

DESIGN BULLETIN #68/2010 (Supersedes Bulletin # 31)

Roundabout Design Guidelines on Provincial Highways

June 28, 2016 Amendment to Design Bulletin #68/2010 (see Technical Guidelines)

- Landscaping in Central Island
- Fastest Path Performance Check reference
- Transverse Rumble Strips at Rural Roundabout Approaches
- Circulatory Roadways – Vertical Consideration Guidelines
 - Mini-Roundabouts
- Plan DWG D-10.1 a, Revision 4. Refer to Attachment 8

November 5, 2014 Amendment to Design Bulletin #68/2010

- Economic Analysis
- Level of Service and Capacity Analysis
- Access Management
- Preferred Roundabout Capacity and Safety Analysis Software Packages
 - Design Vehicles (Updated Modified WB-36 Turnpike Double)
 - Designated Routes (LCV and High Load Corridor)
- Details and Turning Templates of Oversized Vehicles (Heavy Hauler Low Boy, Platform Trailer, and Superload- Reactor Transporter)
 - Design Vehicle Accommodation on Multi-lane Roundabouts (Case 1, 2, and 3)
 - Oversize Vehicle Accommodations
 - Curbing and Curb Types
- Surface Treatment for Truck Aprons, Splitter Islands, Over-run Fillet Areas, Central Islands (Non-Traversable and Traversable)
 - Roundabout Planning Templates and Summary Tables
 - Road Appurtenances
 - Pavement Design
 - Design Exceptions (Oversize Vehicles)
 - Typical Signage at Single Roundabouts (Urban and Rural)
- Typical Pavement Markings at Single-Lane Roundabouts (Urban and Rural)
- Typical Pavement Markings at Multi-Lane Roundabouts (Urban and Rural)

February 25, 2011 Amendment to Design Bulletin #68/2010

- Policy #4, 3rd and 5th Bullets, Page 2 of 3.
- Technical Guideline, Capacity and Safety Analysis, added NCHRP Report 672 method.
- Geometric Design Guidelines, horizontal and vertical alignment to conform to NCHRP Report 672, added NCHRP Report 672 as the general design guide and curbing guideline
- References, added NCHRP Report 672, deleted "FHWA, Roundabout: An Informational Guide"

October 29, 2010 Amendment to Design Bulletin #68/2010

- Technical Guideline, deleted Item 5, Page 2 of 4. Refer to Attachment 1
 - Plan DWG D-10.1a, Revision 1. Refer to Attachment 4

June 9, 2010 Amendment to Design Bulletin #68/2010

- Drawing and or page numbers added to Figures.
- Apron colour added to Drawings TCS-A7-100.1 and TCS-A7-100.2

PURPOSE

This Bulletin supersedes Bulletin 31 concerning the policy and guidelines for the use of roundabouts on roadways under Alberta Transportation's direction and control.

BACKGROUND

Modern roundabouts have been successfully implemented in countries throughout the world. Benefits realized by both transportation agencies and road users include reduction in severity of crashes, traffic calming, reductions in vehicular delays and reduced greenhouse gas emissions. Roundabouts provide opportunities to build more aesthetically pleasing junctions while also being functionally superior to conventional intersections in many ways. Roundabouts continue to effectively move traffic during power outages.

POLICY

1. Roundabouts shall be considered as the first option for intersection designs where, in the exclusive judgment of the department, a greater degree of traffic control than a two-way stop is required on a paved roadway e.g. a signalization or 4 Way stop control. If a different intersection treatment is recommended, the project documentation should include a reason why a roundabout was not selected for that location. Roadway design, economic analysis following the Department's guidelines, capacity analysis and traffic engineering with respect to roundabouts shall be carried out in accordance with the Technical Guidelines attached (refer to Technical Guidelines attached).

The installation of new signals is allowed however an engineering rationale should be prepared and documented to show that a roundabout was considered and to show why the signalization option was chosen. This is not considered a Design Exception. The decision can be made in the Region however Technical Standards Branch (TSB) should be copied on the documentation so that they are aware of the change in traffic control and the reasons why the change was made.

2. Roundabouts shall be considered on all roadways including high speed (70 km/h or greater) corridors. Roundabouts may be considered for intersections with interchange ramps.
3. Locations where roundabouts may be favoured:
 - Where there is a need for traffic calming such as at the boundary between urban and rural environments, in low speed urban environments, between high speed and lower speed roadways and/or between divided highways and undivided highway (such as interchange ramp terminals).
 - Where there is a desire to provide a corridor with a series of consistent intersection layouts (all roundabouts) such as at all interchange terminals along a route or at all at-grade intersections along an arterial roadway (this is frequently used in Europe especially for arterial roadways by-passing urban centres).
 - As a means of deferring road or structure widening through the provision of higher capacity at the nodes (intersections).
4. Locations where the Department would not wish to use roundabouts or any other type of traffic control (such as signals or 4 way stop) which would include a reduced posted speed (this list is intended to save unnecessary analysis and debate):
 - Along main alignment of existing freeways.

- Divided highways which are identified as "future freeways" unless the use of a roundabout for an interim stage is compatible with the staging plan.
 - National highway core routes where the posted speed is expected to be at least 90 km/h unless a roundabout with lower speed is considered compatible with a staged plan (for example, in a low speed urban environment where the ultimate plan is to by-pass the urban centre).
 - Where the preservation of a high speed through highway is both highly desirable and feasible (using options other than a roundabout).
 - Where geometric conditions are unsuitable e.g. where gradients on the through alignments or approaches are unacceptably steep (refer to NCHRP Report 672, Roundabouts: An Informational Guide – Second Edition”, Section 6.8.7 - “Vertical Considerations” for vertical alignment guidelines) or where the sight lines on approaches are unacceptable (where decision sight distance cannot be provided in advance of the roundabout).
 - Where an intersection is located in close proximity to an at-grade railway crossing, the design must evaluate the implications the railway will have on the safe operation of a roundabout. If a roundabout cannot be proven to work safely adjacent to an at-grade crossing, then other alternatives must be evaluated and recommended by designers.
 - Where an intersection is located in close proximity to a bridge, the roundabout design must consider impacts to the roadway geometry, structure width and length, icing concerns, functionality of the barrier treatments, and cost implications. In all cases where roundabouts are to be used near structures the flexibility and stage-ability of future bridge options shall also not be negatively impacted. If proximity impacts cannot be mitigated, additional engineering justification must be provided to the Project Sponsor for acceptance.
5. The timing of roundabout installation may be triggered by 1) the need to provide a higher degree of traffic control than a "two-way stop control", 2) a clear economic benefit based on safety and other considerations under current traffic conditions or 3) implementation of a traffic calming measure based on sound engineering judgment.
6. If an intersection warrants a signal or a four-way stop control within 10 years of the proposed project, the modern roundabout shall be evaluated. Where there is an existing four-way stop control or signalized intersection and there are operational and safety problems with the current traffic control, then a roundabout shall be considered.
7. Level of Service and capacity analysis for roundabouts and signals are based on different methodologies and therefore cannot be compared directly to each other. For this reason the department prefers to compare “average delay on a roundabout” versus “average delay at a signalized intersection” to assist in choosing the optimal type of control. The Level of Service and Capacity analysis is used to optimize the number of lanes and to assist in deciding if right turn by-pass lanes should be provided (in both a roundabout and signalized intersection). If a capacity analysis shows a heavy right-turn volume and a Level of Service (LOS) analysis shows the LOS is lower than D (using the NCHRP Report 672 method), the provision of a separate right turn channelized roadway should be considered.

8. There is no change in Access Management Guidelines as a result of using a roundabout. For example, access by local roads to interchanges under Provincial government jurisdiction must be at least 400 m from the centerline of the roundabout ramp terminal or 150 m from end of ramp terminal taper (whichever distance is greater), remains applicable. Refer to Figure DB68-1.
- In general, and depending on site specific conditions, roundabouts can be used to manage and improve the operation and/or safety along a corridor. Roundabouts may be used at either end of a corridor, facilitating U- turns, and reducing full accesses in between to right-turns only. A continuous median with no cross-overs allowed will considerably reduce the number of conflict points.

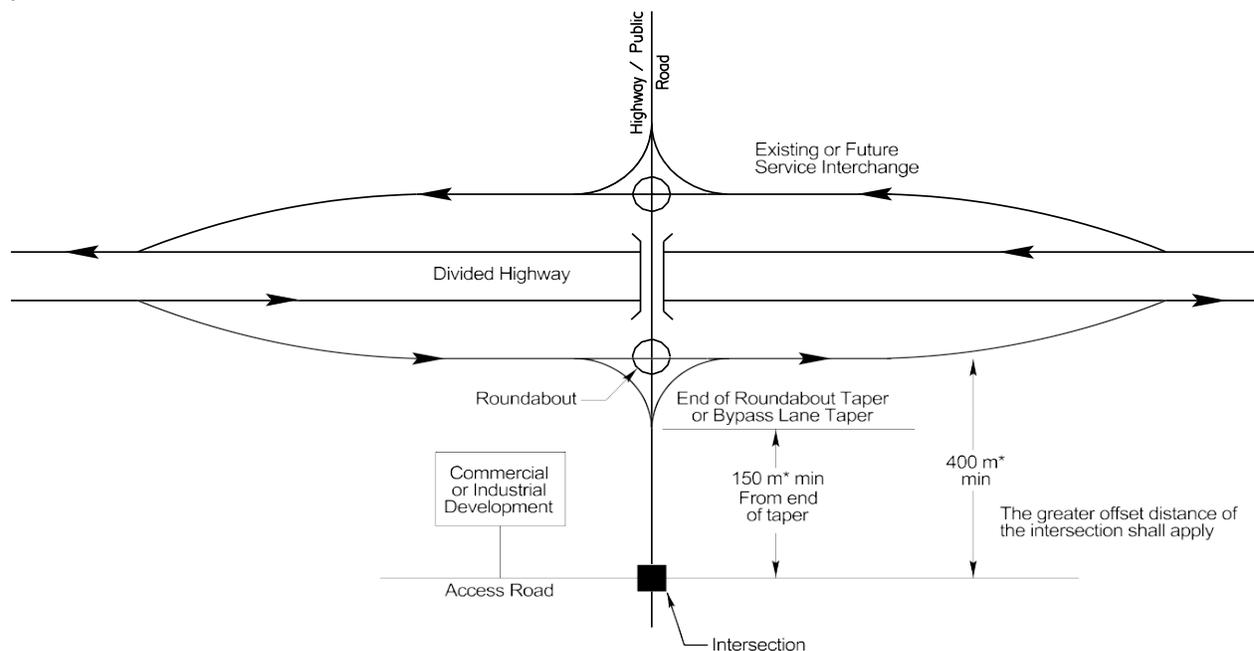


Figure DB 68-1: Highway / Public Road Intersection at Diamond Interchange

METHODOLOGY

The methodology shall be to follow the standard considerations used by the department on typical projects i.e. safety, geometrics, operations, consistency with driver expectations, level-of- service, mobility, access, economics etc. The economic analysis tool to be used is the department's Benefit Cost Analysis Guide. The standard indicators of Internal Rate of Return, Benefit/ Cost Ratio, Net Present Value / Capital Cost etc. shall be considered for each option.

The guidelines as indicated in this Bulletin are to be implemented immediately as per the usual practice (refer to the Technical Guidelines attached).

Date of Issue: May 17, 2010

Effective Date: May 17, 2010.

Revised Date (1): June 9, 2010

Revised Date (2): October 29, 2010

Revised Date (3): February 25, 2011

Revised Date (4): November 5, 2014

Revised Date (5): June 28, 2016

Recommended:

Approved:

Bill Kenny

FK Bill Kenny, P. Eng
Director, Design, Project Management
And Training
Date: JUNE 30/2016

Tom Loo

TL Tom Loo, P. Eng
Executive Director, Technical Standards
Branch
Date: 2016.6.30

Attachments:

1. Technical Guidelines, June 2016
2. Typical Signing at Single-Lane Roundabout (Urban), TCS-A7-100.1, Rev 1, Oct. 15, 2014
3. Typical Signing at Single-Lane Roundabout (Rural), TCS-A7-100.2, Rev 1, Oct. 15, 2014
4. Typical Pavement Markings at Single-Lane Roundabout (Urban), TCS-C-100.1, Oct. 2014
5. Typical Pavement Markings at Single-Lane Roundabout (Rural), TCS-C-100.2, Oct. 2014
6. Typical Pavement Markings at Multi-Lane Roundabout (Urban), TCS-C-100.3, Oct. 2014
7. Typical Pavement Markings at Multi-Lane Roundabout (Rural), TCS-C-100.4, Oct. 2014
8. Roundabout and Cross Section Details Drawing, D-10.1a, Rev.4, June 2016
9. Design Vehicle, LCV Turnpike Double Details (medium and minimum turning radius)
10. Oversize Vehicle, Heavy Hauler
11. Oversize Vehicle, Platform Vehicle
12. Oversize Vehicle, Reactor Transporter (Superload)
13. Technical Memorandum by Ourston Roundabouts Engineering, Truck Accommodation at Multi-lane Roundabouts prepared by, May 25, 2011
14. Roundabout Planning Templates and Summary Tables prepared by Ourston Roundabouts Engineering for Alberta Transportation

TECHNICAL GUIDELINES – REVISED JUNE 2016

Summary: The subjects covered by the Technical Guideline are as follows:

1.0 ECONOMIC ANALYSIS

2.0 CAPACITY AND SAFETY ANALYSIS

3.0 GEOMETRIC DESIGN GUIDELINES

4.0 DESIGN VEHICLE AND OVERSIZE VEHICLE GUIDELINES

4.1 Designated Routes

4.1.1 Long Combination Vehicle Routes

4.1.2 High Load Corridors

4.1.3 Alternative Routes

4.2 Design Vehicles

4.3 Oversize Vehicles

4.3.1 Heavy Hauler (Low Boy) Vehicle

4.3.2 Platform Trailer Vehicle

4.3.3 Reactor Transporter

4.3.4 Farm Equipment Vehicles

4.4 Design Vehicle Accommodations on Multi-Lane Roundabouts

4.5 Oversize Vehicle Accommodations

4.6 Roundabout Planning Templates and Summary Tables

4.7 Road Appurtenances

5.0 CENTRAL ISLAND LANDSCAPING

6.0 PAVEMENT DESIGN

7.0 DESIGN EXCEPTIONS

8.0 SIGNING, PAVEMENT MARKINGS AND ILLUMINATION

8.1 Guide Signage

8.2 Tourist Related Directional Signage

8.3 Regulatory, Warning and Informational Signage

8.4 Pavement Markings

8.5 Illumination

8.6 Transverse Rumble Strips at Approaches

9.0 RECOMMENDATIONS

10.0 CONTACTS

11.0 REFERENCES

1.0 ECONOMIC ANALYSIS

An economic analysis shall be undertaken to assist in evaluating the preferred type of intersection control as per the current version of the Department's Benefit Cost Guide that accounts for all costs and benefits over the design period. The analysis shall also include consideration of societal cost of vehicle collisions, road user cost, environmental and agency cost (construction and operations).

In the United States, nationwide, a before-after comparison of collision data published in NCHRP Report 572 associated with construction of roundabouts in place of traditional intersections showed:

- 76% reduction in injuries and fatalities
- 35% reduction in total collisions

The following conclusions were drawn from the above United States Study:

- **Control type before.** There are large and highly significant safety benefits of converting signalized and two-way stop-controlled intersections to roundabouts. The benefits are larger for injury crashes than for all crash types combined. For the conversions from all-way-stop-controlled intersections, there was no apparent safety effect.
- **Number of lanes.** The safety benefit was larger for single-lane roundabouts than for two-lane designs, for both urban and suburban settings. All rural roundabouts were single lane.
- **Setting.** The safety benefits for rural installations, which were all single lane, were larger than for urban and suburban single-lane roundabouts.

Refer to the NCHRP Report 572 for further details.

Other safety performance references include: Crash Modification Factors (CMF) Clearinghouse, AASHTO Highway Safety Manual (HSM), NCHRP Report 672, other documented studies from other road jurisdictions, etc.

Planners and Designers should develop their rationale and provide justification for the safety performance factors used in their analysis.

2.0 CAPACITY ANALYSIS

The Design Hour is the 100th highest peak hour (considering both morning and afternoon peaks for each direction of travel) in the Design Year. The Design Year is normally the 20th year after construction however shorter design periods may be used where appropriate if dictated by external factors (such as other infrastructure improvements or changing traffic patterns due to development) which may limit the expected service life of the roundabout.

Although a standard design life of 20 years is desirable, it is frequently preferred to implement a roundabout in a "staged" manner. For example, as a single lane roundabout on opening day with provisions for additional lanes when required (which may be as early as 5 years after opening). The advantage of the staged approach is to benefit from the simpler and safer operations of a single lane roundabout for as long as possible and also to allow drivers to become comfortable with the roundabout concept before converting to multi-lane type operations.

Based on a planning level analysis only, a single-lane roundabout shall be the first solution to be considered when the sum of circulating and entering flow rate is less than 1100 veh/hr at each entry approach based on the Design Hour.

Based on a planning level analysis, where the sum of circulating and entering flow rate exceeds 1100 veh/hr on one or more entry legs, then a two lane entry may be considered for that leg. Where the sum of circulating and entering flow rate at multiple legs is in excess of 1100 veh/hr but not greater than 1900 veh/hr, a two lane roundabout may be considered.

Roundabouts may be designed with a combination of single lane and two lane segments on various quadrants depending on traffic demand. There is a trade-off between mobility and safety. By-pass lanes may also be used where justified by a particularly high right turn movement however it is preferred to avoid the additional complexity of by-pass lanes where feasible. Designers are to provide recommendations to Department for acceptance. The suitability of bypass lanes should also take into consideration the characteristic and volume of pedestrians and cyclists. The entries and exits of bypass lanes can increase conflicts with cyclists and pedestrians and introduces merging on the downstream leg.

Level of Service and capacity analysis for roundabouts and signals are based on different methodologies and therefore cannot be compared directly to each other. For this reason the Department prefers to compare “average delay on a roundabout” versus “average delay at a signalized intersection” to assist in choosing the optimal type of control. The Level of Service and Capacity analysis is used to optimize the number of lanes and to assist in deciding if right turn bypass lanes should be provided (in both a roundabout and signalized intersection). If a capacity analysis shows a heavy right-turn volume and a Level of Service (LOS) analysis shows the LOS is lower than D (using the NCHRP Report 672 method), the provision of a separate right turn channelized roadway should be considered. As indicated above, the presence of pedestrians and cyclist should also be considered in evaluating the desirability of a right turn channelized roadway acceptability.

The Department’s preferred roundabout capacity and safety analysis software packages are SIDRA and ARCADY. Engineers shall be aware that analysis results from different software packages may be different for the same roundabout. Field calibration is needed for software application (field calibration is unlikely to happen in the short term). If local field data is not available the recommended parameters in NCHRP Report 572 should be used and supplemented by engineering judgement.

SIDRA should generally be used by Planners and Designers as a planning tool for network modelling, planning level analysis, performance analysis comparison/evaluation of roundabouts and traffic signals (or four-way stops), and traffic impact assessments, etc. ARCADY should generally be used for more detailed performance analysis and detailed geometric design. Other software can be used to supplement or support the base analysis as needed, however the recommended software should be used in the submission. Other software to supplement or support the base analysis software can be used as needed.

3.0 GEOMETRIC DESIGN GUIDELINES

Generally, roundabout design principles include: properly designed entries and exits, site specific design, truck capabilities, appropriate deflection and speed control, properly sized inscribed circle diameter (ICD), positive driving experience and comfort for the public. Roundabout design is a complex task which generally produces a “custom” design for each location (based on unique traffic flow, intersection roadway geometry and physical constraints). Designers shall use design principles to guide the site specific design instead of attempting to apply standard design solutions.

Roundabout geometric design shall follow the guidelines in this bulletin with particular reference to the following:

1. Design Vehicle: design vehicle shall follow the requirements in the Alberta Highway Geometric Design Guide (1999), see Section D.5.1. Any roundabouts where it is expected that truck-trailer combinations will be passing through or turning on a daily basis must accommodate the WB-21 design vehicle and larger vehicles if required. Also, if the highway is divided or can be expected to carry Long Combination Vehicles (LCV), then the appropriate LVC movements must be accommodated. *Designers should refer to the Department’s website for the current information regarding Alberta LCV map and conditions of operation.* The type of accommodation required depends on the number of lanes, the expected traffic conditions and other geometric and operational considerations (see further details below). Roundabouts should generally be designed so that “oversized vehicles” may pass through at low speed under piloted conditions. Oversized vehicles include construction equipment (heavy haulers), platform trailers and the *Reactor Transporter*. *It is recognized that “Reactor Transporter” is generally confined to the High Load Corridor and therefore roundabouts that are “off the corridor” should generally not be designed for the “Reactor Transporter”.* For vehicles that use an intersection on a regular basis, the “medium” turning template should be used. If the movement is very occasional such as a piloted oversized load, then the “minimum” turning template may be used together with the allowance that these vehicles may ride over the curbs onto splitter island, the central island or the shoulders as required. For further details, refer to Design Vehicle and Oversize Vehicle Guidelines below.
2. Based on the Department’s experience, current roundabout construction costs are high compared to the cost of signalization or other conventional intersection improvements. **Planners and designers should be optimizing their designs in terms of safety, capacity and cost. It is important that roundabouts continue to serve the primary purpose of enhancing safety.** The Department’s intent is to maintain a highway system that will have “no bottlenecks” for high loads or other oversized loads. Roundabouts may present a bottleneck if oversize and overweight loads are not considered. This problem can be addressed by constructing extra wide approaches and/or using wide aprons; however, this comes at a cost for construction and may adversely affect operations by regular daily traffic due to higher speed entries. Another strategy is to make the centre island completely traversable by *installing removable signs or other features* which may be *temporarily* removed when large vehicles must utilize the roundabout. Refer to Section 4.6 for further details.
3. It is desirable to use NCHRP Report 672: Roundabouts: An Informational Guide – Second Edition” as the general design guideline.
4. Refer to NCHRP Report 672, Section 6.3.2 - “Alignment of Approaches” for horizontal alignment guidelines of the approach legs.
5. Refer to NCHRP Report 672, Section 6.8.7 - “Vertical Considerations” for vertical alignment guidelines.

6. The slope of the truck apron should generally be no more than 2%. Refer to NCHRP Report 672, Section 6.8.7 - "Vertical Considerations" for crossfall guidelines for single-lane and multi-lane roundabouts.
7. Refer to NCHRP Report 672, Section 6.8.7 - "Vertical Considerations" for truck apron guidelines. A different texture than the travel lane and a mountable concrete curb shall be used to provide definition of the boundary between travel lane and apron. The detailed dimensions of the mountable curb are specified in Drawing D-10.1a attached (a rise of 60 mm over a run of 100 mm). The reason for these specific dimensions is to ensure that the curb is high enough and steep enough to provide some definition (and prevent short cutting) while still being low enough to allow the rear wheels of large vehicles to off-track on to the apron without causing any operational problems.
8. Curbing: Refer to NCHRP Report 672, Section 6.8.5.2 Curbing and this Design Bulletin for details. Curbs shall be provided at all roundabouts (rural and urban) as they are needed to achieve the speed reduction required for safe operations.
9. Performance checks shall be undertaken in accordance with NCHRP Report 672, Section 6.7 - Performance Checks guidelines. Performance checks include fastest path, path alignment considerations, sight distances, angles of visibility, etc. Note that the performance check for fastest path shall be undertaken in accordance with the Wisconsin Department of Transportation Roundabout Design Guide, Section 30.5.2.
10. Refer to NCHRP Report 672, Section 6.8.1 for Pedestrian Design Considerations and Section 6.8.2 for Bicycle Design Consideration.
11. Circulatory Roadways: Refer to NCHRP Report 672, Sections 6.8.7.2 and 6.8.7.3 for Single Lane and Multilane Roundabout for Circulatory Roadways respectively for vertical consideration guidelines.
12. Mini Roundabouts: Where appropriate mini-roundabouts should be considered. Typically characterized by a small diameter and fully traversable islands, mini-roundabouts are typically suited for low-speed environments and where site constraints would preclude the use of a larger roundabout with a raised central island. Refer to NCHRP Report 672, Section 6.6 Mini-Roundabouts.

4.0 DESIGN VEHICLE AND OVERSIZE VEHICLE GUIDELINES

4.1 Designated Routes

The following is an updated provincial map and information on Long Combination Vehicle Routes (LCV) and High Load Corridor.

4.1.1 Long Combination Vehicle Routes

Details of the LCV program and map of highways currently designated as LCV routes can be found on the following AT website:

<http://www.transportation.alberta.ca/3191.htm>

The AT webpage also has information on the Conditions for the Operation of Long Combination Vehicles (LCV). The latest information can be found on the following link:

<http://www.transportation.alberta.ca/3191.htm>

In regards to design vehicle routes notes/conditions, Planners and Designers should take note of the following Sections in the Conditions for the Operation of Long Combination Vehicles (LCV), Sections include (there may be other Sections pertaining to a specific location):

Section H Turnpike Doubles and Triple Trailer Routes

Section I Routes in Urban Centres

Section J Exemptions to Length
Section K Extended Length Double and Rocky Mountain Double Routes
Section L LCV Travel off of Designated Routes

4.1.2 High Load Corridors (HLC)

The High Load Corridor consists of designated highways within the Province of Alberta, which have had the overhead utility lines raised to accommodate loads typically up to 9.0 metres high unless noted otherwise. The loads are typically permitted to be significantly wider than normal loads. There are also designated highways with clearances of up to 12.8 m reserved for pressure type vessels only such as Cokers and Reactor Transporters.

A listing and map of highways designated as high load corridor can be found on the following AT website:

<http://www.transportation.alberta.ca/3192.htm>

Refer to Section 4.3 for detailed dimensions of oversized vehicles.

4.1.3 Alternative Routes

Planners and designers should investigate if there are any alternative routes for bypassing the proposed roundabout (intersection) location which is currently being used by oversize vehicles. Planners and Designers should contact Transportation Safety Services (TSS) - Transport Engineering for any available information on alternative routes.

4.2 Design Vehicles

The normal practices for selecting design vehicles and turning templates (as per the AT Highway Geometric Design Guide) shall be followed for typical design vehicles based on designated route or corridor (LCV, WB21, etc.).

Update: Long Combination Vehicle (LCV) Design Vehicle - Turnpike Double

On highway routes where LCV Turnpike Doubles are permitted, roundabouts should typically accommodate these vehicles for all directions through the roundabout. The following information is an update to the Turnpike Double Design Vehicle.

The maximum overall length permitted for the Turnpike Double is currently 41 m (refer to the attached Conditions for the Operation of Long Combination Vehicles (LCV). Refer to the attached for details of the typical 41m LCV design vehicle dimensions permitted on Alberta Highways from TSS - Transport Engineering.

Moose rack installed on front of trucks/truck tractors is not included in the overall length to the design vehicle as long as it does not extend more than 0.3m. Moose racks should not have an impact on the swept path of the design vehicle, however, the additional dimension of the moose rack should be considered where vehicle storage, refuge, etc is applicable. Examples include (not all listed) median width (i.e. refuge), stacking distance at intersection near railroads, etc.

In the interim for roundabout projects, planners and designers should refer to this design vehicle as the "modified WB36" (note the wheelbase is greater than 36m) with an overall length of 41m which excludes the moose rack.

Where applicable, planners and designers should be using the attached "modified WB 36" design vehicle at all proposed roundabouts.

As per AT's typical practice, the LCV medium turning radius should typically be used for roundabout design. Off tracking outside of their lanes on entry, while circulating and on exit are generally permitted for LCV. These units are a relatively small component of the total traffic and are driven by specially trained professional operators who understand the need to avoid conflicts due to off-tracking on turns. Additional educational signing should generally be provided in advance of multi-lane roundabouts to advise other drivers of the need to "share the road" with other vehicles and to avoid passing large trucks in the roundabout. There are several signs available for this purpose. See more detail in the signing section (below).

The minimum turning radii are typically used only for low speed off-highway operation (under 15 km/h) such as parking lots, gas/garage facilities, shopping centres, bus terminals, etc.

4.3 Oversize Vehicles

In addition to the typical design vehicles, oversized vehicles shall also be accommodated through the roundabout as indicated under this and/or subsequent Sections

Oversize vehicles are considered as occasional users and therefore can be accommodated travelling at low speed through the roundabout with the use of pilot vehicles and special traffic control. There are many configurations of oversize vehicles which travel under permit on the Department's roadway network. In order to provide consistent design guidelines at roundabout locations, three types of oversize vehicles were selected based on input/review of vehicle permit inventory, vehicle configurations, swept path, etc. by Alberta Transportation's Transport Engineering and Technical Standards Branch (TSB). The three types/configurations of oversize vehicles are the Heavy Hauler (Lowboy), Platform Trailer and the Reactor Transporter (Superload). All of the oversized vehicles can climb the curbs (if semi-mountable). Also because these vehicles are piloted / escorted they may be permitted to travel in a counter flow direction through a roundabout.

Turning movement templates for the three oversize vehicles are attached. Plots of wheel paths and swept paths while turning are derived from software. While evaluated by the software, the specific movements for these custom vehicles have not been verified by the Department in the field. Their accuracy is limited by the software. Actual turning paths and swept paths will depend on operator input and assumptions.

4.3.1 Heavy Hauler (Lowboy) Vehicle (refer to attached Drawing No. D-5m)

The Heavy Hauler Lowboy Vehicle can potentially travel under a route-specific permit anywhere in the Province where there is construction and/or development. This vehicle shall typically be accommodated on the highway network for all movements at proposed roundabouts traveling at low speed. The design vehicle has an overall length of 46.8 m with a maximum trailer track width of 5.2 m (tire to tire) and can carry maximum load width of 7.3 m centered on the lowboy. For further details on the design vehicle configuration refer to the attachment.

In addition to the horizontal geometry, planners and designers should also take special care to ensure that these design vehicles have been accommodated for in the vertical geometry (clearance). The clearance height from the road surface to the underside of the lowboy trailer can be as low as 150 mm however the low boy trailer can be raised up to 900 mm. The raising of the lowboy trailer takes about 15 minutes and may cause traffic delays. It is desirable to accommodate these vehicles vertically such that the lowboy trailer doesn't need to be raised.

The Heavy Hauler Vehicle should be modeled under low speed conditions using truck turning software. Note that the maximum trailer track width (tire to tire) for Heavy Hauler (5.2m) for design purposes is greater than the value shown in the example in the attachment.

4.3.2 Platform Trailer Vehicle (refer to attached Drawing No. D-5n)

Platform Trailer Vehicles can potentially travel under a route-specific permit anywhere in the Province. The Platform Trailer vehicle shall typically be accommodated on the highway network for all movements at proposed roundabouts travelling at low speed.

Platform Trailer Vehicles can vary significantly in size and configurations. The design vehicle has an overall length of 54.3 m with a trailer track width of 5.2 m (tire to tire) and can carry a maximum load width of 7.3 m centered on the Platform Trailer. There is no pivot point typically on the Platform Trailer. For further details on the vehicle configuration refer to attachment. The Platform Trailer Vehicle should be modeled under low speed conditions using truck turning software.

4.3.3 Reactor Transporter Vehicle (refer to attached Drawing No. D-5o)

Superload vehicles can vary significantly in configuration, size (and loads) and weight. The vehicle selected to represent all Superloads is the Reactor Transporter. In the case of the Reactor Transporter, the tire to tire typical width to be used on the trailers is 6.7m. All dimensions shall be taken from the attached drawing. The load height and width will vary depending on the payload.

Superload vehicles can travel under route-specific permits generally on designated HLC in the Province, including origin/destination routes to/from the HLC. The Reactor Transporter shall typically be accommodated on the existing and proposed HLC for all designated movements at proposed roundabouts travelling at low speed.

Designated movements include intersection legs located on existing and proposed HLC and all known origin/destination roadways to/from the HLC. Origin-destination roadways to/from the HLC should be confirmed with Transportation Safety Services (TSS) - Transport Engineering.

The generally larger surface areas and curb requirements will be helpful in accommodating all oversized vehicles (including those vehicles smaller than Superloads). Curbing will provide definition (and speed control) for regular traffic.

The Reactor Transporter Vehicle should be modeled under low speed conditions using truck turning software.

4.3.4 Farm Equipment Vehicles

TSS - Transport Engineering does not keep or have available a permit inventory of farm equipment vehicles or details of farm equipment vehicles. Farm equipment vehicles do not require permits on Alberta's highways.

Farm equipment vehicles shall be accommodated at roundabout locations. Suggestions for determining the anticipated farm equipment using the intersection include contacting local landowners, open houses, local farm equipment dealerships, etc.

4.4 Design Vehicle Accommodations on Multi-Lane Roundabouts

Design Vehicles shall be accommodated in a way that is suitable for the type of vehicle and the type and volume of traffic. Smaller design vehicles such as passenger vehicles are normally accommodated within the lane lines while larger vehicles (especially truck trailer combinations) are generally permitted to off-track outside of their lanes on entry, while circulating and on exit. Such off-tracking may be accommodated through the use of aprons, islands and medians. The type of accommodation to be provided is described as Case 1, Case 2 or Case 3.

- Case 1 Roundabouts: Large commercial vehicles (up to WB-21 size) will track across adjacent lanes as they enter, circulate and exit multi-lane roundabouts.
- Case 2 Roundabouts: Large commercial vehicles (up to WB-21 size) can maintain their own lane through the entry, but not as they circulate and exit multi-lane roundabouts.
- Case 3 Roundabouts: Large commercial vehicles (up to WB-21 size) can maintain their own lane as they enter, circulate and exit multi-lane roundabouts.

Planners and designers should review the three cases and determine which case is the most appropriate for their specific project location. The appropriate “case” shall be recommended by the designers for each roundabout and accepted/approved by the Department. The choice of case should be sensitive to the context as well as the traffic characteristics (including speed, volume, vehicle composition, etc). There is a trade-off to be made between case types. Case 1 will generally result in a smaller diameter than Case 2 or 3 and therefore will have lower speed operation and also lower conflicts. Conversely, Case 3 will generally require a larger diameter, will be able to handle larger volumes of large vehicles but also may allow vehicles to enter at a higher speed (which may result in higher severity for crashes). Because of the significant trade-offs being made it is very important that the designer recommends the appropriate treatment based on site specific considerations.

In general, Case 2 is applicable on the Alberta highway network. Case 3 or Case 1 may be considered and could be recommended by the designer where appropriate. Where there is an expectation of many larger truck-trailer units and slightly higher speeds are tolerable, an argument for Case 3 may be made. Conversely where the environment is more conducive to low operating speeds, such as low speed urban environments especially where passenger vehicles are predominant, the designer may prepare a rationale/recommendation for Case 1. The presence or absence of Oversized Units is not a key consideration in selecting the “Case” to be used as Oversized Units are normally piloted and therefore the risk of side swipe collisions is significantly reduced. In all cases, the designer should recommend the appropriate case to be used for each movement and present the rationale to the Project Sponsor for acceptance.

