundabouts and achieve their inherent safety and sustainability benefits.

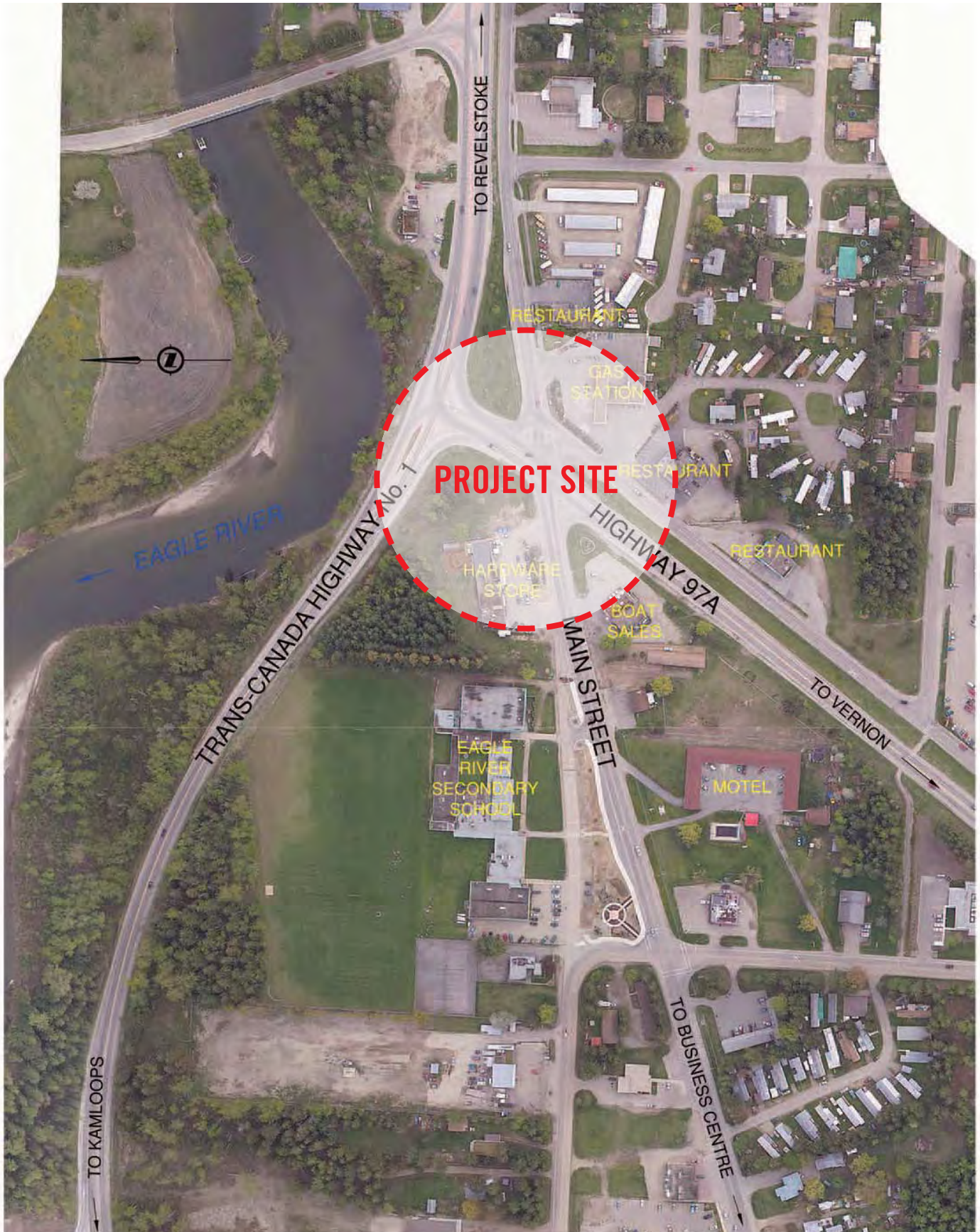
