“Sicamous Roundabout – Taming the Octopus!”

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Abstract

Dubbed locally as “the Octopus”, the Highway 97A / Main Street intersection forms the entrance to Sicamous, British Columbia, a tourism community with a high percentage of elderly residents, and numerous houseboat rental businesses. The original multi-leg, 45-degree skewed intersection configuration was so confusing and geometrically insufficient that local users avoided the intersection. There were no facilities for cyclists or pedestrians, resulting in significant safety concerns with students from the adjacent school crossing irregularly. The retail businesses immediately adjacent to the intersection suffered as a result.

The BC Ministry of Transportation and Infrastructure (MoTI) had identified a 2-lane roundabout as a preferred option for this location but had previously received adverse comment from the trucking industry (BCTA) regarding roundabouts on numbered routes, primarily due to their perceived inability to accommodate oversized loads.

The design of this roundabout therefore needed to carefully balance the safety and operational needs of all users, including oversize permit vehicles, houseboat trailers, and vulnerable users, and required acceptance from the trucking industry and public.

Extensive stakeholder and community engagement, as well as innovative design elements, produced a solution with custom aprons for specific vehicle use to better separate users; standardization of materials, colour and textures to identify intended use; a roll-over median approach island to allow counterflow operation of permit vehicles with pilot cars; and reduced cross fall on circular roadway to reduce heavy vehicle racking and roll-over potential. The design is phased for a double-lane facility ultimately. However, a single-lane was constructed initially to gain familiarity and acceptance and improve safety. Active transportation needs are accommodated by multi-use pathways, cycle paths and ramps, and tactile mats are provided for the visually impaired, making it safe for all active modes and in particular the local school children. The design also includes raingardens and native, drought-tolerant plantings, as well as unique public art features. An unintended spin-off of the project is that several adjacent properties have already been rejuvenated due to the significantly improved access.

This $7.3M project opened in November 2016 and is safely used by heavy and OS/OW permit vehicles. It has been well received by the local council, Splatsin First Nation, BCTA and MoTI. So much so that this project was awarded the 2017 BC MoTI Deputy Minister’s Award of Excellence for Design.

1.0 Background / Introduction

Sicamous is a community of 2500 in the North Okanagan of British Columbia at the junction of Highway 97A and Highway 1 (Trans Canada Highway *(See Figure 1).* Seniors constitute a significant proportion of full-time residents of this tourism-oriented community. There is a large increase in population during the summer months with both tourists and seasonal residents. Shuswap Lake provides both a waterfront for the District of Sicamous and the basis for numerous houseboat rental businesses. There is also a modular building/trailer manufacturer in the area.

The pre-project entrance to the community was via the Main Street / Highway 97A intersection. This intersection was within 65 m of the signalized Highway 97A / Highway 1 intersection, and also incorporated a connection to a combined highway frontage road *(See Figure 2).* The geometry was very poor, with a high skew angle, multiple legs and very minimal storage lengths. Anecdotal commentary indicated that the local community avoided the intersection and travelers found it confusing.

Access to adjacent businesses was irregular, with several properties sharing informal accesses.

There were no facilities provided for pedestrians or cyclists. As a result, students from the adjacent secondary school were often observed crossing the highway informally at several locations in small groups, to access stores and restaurants, and also walking along the highway shoulders.

The BC Ministry of Transportation and Infrastructure (MoTI) had identified a two-lane roundabout as the preferred option for this location, based upon an earlier conceptual study (CH2MHill, 2014) and subsequent stakeholder engagement. McElhanney was assigned the preliminary, functional and detailed design of this roundabout. Known concerns included the requirement for the design to coordinate with planned four-laning of Highway 1 and improvements to the Highway 1 / Highway 97A intersection. There was also an awareness that the recent construction of the first roundabout on a numbered route within the province had garnered some unfavourable comment from some stakeholders.

The British Columbia Trucking Association (BCTA) had expressed concerns regarding roundabout design, and in particular, their use on provincial highways. The BCTA had successfully advocated for some post-construction design changes to the previous roundabout to better facilitate Over Size/Over Weight (OS/OW) vehicles and maintained a preference for signalized intersections over roundabouts on provincial routes.

BCTA policies *(BCTA Policy Positions)* include the following from 2012:

- The provincial government should consult the trucking industry on all roundabouts proposed for provincial highways.
- Roundabouts should be capable of accommodating all vehicle types expected to use the roundabout, including oversize/overweight vehicle combinations, to allow them to move through the roundabout safely, efficiently, and without damaging the vehicle or the load.

2.0 Objectives

Accommodating the competing needs and preferences of the diverse stakeholders and users was recognized as presenting a significant challenge.

The primary objective of this assignment was to design and construct a roundabout that would fulfil future traffic requirements, meet design guidelines, be readily constructible and provide safe and efficient operation for all users.

A secondary objective was to increase the acceptance of roundabouts on provincial routes by the trucking industry and of roundabouts generally by the public.

3.0 Methodology

3.1 Problem Definition

An early task was careful problem definition. We understood that geometric improvements were required, that a two-lane roundabout was the preferred long-term solution, and that we needed to accommodate both OS/OW and other heavy vehicles whilst improving safety for vulnerable users. However, several key concerns were not well understood. Current and future pedestrian demand wasn't apparent. What specific OS/OW and other heavy vehicles were anticipated? What concerns did other stakeholders have?

Several investigations were initiated. Traffic counts were conducted at various times to better understand the composition, capture pedestrian and cyclist counts, and account for the summer season peak increases. A pedestrian survey was conducted to identify demand lines to assist with locating proposed facilities *(See Figure 3)*.