As indicated previously above, the choice of design vehicle shall comply with the Alberta Highway Geometric Design Guide (1999); specifically the truck apron must be designed to accommodate the off-tracking of WB-21 and long combination vehicles (LCV) and/or Log Haul Truck if appropriate depending on the project detailed requirements. Off-tracking outside of their lanes on entry, while circulating and on exit are generally permitted for LCV and Log Haul Trucks regardless of which “Case” is chosen. Oversize vehicles are not treated as regular design vehicles because their operation is “piloted” however the infrastructure must be built to ensure that oversized vehicles can pass through or turn in any direction while mounting curbs on splitter islands, aprons and on the outside edge as needed.

For further details refer to the attached Technical Memorandum prepared by Ourston Roundabout Engineering dated May 25, 2011.

4.5 Oversize Vehicle Accommodations

Where oversize vehicles are to be accommodated by counter flow movement through the roundabout, additional time and traffic management is generally required resulting in long delays to other road users. Same direction of flow is preferred over counter flow movements especially where intersection traffic volumes are high. Planners and designers should review and determine which movements are the most appropriate for their specific project location. Refer to Section 4.6 for further details.

Curbs on Splitter Islands, Over-run Fillet Areas, Central Island

Right side curb shall be provided for all roundabouts, including those on open rural highways. The primary safety benefit of roundabouts is that, properly designed, they reduce maximum speeds and relative speed differentials between vehicles. This is achieved by the use of horizontal curvature through the roundabout approach and entry, and by the presence of a central island. On rural highways, if open rural shoulders were allowed on the right hand side, this could make it possible for all drivers to take a much straighter and faster path through the entry (which could result in more severe collisions).

Oversize vehicles (Heavy Hauler Lowboy, Platform Trailer and Reactor Transporter) can be accommodated at roundabouts by allowing the wheels to over-run the curbs. Where oversized vehicles are to be accommodated, the curb adjacent to splitter islands (both sides), over-run fillet areas and the central island should typically be 125 mm semi-mountable type. Typical 125 mm semi-mountable type curbs (refer to Drawing CB6-4.2M89 on the AT website) are desirable where counter-flow movements are permitted for all turns. Typical 150 mm barrier curbs (refer to Drawing CB6-4.2M89 on the AT website) should only be considered where oversized vehicles do not need to be accommodated. Truck aprons curbs should typically be 60 mm semi-mountable type (refer to Dwg. No. D-10a for roundabout truck apron concrete curb detail).

Surface Treatment on Truck Aprons, Splitter Islands, Central Island and Over-run Fillet Areas

Truck Aprons: shall be concrete or ACP surface. The surface of the roundabout truck apron shall be pigmented (painted surface is not recommended) and finished in a colour equivalent to a Colour 32356 from the U.S. Federal Standard 595C colours fandeck. Asphalt truck aprons should be either a coloured micro surfacing or a coloured epoxy and bauxite and should be a different texture than the roundabout circulatory travel lanes.

Splitter Islands, Over-Run Fillet Areas and Central Island: Where required to accommodate oversized vehicles, splitter islands, over-run fillet areas and/or central islands are to be made traversable. The typical surface treatments are as follows:

- Raised splitter or channelized islands: traversable areas should be either concrete or ACP surface. Colour 32356 from the U.S. Federal Standard 595C colours fandeck is not required.
- Central island (this refers to the central area inside the truck apron if there is an apron): Areas designed to be traversable by oversized trucks should typically be either concrete or ACP. Colour 32356 from the U.S. Federal standard 595C colours fandeck is not required. Other traversable options such as cement stabilized granular interlock with grass (waffle block) may also be considered, subject to review of structural adequacy by the Department. Curb type shall be semi – mountable and not more than 125mm. Refer to Drawing CB6-4.2M89 for the typical 125 mm semi-mountable type curb (on the AT website). The gutter pan can be deleted if required (consultant's judgement). Barrier face curbs shall not be used.

- Over-run fillet areas: Traversable areas should be ACP surface. Colour 32356 from the U.S. Federal Standard 595C colours fandeck is not required. It is anticipated at this time that the usage of curb/gutter on the right side along with removable signs in these areas should be adequate to discourage typical design vehicles. As a minimum, curb/gutter should be provided adjacent to the over-run fillet areas.

For further details refer to attached Roundabout Planning Level Templates under Section 4.6 of this Design Bulletin, showing roundabouts with non-traversable and traversable central island, examples of oversize vehicles running over the curbs on the splitter island, central island, and/or overrun fillet areas.

Pedestrian and Cyclist Design Consideration

For further details refer to Section 3.0, Subsection 10. of this Design Bulletin, reference to NCHRP Report 672.

Where pedestrians and/or cyclists are to be accommodated through or adjacent to the over-run fillet areas, the pattern, texture and or colour of the material used for the sidewalk/trail shall be different than the material used for the over-run fillet areas to delineate, discourage and to avoid confusion for drivers, pedestrians and cyclists. Sidewalk/wheelchair ramps shall also be provided where applicable.

4.6 Roundabout Planning Templates and Summary Tables

Attached are “planning level” templates providing examples of design vehicle and oversize vehicle accommodations on single lane and multi-lane roundabouts where the central island is traversable or non-traversable. Dimensions and areas shown are typical values only and will vary depending on site specific conditions. Summary tables are provided showing typical areas of the pavement, central island/truck apron, outer truck apron and total footprint.

As indicated above, where oversize vehicles are to be accommodated by counter flow movement through the roundabout, additional time and traffic management is generally required resulting in long delays to other road users. Same direction of flow is preferred over counter flow movements especially where intersection traffic volumes are high.

For multi-lane roundabouts, the preferred central island treatment and oversized vehicle movement is to have a non-traversable central island with same direction movement for the Heavy Hauler Lowboy and Platform Trailer vehicles. The Reactor Transporter can be accommodated by counter flow for the left turn movement.

Planners and designers should review and determine which movements are the most appropriate for their specific project location.

4.7 Road Appurtenances

Obstacles such as signs need to be removable, either installed in sleeves or attached by bolt to a flange. Both the sleeves and flanges should be flush with the surrounding surface.

On designated High Load Corridors, side mounting or cantilever on a swivel base would need to be considered for signs.

It is desirable to have no fixed obstacles in the centre island area of the roundabout if the area is required to accommodate the swept path and the load (centre and ends) of oversized vehicles. The extent of this constraint will depend on the site and load dimensions / vehicle characteristics (based on radius, number of lanes, angles etc.). Chevrons or other necessary signs should be removable.

5.0 CENTRAL ISLAND LANDSCAPING

Stopping and intersection sight distance requirements are used to specify visibility envelopes at roundabouts (i.e. the Clear View Area diagram). Within the central island the width of the restricted and unrestricted height areas will vary according to circle size, and approach and circulating design speeds. These visibility envelopes can be used to define zones for the placement of landscaping and other objects in the central island. The outside edge (Zone 1) corresponds to the restricted height area as determined through the Clear View Area diagram. Zone 2 corresponds to the unrestricted height area. Refer to Figure DB68-2.

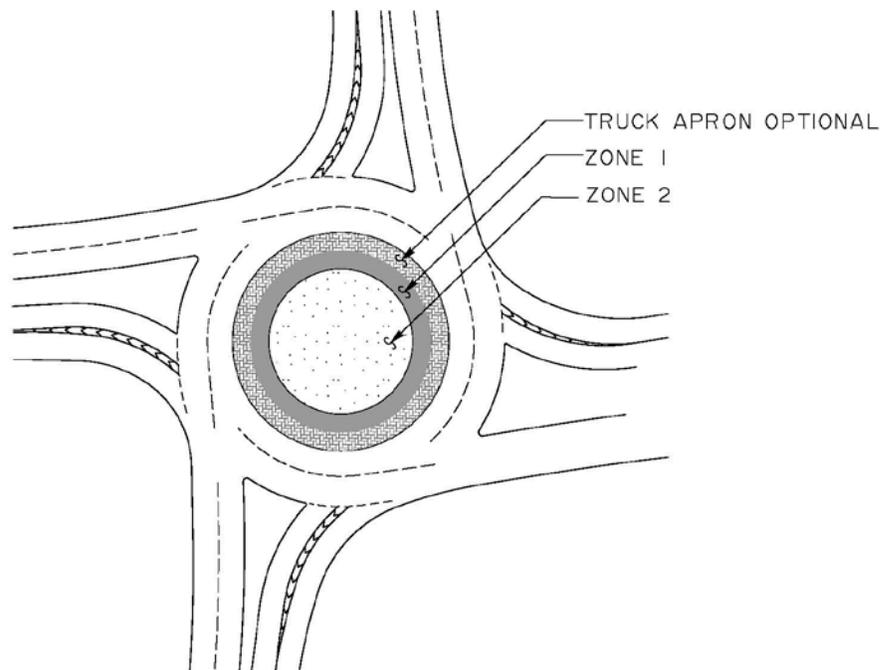


Figure DB68-2: Landscaping Zones within Central Island

To discourage typical design vehicles from short-cutting through the central island, removable and crash-worthy features/structures should be provided in the island. In addition, proposed features/structures should desirably provide a visual cue for approaching traffic and block headlight glare of oncoming vehicles, however not restrict sight distances for circulating traffic.

Objects in the central island shall be crashworthy. Fixed objects (e.g. large trees, walls or large rocks) extending above the ground surface more than 100mm are hazards and shall not be permitted in the central island. Proposed vegetation shall not exceed 100mm diameter when mature.

Acceptable Central Island Treatments are shown in Table DB68-1. The zones are described below.

Zone 1: Outside Edge of Central Island

In Zone 1, visual obstructions or fixed objects should be clear a minimum 2.0 m behind the outside edge of the central island (in addition to any truck apron) to provide a minimum level of roadside safety and unobstructed sight distance.

Zone 2: Restricted Area

Zone 2 applies to the remainder of the central island not designated as Zone 1. Encroachment distances onto the central island of a roundabout are presumed to include the entire island area. Although plantings and small trees (≤ 100 mm caliper) are frangible and may be placed for aesthetic value, no fixed objects (large trees, walls or large rocks) should be permitted within the entire central island. This is because the trajectory of an errant vehicle at higher speeds is not deterred by curb and gutter.

Table DB68-1: Acceptable Central Island Treatments

Area of Influence	Acceptable Material
Zone 1: Outside Edge of Central Island No Visual Obstructions or Fixed Objects	<ul style="list-style-type: none"> • Concrete pavement (flush) • Asphalt pavement (flush) • Brick (flush) • Grass • Mulch • Stabilized stone (≤ 100 mm dia.)
Zone 2: Restricted Area Traversable Landscaping (regardless of Design Speed)	<ul style="list-style-type: none"> • Earth slopes no steeper than 6:1 • Short grass/plants • No large deciduous trees, medium deciduous trees, or large evergreen trees (>100 mm caliper at maturity) • Breakaway supports

6.0 PAVEMENT DESIGN

Due to the curbing requirements and constraints for future ACP overlays, the pavement structure within the roundabout lanes, and the truck apron and pavement area extending to just beyond the splitter islands and or right side approach and exit curbs should typically be designed so that the elevation of the surface can remain constant for the design life of the roundabout, which may be between 10 and 50 years depending on the location. Refer to Pavement Design Bulletin 77/2013, Amendments to the Pavement Design Manual – Updated Requirements for Agency Practice, Design Inputs and Design Report Contents for further details.

7.0 DESIGN EXCEPTIONS

A Design Exception Request (subject to approval) will be required under the following conditions:

- Where the Heavy Hauler and Platform Trailer vehicle are not accommodated on the highway network for all movements at proposed roundabouts. The Design Exception Request may apply to one or more legs or movements as applicable.
- Where the Reactor Transporter vehicle have not been accommodated on the existing and proposed HLC for all designated movements at proposed roundabouts. Designated movements include intersection legs located on existing and proposed HLC and all known origin/destination roadways to/from the HLC

In some locations there may be alternative routes available, constraints or indications that large vehicles would not use the subject roundabout (regular size bridges, built up urban area in the vicinity, etc.). The Design Exception Request may apply to one or more legs or movements as applicable. Refer to Design Bulletin 72/2010 Design Standards / Practice Exception Process for further details.

<http://www.transportation.alberta.ca/649.htm>

8.0 SIGNING, PAVEMENT MARKINGS AND ILLUMINATION

Further guidance on traffic control for multi-lane roundabouts is referenced in the TAC Manual of Uniform Traffic Control Devices (MUTCD) for Canada, 5th Edition.

8.1 Guide Signage

SINGLE-LANE ROUNDABOUT (APPLICABLE ALSO TO MULTI-LANE ROUNDABOUT)

Refer to Typical Signing at Single-Lane Roundabouts TCS-A7-100.1 (Urban) and TCS-A7-100.2 (Rural).

Diagrammatic advance guide sign:

- Include highway route markers and destination information as outlined in Highway Guide and Information Sign Manual for standard guide signage.
- Roundabout diagram/symbol should utilize arrowheads (not pointers), no dot in the centre, thinner line width for minor roads (i.e., local roads/accesses).
- Potential use of overhead signage, perhaps where there is a right turn channelized roadway or more complex roundabout arrangement

Guide signs within roundabout:

- Visible in advance of the exit point.
- Should provide highway route marker.
- Should provide destination information if applicable, according to Highway Guide and Information Sign Manual.

- Should be standard rectangular shape with standard arrow.
- Letter size for destination information should be 102 mm (4 inch) minimum.
- Should be placed either on the splitter island or on the right side of the roundabout, depending on the characteristics of the roundabout (angle between approach legs, number of lanes, presence of sidewalk, etc.). Care should be taken to ensure that these signs do not obstruct the view of users entering the intersection (pedestrians, cyclists, and vehicles).
- Where off-tracking from oversize loads is expected to interfere with sign placement, removable signs may be used where necessary.
- Confirmation destination signs a minimum of 100 m beyond any tapers.

8.2 Tourist Related Directional Signage

TODS/attractions signage:

- Shall be the same sign placement as if the intersection were a typical 'T' or '+' intersection, with directional signs in advance of the roundabout (none within the roundabout).
- If confusion develops (determine on case-by-case basis), additional TODS confirmation directional signage may be considered on the downstream intersection leg(s)

8.3 Regulatory, Warning and Informational Signage

Regulatory:

- Speed limit signage as required in advance of the intersection and downstream on each intersection leg (50 m beyond confirmation destination sign).
- Two (2) RA-2 Yield signs on each side, at each entry.
- Keep Right assembly on the near side of raised median/splitter islands.
- Where Lane Designation signs are used at a multi-lane roundabout, these signs shall utilize standard fish-hook arrows as set out in the TAC MUTCD.

Warning:

- WA-39 Roundabout Ahead sign 250-300 m in advance of intersection.
- WA-30-T Distance tab sign below WA-39 sign displaying the distance to the roundabout.
- (Optional) WB-2 Yield Ahead sign 50-150 m in advance of intersection.
- One or more WA-38 Roundabout Directional Sign, orientated directly in line with the path of approaching traffic at each entrance leg, within the roundabout central island.
- Keep Right assembly as noted above.

Informational:

- Highway route marker/junction signage 50 m in advance of destination directional (diagrammatic) sign.
- Highway route marker signage approximately 30 m downstream of the intersection on each leg.

8.4 Pavement Markings

Durable markings should be considered for all markings for roundabouts.

Single-lane roundabouts:

- Refer to Typical Pavement Markings TCS-C-100.1 (Urban) and TCS-C-100.2 (Rural) for details.
- Yield lines at entrances to the roundabout should be 0.6 m line and 0.6 m skip, 300- 600mm wide Centerline, shoulder, etc. lines should use principles in the Highway Pavement Marking Guide.

Multi-lane roundabouts:

- Refer to Typical Pavement Markings TCS-C-100.3 (Urban) and TCSC-100.4 (Rural) for details.
- Pavement arrows should be marked on all approaches to multi-lane roundabouts. Standard fish-hook pavement arrows should be used as set out in the TAC MUTCD.
- Yield lines at multi-lane entrances to the roundabout should be 1.0 m line and 0.6 m skip,
- Lane lines in the circulatory road shall be marked for multi-lane roundabouts having three or more entry lanes or exclusive left turns, but be optional otherwise.

8.5 Intersection Illumination

- All roundabouts should be adequately illuminated.
- Illumination should be designed in accordance with Chapter 11 of the Transportation Association of Canada Guide for the Design of Roadway Lighting.

8.6 Transverse Rumble Strips on Approaches

- Transverse rumble strips shall be placed at the approaches of all roundabouts located in a rural environment.
- The rumble strips on each approach shall be similar to typical rumble strips for stop condition as per CB6-3.52M3 except with reduced depth (8 mm instead of 12 mm) and only two sets (generally the second and fourth set) of rumble strips instead of five.
- Rumble strips should not be installed within 300 m of a residence to avoid noise concerns.

9.0 RECOMMENDATIONS

The guidance as shown here is to be implemented immediately as per the usual practice.

Date of Issue: May 17, 2010

Effective Date: May 17, 2010.

Revised Date (1): June 9, 2010

Revised Date (2): October 29, 2010

Revised Date (3): February 25, 2011

Revised Date (4): November 5, 2014.

Revised Date (5): June 28, 2016

10.0 CONTACT

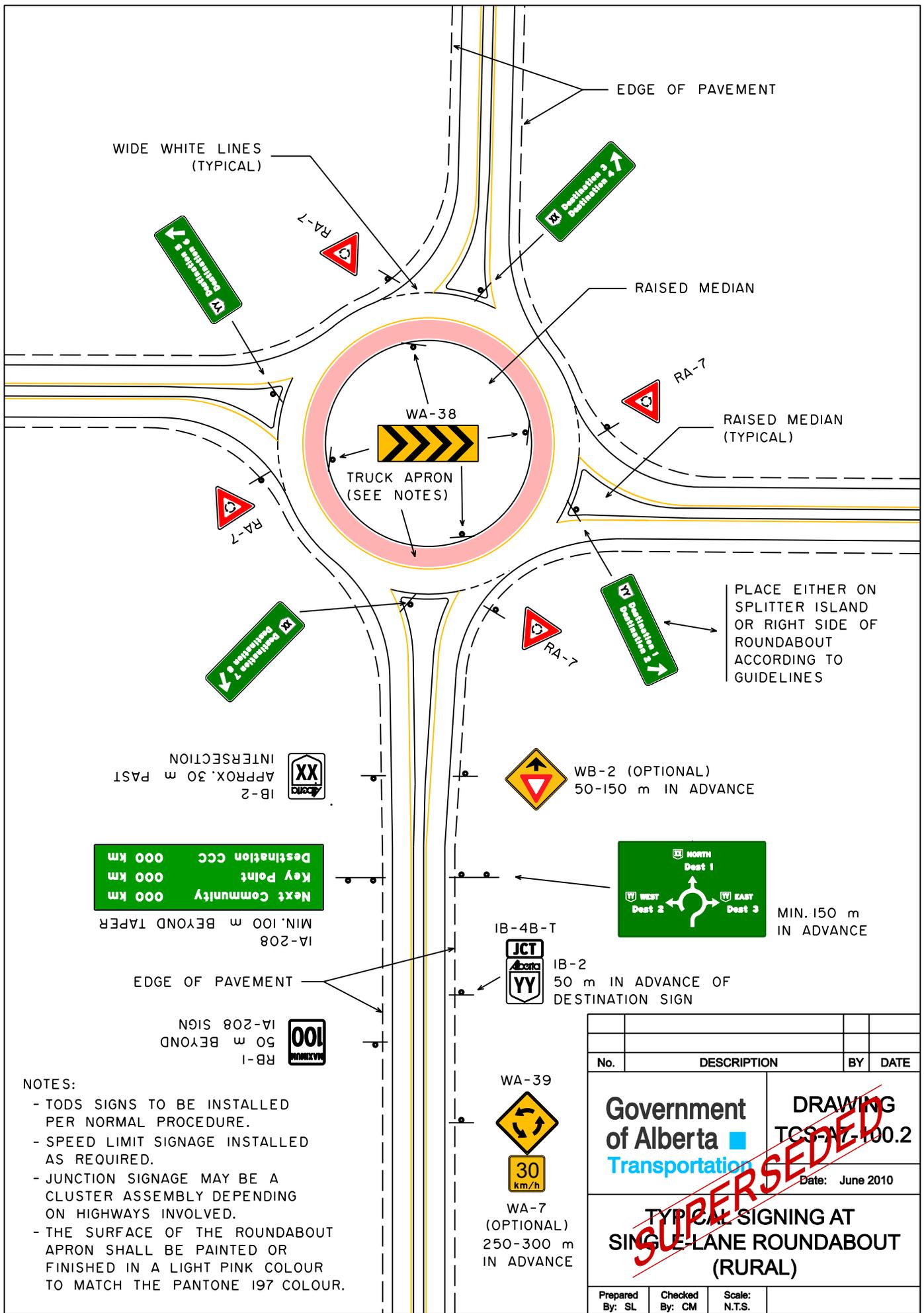
Peter Mah at (780) 427-7129 or Bill Kenny at (780) 415-1048

Technical Standards Branch, Alberta Transportation.

11.0 REFERENCES

- Alberta Transportation Highway Geometric Design Guide (1999)
- Alberta Transportation Roadside Design Guide
- Alberta Transportation Highway Pavement Marking Guide
- Alberta Transportation Highway Guide and Information Sign Manual
- Tourism Highway Signage Initiative Technical Details Package
- Alberta Transportation Design Bulletins
- Highway Capacity Manual (2010)

- TAC Geometric Design Guide
- AASHTO, A Policy on Geometric Design of Highways and Streets, 2011
- TAC Manual of Uniform Traffic Control Devices (MUTCD) for Canada, 5th Edition
- TAC Guide for the Design of Roadway Lighting
- Collision Modification Factors (CMF) Clearinghouse
- NCHRP Report 572: Roundabouts in the United States
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_572.pdf
- NCHRP Report 672: Roundabouts: An Informational Guide – Second Edition
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf
- Canada's National Highway System, Condition Report, January 2009
<http://www.comt.ca/english/NHS-Condition09.pdf>
- Fastest Path Determination, Excerpt from Wisconsin Department of Transportation Roundabout Design Guide, FDM 11-26, dated July 23, 2015.
<http://wisconsindot.gov/rdwy/fdm/fd-11-26.pdf>

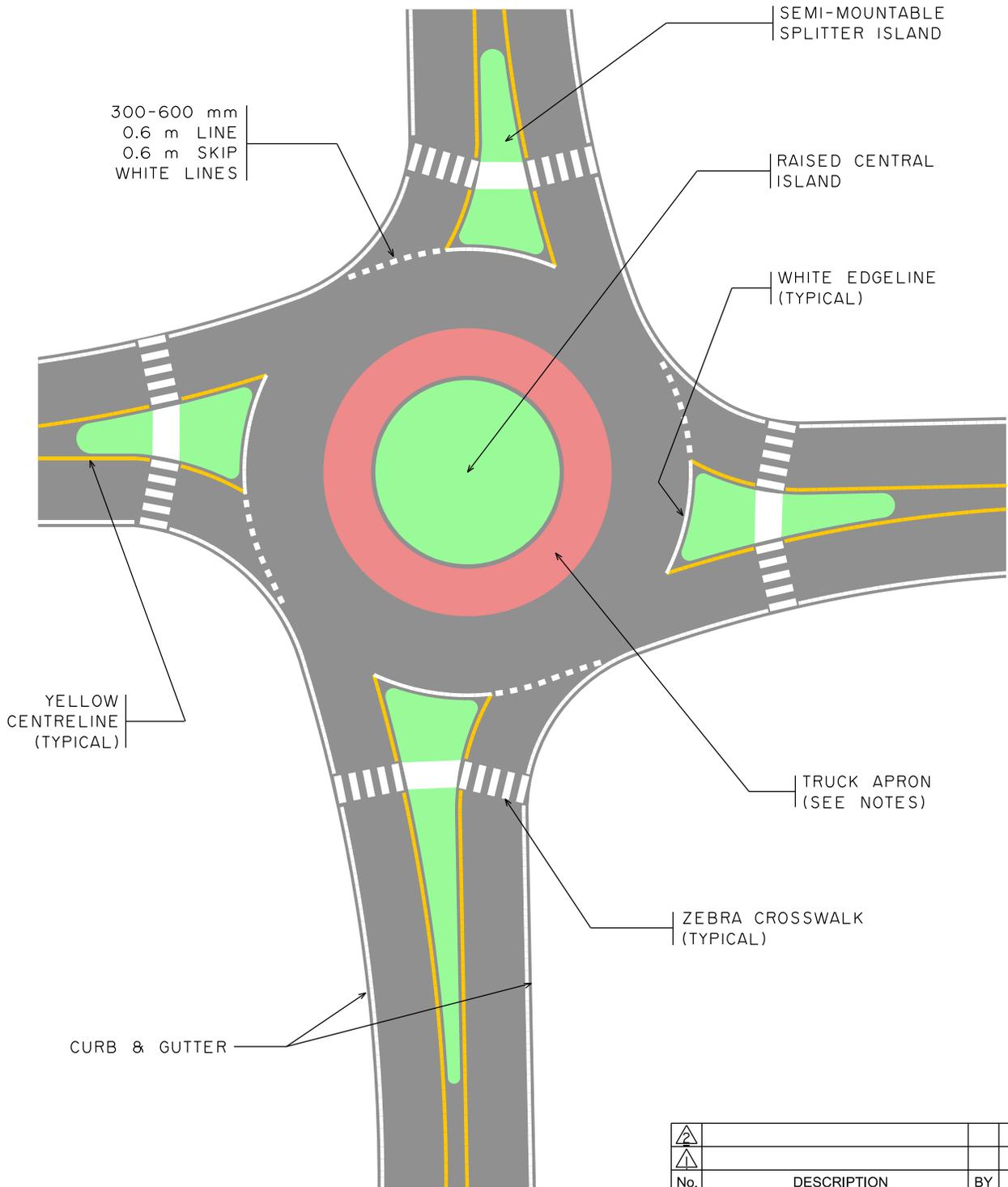


NOTES:

- TODS SIGNS TO BE INSTALLED PER NORMAL PROCEDURE.
- SPEED LIMIT SIGNAGE INSTALLED AS REQUIRED.
- JUNCTION SIGNAGE MAY BE A CLUSTER ASSEMBLY DEPENDING ON HIGHWAYS INVOLVED.
- THE SURFACE OF THE ROUNDABOUT APRON SHALL BE PAINTED OR FINISHED IN A LIGHT PINK COLOUR TO MATCH THE PANTONE 197 COLOUR.

No.	DESCRIPTION	BY	DATE
	Government of Alberta Transportation		DRAWING TCS-A7-100.2 Date: June 2010
TYPICAL SIGNING AT SINGLE-LANE ROUNDABOUT (RURAL)			
Prepared By: SL	Checked By: CM	Scale: N.T.S.	

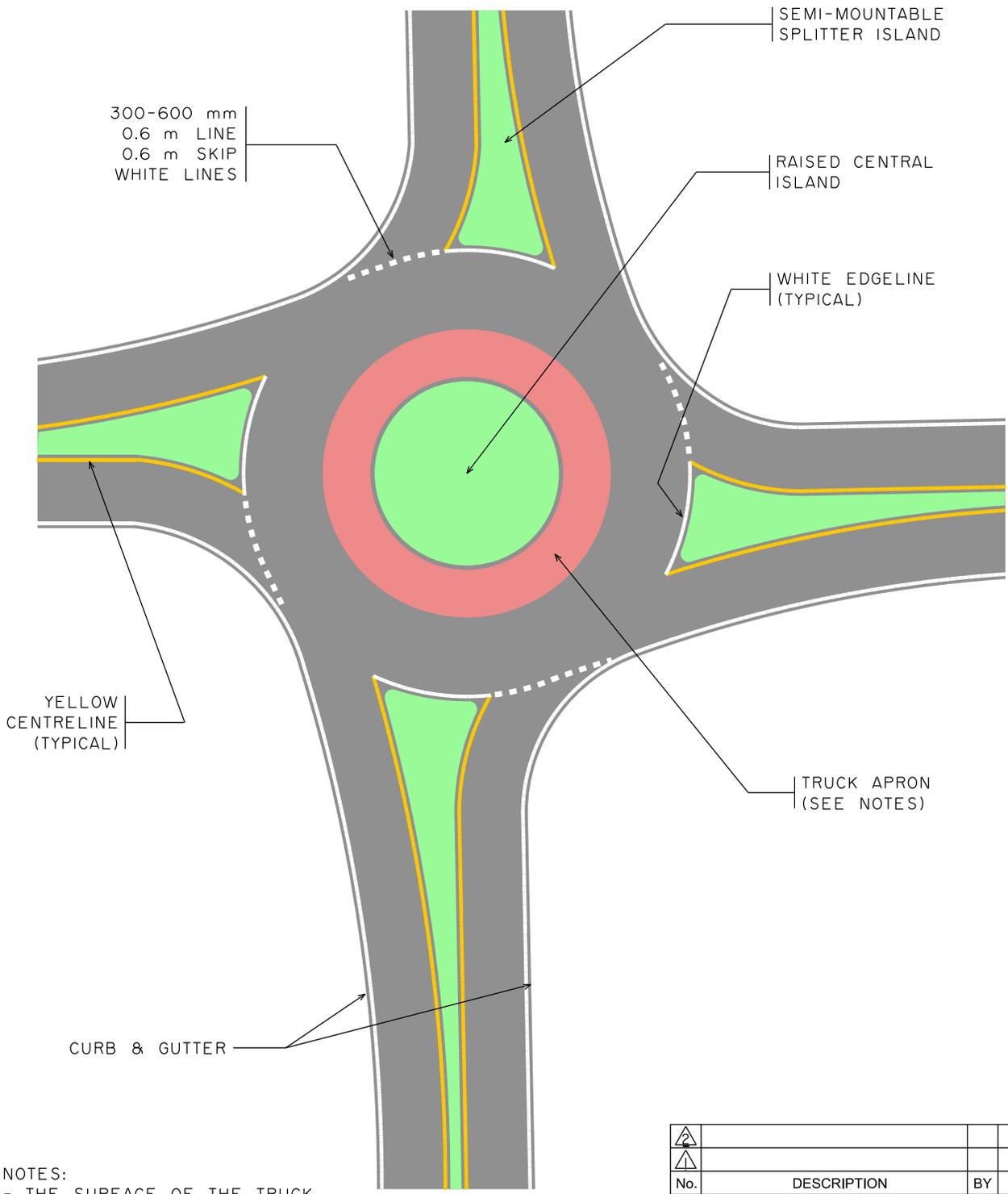
SUPERSEDED



NOTES:

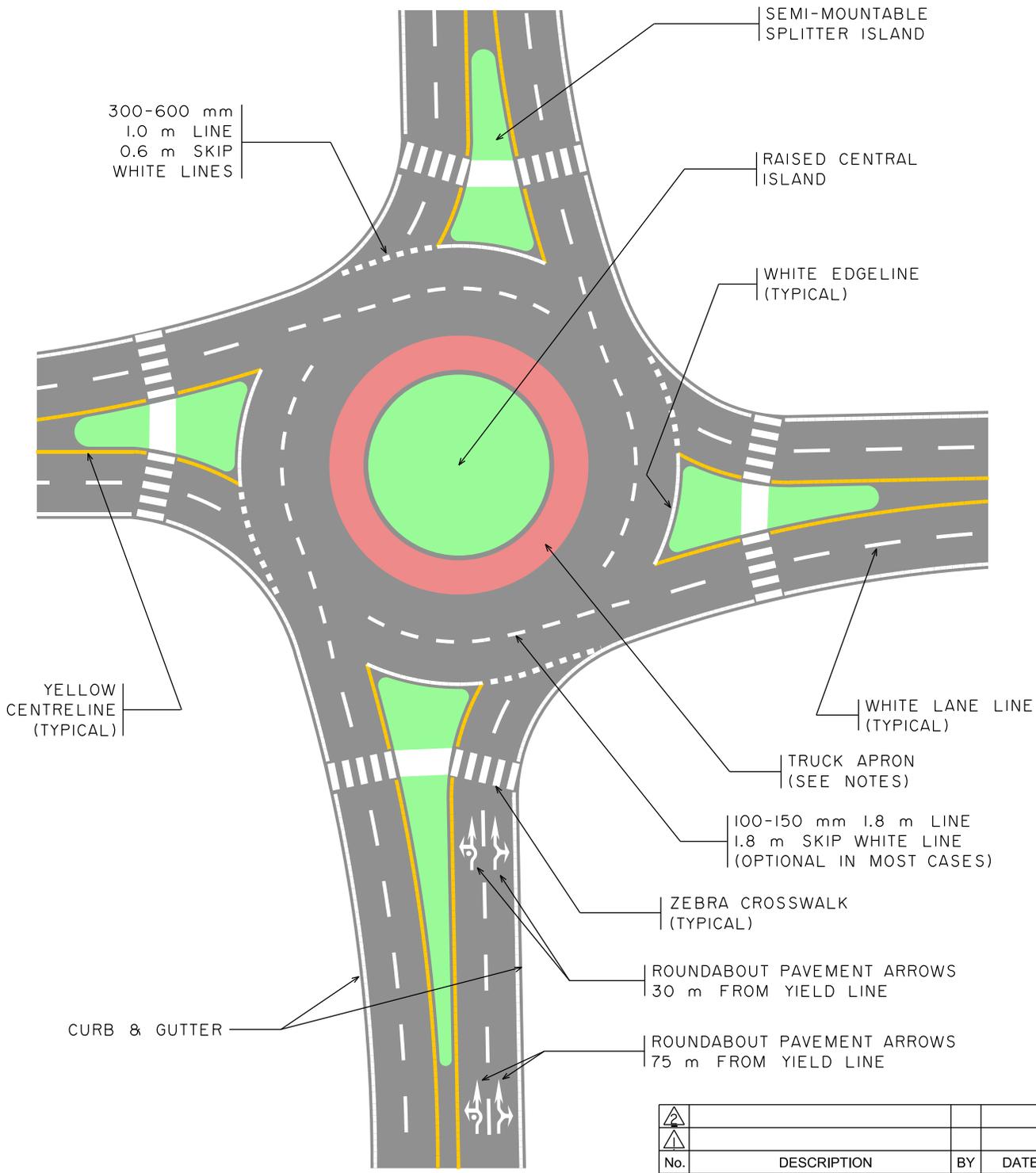
- THE SURFACE OF THE TRUCK APRON SHALL BE FINISHED IN A COLOUR EQUIVALENT TO COLOUR 32356 FROM THE FEDERAL STANDARD 595B COLOURS FANDECK.
- REFER TO DWG. NO. D-10.1a UNDER DESIGN BULLETIN 68 FOR OUTER TRUCK APRON CURB DETAIL.