APPENDIX A

PROJECT PHOTOS

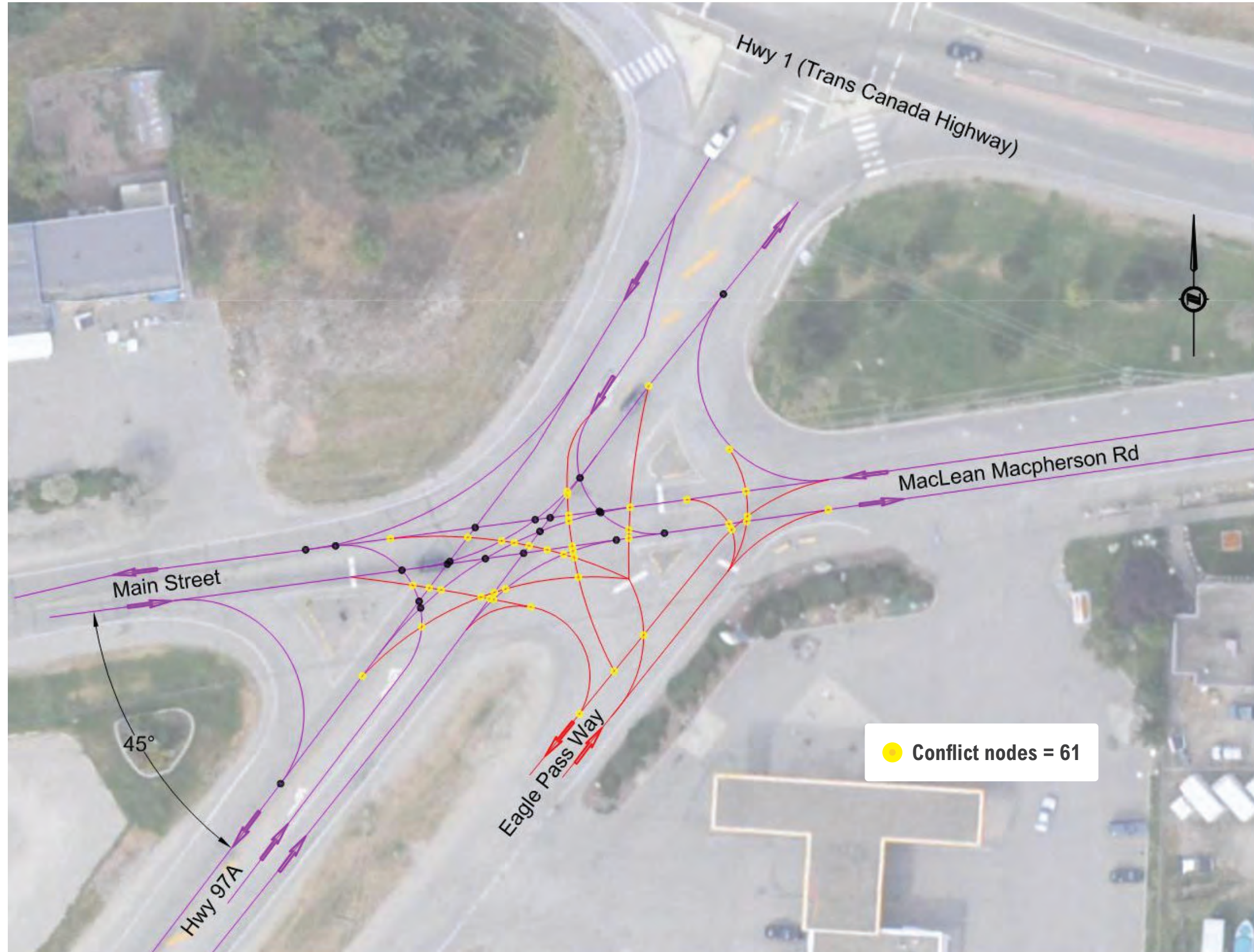
DIAGRAMS

DRAWINGS