The project team (BC MoTI/McElhanney Consultant Team) undertook extensive public outreach and stakeholder engagement. Stakeholders included the District of Sicamous, several First Nations, Columbia Shuswap Regional District, BCTA, Schools and School District No. 83, BC Commercial Vehicle Safety and Enforcement (CVSE), individual businesses, the Chamber of Commerce, emergency services, the health centre, recreation facilities, tourism groups, seniors' groups and facilities, local print and radio media, cycling groups, and adjacent property owners.

Local houseboat rental firms haul their boats between the lake and winter maintenance facilities using custom trailers designed to handle their specific fleet of boats *(See Figures 4 & 5)*. Discussions with these business owners provided extremely detailed information, such as the dimensions of their largest vessels and trailer, the route typically covered, timing of boat hauling, previous issues, range of hydraulic lift available on the trailer to provide clearance, and concerns or preferences for this proposed roundabout.

With this data and analysis in-hand, we better understood the specific requirements we sought to achieve, and stakeholder expectations. These included:

- Heavy vehicle (WB20) and Long Load Logging Truck (LLT) - conventional operation
- Largest loaded custom houseboat trailer currently in use - conventional operation
- 11-axle “Expando” low-bed OS/OW combination and larger - counterflow operation
- Reduced crossfall and other measures to mitigate load shifting and trailer torsion
- Provision of pedestrian facilities reflecting demand lines identified
- Ability for cyclists to traverse roundabout using separated facilities
- Option for cyclists to traverse roundabout using circulatory roadway if desired
- Compatibility with planned future upgrades to Highway 1, and Highway 1/Highway 97A intersection
- Maintaining or improving property and business access
- Reducing number of conflict points and available routes through the junction
- Provision of an entrance feature for District of Sicamous

3.2 Options Development

3.2.1 Research and Consultation

Before initiating design, the design team researched guidelines and standards in other jurisdictions, as well as technical papers, to gain an understanding of the nature and range of potential solutions (Russell, E and others, 2013). Research identified the potential application of reduced cross-fall within a crowned circulatory roadway to minimize the combined vertical difference for very long or wide loads and reduce the resultant torqueing of the trailer and load shifting (GHD, 2014). This approach was further supported by limiting the height and softening the profile of roll-over curbs to ease transitions and avoid damaging tires.

Houseboat haulers, the CVSE and the BCTA all provided information on the current and anticipated largest vehicles, as well as their routes and frequency.

Research included compilations of comments from other trucking industry groups responding to similar concerns and constraints. This was particularly helpful regarding professional driver perceptions of surface colours and textures for aprons and other elements, as well as driver understanding of how these and other roundabout elements were intended to function. This led to a further objective of simplifying and clarifying these elements to better convey the intended purpose to truck drivers and others.

3.2.2 Standardized colours and textures

Review of existing roundabouts in BC and elsewhere confirmed that in many instances the same surface texture and colour (often red brick stamped concrete) was used for truck aprons, landscaping, and even pedestrian areas. Guidelines for visually impaired pedestrians also indicated a focus on high-contrast colours and tactile surfaces at the edges of pedestrian zones. These and other considerations evolved into a simple hierarchy of standard colours and surface textures to indicate intended use *(See Figure 6)*:

- Broom-finish brick red concrete for truck aprons
- Broom finish standard concrete for pedestrian and cyclist facilities
- Dark Grey brick textured concrete "Landscape Strip" behind curbs
- Yellow tactile mats at transitions to/from pedestrian areas

3.2.3 Iterative design

A conceptual design phase was included, that developed simplified concepts of various options for review and consideration by MoTI and stakeholders. This phase quickly confirmed the general configuration and location of the roundabout.

Custom vehicles were modelled in AutoTURN and Autodesk Vehicle Tracking to simulate the largest current loaded houseboat trailer combination, and various potential OS/OW lowbed haulers, up to the 11-axle "EXPANDO" combination *(See Figure 7).* Long load logging trucks, pole and pipe trailers, and others were also modelled. The path tracking of these vehicles determined the geometry for the two-lane roundabout design.

Traffic analysis indicated that a two-lane facility would not be required for several years, and so it was decided to design the ultimate configuration but construct a single lane roundabout initially *(See Figure 8).* This would ensure that future considerations and costs were accommodated, (e.g. right of way acquisition, utility relocation, pedestrian and cyclist facilities, lighting, etc.), but would allow the community to become comfortable with a simpler facility initially. This was hoped to provide better safety and increased community acceptance.

3.3 Options Analysis

Stakeholders were kept abreast of design development and the design was presented for review at various stages of development. This included an open house, public council meetings, one-on-one conversations, presentations to different groups, using local media and the MoTI project website.

The roundabout design was reviewed by MoTI Headquarters at several stages and comments were incorporated.

An independent Road Safety Audit (Trutch, B and others, 2015) was also conducted on the 100% detailed design and further guided the design development.

4.0 Results

4.1 Description of final design

The final constructed design is comprised of a four-leg, single-lane roundabout that has several elements pre-constructed to allow a ready expansion to a two-lane facility in the future, with minimal disruption to traffic or the community and little throw-away *(See Figures 9 & 10)*.

This design includes "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. Colours and textures, as previously described, are incorporated to further strengthen this delineation *(See Figure 6)*.

Custom truck aprons on both the central island and outside of lanes are used to provide safe use by heavy trucks and OS/OW combinations *(See Figure 11)*. A custom roll-over median approach island allows counterflow operation of extreme OS/OW permit vehicles operating under permit accompanied by pilot cars *(See Figure 12)*. The colour and materials for this median are consistent with the adjoining median preceding and following this section, in order to avoid confusion by the general-purpose traffic operating conventionally.