No.	DESCRIPTION	BY	DATE
		DRAWING TCS-C-100.1	
		Date: October 2014	
TYPICAL PAVEMENT MARKINGS AT SINGLE-LANE ROUNDABOUT (URBAN)			
Prepared By: SL	Checked By: CM	Scale: N.T.S.	



- NOTES:
- THE SURFACE OF THE TRUCK APRON SHALL BE FINISHED IN A COLOUR EQUIVALENT TO COLOUR 32356 FROM THE FEDERAL STANDARD 595B COLOURS FANDECK.
 - REFER TO DWG. NO. D-10.1a UNDER DESIGN BULLETIN 68 FOR OUTER TRUCK APRON CURB DETAIL.
 - OPEN SHOULDER TO CURB TRANSITION AS DETERMINED BY DESIGNER.

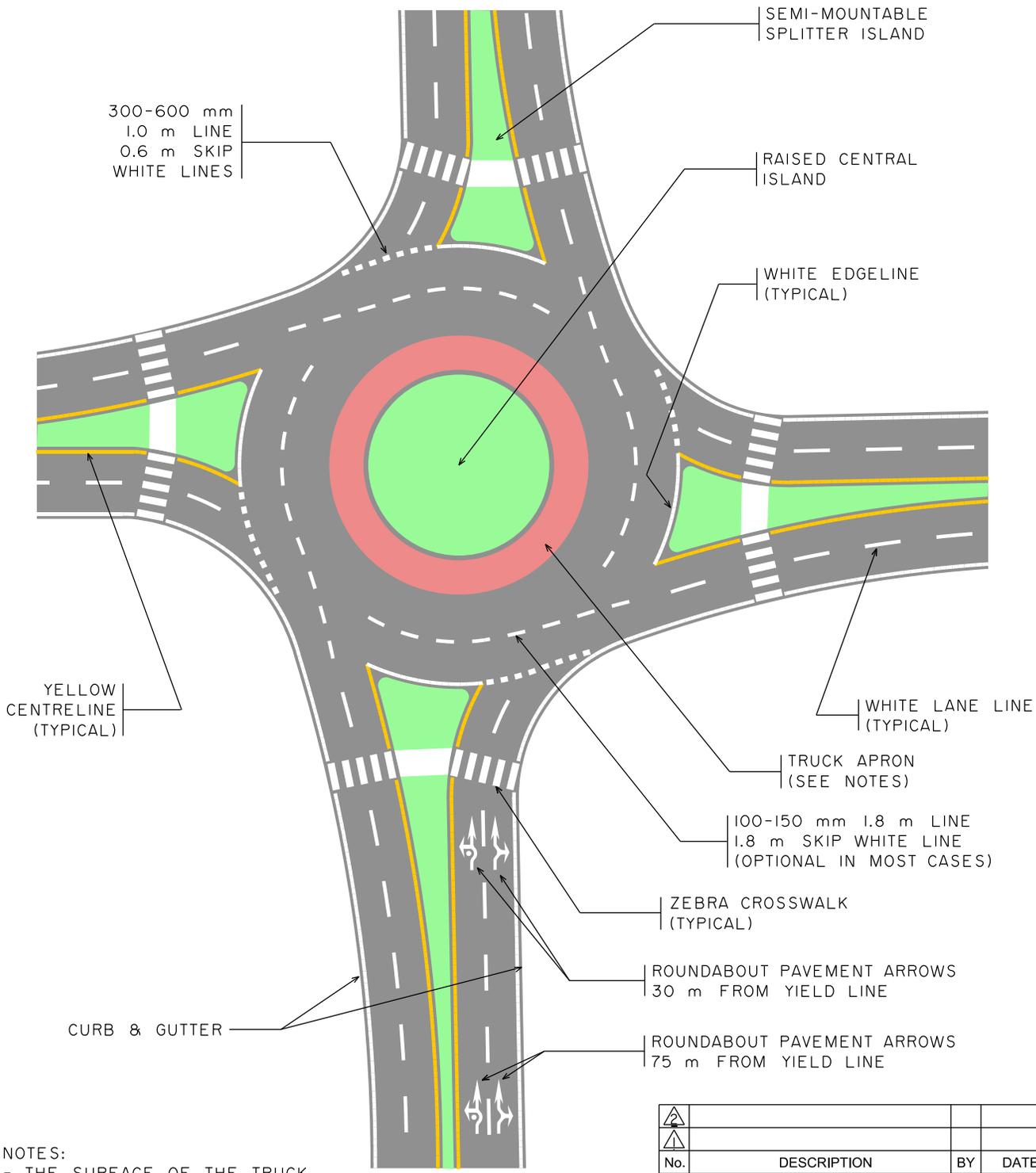
No.	DESCRIPTION	BY	DATE
		DRAWING TCS-C-100.2	
		Date: October 2014	
TYPICAL PAVEMENT MARKINGS AT SINGLE-LANE ROUNDABOUT (RURAL)			
Prepared By: SL	Checked By: CM	Scale: N.T.S.	



NOTES:

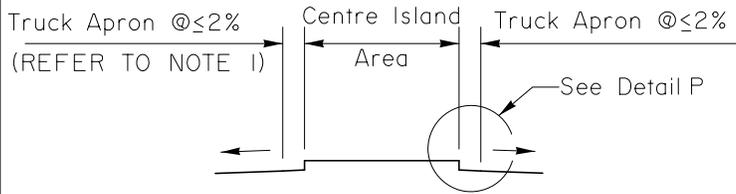
- THE SURFACE OF THE TRUCK APRON SHALL BE FINISHED IN A COLOUR EQUIVALENT TO COLOUR 32356 FROM THE FEDERAL STANDARD 595B COLOURS FANDECK.
- REFER TO DWG. NO. D-10.1g UNDER DESIGN BULLETIN 68 FOR OUTER TRUCK APRON CURB DETAIL.

		DRAWING TCS-C-100.3	
		Date: October 2014	
TYPICAL PAVEMENT MARKINGS AT MULTI-LANE ROUNDBOUT (URBAN)			
Prepared By: SL	Checked By: CM	Scale: N.T.S.	

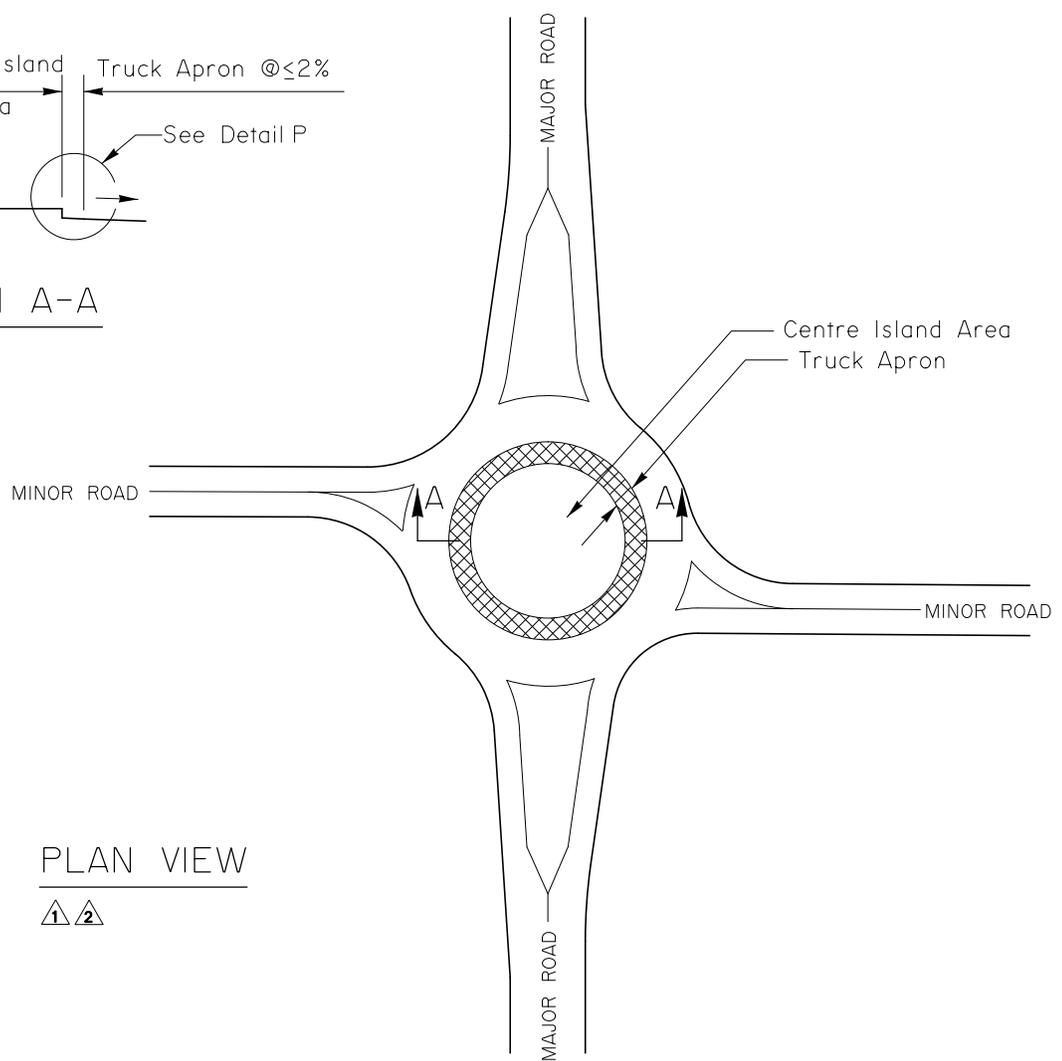


- NOTES:
- THE SURFACE OF THE TRUCK APRON SHALL BE FINISHED IN A COLOUR EQUIVALENT TO COLOUR 32356 FROM THE FEDERAL STANDARD 595B COLOURS FANDECK.
 - REFER TO DWG. NO. D-10.1a UNDER DESIGN BULLETIN 68 FOR OUTER TRUCK APRON CURB DETAIL.
 - OPEN SHOULDER TO CURB TRANSITION AS DETERMINED BY DESIGNER.

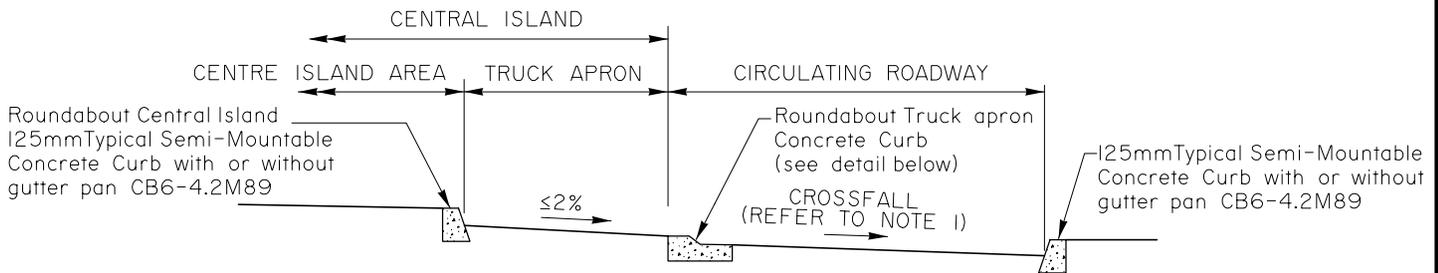
		DRAWING TCS-C-100.4	
		Date: October 2014	
TYPICAL PAVEMENT MARKINGS AT MULTI-LANE ROUNDABOUT (RURAL)			
Prepared By: SL	Checked By: CM	Scale: N.T.S.	



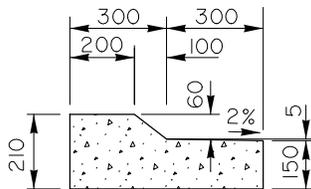
SECTION A-A



PLAN VIEW



DETAIL P



ROUNDABOUT TRUCK APRON
CONCRETE CURB DETAIL

NOTES:

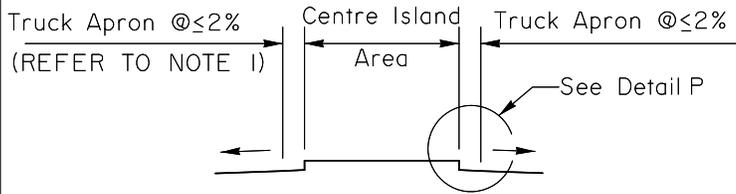
1. REFER TO NCHRP REPORT 672 FOR GUIDELINES ON:
 - VERTICAL AND HORIZONTAL ALIGNMENT
 - CIRCULATING ROADWAY AND TRUCK APRON CROSSFALL
2. IT IS DESIRABLE TO HAVE REMOVABLE CRASH-WORTHY FEATURES/STRUCTURES IN THE CENTRE ISLAND AREA IF THIS AREA IS REQUIRED TO ACCOMMODATE THE SWEEP PATH AND LOAD (CENTRE AND ENDS) OF OVERSIZED VEHICLES.
3. OBJECTS IN CENTRE ISLAND AREA MUST BE CRASH-WORTHY.
4. SIGHT LINES FOR THE APPROPRIATE 'LOW' DESIGN SPEED MUST BE PRESERVED.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

	REFERENCE TO BARRIER CURB DELETED	P.M.	28JUN16
	NOTES AND CURB DETAILS	P.M.	15OCT14
	NOTES, ROADWAY CROSSFALL AND APRON	P.M.	18FEB11
	REFERENCE TO D-3.3a and D-3.3b DELETED	J.X.	1NOV10
No.	REVISIONS	BY	DATE

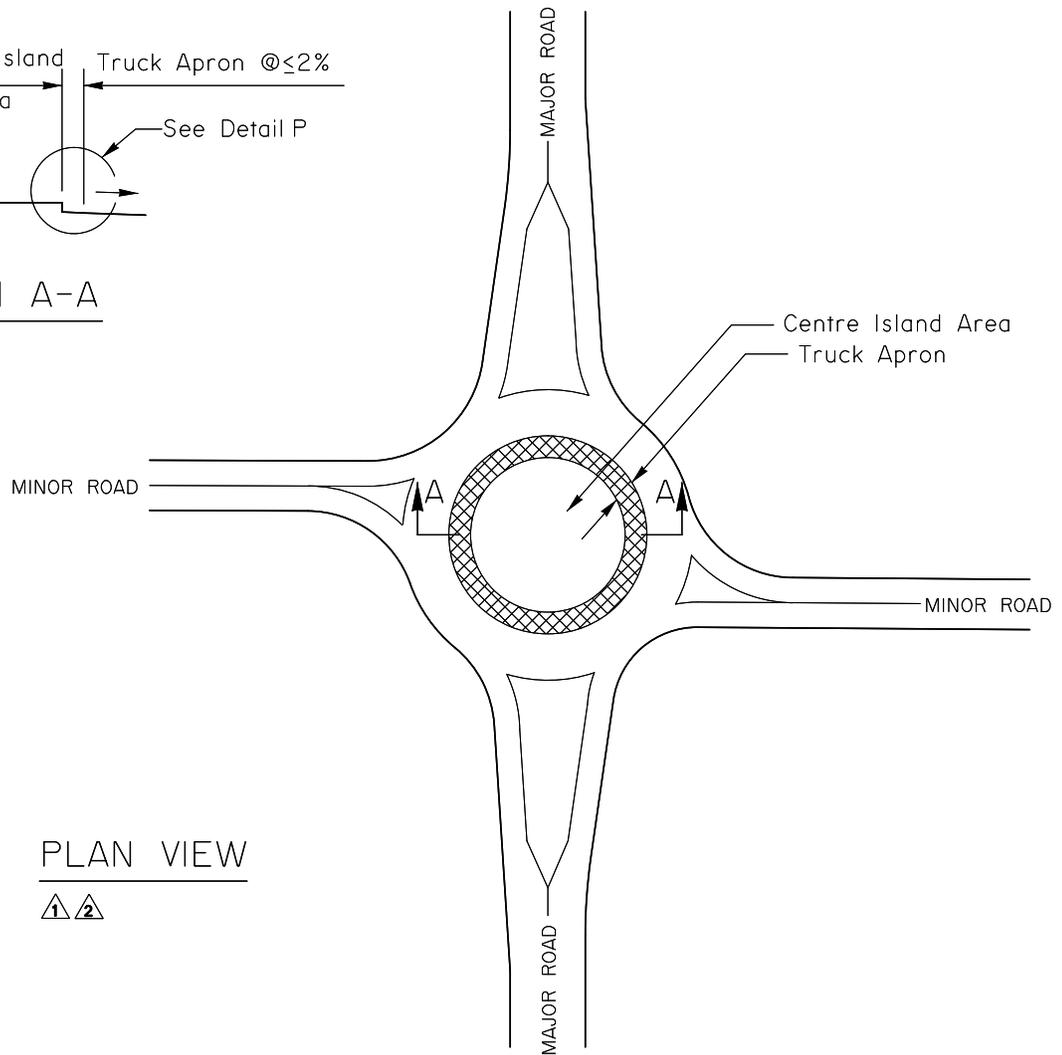
Approved:		Government of Alberta Transportation
LLOYD ATKIN for Executive Director, Technical Standards Branch		
Date: May, 2010		

**ROUNDABOUT AND
CROSS SECTION DETAILS**

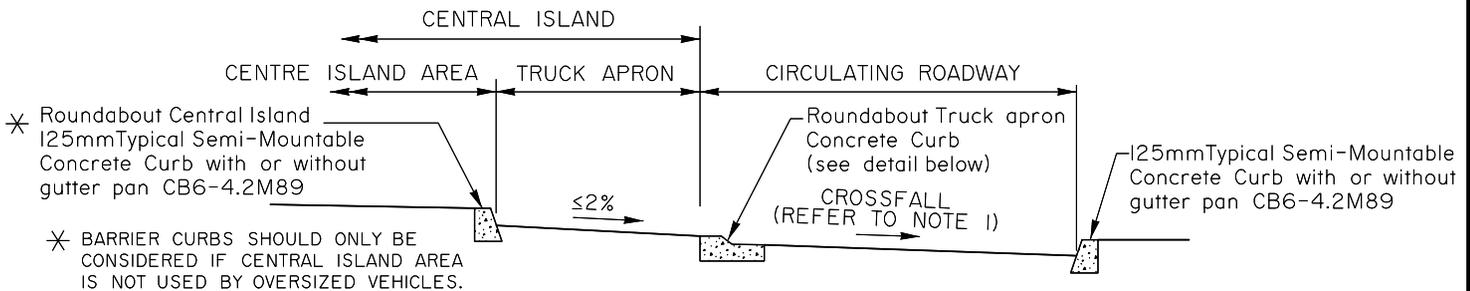
Prepared By: GEC	Checked By: BK	Scale: NTS	Dwg No.: D-10.1a
------------------	----------------	------------	------------------



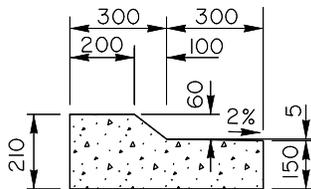
SECTION A-A



PLAN VIEW



DETAIL P



ROUNDABOUT TRUCK APRON
CONCRETE CURB DETAIL

NOTES:

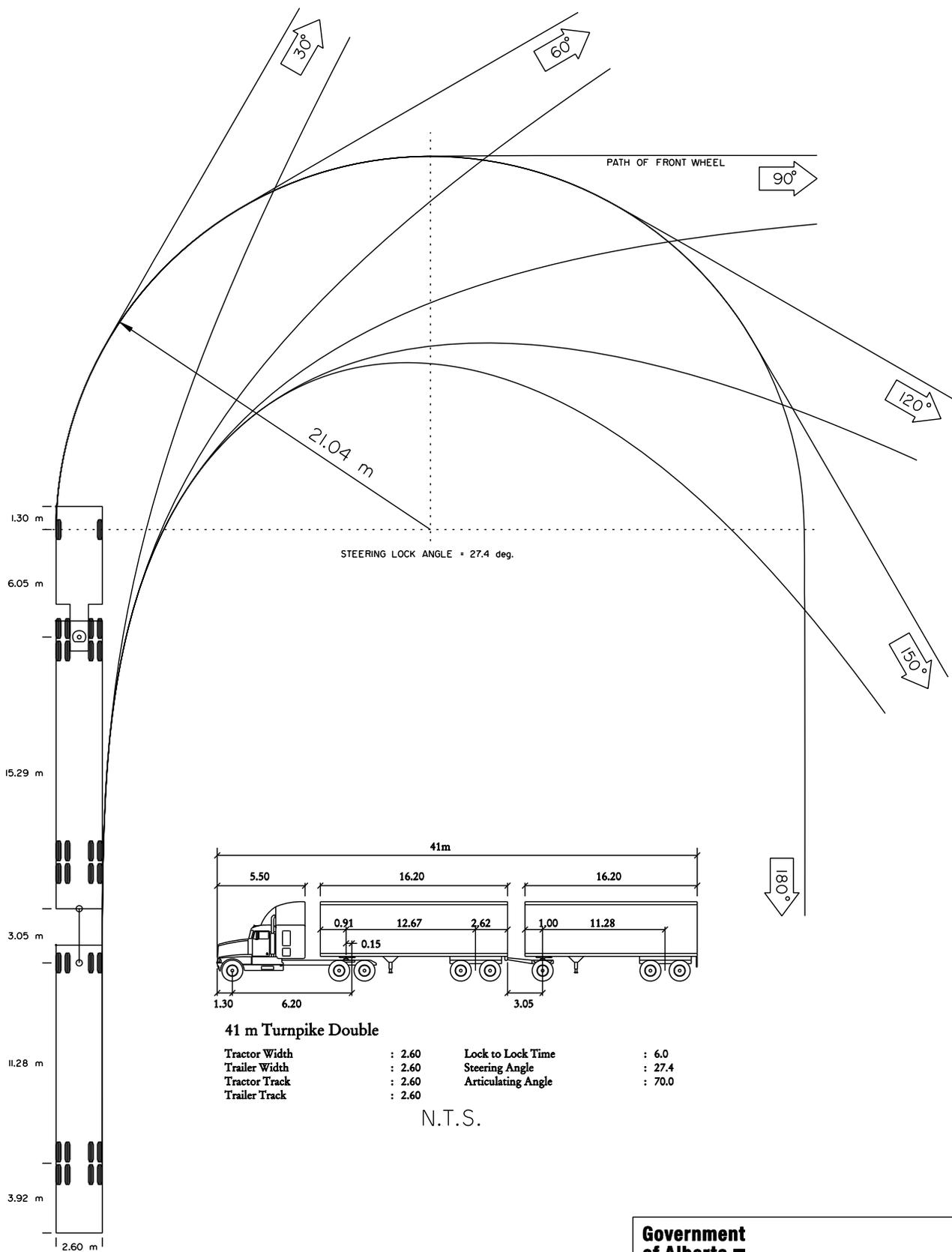
1. REFER TO NCHRP REPORT 672 FOR GUIDELINES ON:
 - VERTICAL AND HORIZONTAL ALIGNMENT
 - CIRCULATING ROADWAY AND TRUCK APRON CROSSFALL
2. IT IS DESIRABLE TO HAVE REMOVABLE CRASH-WORTHY FEATURES/STRUCTURES IN THE CENTRE ISLAND AREA IF THIS AREA IS REQUIRED TO ACCOMMODATE THE SWEEP PATH AND LOAD (CENTRE AND ENDS) OF OVERSIZED VEHICLES.
3. OBJECTS IN CENTRE ISLAND AREA MUST BE CRASH-WORTHY.
4. SIGHT LINES FOR THE APPROPRIATE 'LOW' DESIGN SPEED MUST BE PRESERVED.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

	NOTES AND CURB DETAILS	P.M.	15OCT14
	NOTES, ROADWAY CROSSFALL AND APRON	P.M.	18FEB11
	REFERENCE TO D-3.3a and D-3.3b DELETED	J.X.	1NOV10
No.	REVISIONS	BY	DATE

Approved:		Government of Alberta Transportation
LLOYD ATKIN for Executive Director, Technical Standards Branch		
Date: May, 2010		

ROUNDABOUT AND CROSS SECTION DETAILS			
Prepared By: GEC	Checked By: BK	Scale: NTS	Dwg No.: D-10.1a

SUPERSEDED

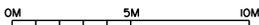


41 m Turnpike Double

Tractor Width	: 2.60	Lock to Lock Time	: 6.0
Trailer Width	: 2.60	Steering Angle	: 27.4
Tractor Track	: 2.60	Articulating Angle	: 70.0
Trailer Track	: 2.60		

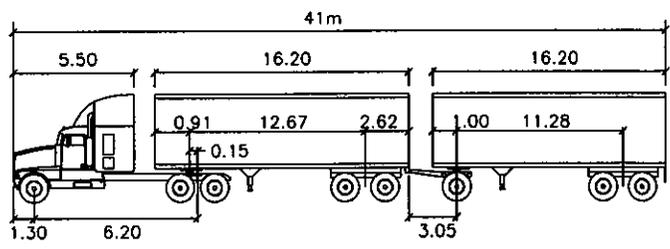
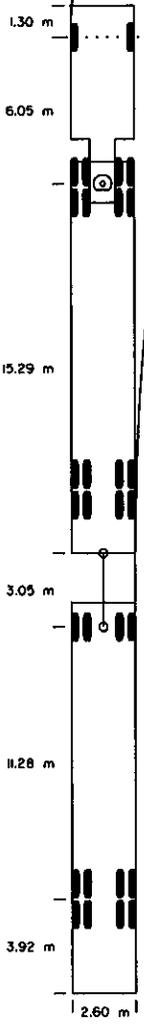
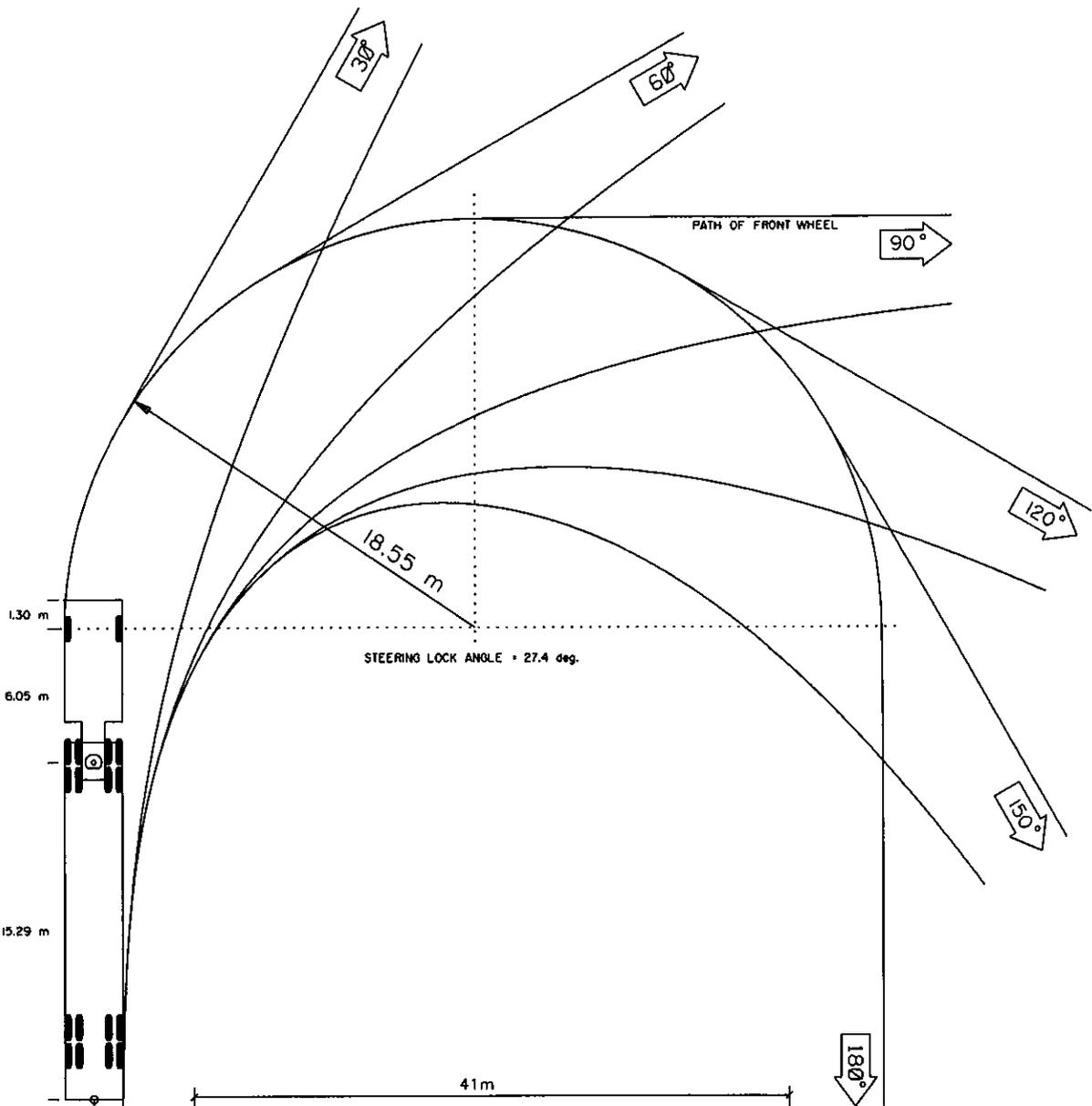
N.T.S.

41 m Turnpike Double



Government of Alberta

TURNPIKE DOUBLE
 MODIFIED WB - 36
 MEDIUM TURNING TEMPLATE
 DECEMBER, 2011

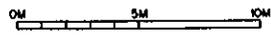


41 m Turnpike Double

Tractor Width	: 2.60	Lock to Lock Time	: 6.0
Trailer Width	: 2.60	Steering Angle	: 27.4
Tractor Track	: 2.60	Articulating Angle	: 70.0
Trailer Track	: 2.60		

N.T.S.

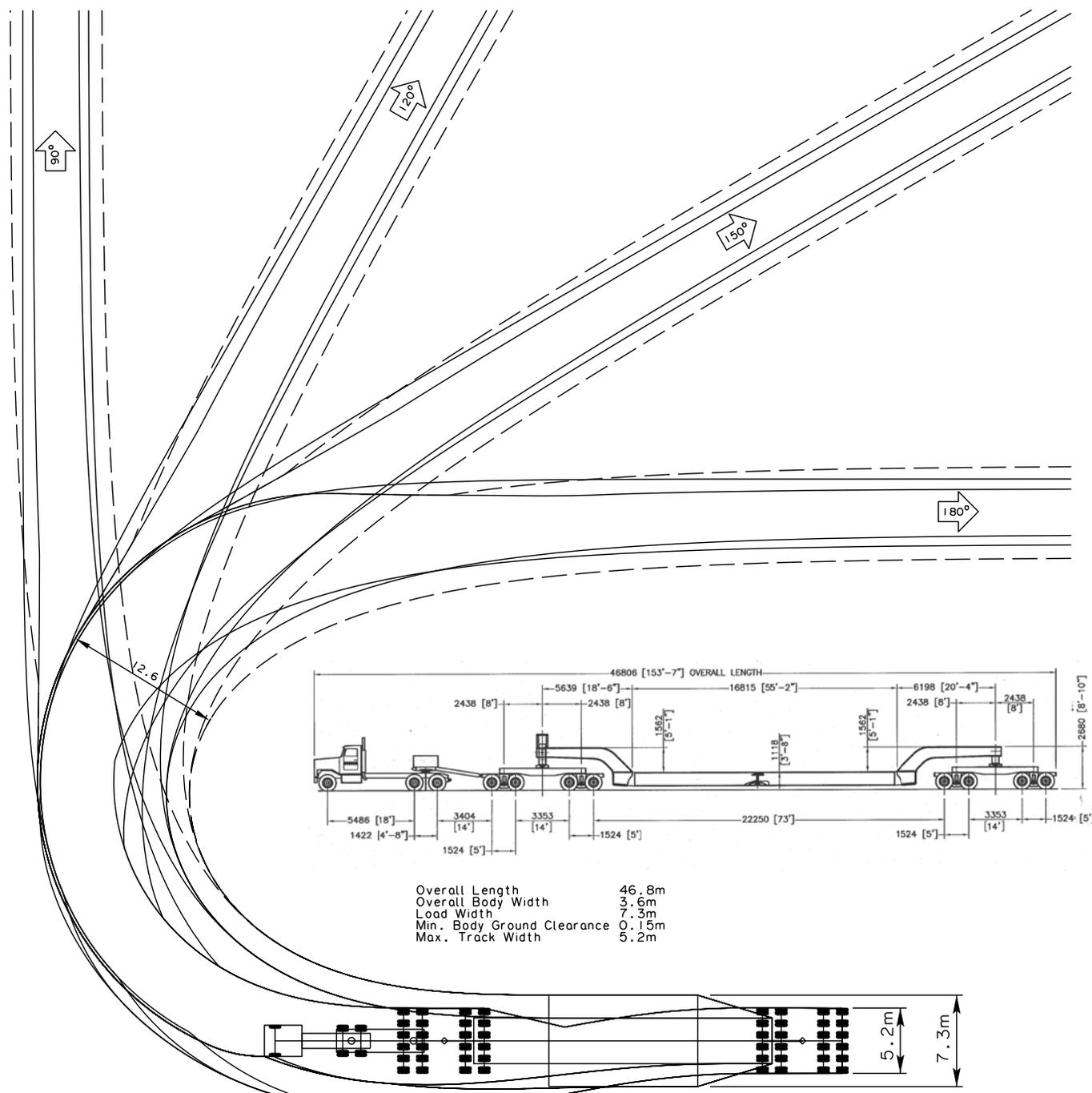
41 m Turnpike Double



Government of Alberta

TURNPIKE DOUBLE
MODIFIED WB - 36
MINIMUM TURNING TEMPLATE

DECEMBER, 2011



NOTES:

1. RESULTS OF LIMITS OR TRUCK TURNING MOVEMENTS AND SWEEP PATHS LIMITS ARE DERIVED FROM SOFTWARE. WHILE EVALUATED BY THE SOFTWARE SUPPLIER THE SPECIFIC MOVEMENTS FOR CUSTOM VEHICLES HAVE NOT BEEN TESTED IN THE FIELD. THEIR ACCURACY IS LIMITED BY THE ABILITIES OF THE SOFTWARE, AND ACTUAL RESULTS WILL VARY BASED ON OPERATOR EXPERIENCE AND SKILL.