▼ Figure 1: Key Plan - Pre-Project Conditions

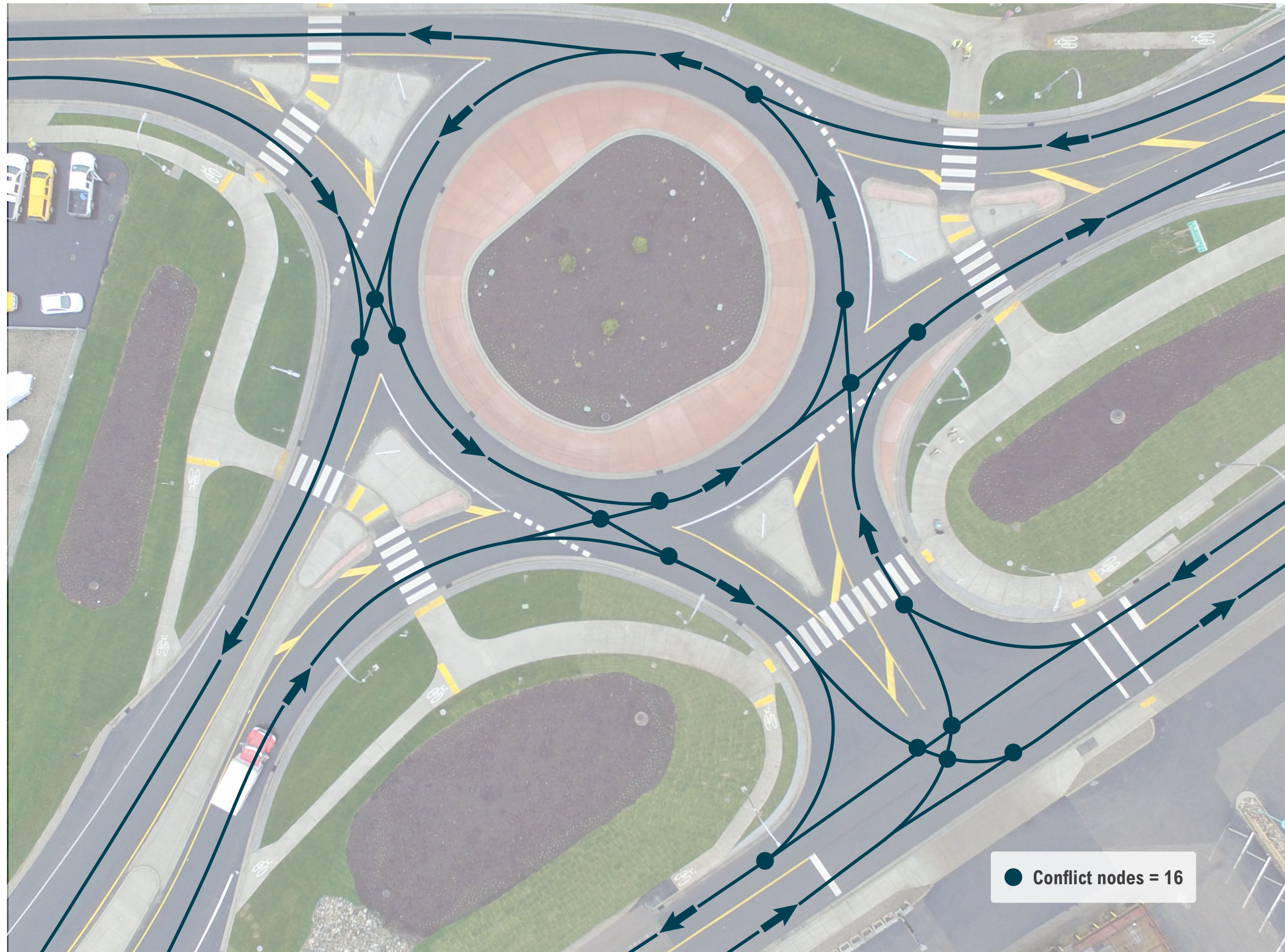


▼ Figure 2: Conflict