The central island truck apron slopes to the outside creating a valley at the outer edge of the truck apron, with catchbasins placed at several locations. The current single circulatory roadway lane slopes inwards towards this valley. The future second, outer circulatory roadway will slope outwards, creating a crown between the two lanes. All crossfall within the roundabout was limited to 1.5% maximum *(See Figure 13)*. Gradients, rates of change of crossfall and heights of curb are carefully controlled to provide adequate vertical clearance for very OS/OW lowbed trailer combinations with clearances as little as 100mm.

Pedestrians and cyclists are accommodated by a system of connecting Multi Use Pathways (MUPs), cycle paths and sidewalks reflecting the identified demand. These are designed so cyclists have the option to either remain mounted and ride around the outside of the circulatory roadway on a separated facility, or they can opt to traverse the circulatory roadway. They are expected to dismount to cross roadways. Ramps allow cyclists to enter and exit between this system and the roadways. Signage and pavement markings alert both cyclists and pedestrians wherever an intended user transition occurs. Pedestrians have marked crossings with level refuge islands, accessed by low gradient ramps. All transitions between pedestrian areas and areas that include either cyclists or roadway are marked by a high-contrast yellow tactile mat to provide security for pedestrians with poor vision.

4.2 Roundabout operation / safety

The single-lane roundabout has been observed to be operating well, with no apparent reluctance or confusion from drivers of all types. Anecdotal comment received indicates that the single-lane facility has proven to be less intimidating for the local drivers, especially seniors.

Heavy vehicles have been observed operating very much as modelled and intended, with no apparent confusion or reluctance to use the appropriate truck aprons.

Vehicle speeds have also been reduced significantly. Designed entry speeds are 30 km/h or less and observation confirms that vehicles are generally travelling within the intended speed range.

The roundabout has now been open through a busy summer and none of the previous queuing through the intersection was reported, nor have other traffic concerns been noted.

Several design features contribute to increased safety. The inherent benefits of roundabout design reduced the conflict nodes from 61 for the pre-project intersection to 16. *(See Figures 14 & 15)*. 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 is not collision prone and local residents have been avoiding 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.

4.3 Pedestrian and cyclist use / safety

Many of the safety benefits expected from the roundabout pertain to the new facilities for pedestrians and cyclists. No statistics were available for pedestrian or cyclist collisions, so it is difficult to quantify. However, considering that there were only paved shoulders previously, these new pathways, sidewalks, crosswalks and refuge islands should reliably improve safety for these users.

Locating facilities on demand lines increases the likelihood that they will be used as intended. Some landscaping was designed to also discourage short-cutting or crossing at poor locations.

Casual observation of pedestrian and cyclist use indicates acceptance and appropriate use, especially regarding students. This was even the case mid-winter with heavy snow cover, when pedestrian facilities had been kept clear by the District of Sicamous maintenance. Use by persons with visual and other disabilities was also observed to be as intended, with no apparent difficulty.

4.4 Communication & promotional activities

This project made use of numerous communication options within a coordinated strategy to ensure that all users and stakeholders had input into the design and were updated on 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 MoTI website provided project updates during design and construction. Presenting videos of several model vehicles tracking through the design (including custom vehicles representing specific houseboat trailers), as well as traffic modelling, was instrumental in helping participants to better understand the design and what to expect.

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

4.5 Landscaping / community public art installation

The landscaping contributes both aesthetically and functionally. Higher shrubs and trees have been placed where old roadways had previously continued, to emphasize the curvature of the new roadway and provide a visual cue of the approach to the roundabout. Raingardens were included to provide recharge to the water table and to avoid a new discharge into the Eagle River. They also help to direct pedestrians and discourage shortcutting. Landscape plantings are drought-resistant native species to minimize maintenance, irrigation and fertilizer use.

A presentation was made to District of Sicamous council early in the design stage describing the opportunity for the central island to function as an entrance feature for the community and outlining some possibilities and considerations. This potential for the roundabout to provide an iconic introduction to Sicamous has been realized. The construction period coincided with a "branding" exercise undertaken by the District of Sicamous, and they partnered with the Splatsin First Nation, and Columbia Shuswap Regional District to cooperatively fund and develop the design of the central island landscaping and public art installation. The final installation incorporates elements from all partner communities *(See Figure 16)*.

4.6 Acceptance by trucking industry, community and public

This design has gained the acceptance of the trucking industry, local community and public.

The BCTF wrote to thank the MoTI for consulting with them and their members regarding the roundabout and expressed their appreciation for the turn movement analysis of vehicle combinations provided by their Oversize-Overweight (OS-OW) Vehicle Committee (BCTA Bulletin, 2016). They also expressed appreciation for the design modifications provided to islands and crossfall, including those that facilitate the counter-flow movement.

Several businesses reported increased traffic and revenue after the roundabout opened. Some of the adjacent properties changed hands and/or are being redeveloped shortly afterwards.

Local media (InfoNews, 2016) reported very favourable comments, including the following from Mayor Terry Rysz, “After years of concern for the travelling public and local residents, the Ministry of Transportation and Infrastructure in collaboration with past and present municipal councils has accomplished what will be an amazing solution for traffic flow, and the end of what was formally known as ‘the Octopus.’”

5.0 Conclusions

This project is a good example of a well-designed modern roundabout. It fulfils divergent specific local requirements, (such as providing safe active transportation facilities), within a project that also accommodates unique, oversize vehicles (houseboat trailers), all while improving local access, business and tourism.

The conclusions are:

1. OS/OW permit vehicles can safely use roundabouts on numbered highways if site-specific conditions and needs are adequately considered in design and balanced against other requirements.
2. Phased construction with an initial single-lane facility helps to gain acceptance and increases safety.
3. Stakeholder engagement throughout the process is critical to successful design.
4. Owner consideration of non-standard design can result in a superior facility.