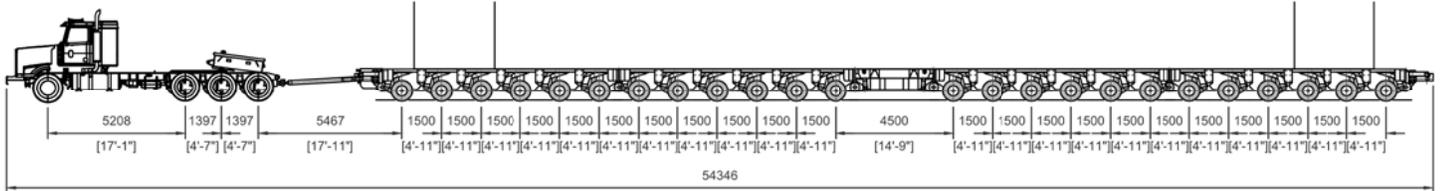
Alberta Transportation

HEAVY HAULER (LOWBOY)

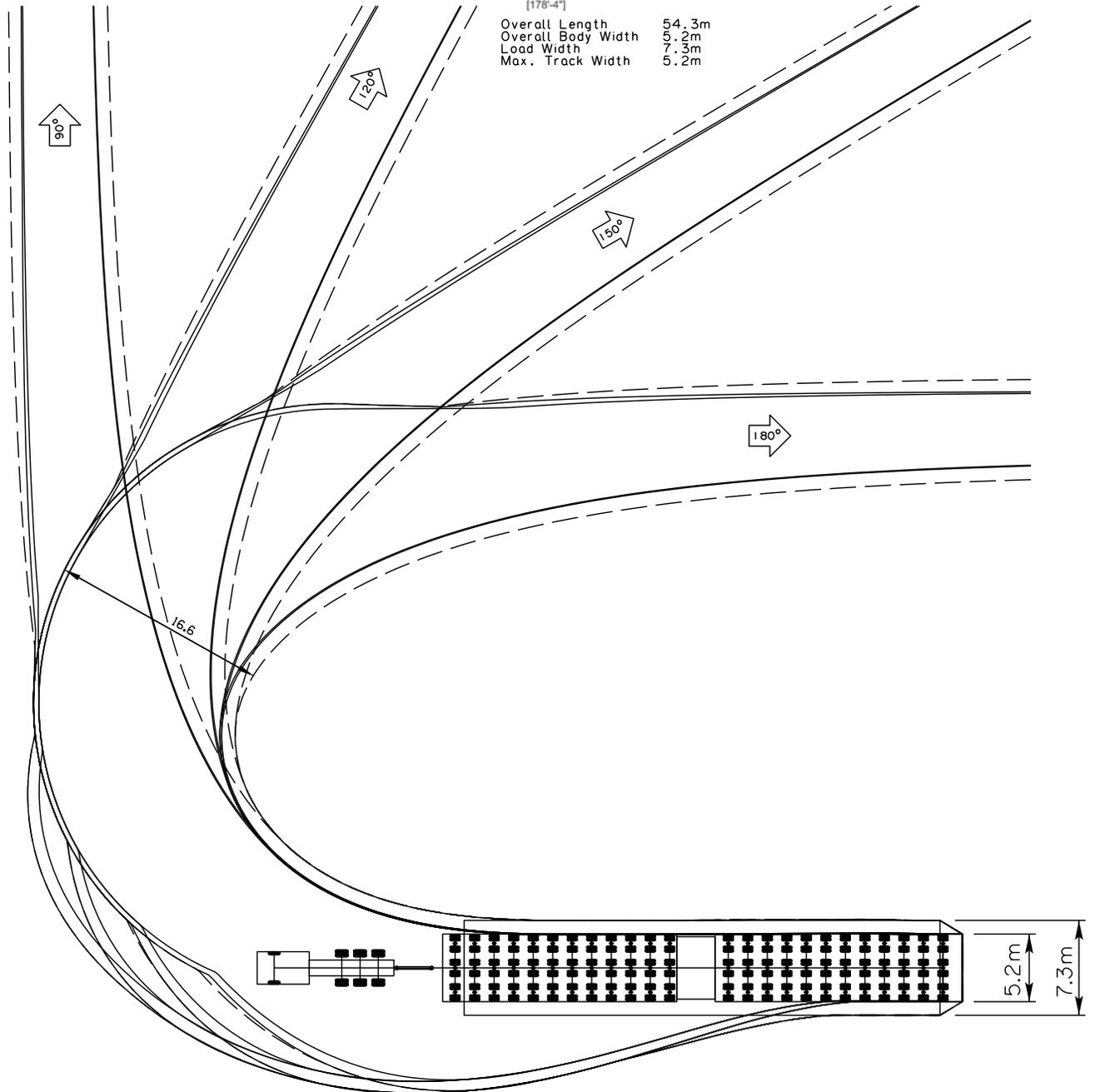
OCT. 2014

SCALE 1:500

FIG. D-5m



54346
[178'-4"]
Overall Length 54.3m
Overall Body Width 5.2m
Load Width 7.3m
Max. Track Width 5.2m



NOTES:

- RESULTS OF LIMITS OR TRUCK TURNING MOVEMENTS AND SWEEPED PATHS LIMITS ARE DERIVED FROM SOFTWARE. WHILE EVALUATED BY THE SOFTWARE SUPPLIER THE SPECIFIC MOVEMENTS FOR CUSTOM VEHICLES HAVE NOT BEEN TESTED IN THE FIELD. THEIR ACCURACY IS LIMITED BY THE ABILITIES OF THE SOFTWARE, AND ACTUAL RESULTS WILL VARY BASED ON OPERATOR EXPERIENCE AND SKILL.

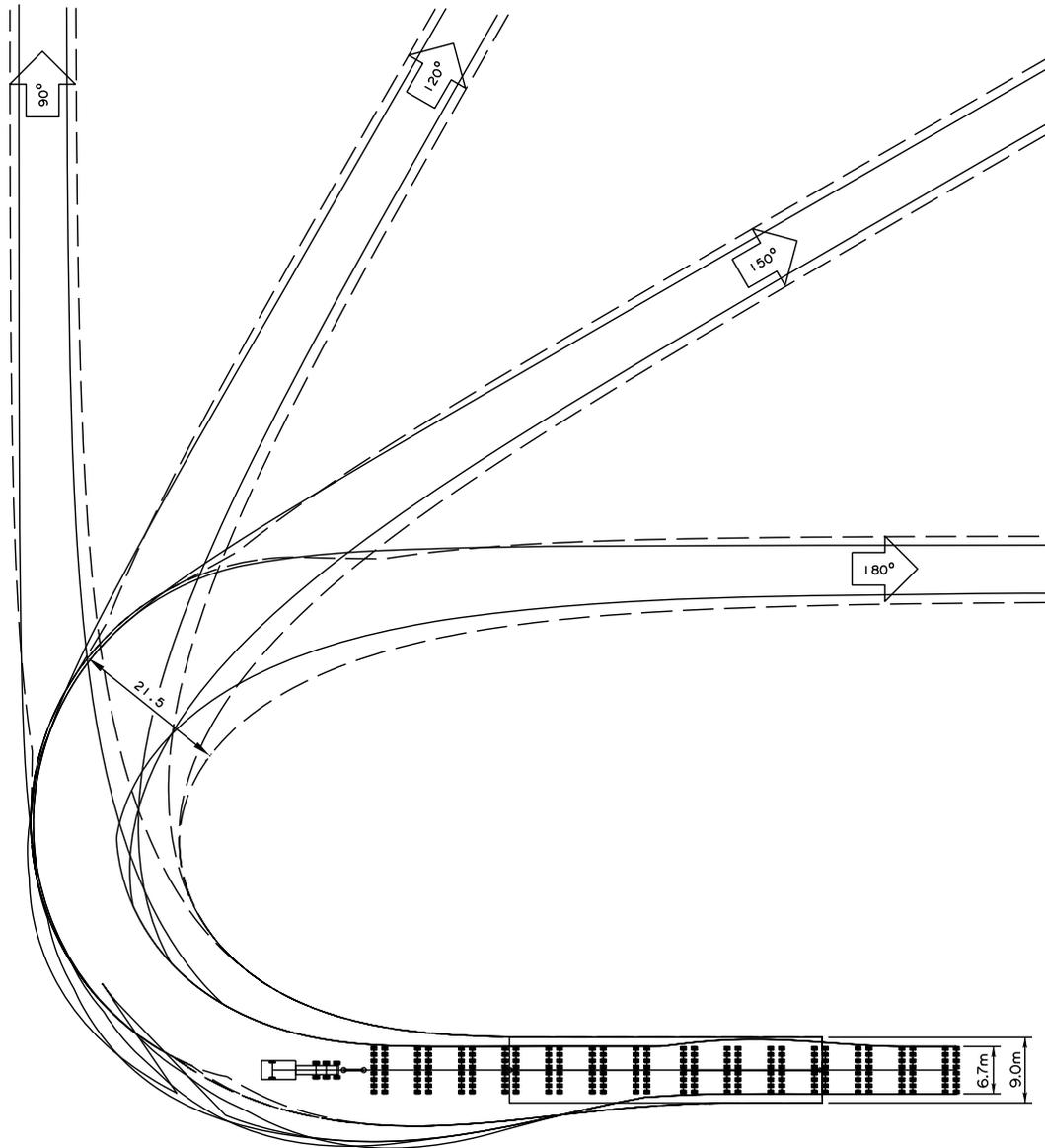
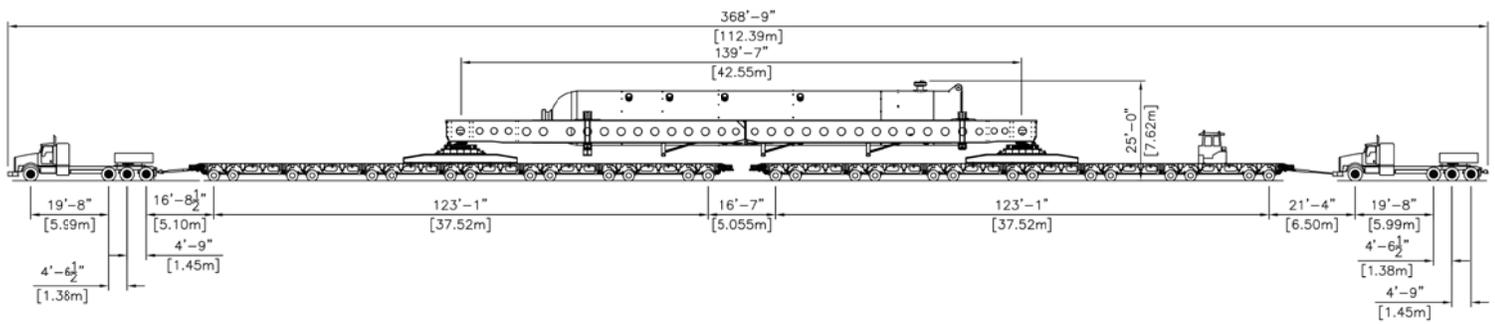
Alberta Transportation

PLATFORM TRAILER (TRAILER 4)

OCT. 2014

SCALE 1:500

FIG. D-5n



NOTES:

1. RESULTS OF LIMITS OR TRUCK TURNING MOVEMENTS AND SWEEPED PATHS LIMITS ARE DERIVED FROM SOFTWARE. WHILE EVALUATED BY THE SOFTWARE SUPPLIER THE SPECIFIC MOVEMENTS FOR CUSTOM VEHICLES HAVE NOT BEEN TESTED IN THE FIELD. THEIR ACCURACY IS LIMITED BY THE ABILITIES OF THE SOFTWARE, AND ACTUAL RESULTS WILL VARY BASED ON OPERATOR EXPERIENCE AND SKILL.

Alberta Transportation

REACTOR TRANSPORTER
CONFIGURATION WITH
LOAD CELL WEIGHTS

OCT. 2014

SCALE 1:1000

FIG. D-5o



MEMORANDUM

To: Alberta Transportation

From: Ourston Roundabout Engineering

Date: May 25, 2011

Subject: Truck Accommodation at Multi-Lane Roundabouts

This memo discusses the accommodation of trucks at multi-lane roundabouts. Unlike single-lane roundabouts, no special geometric treatments such as truck aprons are necessarily needed to physically accommodate large commercial vehicles at multi-lane roundabouts. However there are still a number of considerations in terms of lane use. They include whether to allow for trucks to overtrack adjacent lanes, and whether to install lane lines in the circulatory road.

Truck Accommodation Philosophies

Case 1 Roundabouts

With so-called Case 1 designs, large commercial vehicles will track across adjacent lanes as they enter, circulate and exit a multi-lane roundabout. See Figure 1. This is analogous to other types of intersections where trucks will track across adjacent lanes as they make left or right turns. The difference with Case 1 roundabouts is that large trucks will need to do this for through movements as well.



Photo: Ourston Roundabout Engineering

Figure 1 Example of a Case 1 design. The commercial vehicle requires the entire width to enter the roundabout.



There is an obvious disadvantage with Case 1 in that it may lead to side-swipe collisions between light vehicles and trucks through the roundabout entry. This can be mitigated by training truck drivers to straddle the entry lanes so that other drivers cannot drive beside them. This is easier to accomplish when a roundabout entry adds lanes through a flare (one lane flares to two, for example), than when these lanes are continuous (two lanes throughout, for example).

Not as obvious is that there are several advantages to Case 1 designs. They will likely be smaller than roundabouts where trucks can maintain their lane, with narrower entries and exits and higher entry angles. These features will act to increase a roundabout's overall safety potential through more speed control and better sight-to-the-left for entering drivers. Also, since Case 1 roundabouts are smaller they will occupy less land area and be less expensive to construct.

Case 2 Roundabouts

With Case 2 design large commercial vehicles can maintain their own lane through the entry, but not as they circulate and exit. See Figure 2. The entry will be wider than for a Case 1 design so that a light vehicle and a large truck can line up side-by-side, after which one vehicle will have to give way to the other upon proceeding into the roundabout. In some cases two large trucks can line up at the entry side-by-side, although this is relatively rare because it usually means that a Case 3 roundabout can be achieved.



Photo: Ourston Roundabout Engineering

Figure 2 Example of a Case 2 design. The entry gore striping keeps trucks from encroaching into the adjacent lane.

A disadvantage with Case 2 is that it may relocate side-swipe collisions from the entry to within the circulatory road. The probability should not be as high as with Case 1 designs because even when two vehicles line up side-by-side, one will naturally pull ahead. This will either be a faster passenger car, or the vehicle in the inner lane



because it takes a shorter path. Another disadvantage with a Case 2 design is that the wider entry will make it more difficult to achieve sufficient speed control.

The advantage of Case 2 designs is the ability to handle higher truck percentages more safely than Case 1 designs. They can therefore be considered more appropriate on roads with a high percentage of trucks and where the design compromises associated with accommodating them are reasonable.

Case 3 Roundabouts

With Case 3 designs, large commercial vehicles can maintain their own lane as they enter, circulate and exit a multi-lane roundabout. See Figure 3. Usually this means a passenger car and a large truck can be accommodated side-by-side through the roundabout, although in extreme cases it may mean that two large trucks can be accommodated side-by-side.



Photo: MTJ Engineering LLC.

Figure 3 Example of a Case 3 design. Note the straight, wide entry and wide central island truck apron.

Case 3 roundabouts will be larger and faster than Case 1 and 2 roundabouts, and will require a central island truck apron to keep trucks in the inner lane as they circulate (unless the roundabout is made very large). Truck aprons are common at single-lane roundabouts but are not usually needed at multi-lane roundabouts. As mentioned in an earlier section, care is needed in the design and construction of truck aprons so that they provide as much speed control as non-traversable central islands, yet do not create under-clearance or stability problems for trucks.

Generally Case 3 roundabouts should only be considered when truck percentages are very high and the design compromises associated with accommodating them completely within their lanes are acceptable.



Circulatory Road Striping

In most countries, multi-lane roundabouts have lane striping on the entries and exits, but not in the circulatory road unless special conditions make them necessary. This is analogous to signalized intersections not having lines continue through except to aid certain movements. Circulatory road striping now tends to be the rule rather than the exception in the United States, although early designs in the U.S. (prior to 2001) did not have circulatory road striping at all.

Advantages of circulatory road striping:

- Provides a reminder to drivers to maintain their lane position while circulating;
- May improve lane utilization and therefore increase capacity;
- Educates drivers on how to correctly turn left (but only if approach signs and markings correctly assign lane choice); and
- Necessary for complex configurations with exclusive left turns to guide drivers through the roundabout.

Disadvantages of circulatory road striping:

- Can be tricky to design, and difficult to implement accurately in the field;
- Can lessen the potential to yield at entry because the striping looks like a continuation of the through road;
- May accentuate inherent path overlap problems;
- May necessitate truck aprons where not normally required; and
- Where the design does not allow for trucks to maintain their own lane in the circulatory road (Case 1 and Case 2), can encourage passenger car drivers to circulate next to trucks.

The decision to implement circulatory road striping at a multi-lane roundabout should therefore be made on a case-by-case basis.

An effort to counter the tendency for drivers of light vehicles to circulate next to trucks at roundabouts with circulatory road striping is seen in the BC Ministry of Transportation sign in Figure 4. This sign, with a “Do Not pass” tab, will be incorporated into the upcoming Division 7 of the Manual of Uniform Traffic Control Devices (MUTCD) for Canada.



Photo: Ourston Roundabout Engineering

Figure 4 “Truck Encroachment” warning sign.



Truck Accommodation at Multi-Lane Roundabouts
Alberta Transportation
May 25, 2011
Page 5

We hope the foregoing is helpful. Please advise if you have any questions or require further information.

Yours truly,

OURSTON ROUNDABOUT ENGINEERING (CANADA)

(A Member of The Sernas Group Inc.)

A handwritten signature in black ink, appearing to read 'P. Weber'.

Phil Weber, M.Eng, P.Eng.
Principal, Project Manager

A handwritten signature in black ink, appearing to read 'Mark Lenters'.

Mark Lenters, P.Eng.
General Manager

/pw

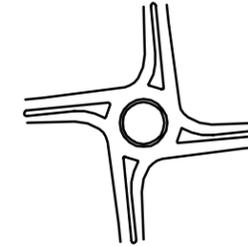
TYPICAL ROUNDABOUTS

SINGLE-LANE ROUNDABOUT
MULTI-LANE ROUNDABOUT, CASE 1 TRUCK ACCOMMODATION
MULTI-LANE ROUNDABOUT, CASE 2 TRUCK ACCOMMODATION (TWO WB-21'S SIDE-BY-SIDE)
MULTI-LANE ROUNDABOUT, CASE 2 TRUCK ACCOMMODATION (TWO WB-36'S SIDE-BY-SIDE)
MULTI-LANE ROUNDABOUT, CASE 3 TRUCK ACCOMMODATION (TWO WB-21'S SIDE-BY-SIDE)
MULTI-LANE ROUNDABOUT, CASE 3 TRUCK ACCOMMODATION (TWO WB-36'S SIDE-BY-SIDE)

DESIGN VEHICLES

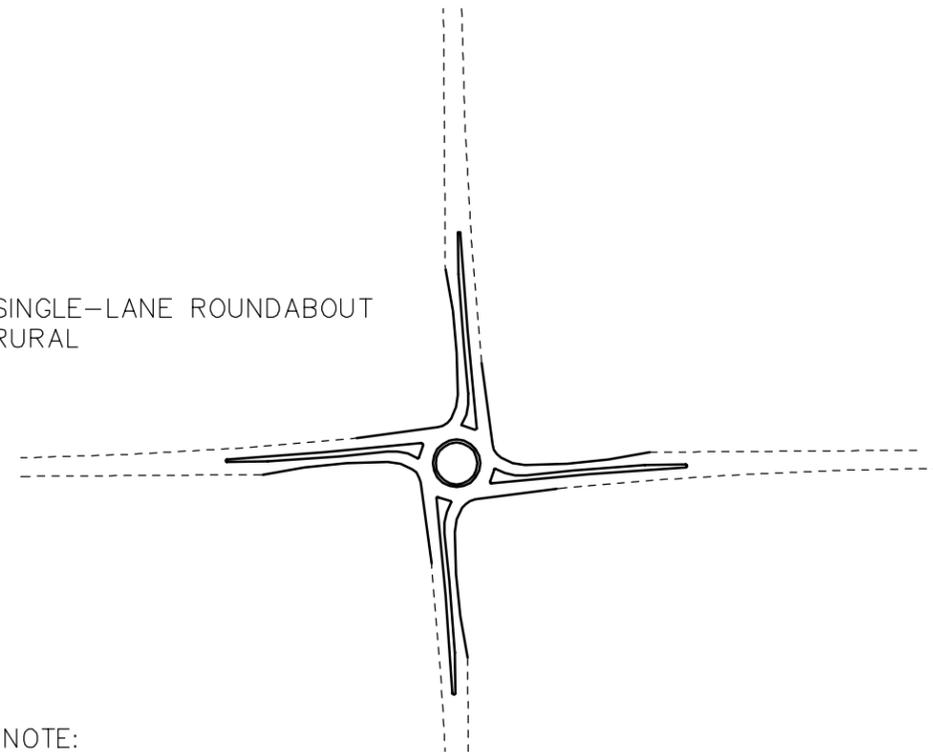
WB-21 TRUCK
MODIFIED WB-36 TRUCK
54m PLATFORM TRAILER
98m REACTOR TRANSPORTER

SINGLE-LANE ROUNDABOUT
URBAN



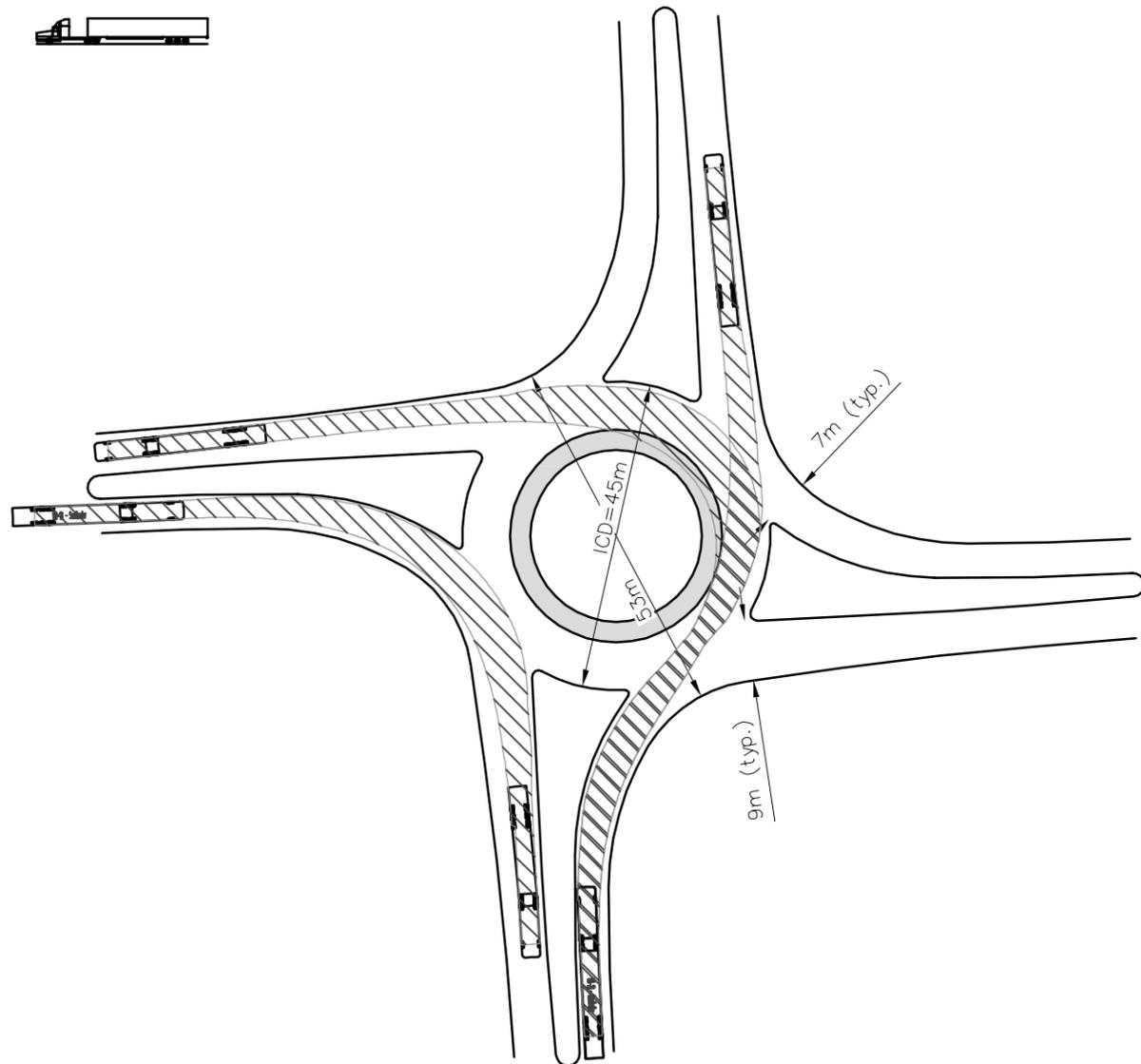
NOTE:
Roundabouts in urban locations will typically be designed for slower speeds and more restrictive truck accommodation than in rural locations.

SINGLE-LANE ROUNDABOUT
RURAL



NOTE:
Roundabouts in rural locations will typically have much longer splitter islands to initiate speed reduction farther upstream than in urban locations.

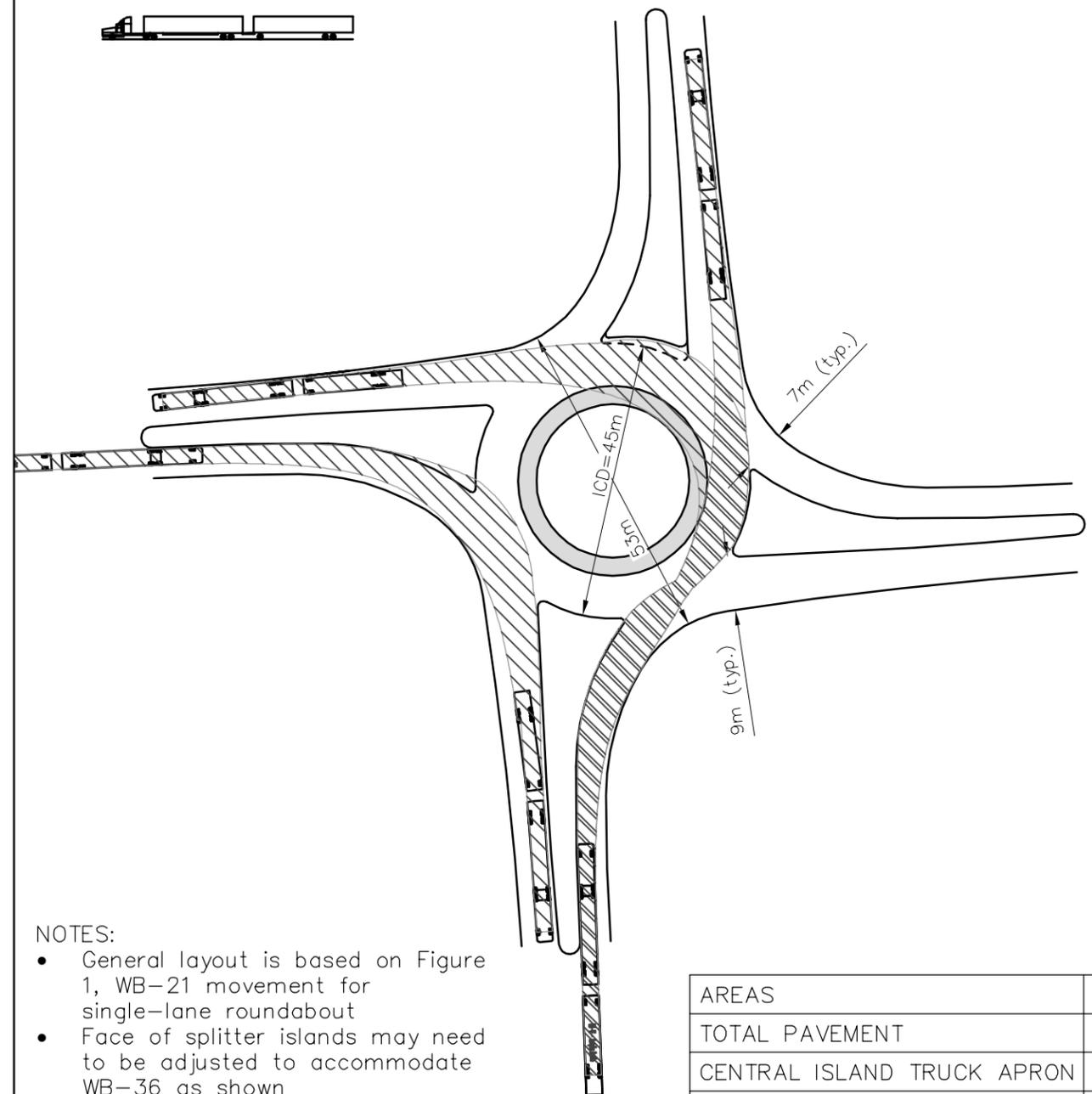
FIGURE 1
WB-21 TRUCK



AREAS	m ²
TOTAL PAVEMENT	3890
CENTRAL ISLAND TRUCK APRON	750
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	5990

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

FIGURE 2
MODIFIED WB-36
TRUCK



NOTES:

- General layout is based on Figure 1, WB-21 movement for single-lane roundabout
- Face of splitter islands may need to be adjusted to accommodate WB-36 as shown

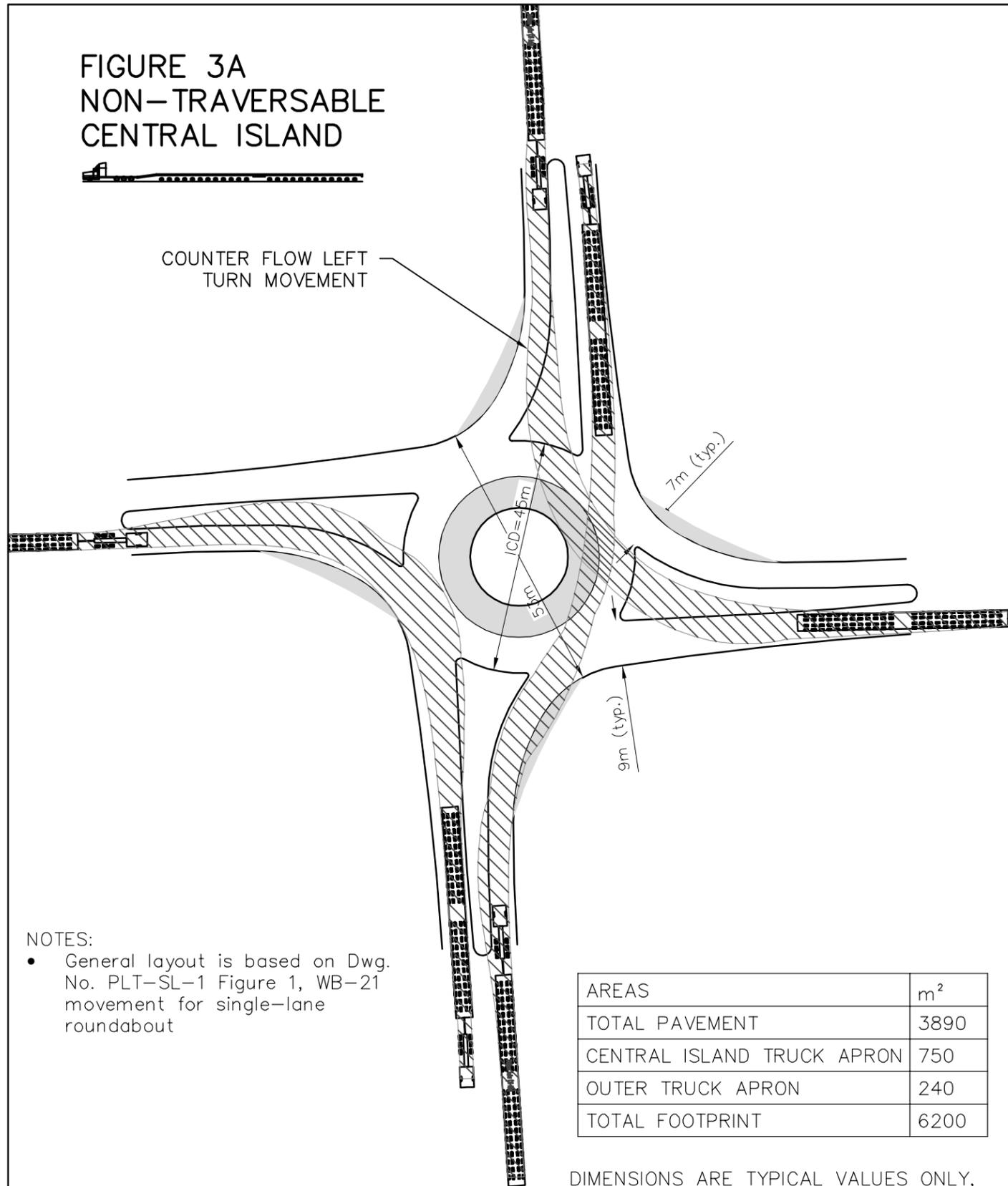
AREAS	m ²
TOTAL PAVEMENT	3890
CENTRAL ISLAND TRUCK APRON	750
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	5990