Nodes - Pre-project

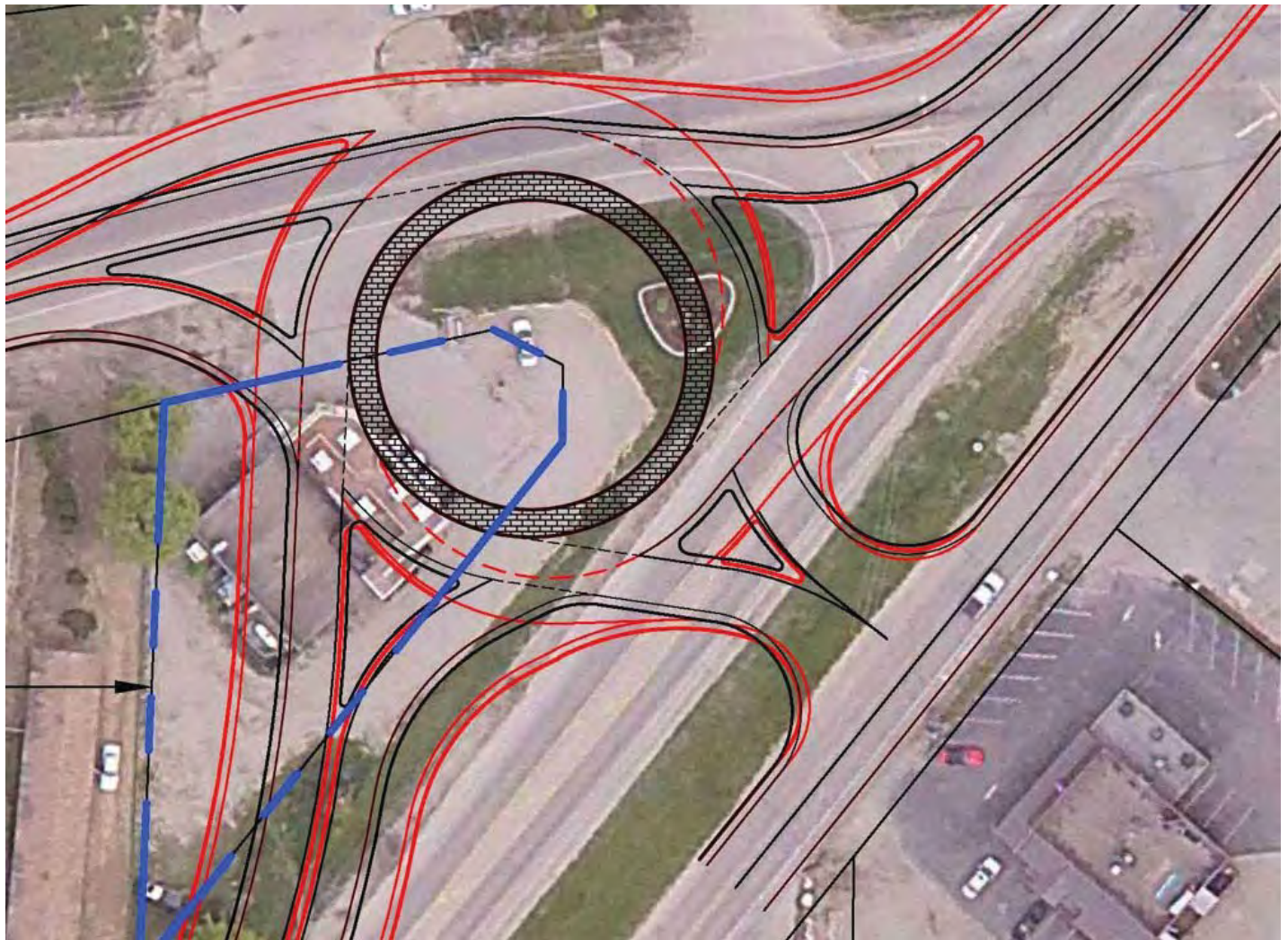


Courtesy of Ch2M Hill