References

BCTA Policy Positions, 2018
British Columbia Trucking Association (BCTA)
"Policy Positions - Infrastructure Development & Maintenance"
[Viewed 9 May, 2018] https://bctrucking.com/advocacy/policy

BCTA Bulletin, 2016-03-07
British Columbia Trucking Association (BCTA)
"BCTA Helps Improve Design for Proposed Sicamous Roundabout"
[Viewed 9 May, 2018] https://bctrucking.com/bulletin/2016/03/07/bcta-helps-improve-design-proposed-sicamous-roundabout

"Highway 97A – Main Street Conceptual Planning"
CH2MHill, May 2014.

GHD, "Roundabout Design Details"
In *4th International Conference on Roundabouts North American Roundabout Workshop*, 2014, Seattle WA, USA, Transportation Research Board (TRB)

InfoNews, 2016-11-28
"Roundabout now complete in Sicamous,"
[Viewed 9 May, 2018] https://infotel.ca/newsitem/roundabout-now-complete-in-sicamous/it37262

Russell, E., Landman, E., Godavarthy, R., January 2013, "Accommodating Oversize/Overweight Vehicles at Roundabouts," Kansas State University Transportation Center

Trutch, P., Oliveira, B., De Leur, P., 2015, "*Road Safety Audit, Highway 97A & Main Street Roundabout, Sicamous, BC,"* Stantec