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

**FIGURE 3A
NON-TRAVERSABLE
CENTRAL ISLAND**



COUNTER FLOW LEFT
TURN MOVEMENT

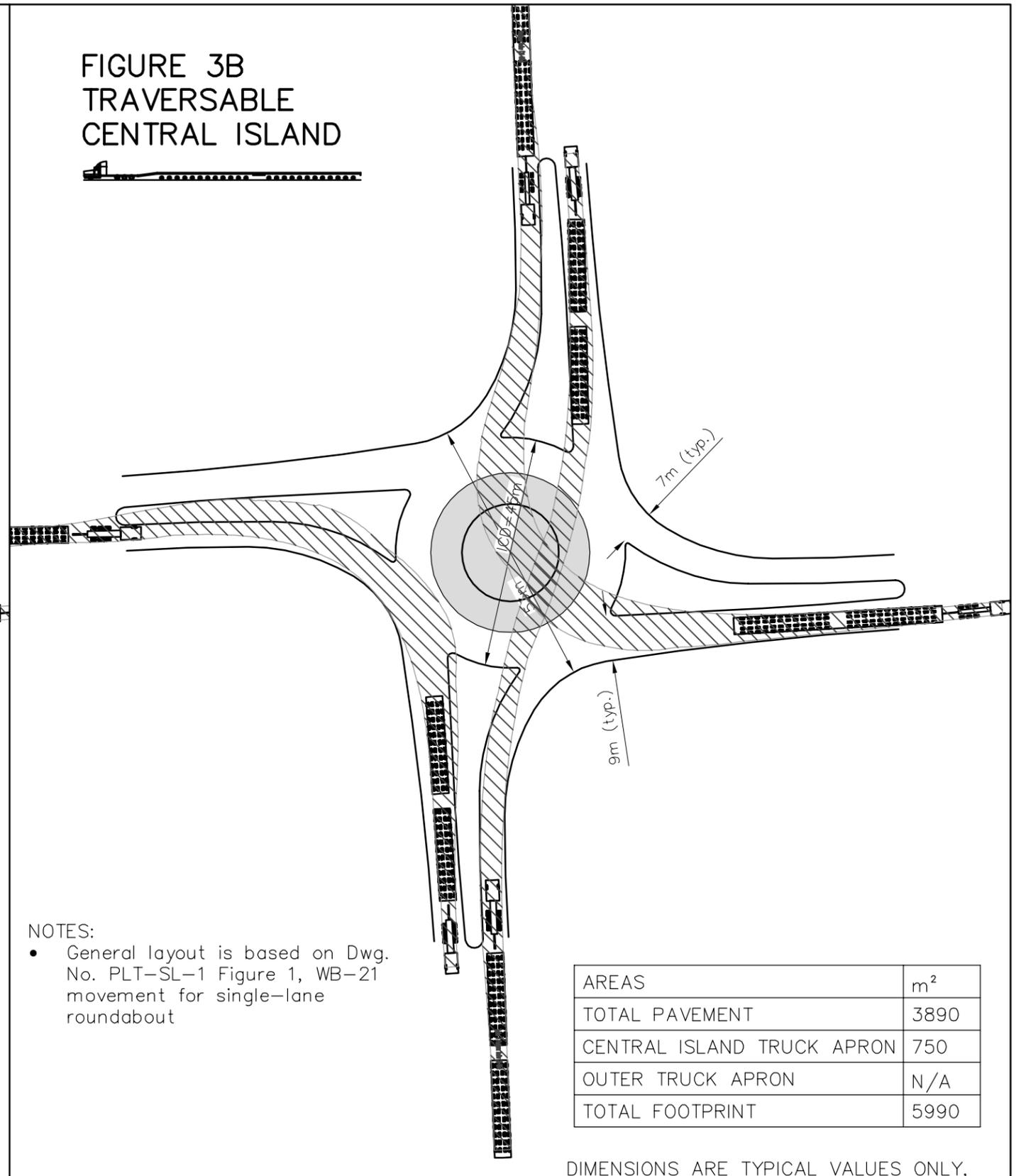


- NOTES:
- General layout is based on Dwg. No. PLT-SL-1 Figure 1, WB-21 movement for single-lane roundabout

AREAS	m ²
TOTAL PAVEMENT	3890
CENTRAL ISLAND TRUCK APRON	750
OUTER TRUCK APRON	240
TOTAL FOOTPRINT	6200

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

**FIGURE 3B
TRAVERSABLE
CENTRAL ISLAND**

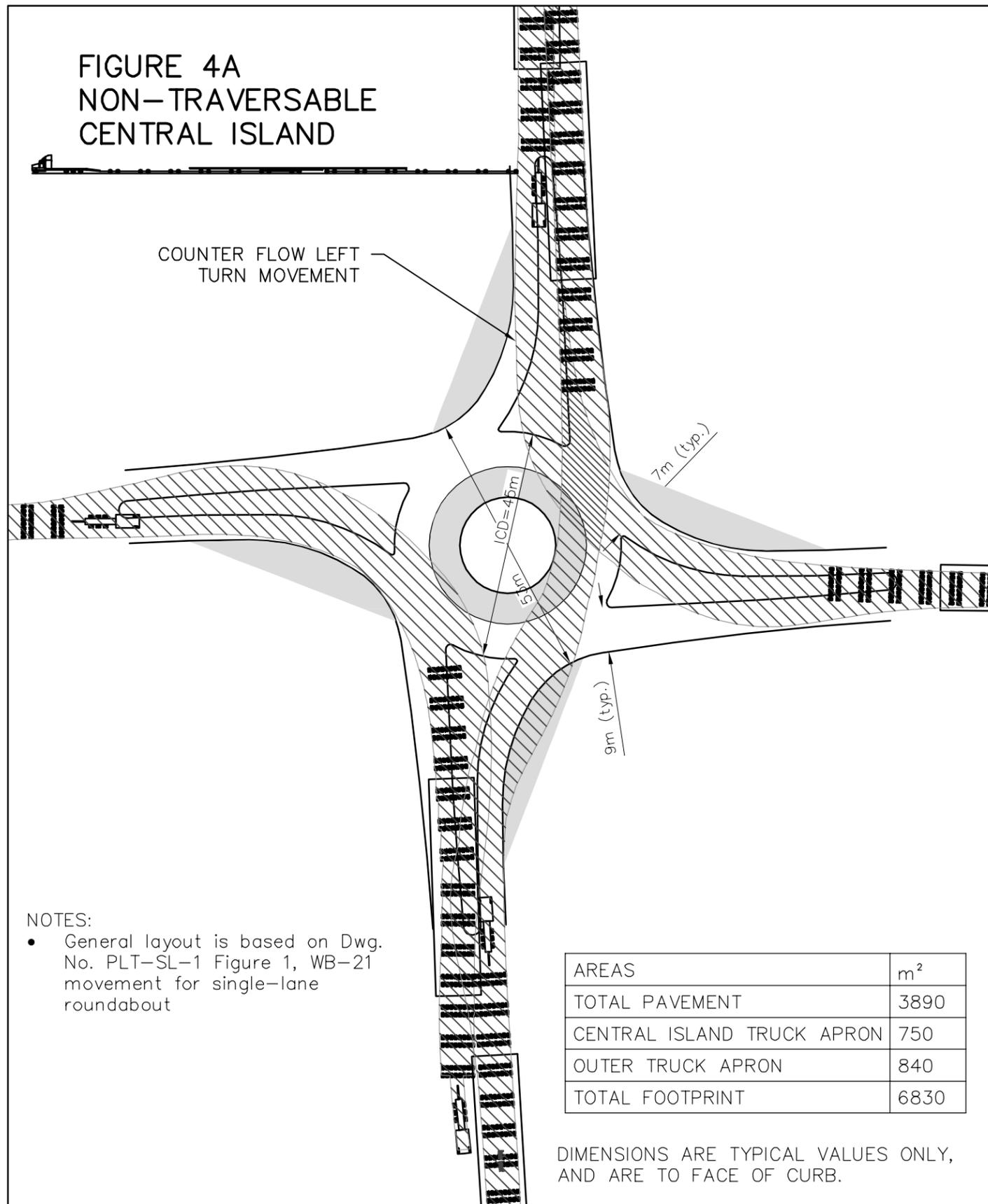


- NOTES:
- General layout is based on Dwg. No. PLT-SL-1 Figure 1, WB-21 movement for single-lane roundabout

AREAS	m ²
TOTAL PAVEMENT	3890
CENTRAL ISLAND TRUCK APRON	750
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	5990

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

**FIGURE 4A
NON-TRAVERSABLE
CENTRAL ISLAND**



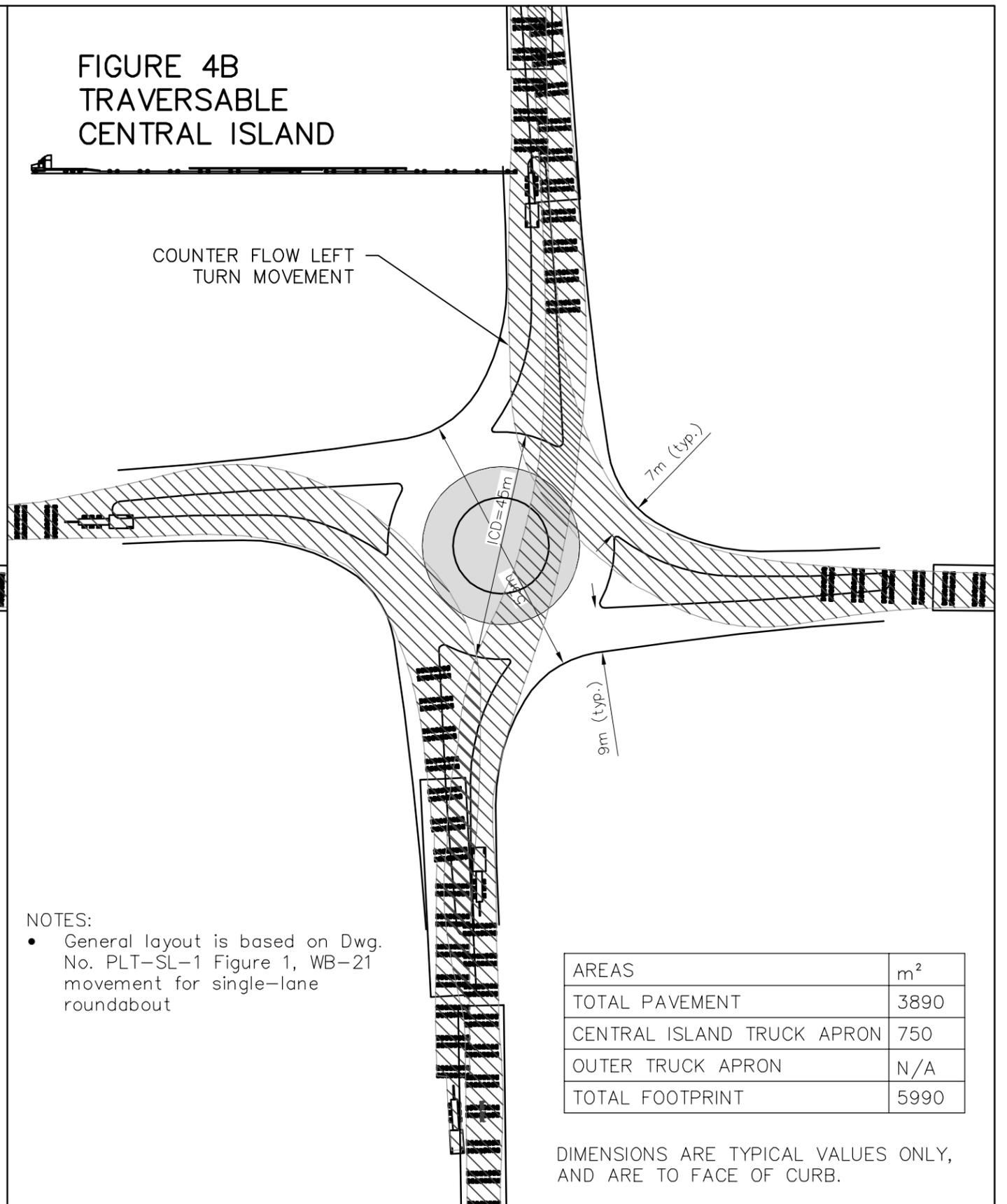
NOTES:

- General layout is based on Dwg. No. PLT-SL-1 Figure 1, WB-21 movement for single-lane roundabout

AREAS	m ²
TOTAL PAVEMENT	3890
CENTRAL ISLAND TRUCK APRON	750
OUTER TRUCK APRON	840
TOTAL FOOTPRINT	6830

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

**FIGURE 4B
TRAVERSABLE
CENTRAL ISLAND**



NOTES:

- General layout is based on Dwg. No. PLT-SL-1 Figure 1, WB-21 movement for single-lane roundabout

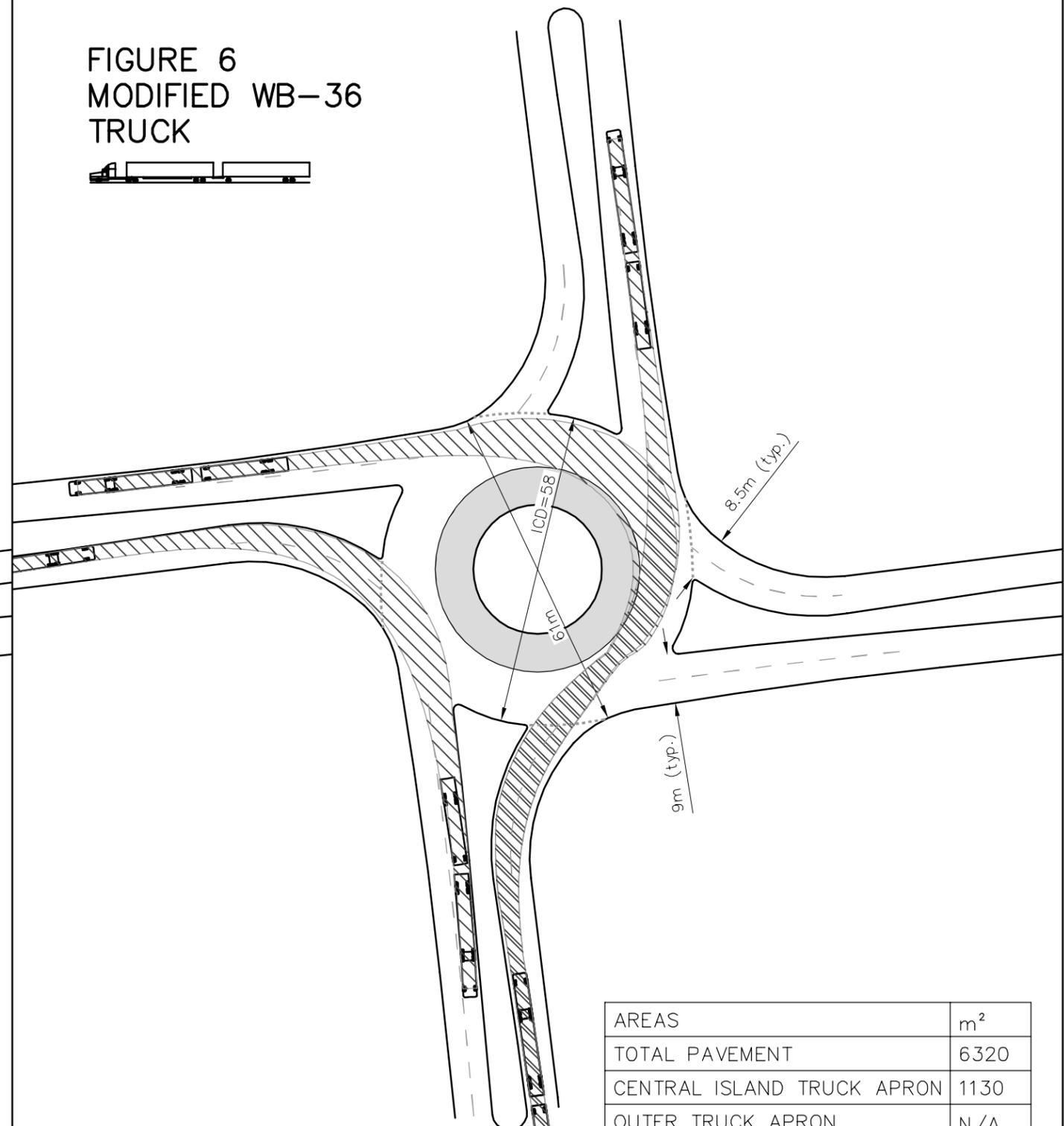
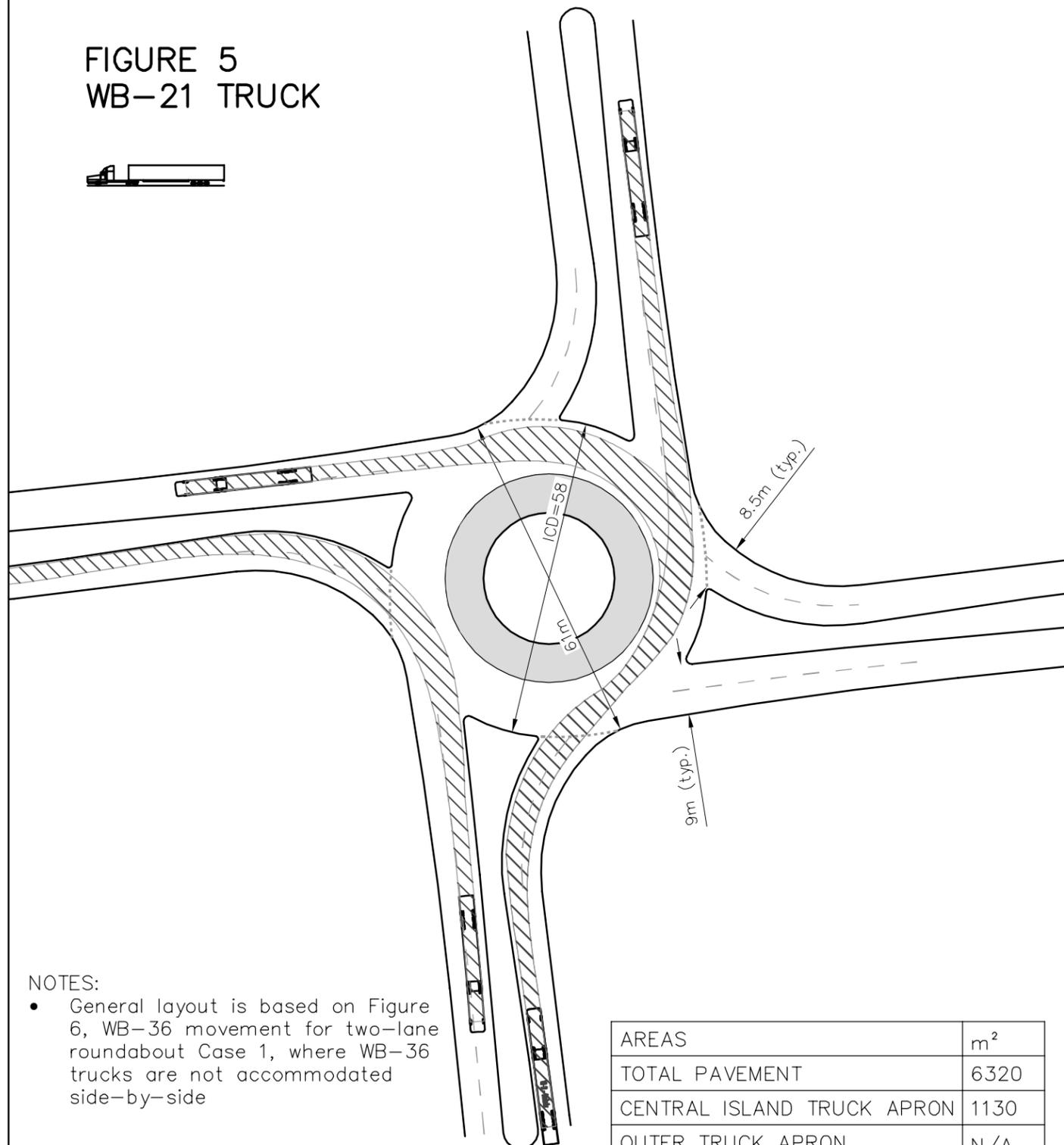
AREAS	m ²
TOTAL PAVEMENT	3890
CENTRAL ISLAND TRUCK APRON	750
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	5990

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 5
WB-21 TRUCK



FIGURE 6
MODIFIED WB-36
TRUCK



NOTES:

- General layout is based on Figure 6, WB-36 movement for two-lane roundabout Case 1, where WB-36 trucks are not accommodated side-by-side

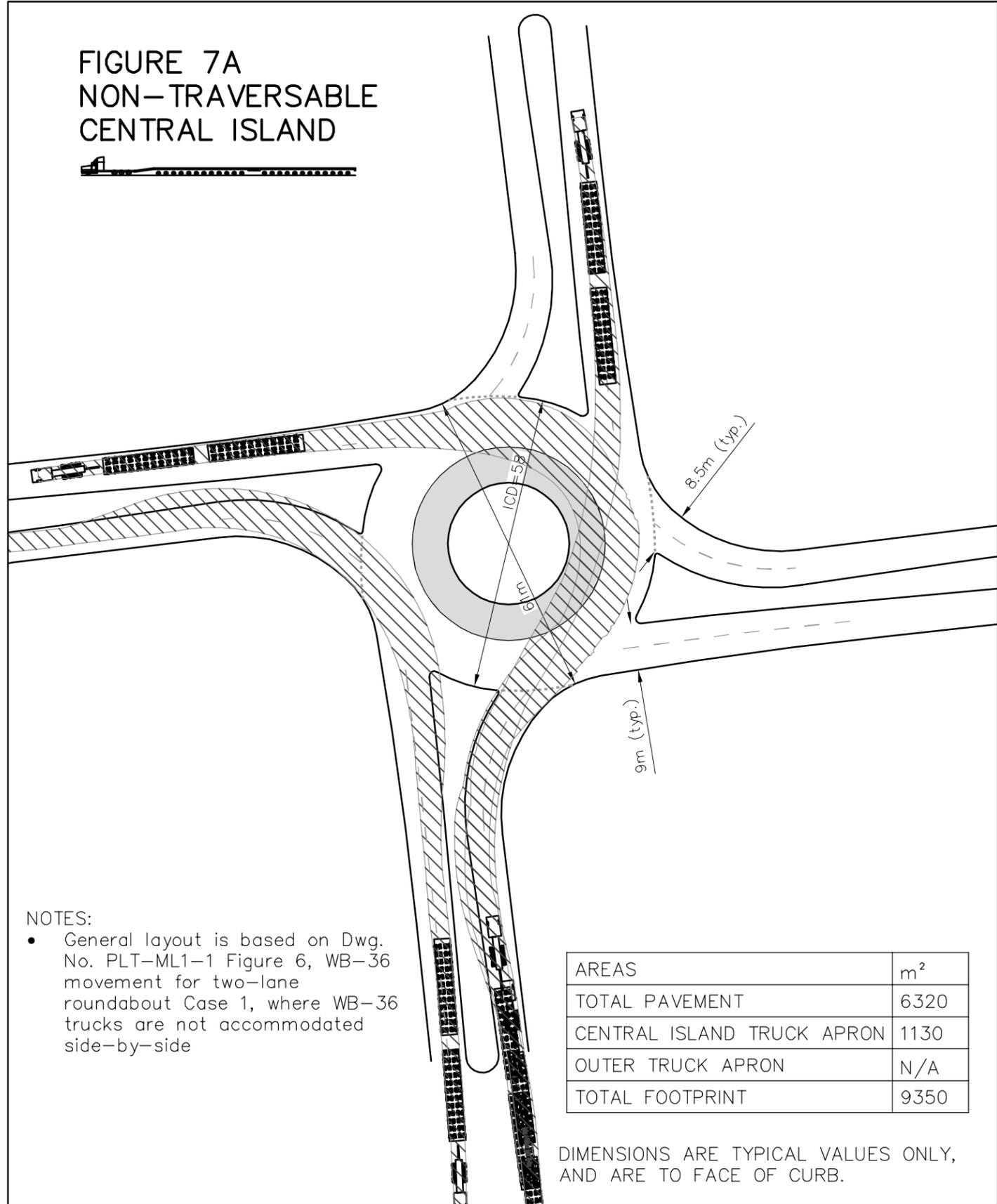
AREAS	m ²
TOTAL PAVEMENT	6320
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	9350

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

AREAS	m ²
TOTAL PAVEMENT	6320
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	9350

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

FIGURE 7A
NON-TRAVERSABLE
CENTRAL ISLAND



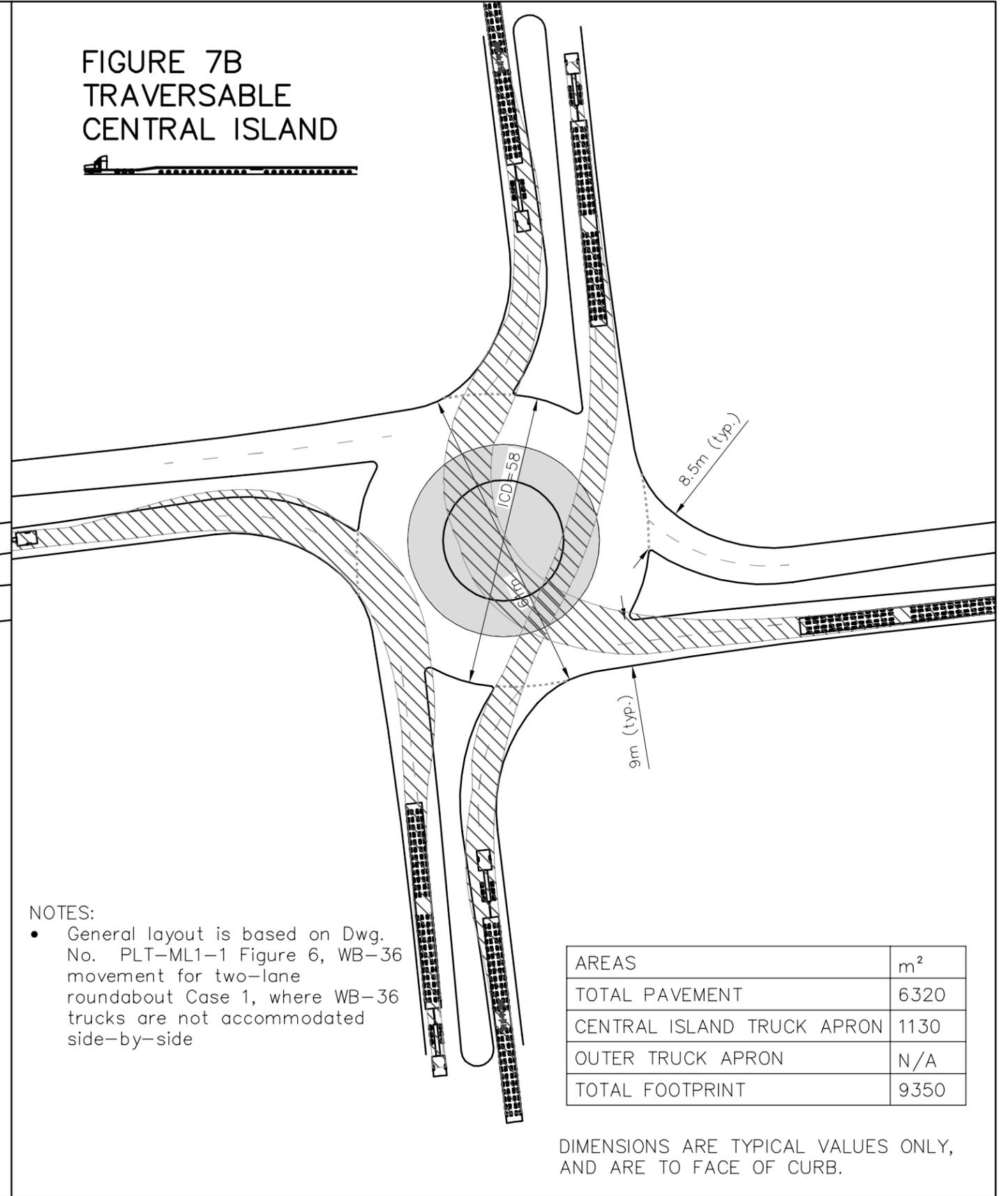
NOTES:

- General layout is based on Dwg. No. PLT-ML1-1 Figure 6, WB-36 movement for two-lane roundabout Case 1, where WB-36 trucks are not accommodated side-by-side

AREAS	m ²
TOTAL PAVEMENT	6320
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	9350

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

FIGURE 7B
TRAVERSABLE
CENTRAL ISLAND



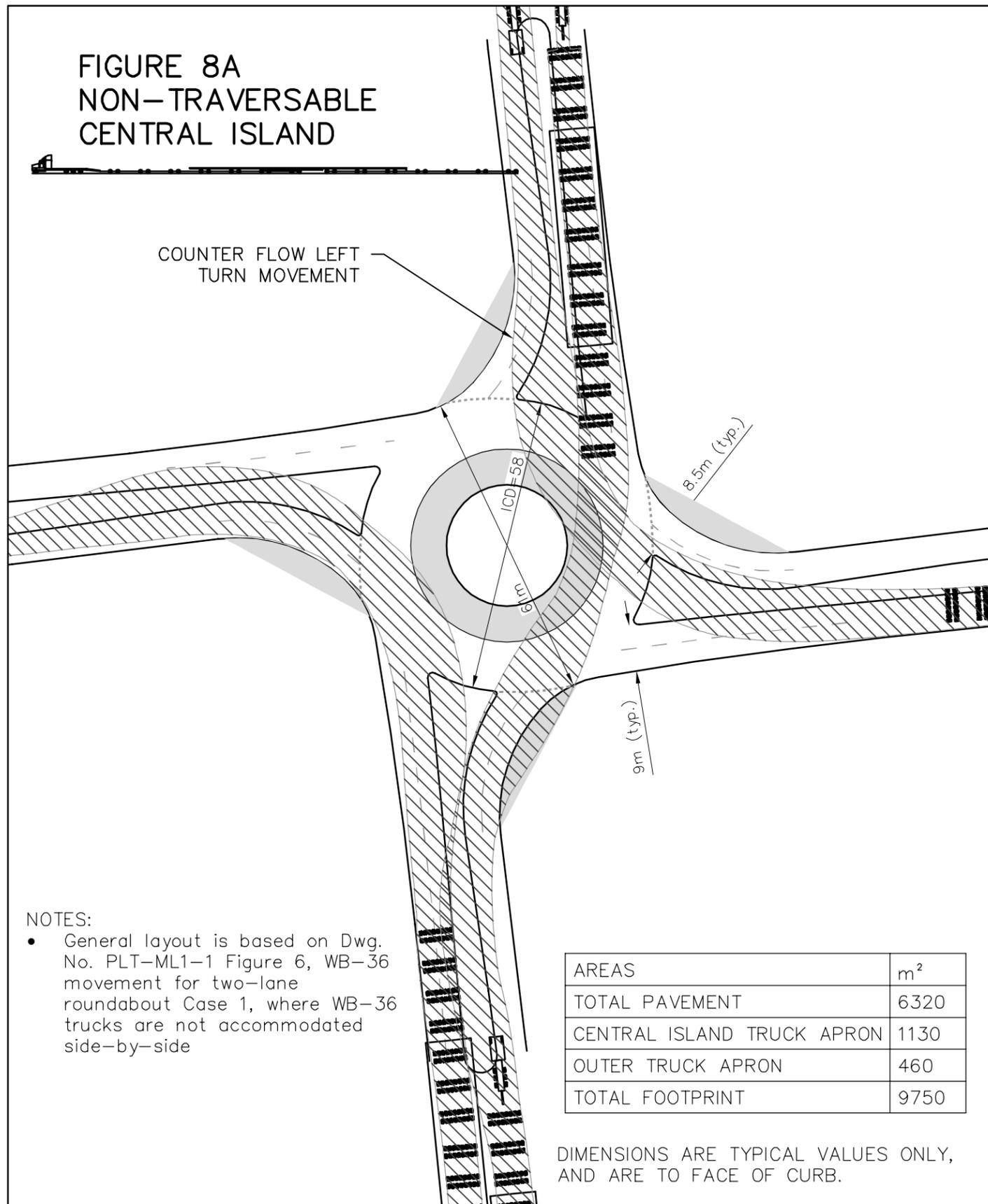
NOTES:

- General layout is based on Dwg. No. PLT-ML1-1 Figure 6, WB-36 movement for two-lane roundabout Case 1, where WB-36 trucks are not accommodated side-by-side

AREAS	m ²
TOTAL PAVEMENT	6320
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	9350

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

**FIGURE 8A
NON-TRAVERSABLE
CENTRAL ISLAND**



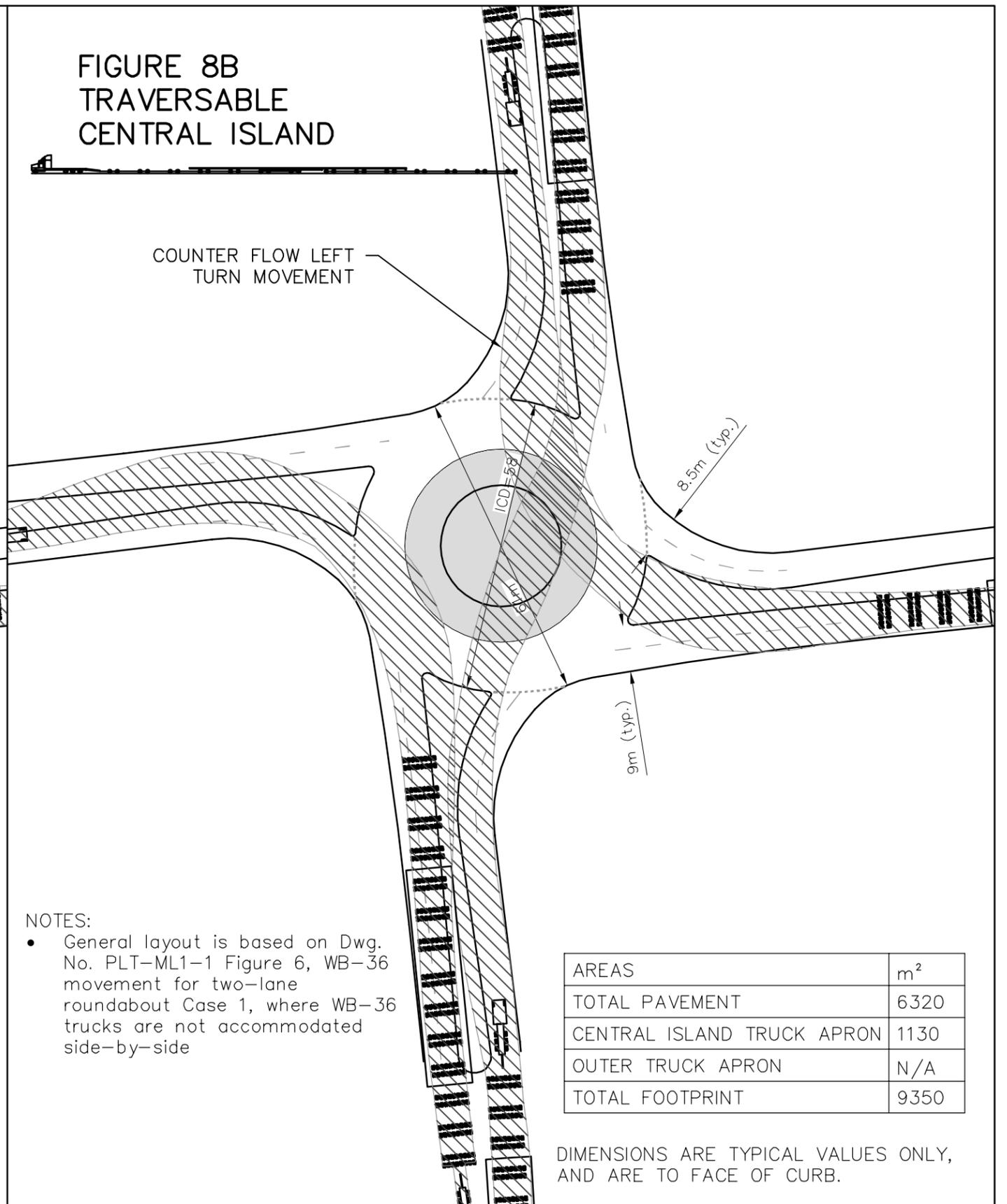
NOTES:

- General layout is based on Dwg. No. PLT-ML1-1 Figure 6, WB-36 movement for two-lane roundabout Case 1, where WB-36 trucks are not accommodated side-by-side

AREAS	m ²
TOTAL PAVEMENT	6320
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	460
TOTAL FOOTPRINT	9750

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

**FIGURE 8B
TRAVERSABLE
CENTRAL ISLAND**



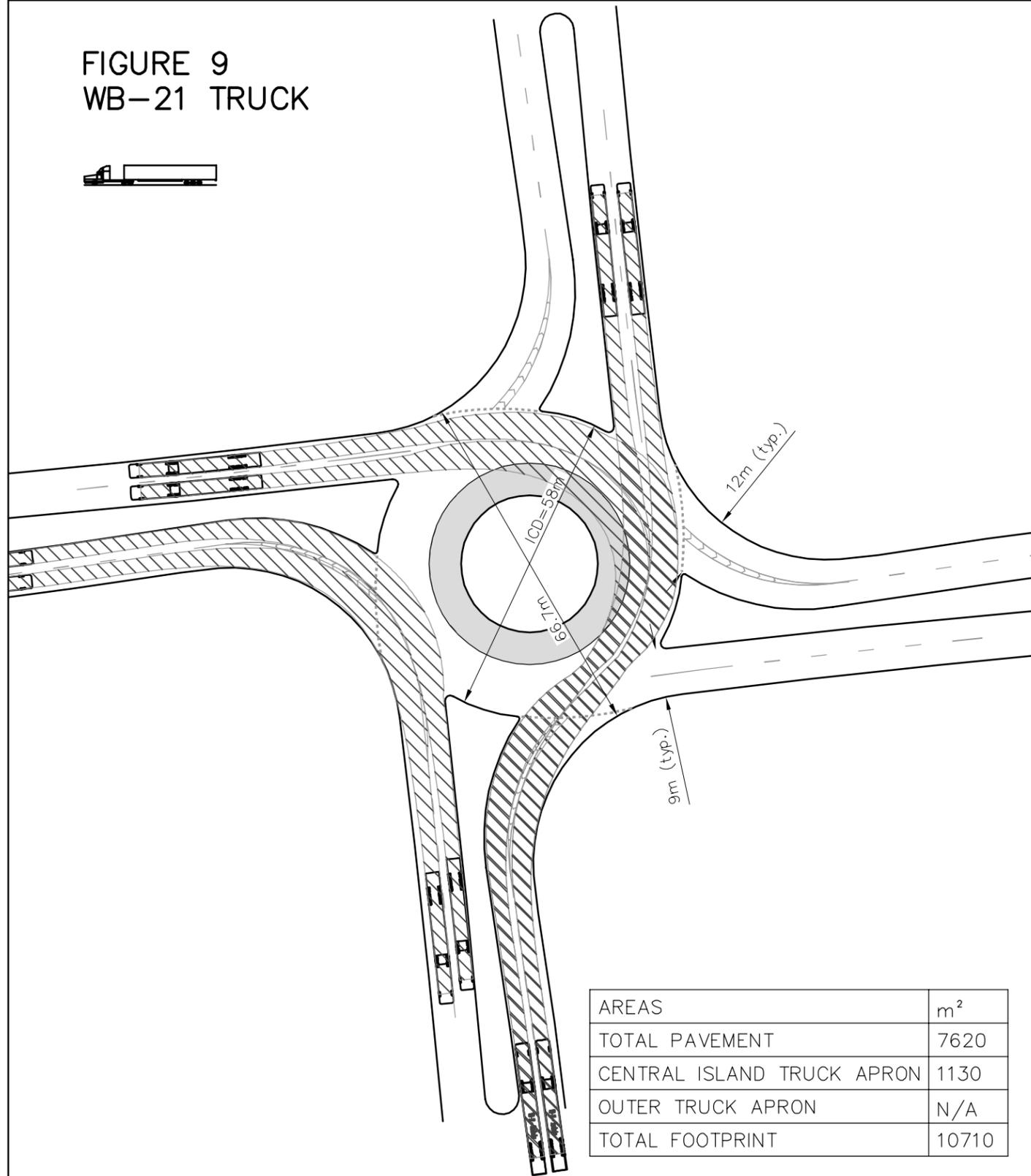
NOTES:

- General layout is based on Dwg. No. PLT-ML1-1 Figure 6, WB-36 movement for two-lane roundabout Case 1, where WB-36 trucks are not accommodated side-by-side

AREAS	m ²
TOTAL PAVEMENT	6320
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	9350

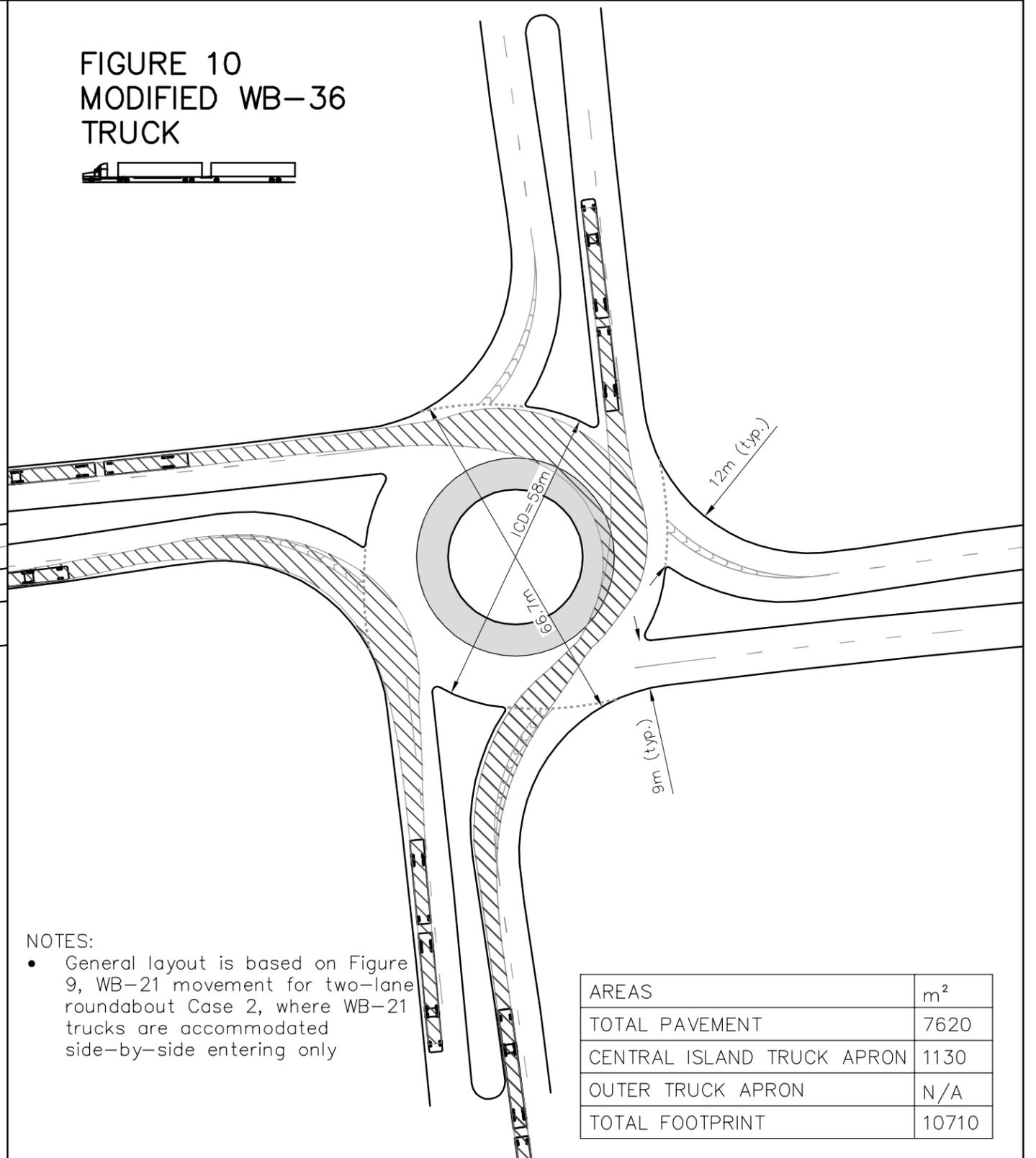
DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 9
WB-21 TRUCK



DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

FIGURE 10
MODIFIED WB-36
TRUCK

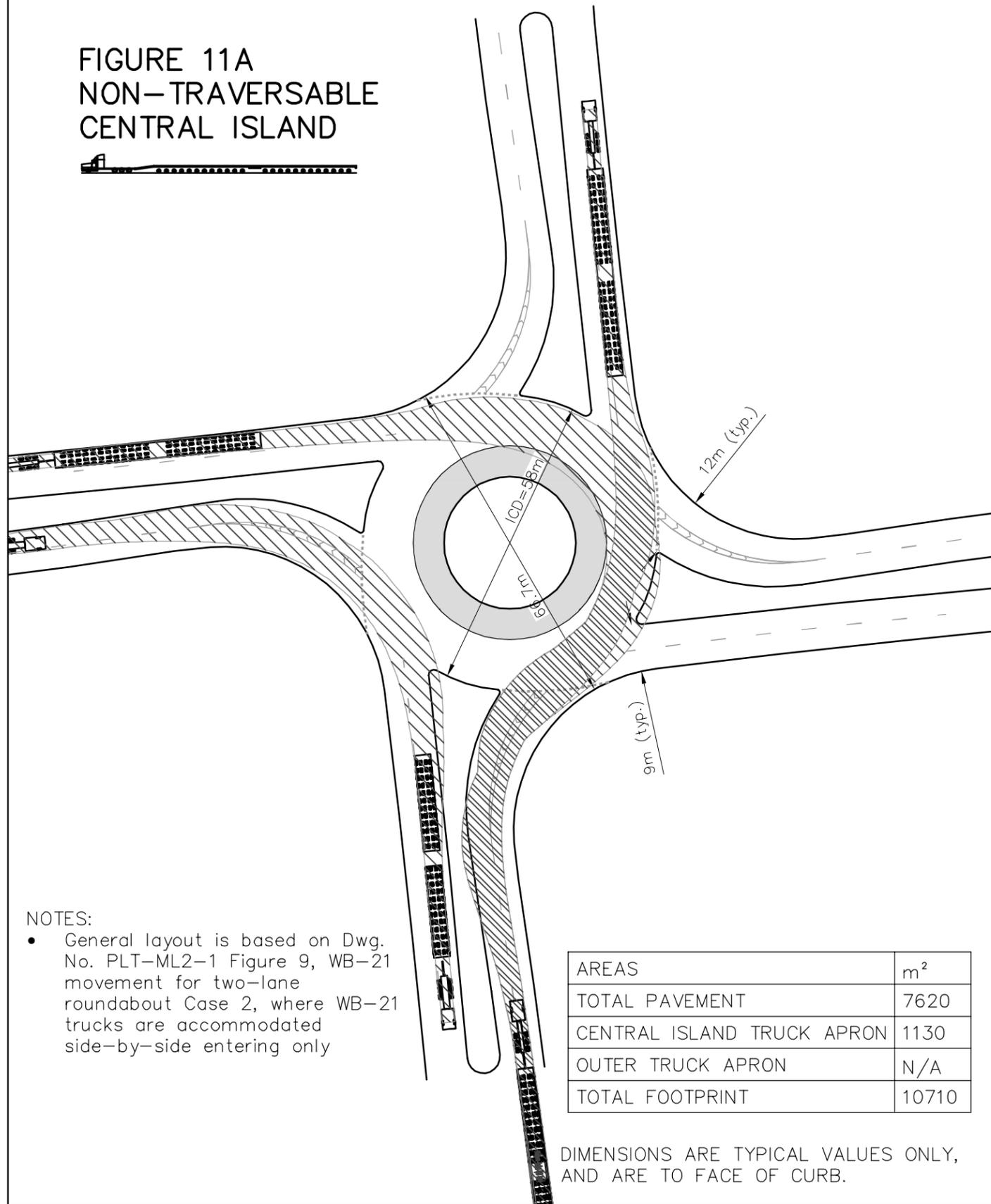


DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

NOTES:

- General layout is based on Figure 9, WB-21 movement for two-lane roundabout Case 2, where WB-21 trucks are accommodated side-by-side entering only

FIGURE 11A
NON-TRAVERSABLE
CENTRAL ISLAND



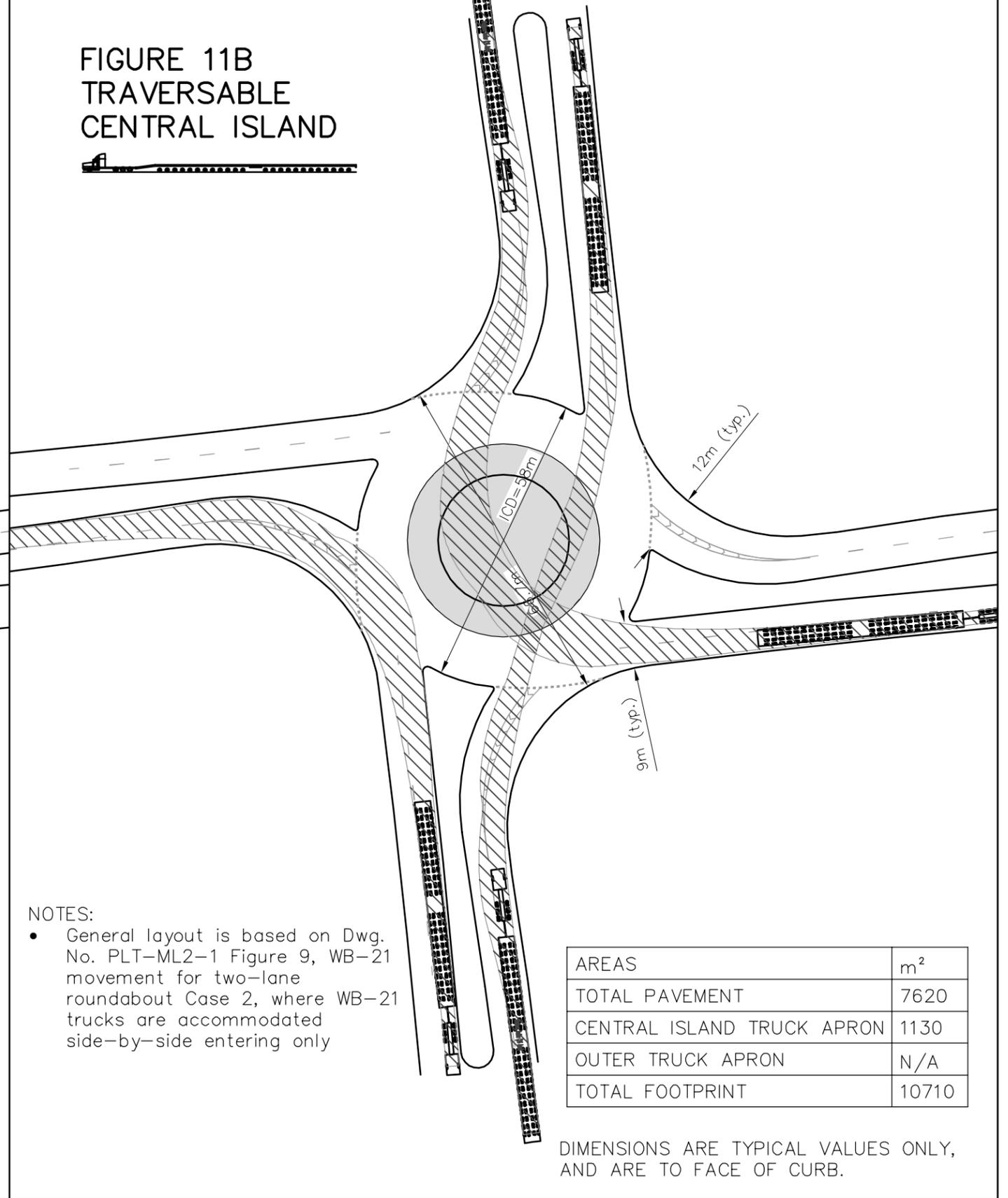
NOTES:

- General layout is based on Dwg. No. PLT-ML2-1 Figure 9, WB-21 movement for two-lane roundabout Case 2, where WB-21 trucks are accommodated side-by-side entering only

AREAS	m ²
TOTAL PAVEMENT	7620
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	10710

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

FIGURE 11B
TRAVERSABLE
CENTRAL ISLAND



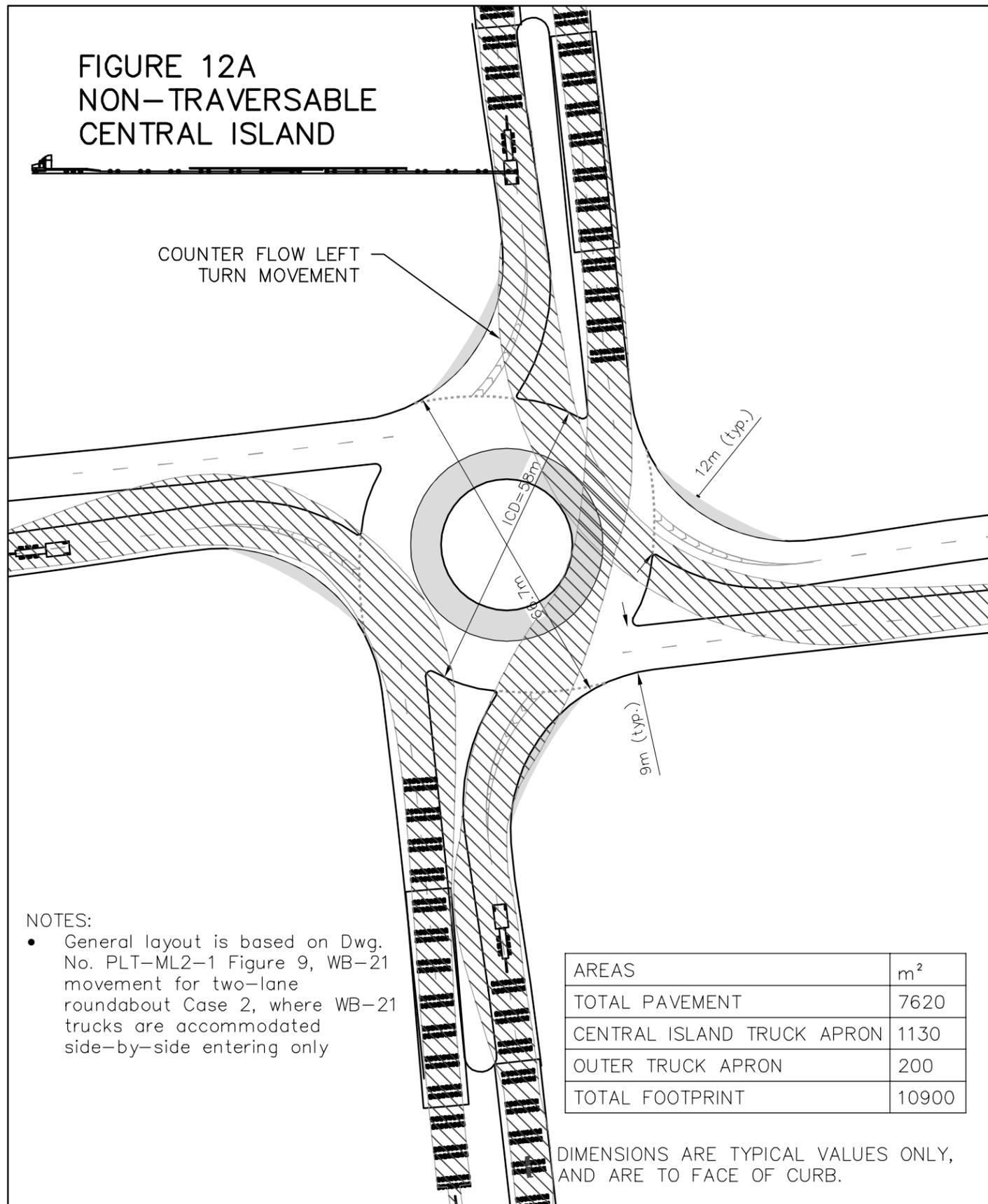
NOTES:

- General layout is based on Dwg. No. PLT-ML2-1 Figure 9, WB-21 movement for two-lane roundabout Case 2, where WB-21 trucks are accommodated side-by-side entering only

AREAS	m ²
TOTAL PAVEMENT	7620
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	10710

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

**FIGURE 12A
NON-TRAVERSABLE
CENTRAL ISLAND**



COUNTER FLOW LEFT
TURN MOVEMENT

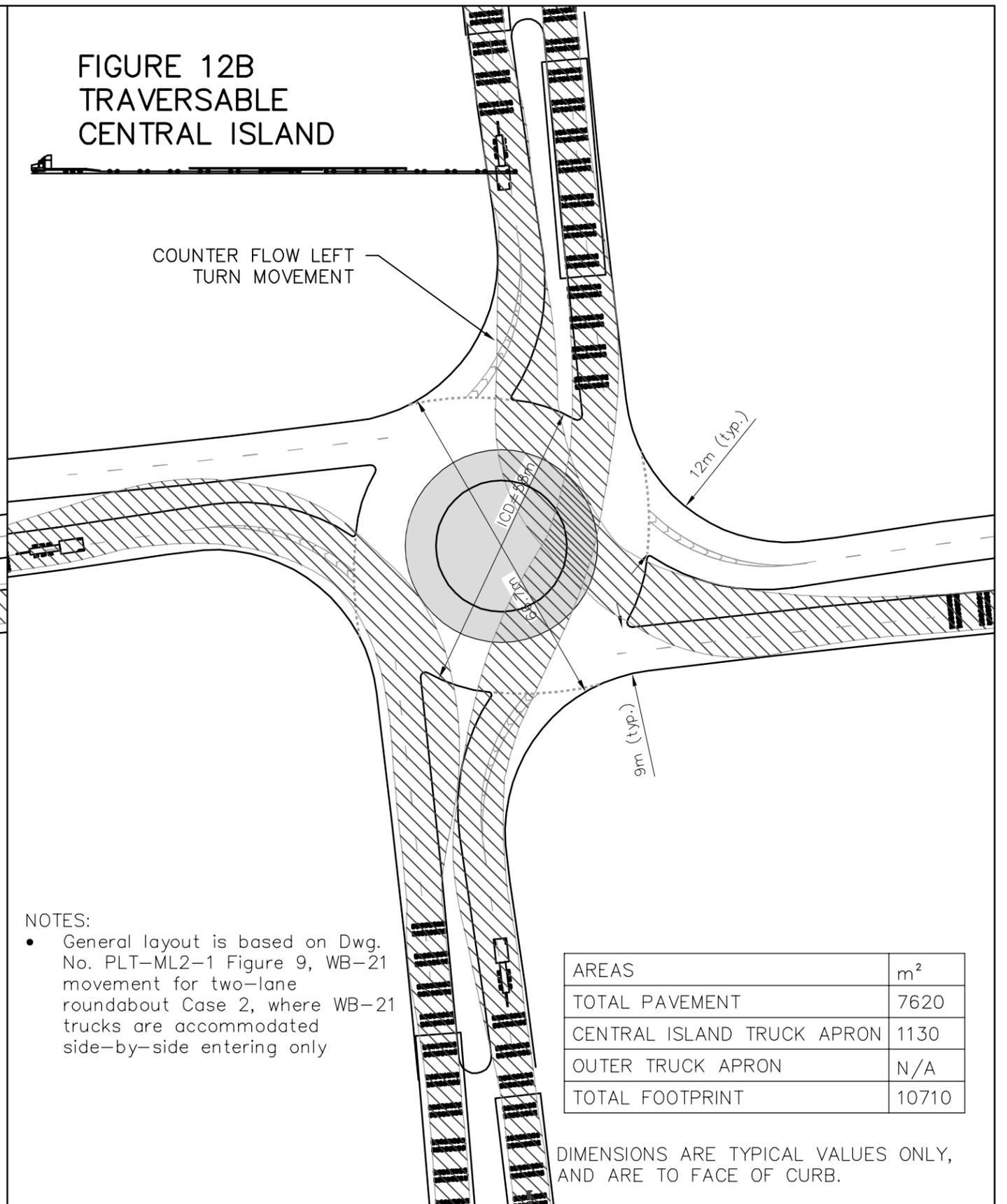
NOTES:

- General layout is based on Dwg. No. PLT-ML2-1 Figure 9, WB-21 movement for two-lane roundabout Case 2, where WB-21 trucks are accommodated side-by-side entering only

AREAS	m ²
TOTAL PAVEMENT	7620
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	200
TOTAL FOOTPRINT	10900

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

**FIGURE 12B
TRAVERSABLE
CENTRAL ISLAND**



COUNTER FLOW LEFT
TURN MOVEMENT

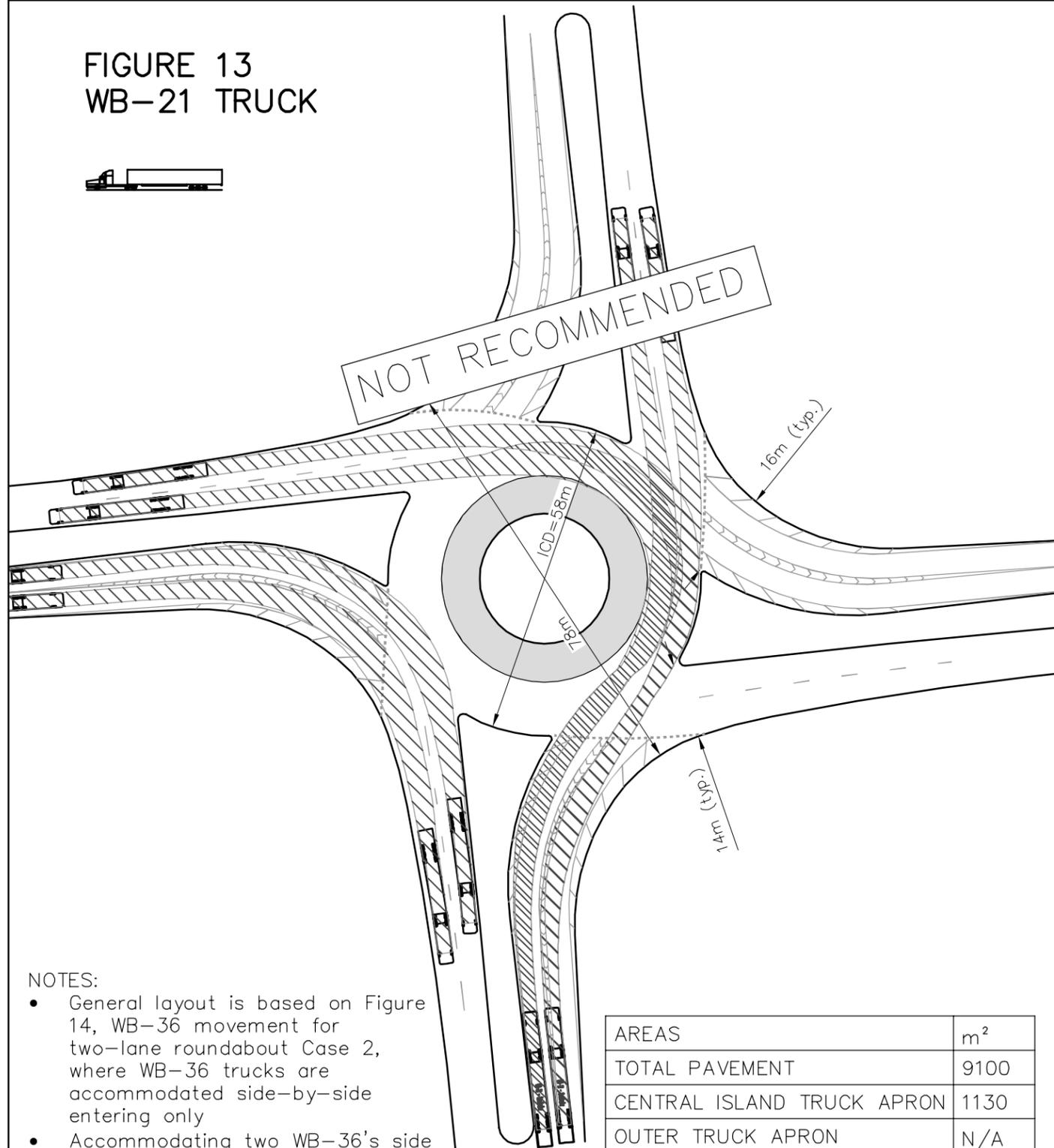
NOTES:

- General layout is based on Dwg. No. PLT-ML2-1 Figure 9, WB-21 movement for two-lane roundabout Case 2, where WB-21 trucks are accommodated side-by-side entering only

AREAS	m ²
TOTAL PAVEMENT	7620
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	10710

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

FIGURE 13
WB-21 TRUCK



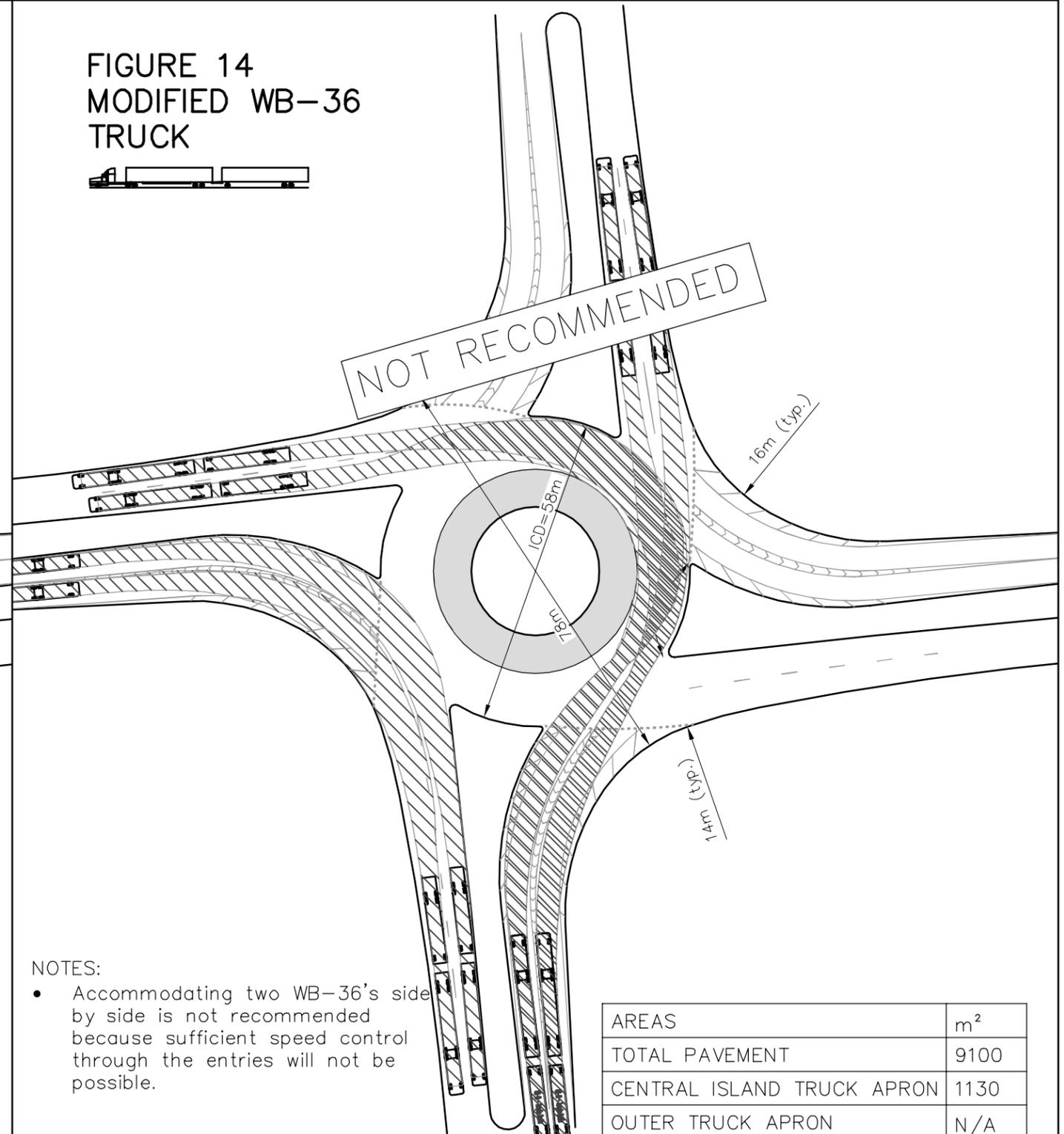
NOTES:

- General layout is based on Figure 14, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

AREAS	m ²
TOTAL PAVEMENT	9100
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	12580

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 14
MODIFIED WB-36
TRUCK



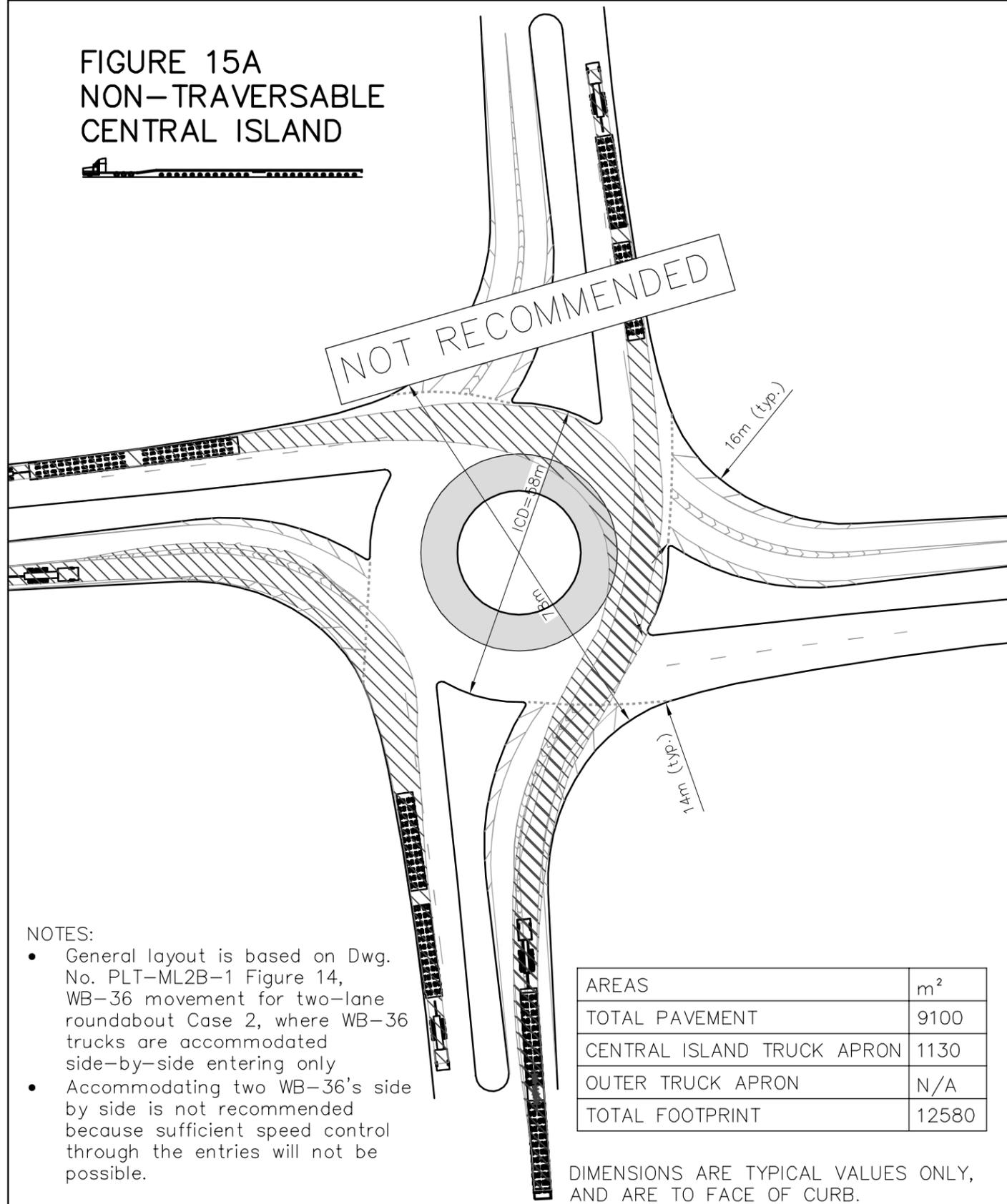
NOTES:

- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

AREAS	m ²
TOTAL PAVEMENT	9100
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	12580

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 15A
NON-TRAVERSABLE
CENTRAL ISLAND



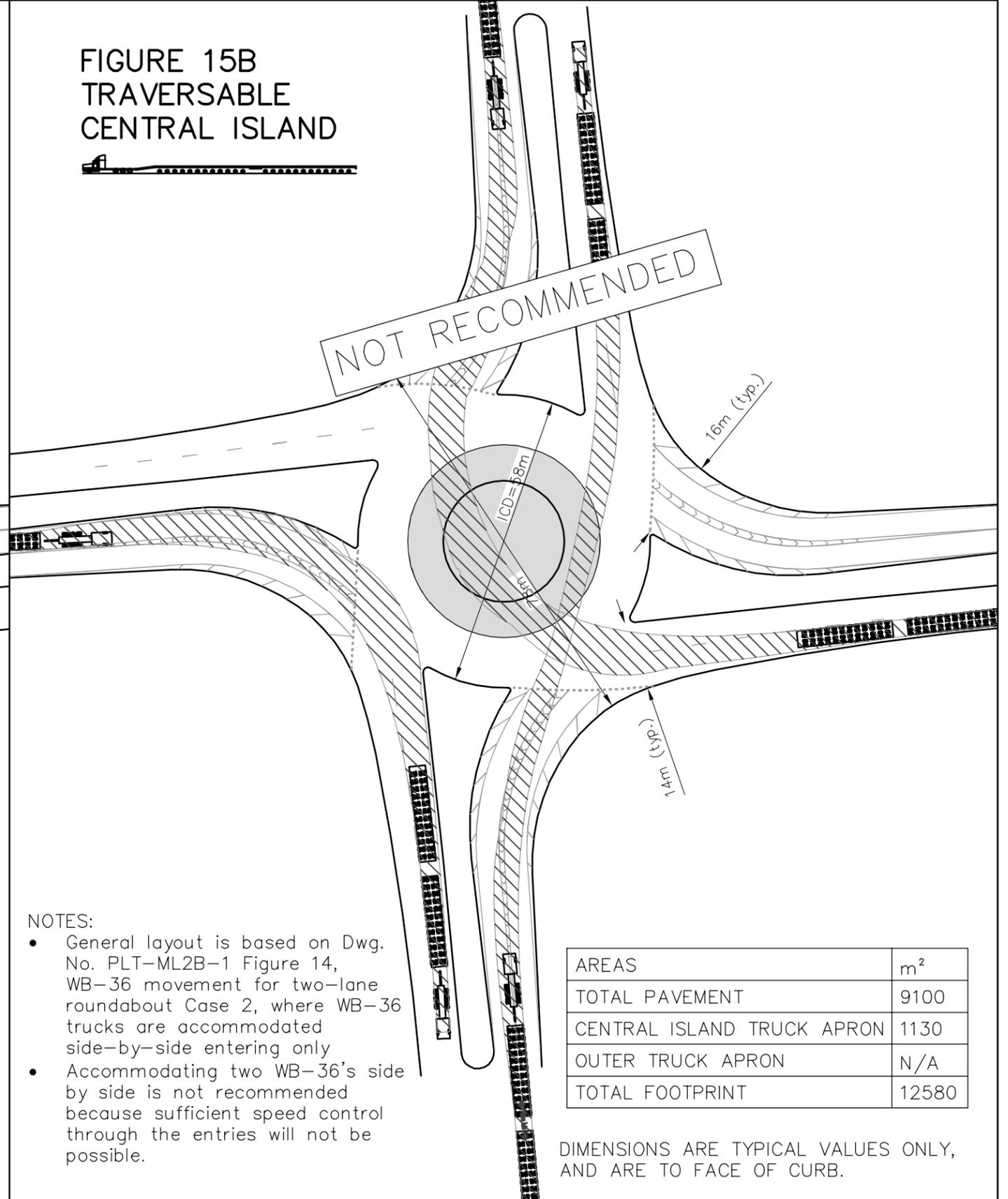
NOTES:

- General layout is based on Dwg. No. PLT-ML2B-1 Figure 14, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

AREAS	m ²
TOTAL PAVEMENT	9100
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	12580

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 15B
TRAVERSABLE
CENTRAL ISLAND



NOTES:

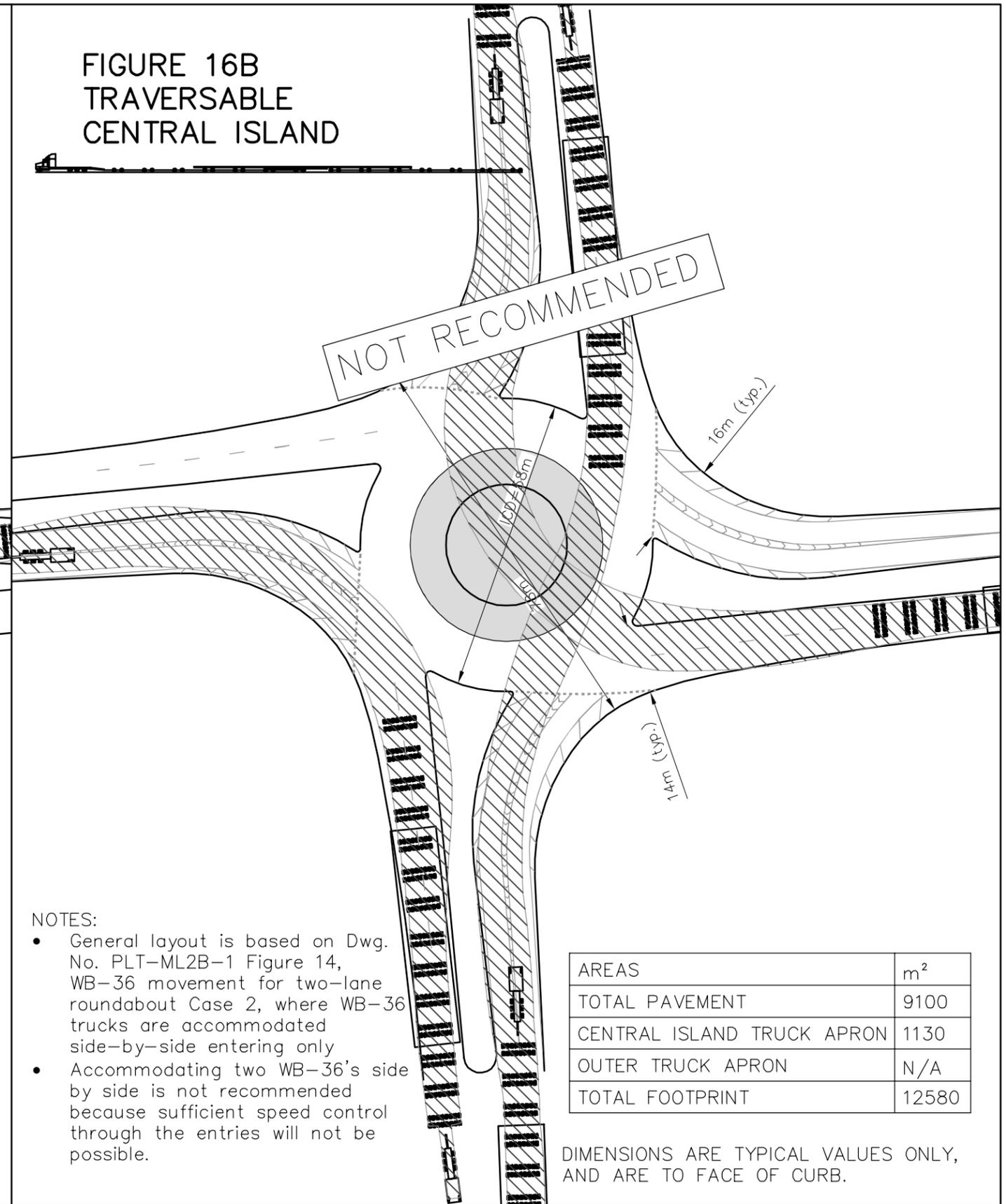
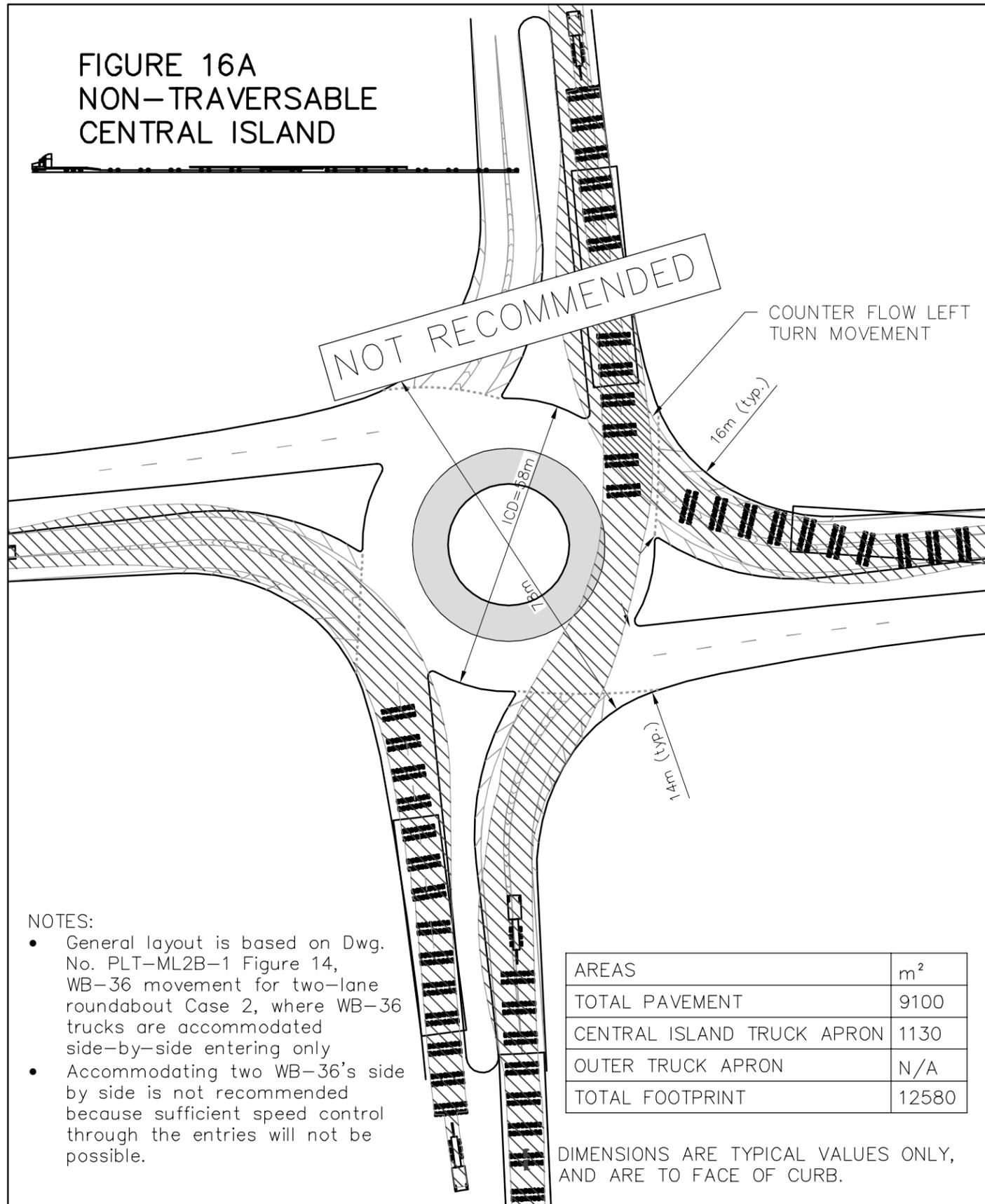
- General layout is based on Dwg. No. PLT-ML2B-1 Figure 14, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

AREAS	m ²
TOTAL PAVEMENT	9100
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	12580

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 16A
NON-TRAVERSABLE
CENTRAL ISLAND

FIGURE 16B
TRAVERSABLE
CENTRAL ISLAND



NOTES:

- General layout is based on Dwg. No. PLT-ML2B-1 Figure 14, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

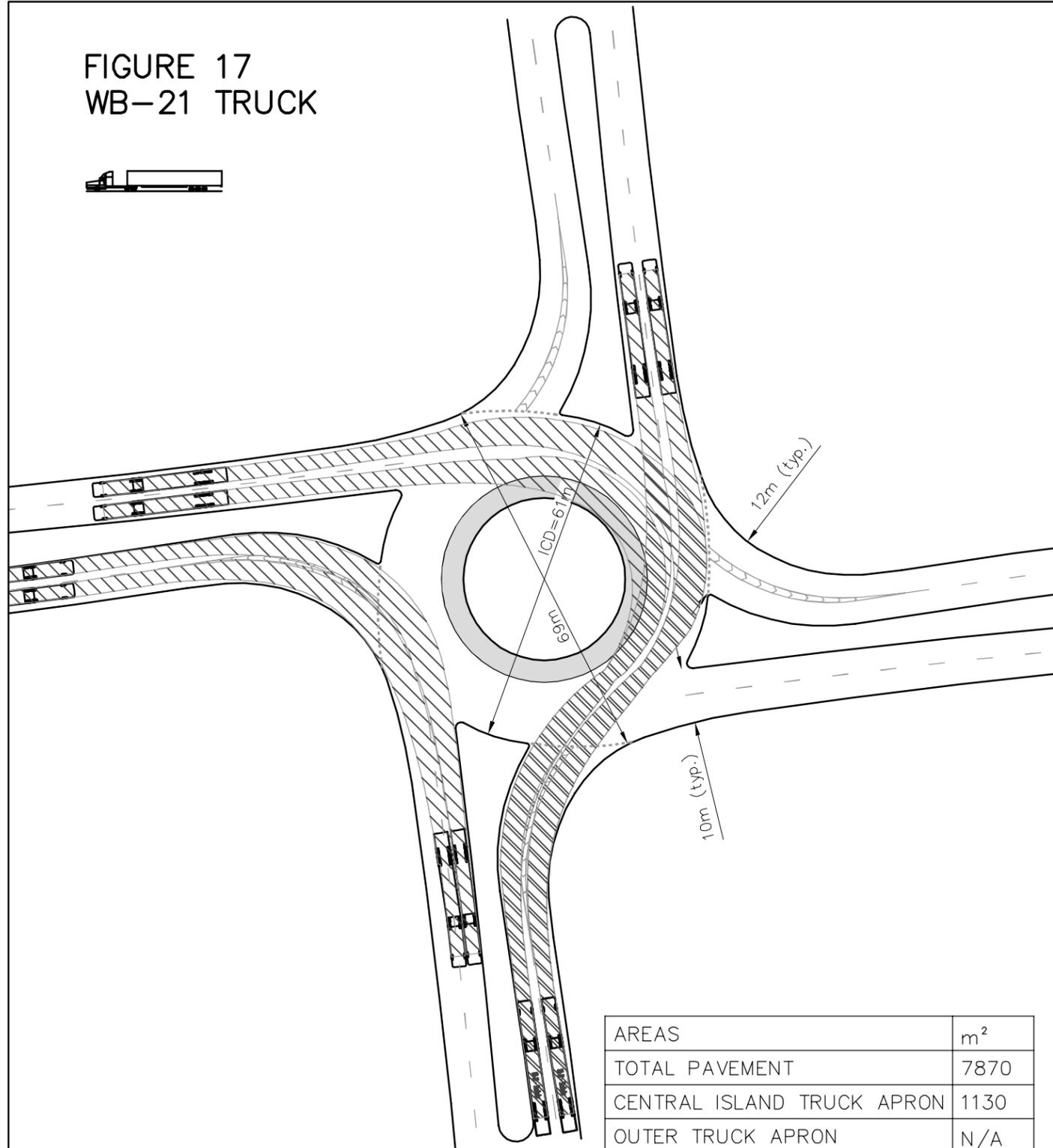
NOTES:

- General layout is based on Dwg. No. PLT-ML2B-1 Figure 14, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

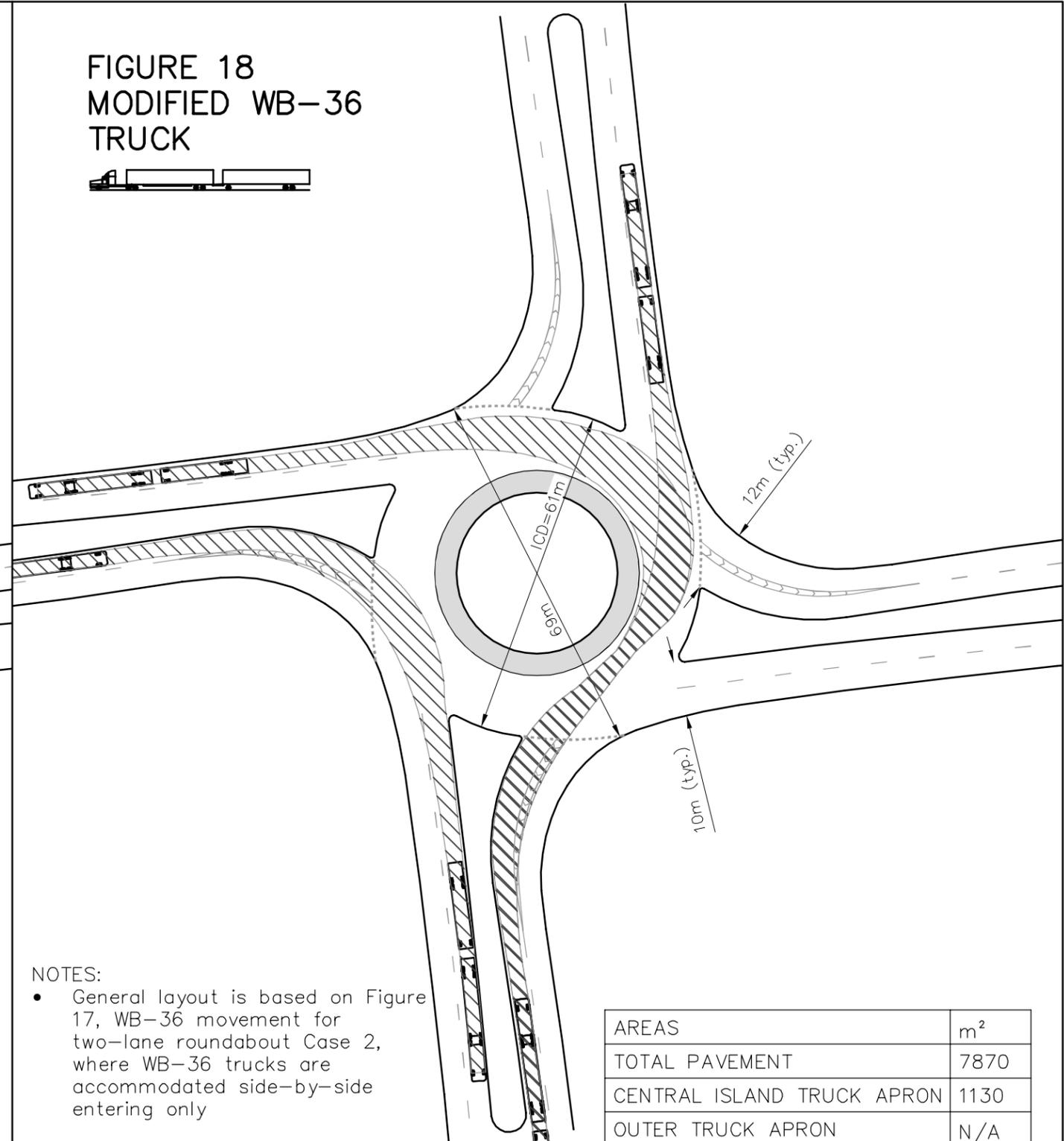
DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 17
WB-21 TRUCK



DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

FIGURE 18
MODIFIED WB-36
TRUCK

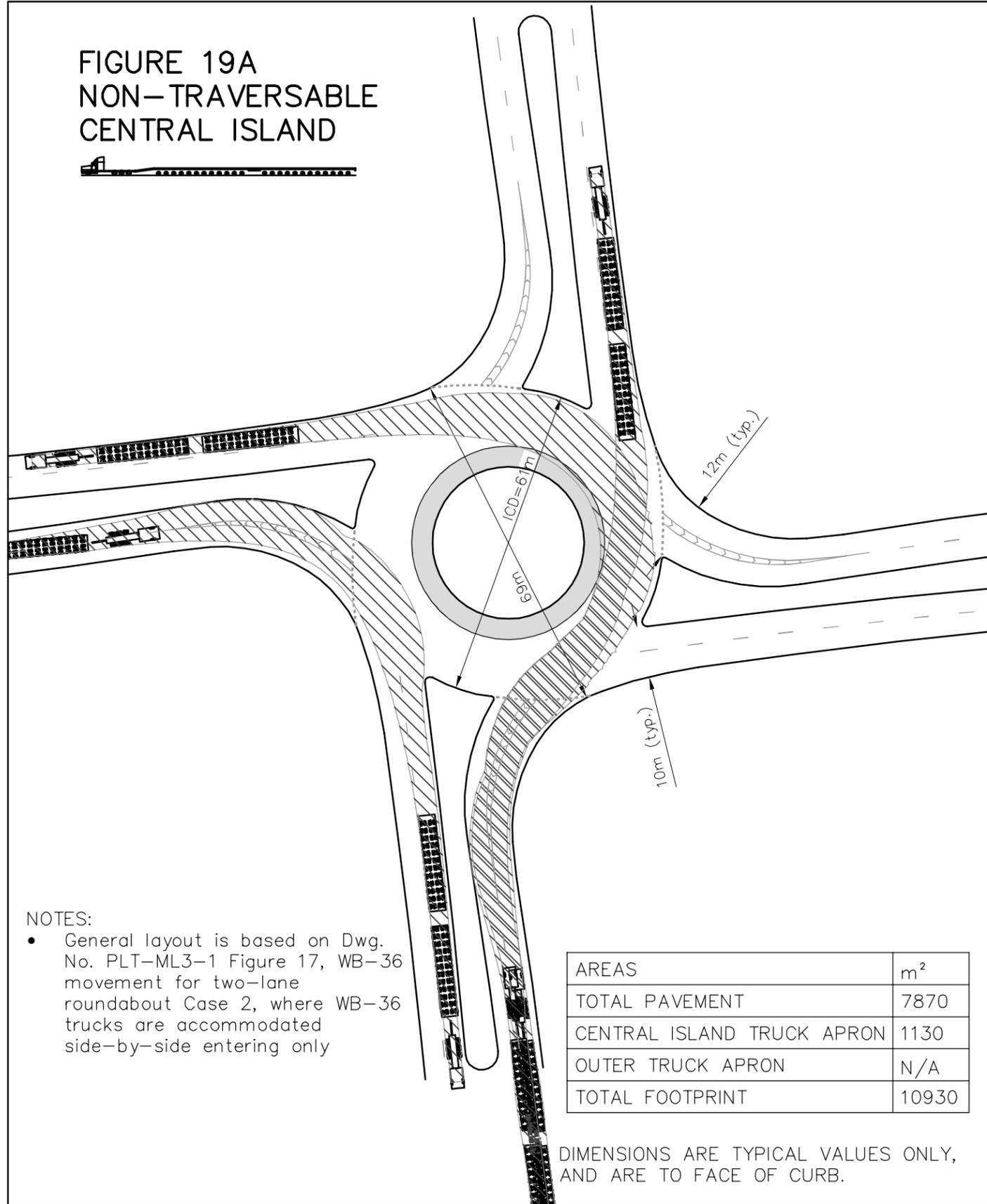


DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

NOTES:

- General layout is based on Figure 17, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only

FIGURE 19A
NON-TRAVERSABLE
CENTRAL ISLAND



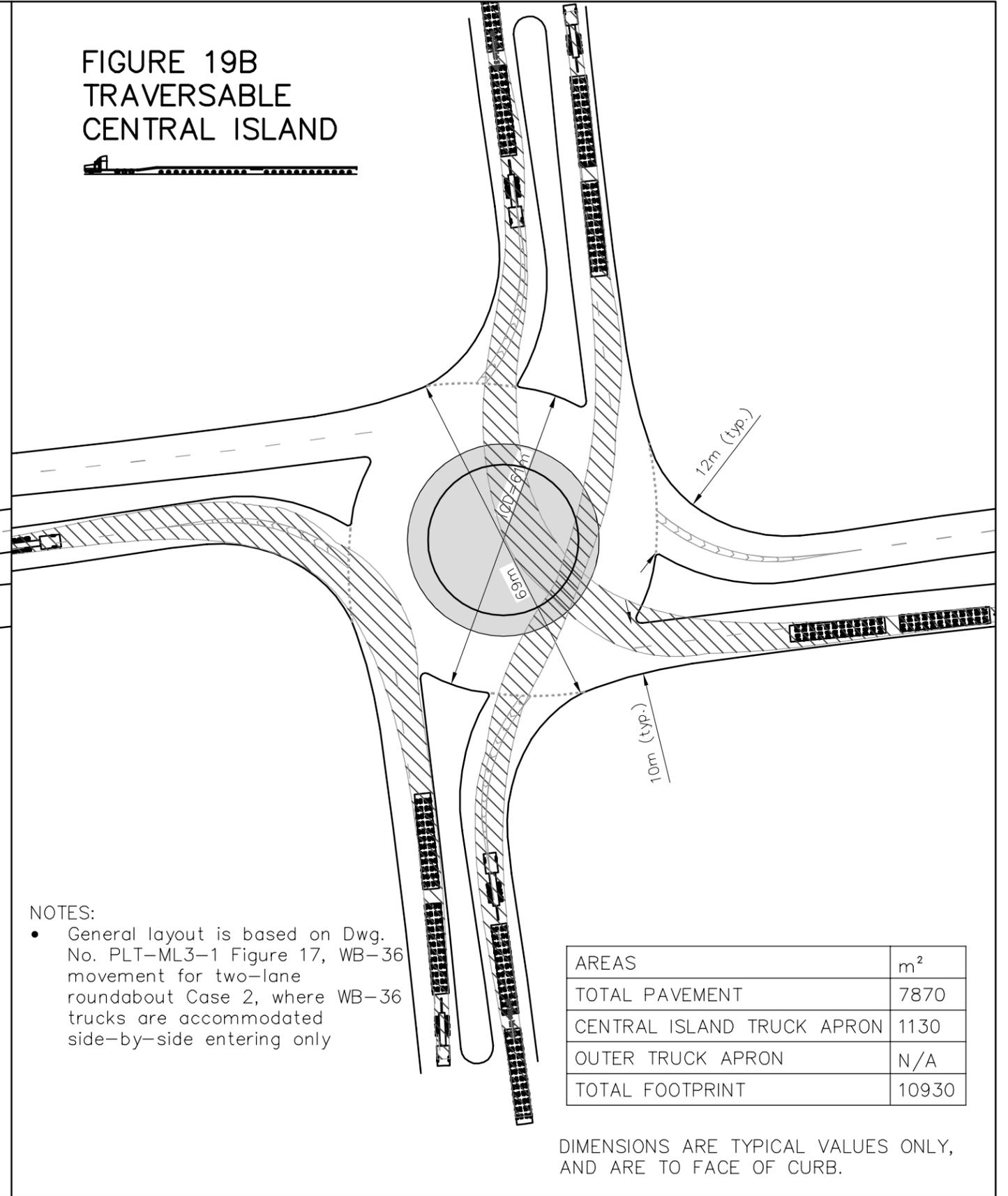
NOTES:

- General layout is based on Dwg. No. PLT-ML3-1 Figure 17, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only

AREAS	m ²
TOTAL PAVEMENT	7870
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	10930

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

FIGURE 19B
TRAVERSABLE
CENTRAL ISLAND



NOTES:

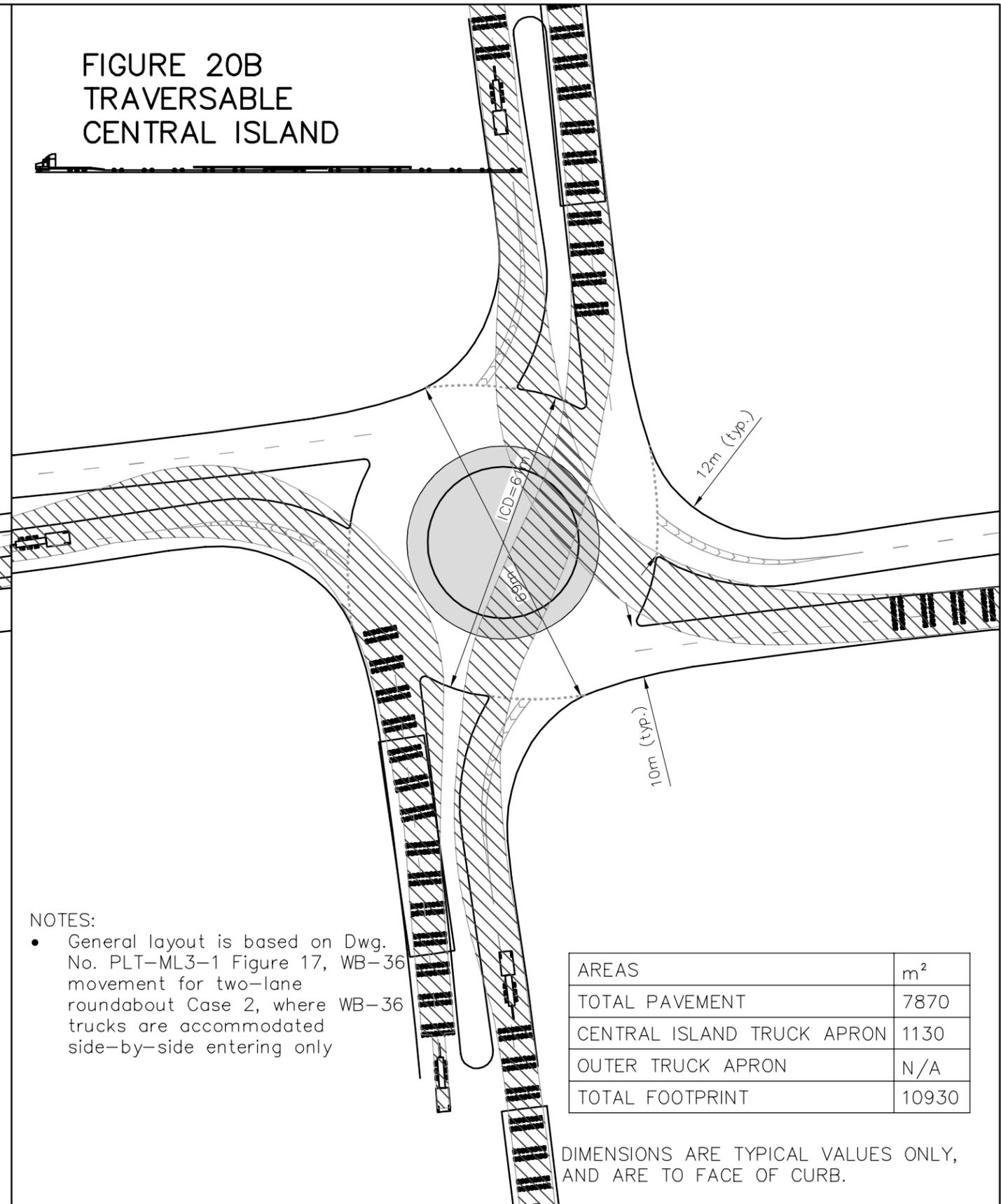
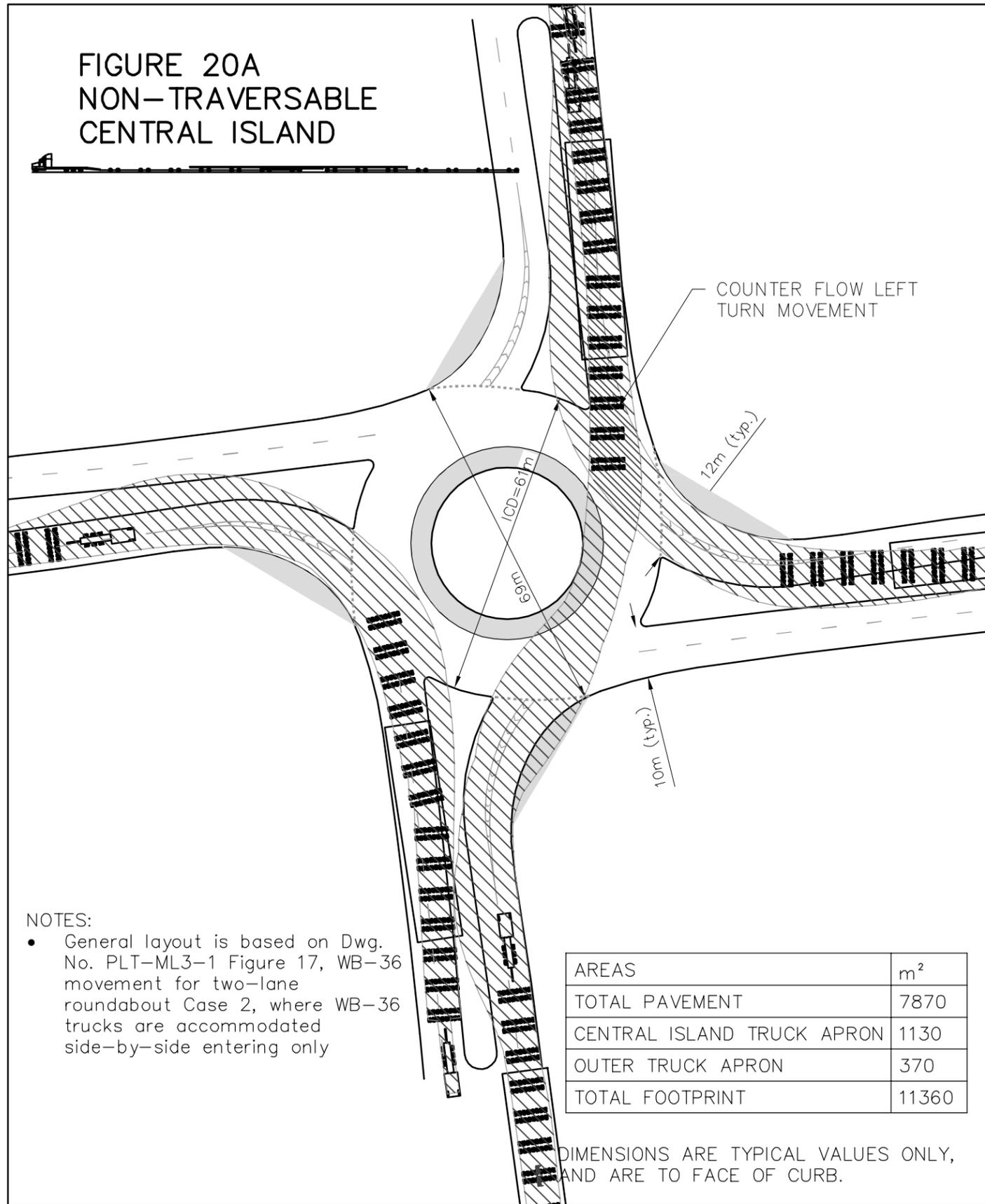
- General layout is based on Dwg. No. PLT-ML3-1 Figure 17, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only

AREAS	m ²
TOTAL PAVEMENT	7870
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	10930

DIMENSIONS ARE TYPICAL VALUES ONLY,
AND ARE TO FACE OF CURB.