Conceptual Report, May 2014

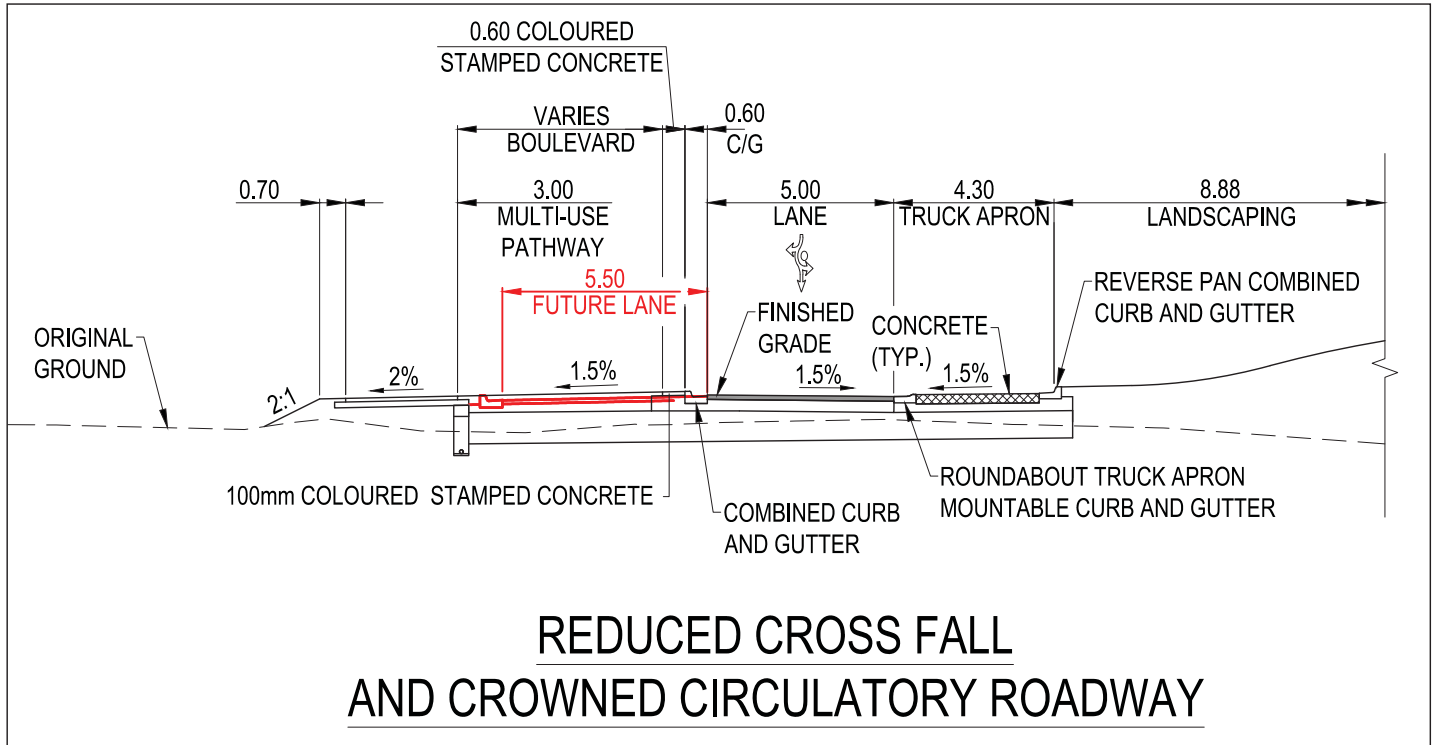
▼ **Figure 3: Conflict Nodes - Roundabout**