Figures

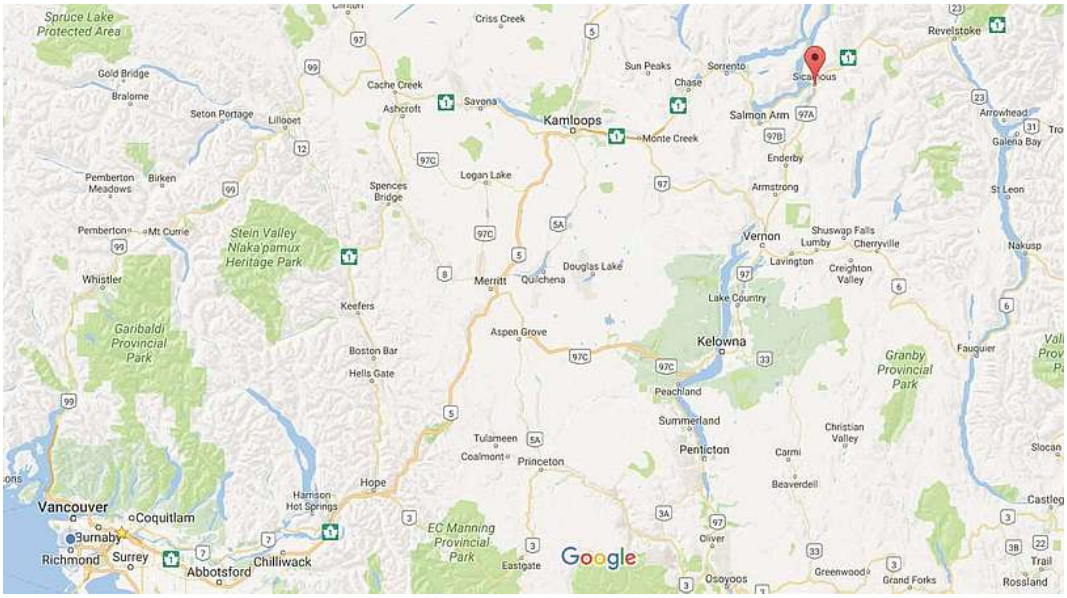

Figure 1 - Sicamous

Figure 2 - Original Intersection

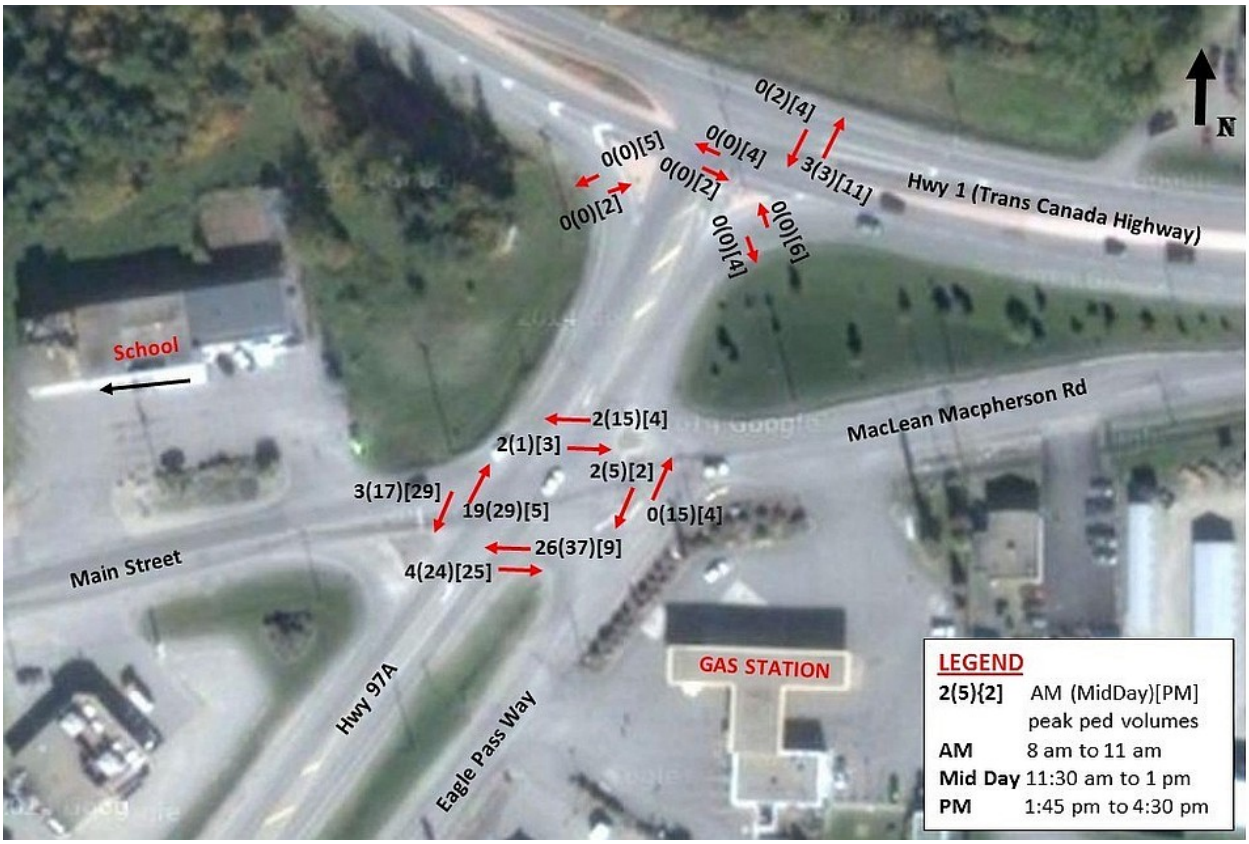

Figure 3 - Pedestrian Demand

Figure 4 - Shuswap Houseboat

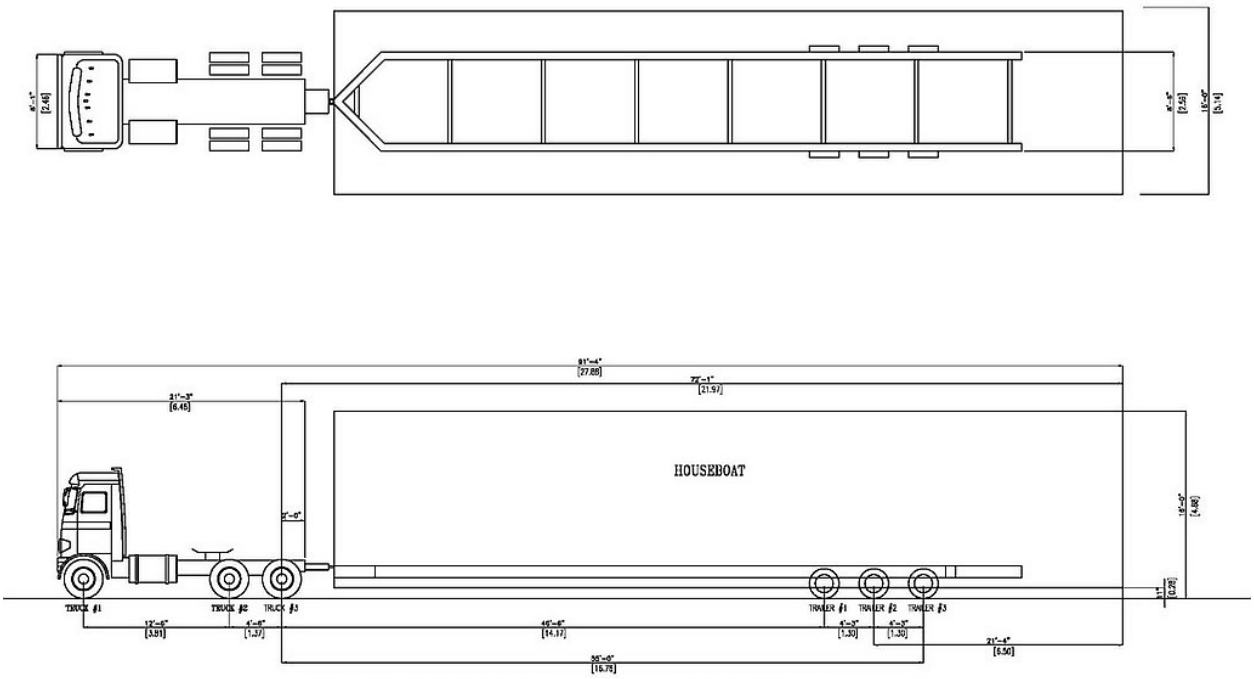