**FIGURE 20A
NON-TRAVERSABLE
CENTRAL ISLAND**

**FIGURE 20B
TRAVERSABLE
CENTRAL ISLAND**



NOTES:

- General layout is based on Dwg. No. PLT-ML3-1 Figure 17, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only

AREAS	m ²
TOTAL PAVEMENT	7870
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	370
TOTAL FOOTPRINT	11360

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

NOTES:

- General layout is based on Dwg. No. PLT-ML3-1 Figure 17, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering only

AREAS	m ²
TOTAL PAVEMENT	7870
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	10930

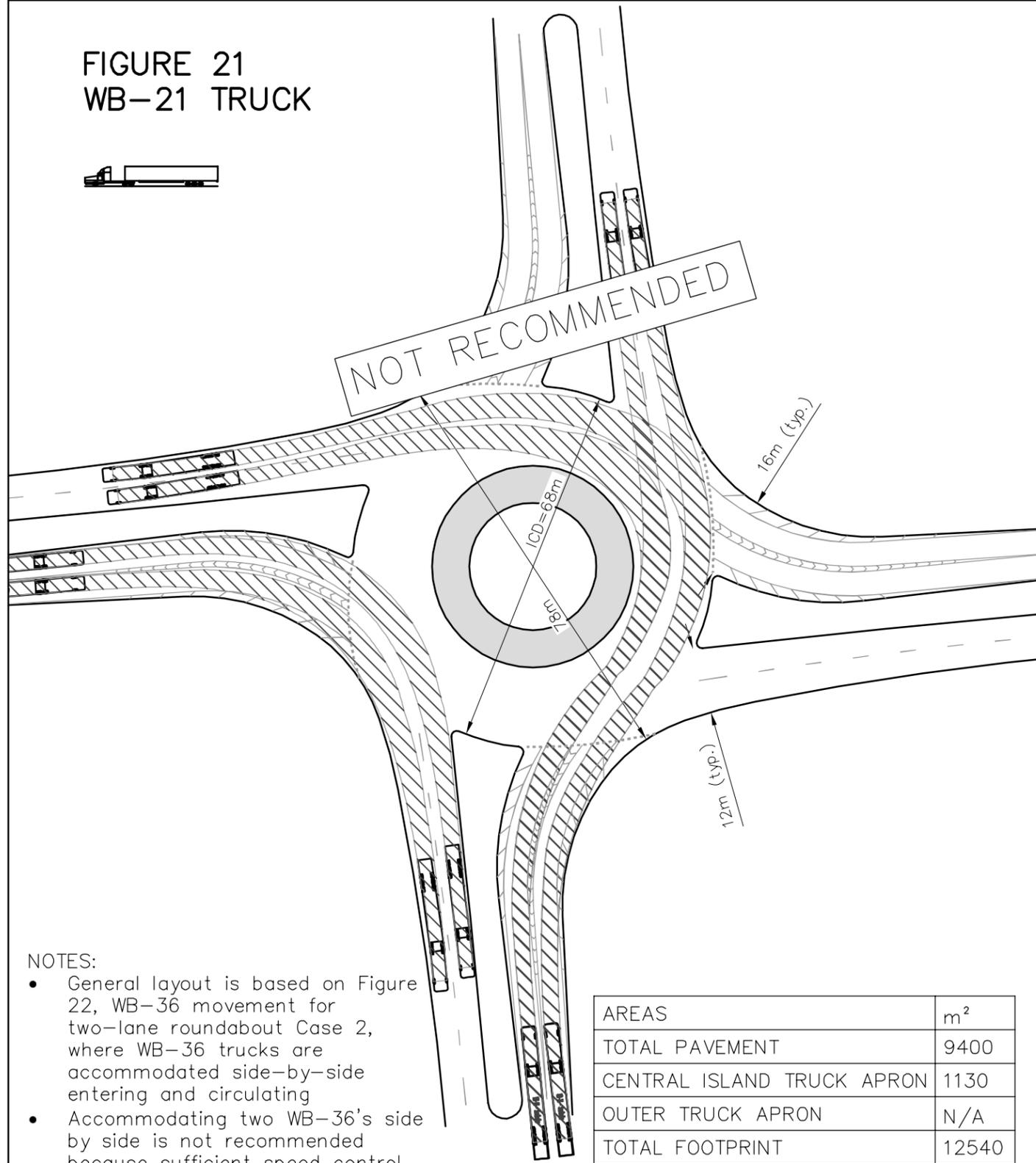
DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.



**REACTOR TRANSPORTER MOVEMENTS
TWO-LANE ROUNDABOUT
CASE 3 (WB-21 ACCOMMODATED SIDE-BY-SIDE ENTERING AND CIRCULATING)**

DATE	FEB. 2014	DRAWING NO.	PLT-ML3-3
SCALE	1:1000		

FIGURE 21
WB-21 TRUCK



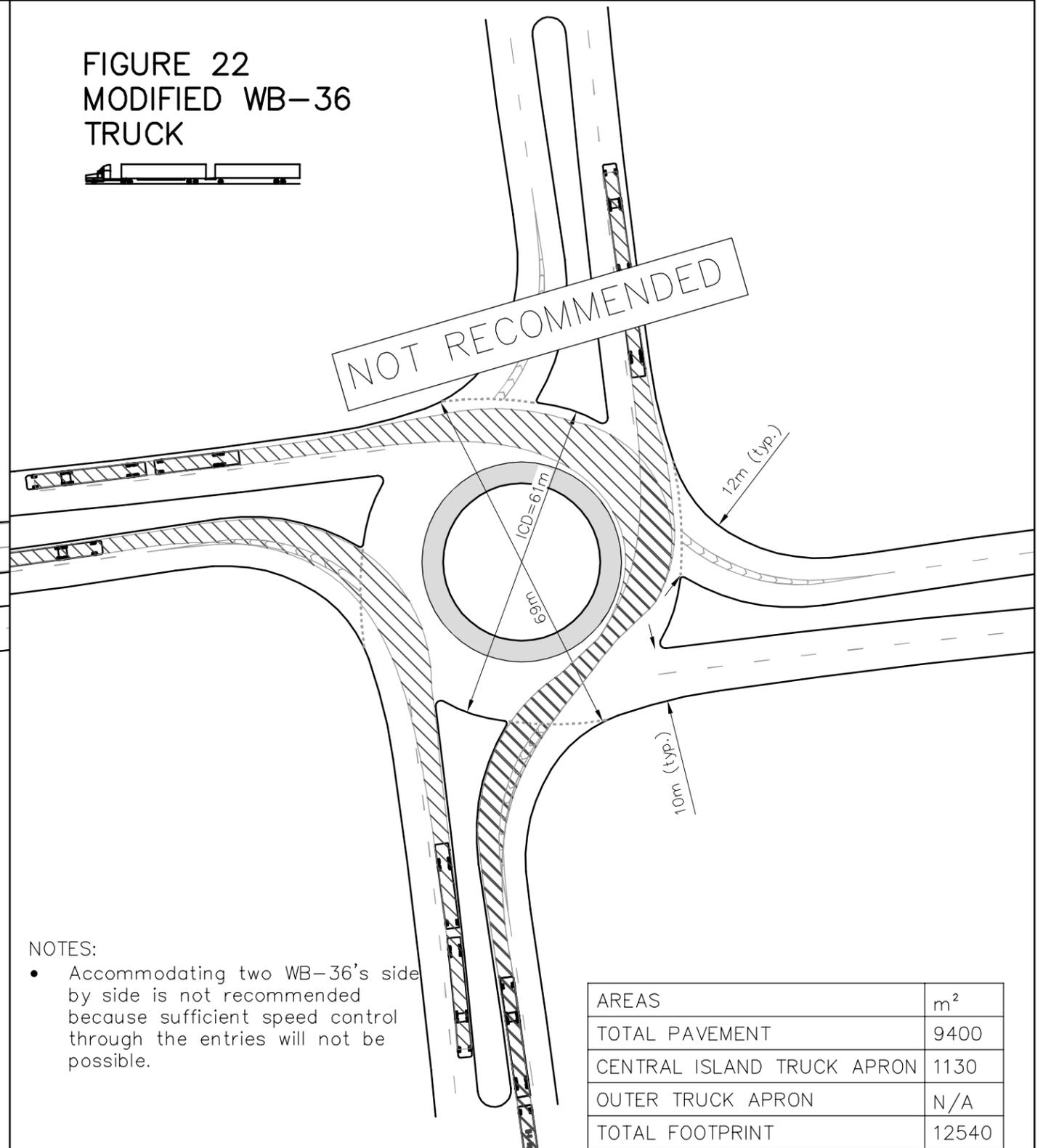
NOTES:

- General layout is based on Figure 22, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering and circulating
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

AREAS	m ²
TOTAL PAVEMENT	9400
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	12540

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 22
MODIFIED WB-36
TRUCK



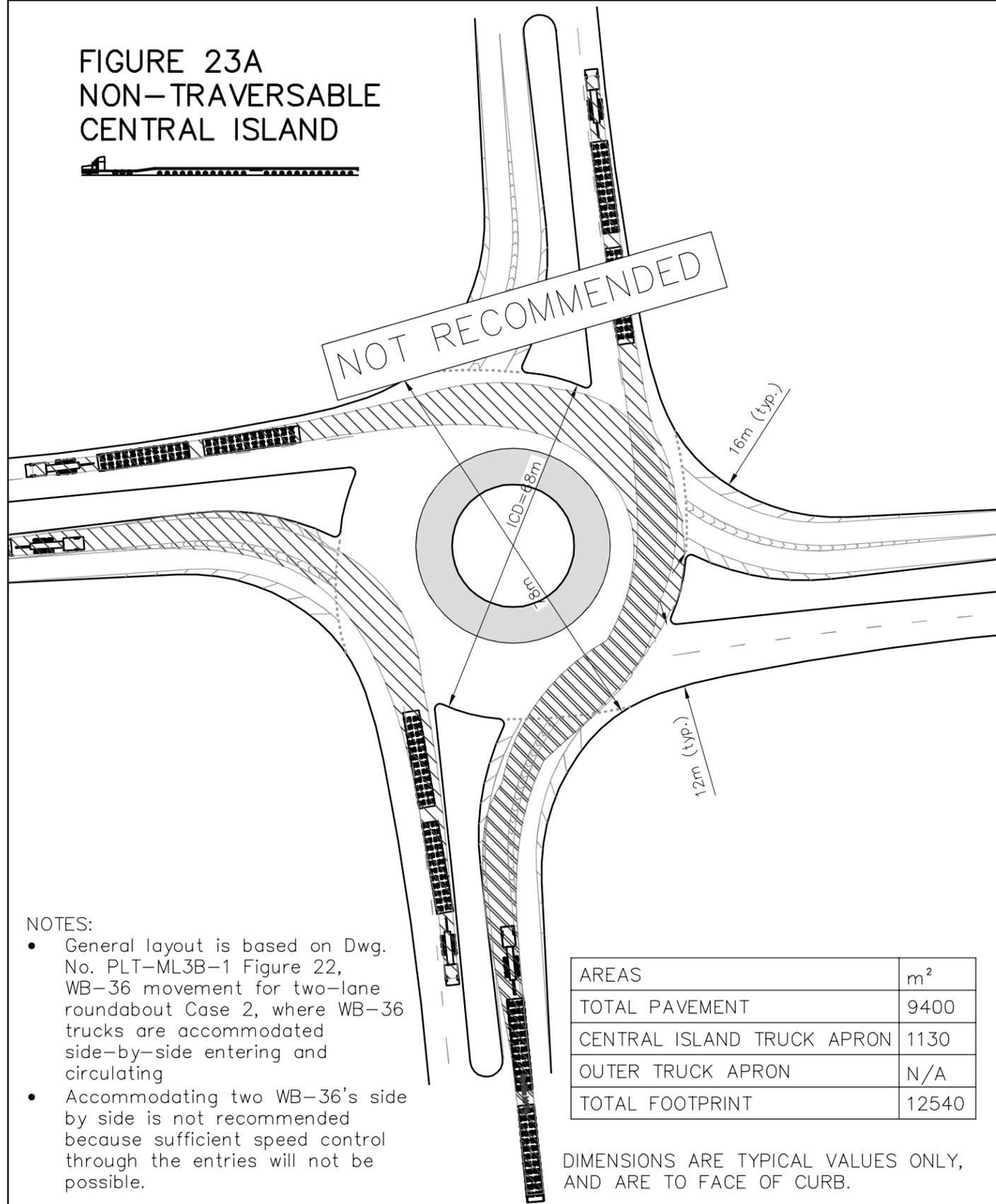
NOTES:

- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

AREAS	m ²
TOTAL PAVEMENT	9400
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	12540

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 23A
NON-TRAVERSABLE
CENTRAL ISLAND



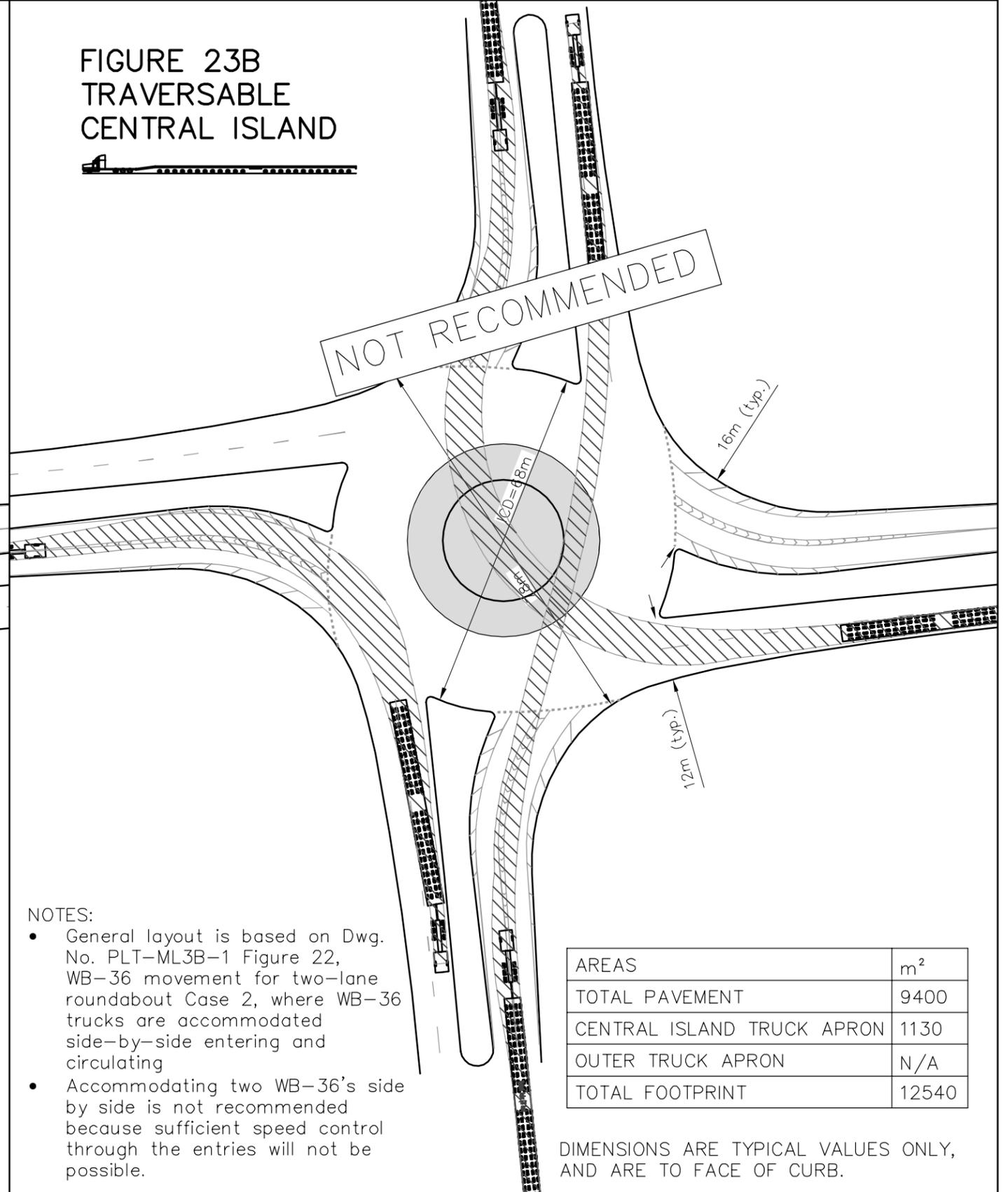
NOTES:

- General layout is based on Dwg. No. PLT-ML3B-1 Figure 22, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering and circulating
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

AREAS	m ²
TOTAL PAVEMENT	9400
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	12540

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 23B
TRAVERSABLE
CENTRAL ISLAND



NOTES:

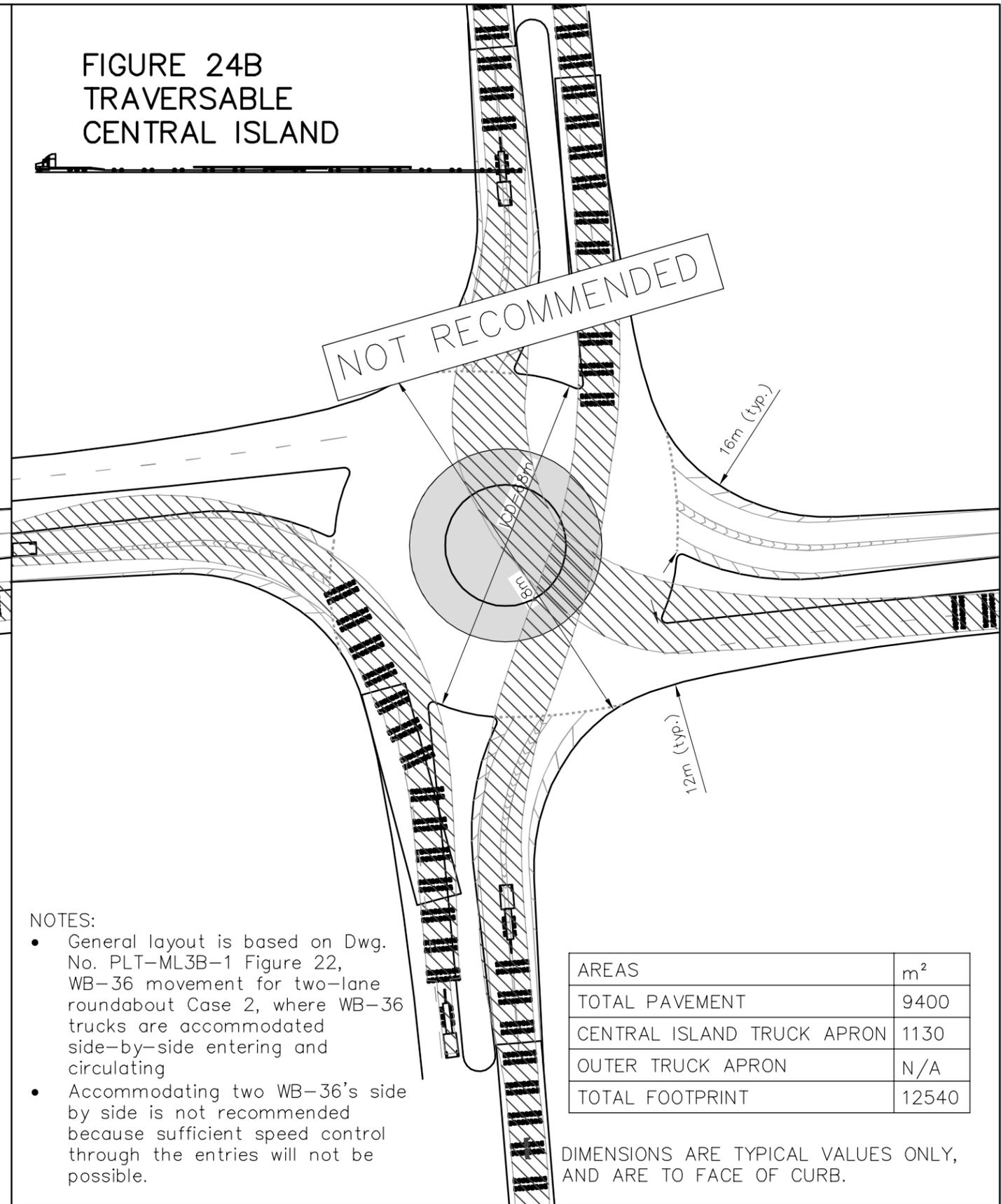
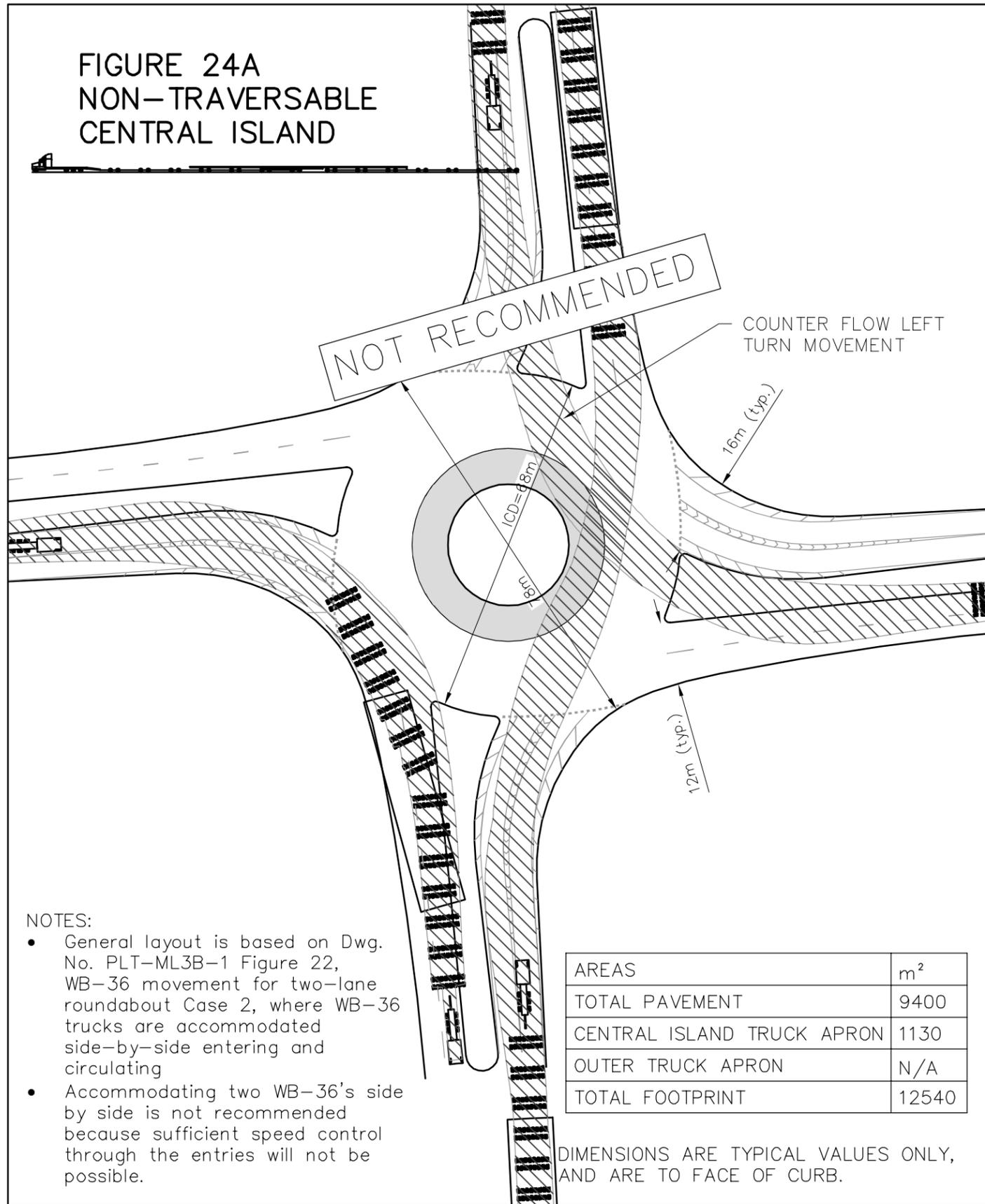
- General layout is based on Dwg. No. PLT-ML3B-1 Figure 22, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering and circulating
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

AREAS	m ²
TOTAL PAVEMENT	9400
CENTRAL ISLAND TRUCK APRON	1130
OUTER TRUCK APRON	N/A
TOTAL FOOTPRINT	12540

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

FIGURE 24A
NON-TRAVERSABLE
CENTRAL ISLAND

FIGURE 24B
TRAVERSABLE
CENTRAL ISLAND



NOTES:

- General layout is based on Dwg. No. PLT-ML3B-1 Figure 22, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering and circulating
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

NOTES:

- General layout is based on Dwg. No. PLT-ML3B-1 Figure 22, WB-36 movement for two-lane roundabout Case 2, where WB-36 trucks are accommodated side-by-side entering and circulating
- Accommodating two WB-36's side by side is not recommended because sufficient speed control through the entries will not be possible.

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.

DIMENSIONS ARE TYPICAL VALUES ONLY, AND ARE TO FACE OF CURB.



A Member of The Sernas Group Inc.

Roundabout Planning Templates

Client: Alberta Transportation
Project: Template Areas

Project No.: 11209
Date: Feb. 11, 2014

Design Vehicle and Central Island Type	Total Pavement Area (m ²)	Central Island Truck Apron Area (m ²)	Outer Truck Apron Area (m ²)	Total Footprint (m ²)
--	---------------------------------------	---	--	-----------------------------------

Single-Lane Roundabout				
WB-21 Truck	3890	750	-	5990
Modified WB-36 Truck	3890	750	-	5990
Platform Trailer, Non-Traversable Central Island	3890	750	240	6200
Platform Trailer, Traversable Central Island	3890	750	-	5990
Reactor Transporter, Non-Traversable Central Island	3890	750	840	6830
Reactor Transporter, Traversable Central Island	3890	750	-	5990

Multi-Lane Roundabout, Case 1 Truck Accommodation (Trucks Not Accommodated Side-By-Side)				
WB-21 Truck	6320	1130	-	9350
Modified WB-36 Truck	6320	1130	-	9350
Platform Trailer, Non-Traversable Central Island	6320	1130	-	9350
Platform Trailer, Traversable Central Island	6320	1130	-	9350
Reactor Transporter, Non-Traversable Central Island	6320	1130	460	9750
Reactor Transporter, Traversable Central Island	6320	1130	-	9350

Multi-Lane Roundabout, Case 2 Truck Accommodation (Two WB-21's Side-By-Side Entering)				
WB-21 Truck	7620	1130	-	10710
Modified WB-36 Truck	7620	1130	-	10710
Platform Trailer, Non-Traversable Central Island	7620	1130	-	10710
Platform Trailer, Traversable Central Island	7620	1130	-	10710
Reactor Transporter, Non-Traversable Central Island	7620	1130	200	10900
Reactor Transporter, Traversable Central Island	7620	1130	-	10710

Multi-Lane Roundabout, Case 2 Truck Accommodation (Two WB-36's Side-By-Side Entering)*				
WB-21 Truck	9100	1130	-	12580
Modified WB-36 Truck	9100	1130	-	12580
Platform Trailer, Non-Traversable Central Island	9100	1130	-	12580
Platform Trailer, Traversable Central Island	9100	1130	-	12580
Reactor Transporter, Non-Traversable Central Island	9100	1130	-	12580
Reactor Transporter, Traversable Central Island	9100	1130	-	12580

Multi-Lane Roundabout, Case 3 Truck Accommodation (Two WB-21's Side-By-Side Entering + Circulating)				
WB-21 Truck	7870	1130	-	10930
Modified WB-36 Truck	7870	1130	-	10930
Platform Trailer, Non-Traversable Central Island	7870	1130	-	10930
Platform Trailer, Traversable Central Island	7870	1130	-	10930
Reactor Transporter, Non-Traversable Central Island	7870	1130	370	11360
Reactor Transporter, Traversable Central Island	7870	1130	-	10930

Multi-Lane Roundabout, Case 3 Truck Accommodation (Two WB-36's Side-By-Side Entering + Circulating)*				
WB-21 Truck	9400	1130	-	12540
Modified WB-36 Truck	9400	1130	-	12540
Platform Trailer, Non-Traversable Central Island	9400	1130	-	12540
Platform Trailer, Traversable Central Island	9400	1130	-	12540
Reactor Transporter, Non-Traversable Central Island	9400	1130	-	13210
Reactor Transporter, Traversable Central Island	9400	1130	-	12540

* Note that accommodating two WB-36's side by side (shaded areas) is not recommended because sufficient speed control through the entries will not be possible.

Roundabout Planning Templates

Client: Alberta Transportation
Project: Template Area Comparison
Compared to Base Case

Project No.: 11209
Date: Feb. 11, 2014

Design Vehicle and Central Island Type	Total Pavement Area (m ²)	Central Island Truck Apron Area (m ²)	Outer Truck Apron Area (m ²)	Total Footprint (m ²)
--	---------------------------------------	---	--	-----------------------------------

Single-Lane Roundabout				
WB-21 Truck	-	-	-	-
Modified WB-36 Truck	-	-	-	-
Platform Trailer, Non-Traversable Central Island	-	-	NA	4%
Platform Trailer, Traversable Central Island	-	-	-	-
Reactor Transporter, Non-Traversable Central Island	-	-	NA	14%
Reactor Transporter, Traversable Central Island	-	-	NA	-

Multi-Lane Roundabout, Case 1 Truck Accommodation (Trucks Not Accommodated Side-By-Side)				
WB-21 Truck	-	-	-	-
Modified WB-36 Truck	-	-	-	-
Platform Trailer, Non-Traversable Central Island	-	-	NA	-
Platform Trailer, Traversable Central Island	-	-	-	-
Reactor Transporter, Non-Traversable Central Island	-	-	NA	4%
Reactor Transporter, Traversable Central Island	-	-	-	-

Multi-Lane Roundabout, Case 2 Truck Accommodation (Two WB-21's Side-By-Side Entering)				
WB-21 Truck	21%	-	-	15%
Modified WB-36 Truck	21%	-	-	15%
Platform Trailer, Non-Traversable Central Island	21%	-	NA	15%
Platform Trailer, Traversable Central Island	21%	-	-	15%
Reactor Transporter, Non-Traversable Central Island	21%	-	NA	17%
Reactor Transporter, Traversable Central Island	21%	-	-	15%

Multi-Lane Roundabout, Case 2 Truck Accommodation (Two WB-36's Side-By-Side Entering)*				
WB-21 Truck	44%	-	-	35%
Modified WB-36 Truck	44%	-	-	35%
Platform Trailer, Non-Traversable Central Island	44%	-	-	35%
Platform Trailer, Traversable Central Island	44%	-	-	35%
Reactor Transporter, Non-Traversable Central Island	44%	-	NA	35%
Reactor Transporter, Traversable Central Island	44%	-	-	35%

Multi-Lane Roundabout, Case 3 Truck Accommodation (Two WB-21's Side-By-Side Entering + Circulating)				
WB-21 Truck	25%	-	-	17%
Modified WB-36 Truck	25%	-	-	17%
Platform Trailer, Non-Traversable Central Island	25%	-	NA	17%
Platform Trailer, Traversable Central Island	25%	-	-	17%
Reactor Transporter, Non-Traversable Central Island	25%	-	NA	21%
Reactor Transporter, Traversable Central Island	25%	-	-	17%

Multi-Lane Roundabout, Case 3 Truck Accommodation (Two WB-36's Side-By-Side Entering + Circulating)*				
WB-21 Truck	49%	-	-	34%
Modified WB-36 Truck	49%	-	-	34%
Platform Trailer, Non-Traversable Central Island	49%	-	-	34%
Platform Trailer, Traversable Central Island	49%	-	-	34%
Reactor Transporter, Non-Traversable Central Island	49%	-	NA	41%
Reactor Transporter, Traversable Central Island	49%	-	-	34%

* Note that accommodating two WB-36's side by side (shaded areas) is not recommended because sufficient speed control through the entries will not be possible.

Base Case Area (Single-Lane Roundabout)			
3890	750	0	5990

Base Case Area (Multi-Lane Roundabout, Case 1 Truck Accommodation)			
6320	1130	0	9350