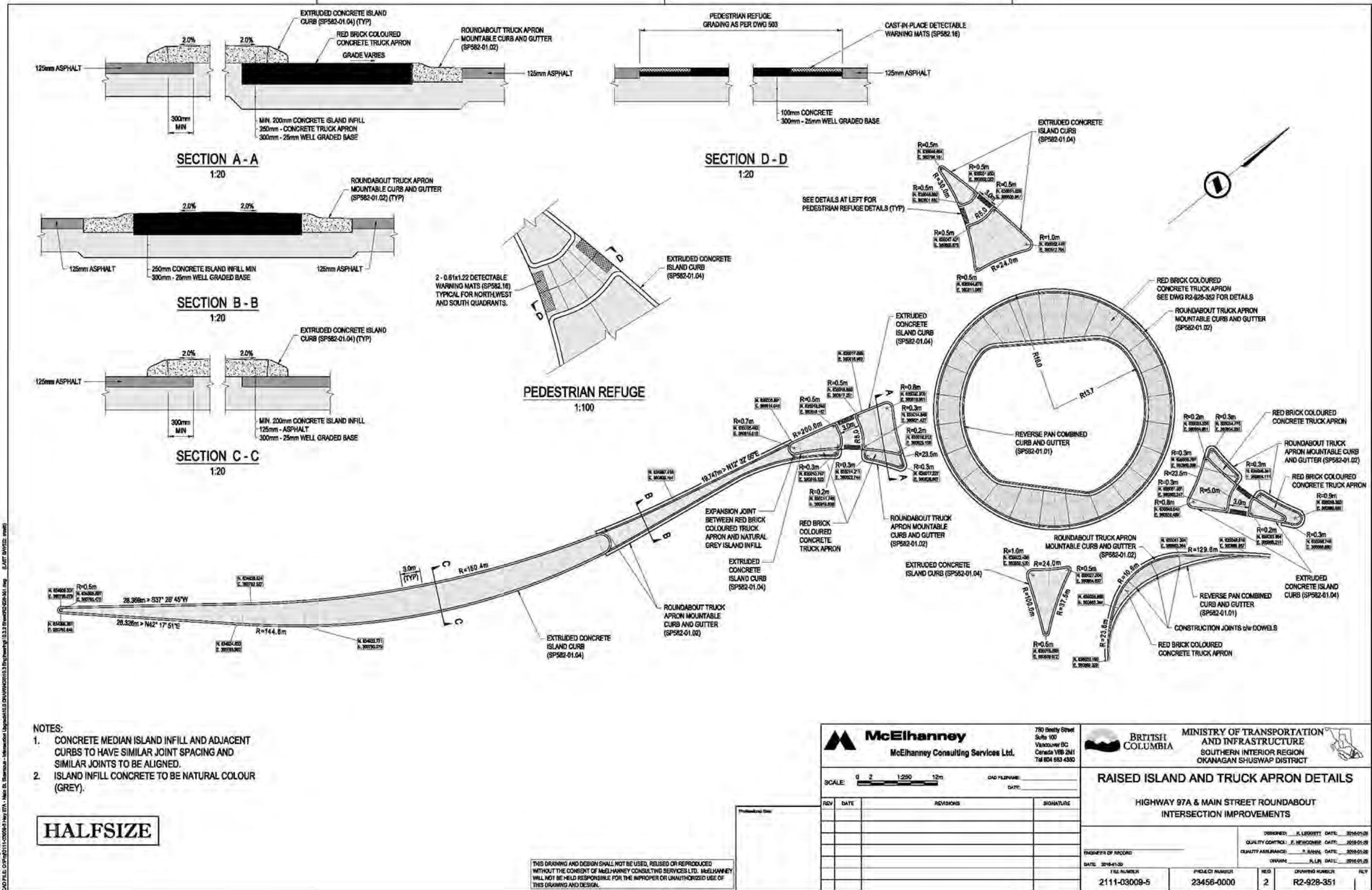
▼ **Figure 4: Staging to 2-Lane Configuration**