Figure 5 - Houseboat Trailer

Figure 6 - Colours and Textures

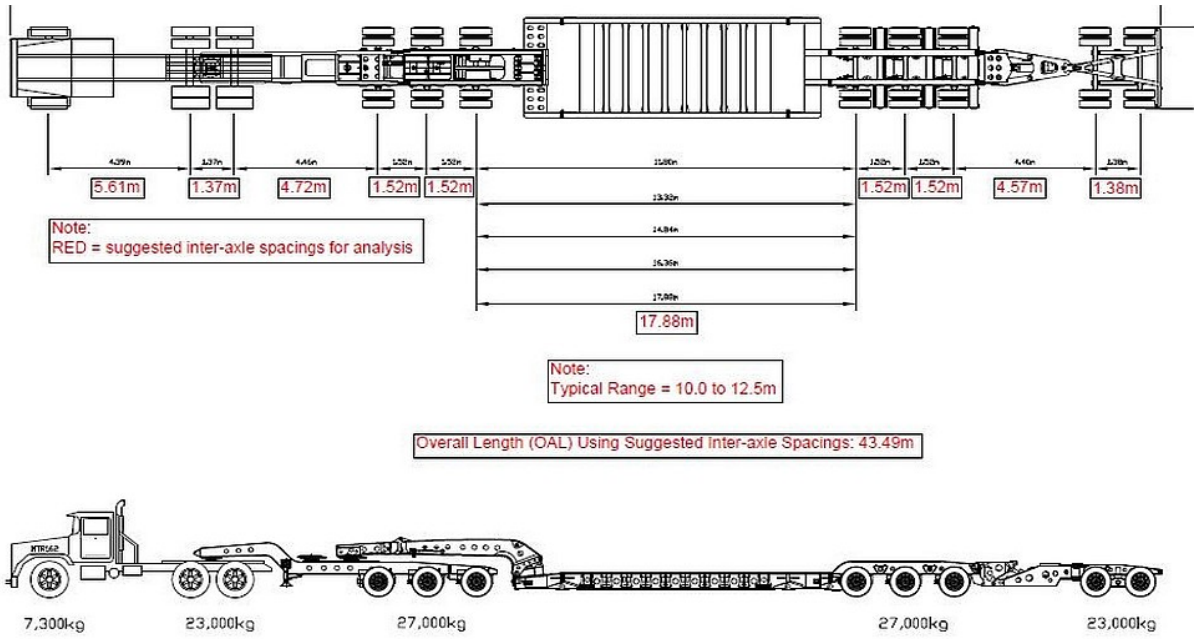

Figure 7- 11 Axle EXPANDO Low Bed

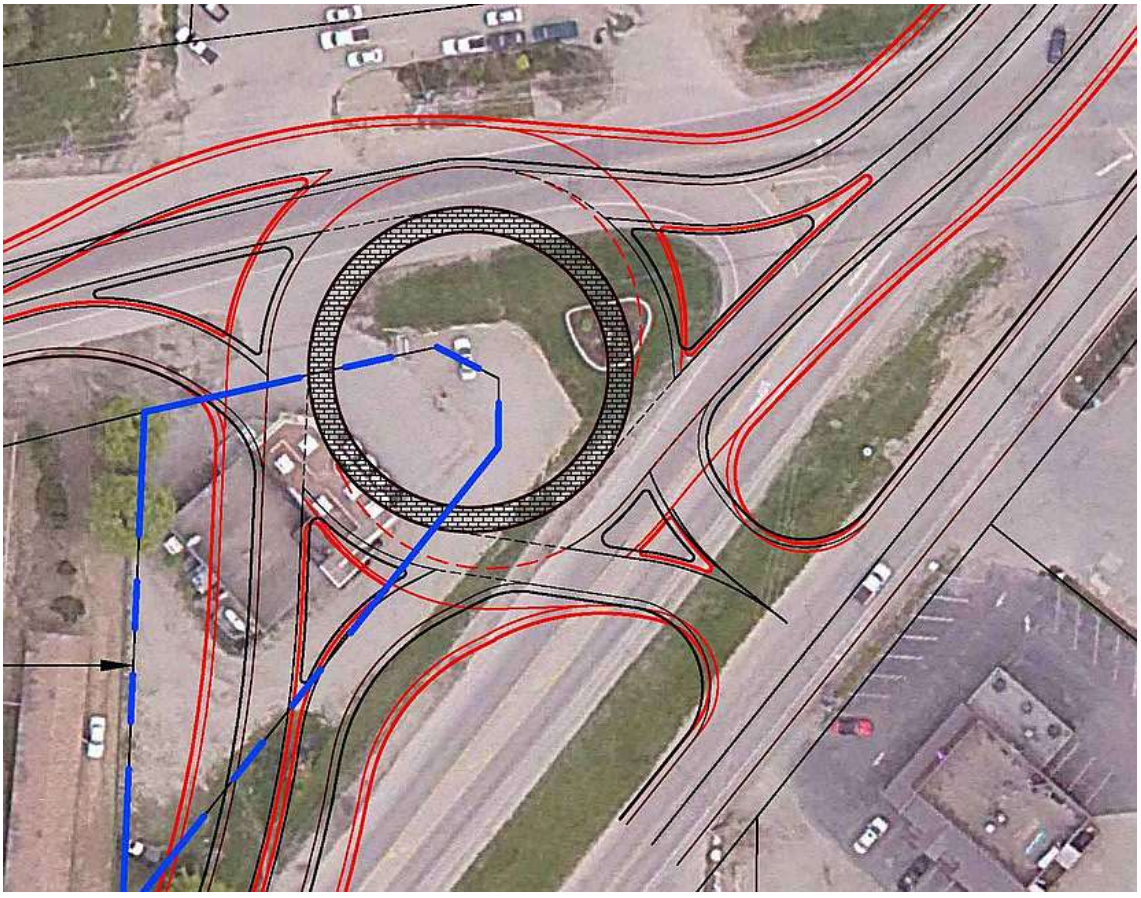

Figure 8 - Staging to two-lane roundabout

Figure 9 – Roundabout as constructed

Figure 10 – Roundabout as constructed

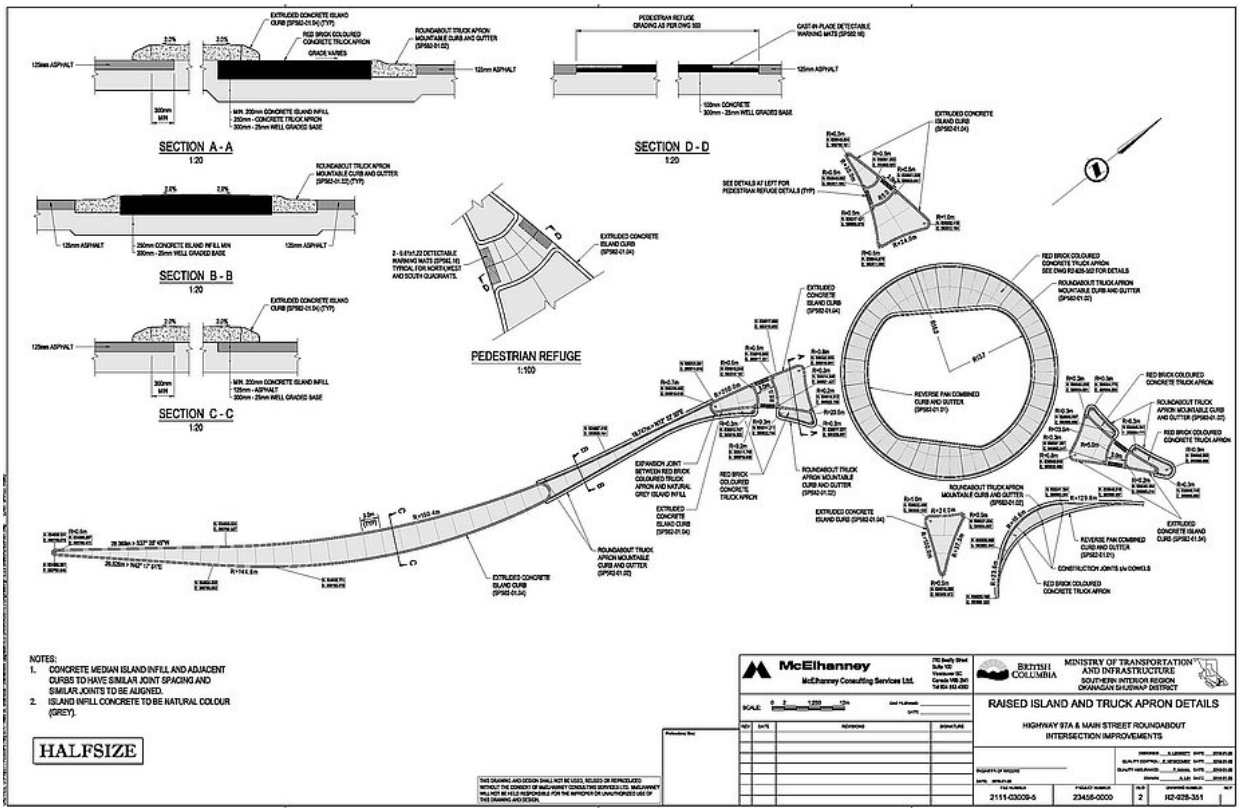

Figure 11 – Custom Truck Aprons

Figure 12 – Roll-Over Median for Counterflow Operation

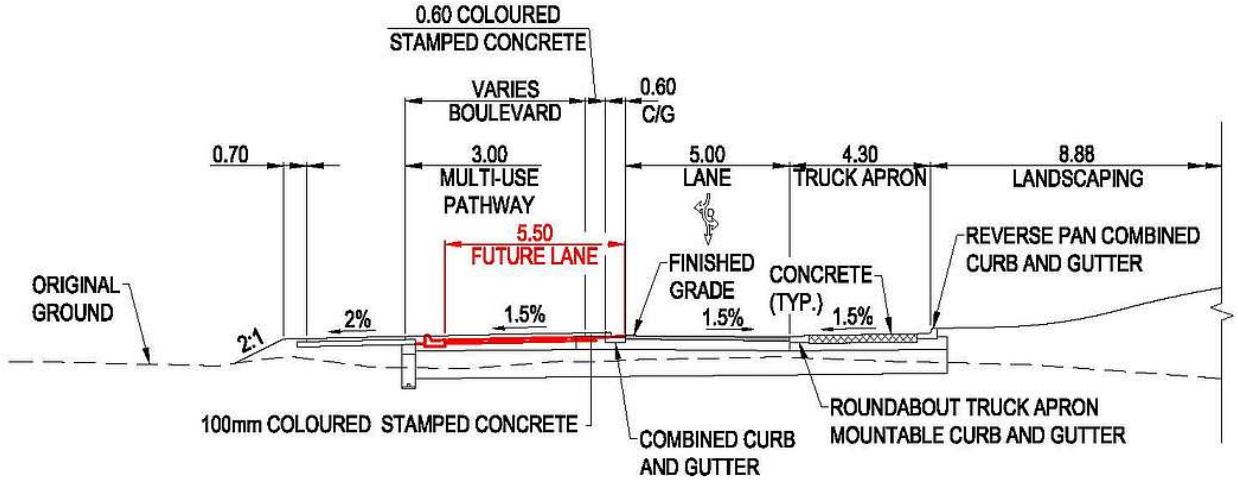