▼ **Figure 5: Crowned Circulatory Roadway Typical Section**



▼ Figure 6: Raised Island and Truck Aprons Details



▼ **Figure 7: Roll-over Median for Counterflow Oversize Vehicles**

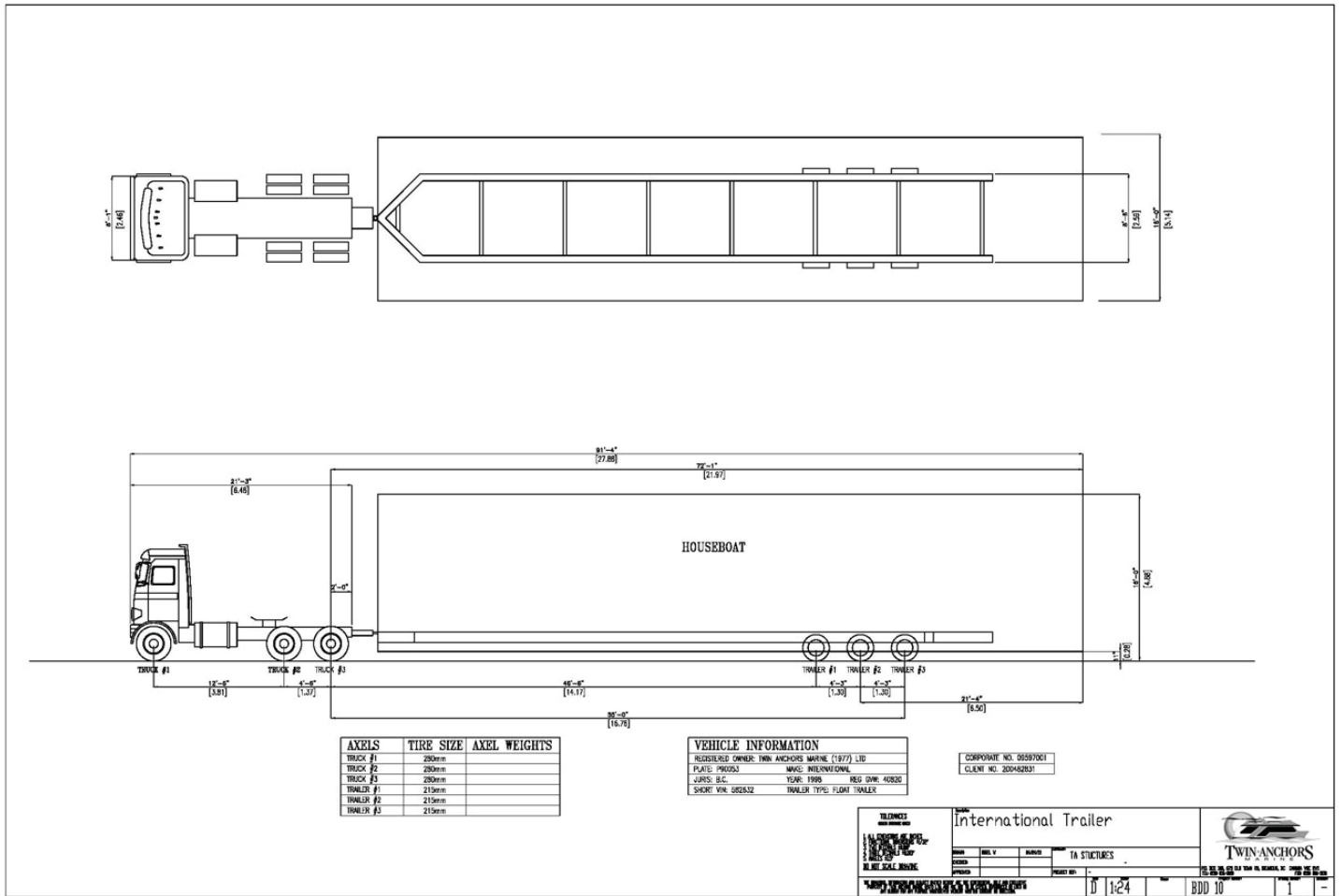


▼ **Figure 8: Custom Islands and Materials**

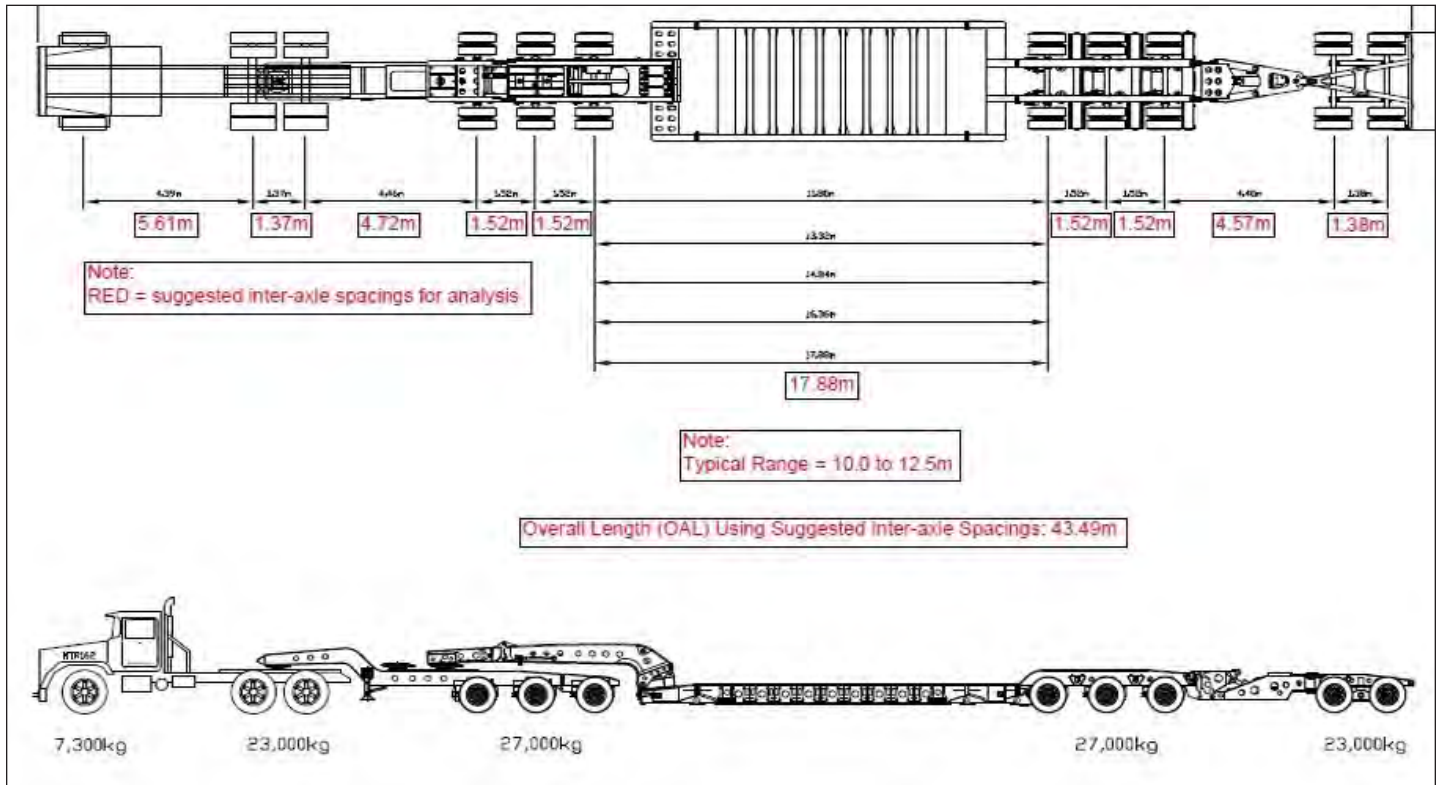


- 1 Black asphalt roadway
- 2 Yellow tactile mats (high contrast) defining limits of pedestrian areas
- 3 Red broom-finish concrete truck aprons
- 4 Grey broom-finish concrete islands and medians
- 5 Dark grey, stamped concrete boulevard (high contrast)
- 6 Grey broom-finish concrete sidewalks, multi-use pathways, cycle paths, and pedestrian refuge areas

▼ Figure 9: Local Houseboat Trailer Modelled for Tracking



▼ **Figure 10: 11-axle Oversize Permit Vehicle Modelling for Tracking**



▼ **Figure 11: Before (left) and After (right) Photo of Project Site**