Figure 13 - Section through Circulatory Roadway

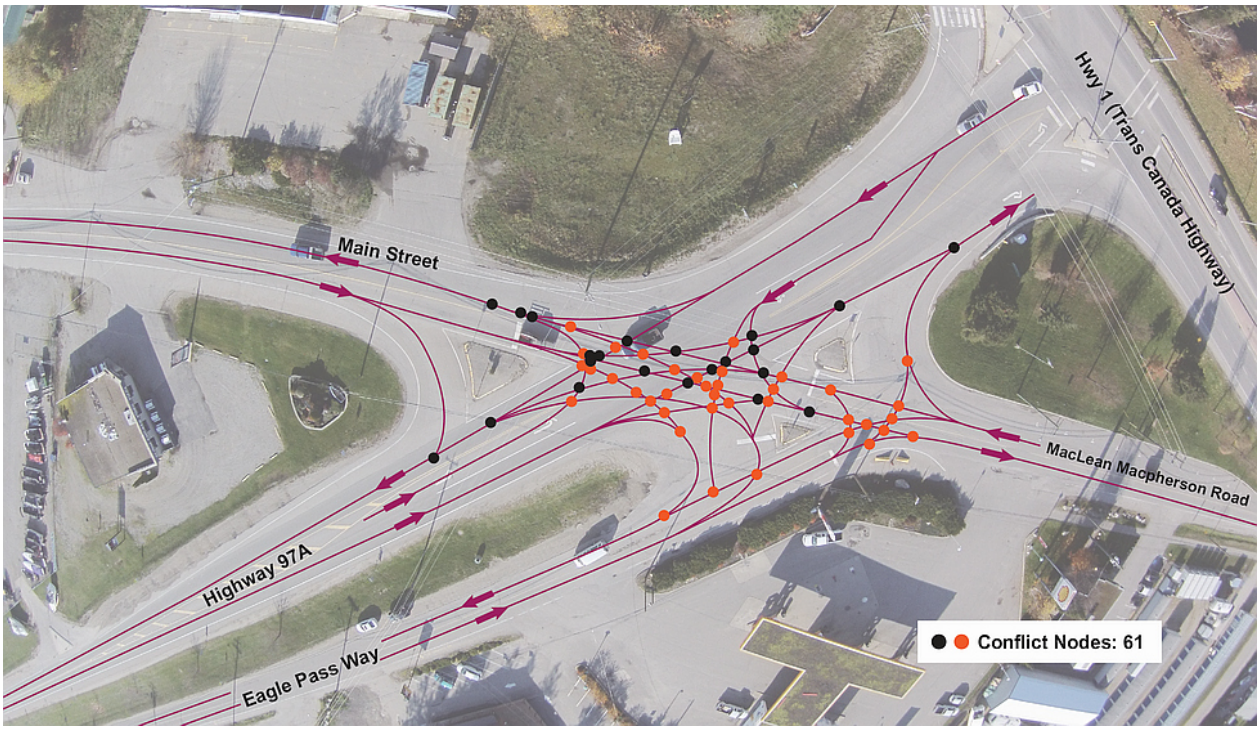

Figure 14 - Conflict Nodes - Previous Configuration

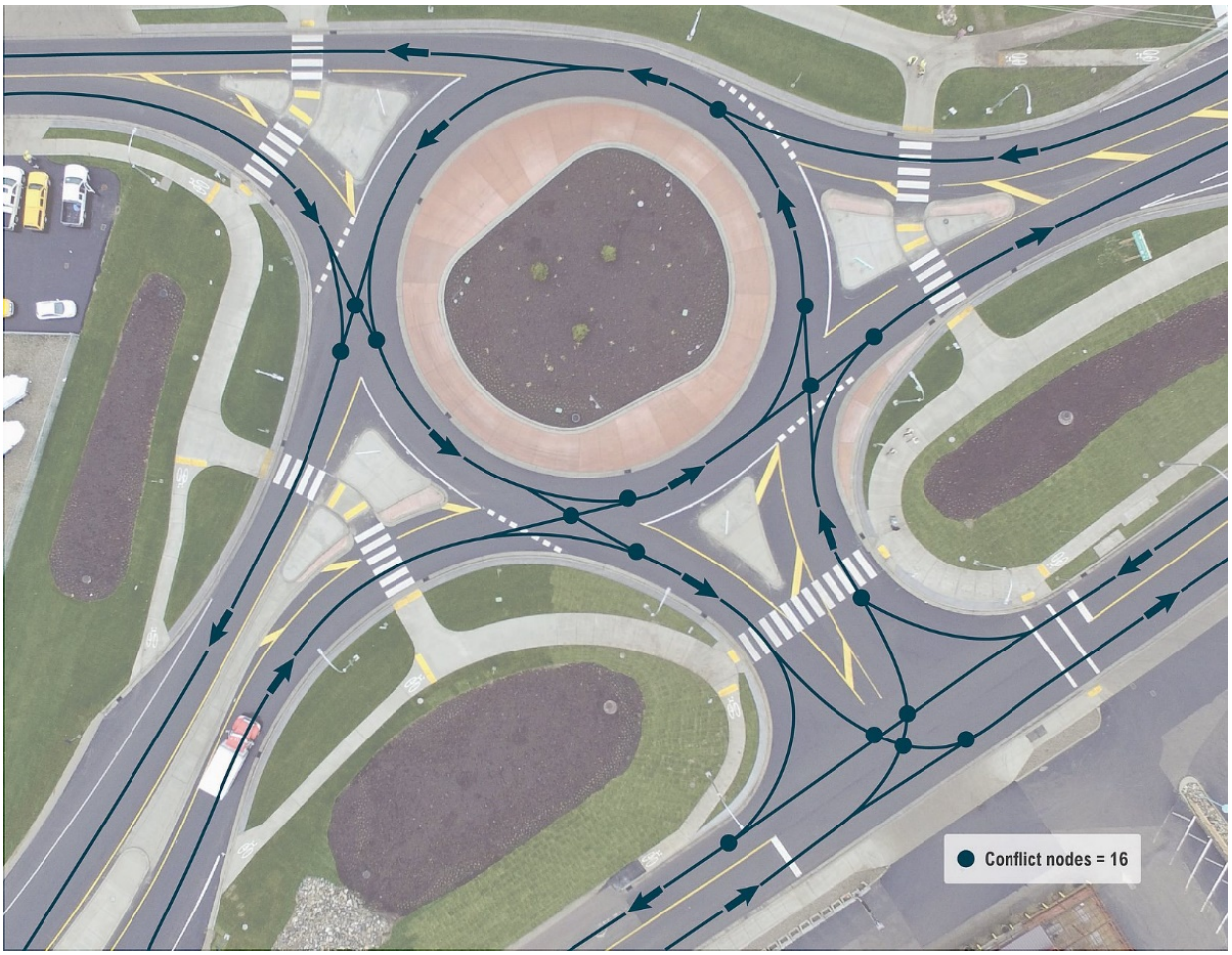

Figure 15 - Conflict Nodes - Roundabout

Figure 16 - Central Island Landscaping