Highway and Rail Network Planning and Design for Inland Ports

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Abstract

Many North American jurisdictions have developed inland ports in response to rising demand for freight transportation and the need for fluid multimodal freight transportation networks and accompanying administrative systems. In response to this demand, inland ports have been developed over the last decade in Winnipeg (CentrePort Canada), Regina (Global Transportation Hub), and Calgary (Calgary Region Inland Port). Each of these ports has a unique value proposition aimed at attracting industry investment.

Manitoba has strategically invested in its inland port, CentrePort Canada, to facilitate existing trade to and from the province and grow opportunities for future trade linkages. CentrePort Canada is a tri-modal (air, rail, and truck) inland port that offers all the benefits of Canada's Foreign Trade Zone programs. It is designed to be a single window for attracting businesses to the Winnipeg area and enhancing the competitiveness of the province. Located in northwest Winnipeg, CentrePort Canada has direct highway connections to Winnipeg's Perimeter Highway and Manitoba's National Highway System. Additionally, CentrePort Canada provides companies with connections to three Class 1 rail carriers and a 24/7 international airport.

The development of CentrePort Canada has the potential to attract and generate increasing truck, rail, and air traffic, representing both economic growth and potential infrastructure impacts. From a planning perspective, understanding these impacts and strategically investing in appropriate upgrades depends on the interests of multiple stakeholders and the characteristics of future demand. Moreover, proactive design decisions such as selecting an appropriate design vehicle and forecasting future truck traffic volume fundamentally influence geometric and structural features. Useful insights arising from these planning and design challenges provide a foundation for inland ports across Canada to collaborate in pursuit of their common goal—to enhance Canada's economy.

1. Introduction

Many North American jurisdictions have developed inland ports in response to the rising demand for freight transportation and the need for fluid multimodal freight transportation networks and accompanying administrative systems. The economic viability and ongoing success of inland ports principally depend on existing demand, locational advantage, international trade facilitation, and a management plan [1]. In response to this demand and upon consideration of these and other factors, inland ports have been developed over the last decade in Winnipeg (CentrePort Canada), Regina (Global Transportation Hub), and Calgary (Calgary Region Inland Port). Each of these ports has unique value propositions designed to strategically emphasize operational advantages pertaining to the five foregoing factors.

Numerous considerations influence the planning and design of transportation infrastructure serving an inland port. Broadly speaking, these considerations encompass: (1) the magnitude and nature of the freight transportation demand induced by port development (e.g., mode choice, types of industries and commodities, current and future traffic volume); and (2) current characteristics of the transportation networks and future geometric, structural, and pavement design features required to accommodate this demand. These considerations are relevant for transportation infrastructure within the inland port and the extensive connections providing access to and from the port.

This paper discusses the proactive measures that have been undertaken during the planning and design of CentrePort Canada's surface freight transportation infrastructure, from the perspective of a public sector infrastructure provider. With this perspective, the highway mode is emphasized. Specifically, the objectives of this paper are:

- to describe specific features of Manitoba's inland port, CentrePort Canada;
- to outline unique planning and design considerations that have influenced the provision of transportation infrastructure for CentrePort; and
- to develop and present experiential insights arising from these planning and design efforts.

While details about the planning and design of the transportation infrastructure serving CentrePort are specific to the Winnipeg, Manitoba context, the considerations and insights described in the paper are transferrable to other inland port cities and contribute to the common goal of meeting industry needs and building Canada's economy.

2. An Overview of CentrePort Canada Planning and Development

Manitoba has strategically invested in its inland port, CentrePort Canada (CentrePort), to facilitate existing trade to and from the province and grow opportunities for future trade linkages. CentrePort was established when the *CentrePort Canada Act* was passed by the Manitoba Legislature in October of 2008. The *Act* designates approximately 20,000 acres of land in northwest Winnipeg (near the James Armstrong Richardson International Airport) for the development of the inland port in cooperation with a number of government and private sector partners. The development is to be based on a single transportation, infrastructure, and land-use plan. There are two distinct titles that need to be clarified when describing CentrePort Canada and its operations:

1. *CentrePort Canada* (also referred to as CentrePort) is the physical land area to be developed as an inland port.

2. *CentrePort Canada Inc.* is the entity that is in charge of facilitating development within the CentrePort lands.

CentrePort is Canada's only inland tri-modal port and foreign trade zone (FTZ). With its sizeable footprint, it offers opportunities for companies to locate within close proximity to transportation and logistics service providers and facilities which enable transloading between modes. These companies can take advantage of numerous FTZ programs (e.g., duty deferral, sales tax relief, customs bonded warehouses) accessible via a single window model.

A fundamental component of CentrePort's value proposition is its location at the nexus of major North American trade corridors. Specifically, as illustrated by the major highway and rail networks linked to Manitoba in Figure 1, CentrePort's location provides its tenants with tri-modal access to [3]:

- the *Gateway to the North* (Port of Churchill, North America's only deep water Arctic seaport; staging area for northern Canada; future Arctic Gateway to Asia, Europe and India);

- the *Gateway to the East* (Ports of Thunder Bay, Montreal, and Halifax; the Atlantic Gateway with access to Europe, the Middle East, and Asia);

- the *Gateway to the South* (Mid-Continent Trade and Transportation Corridor with access to United States and Mexico, and the Ports of Manzanillo and Lazaro Cardenas); and

- the *Gateway to the West* (Port Metro Vancouver and Port of Prince Rupert; Asia-Pacific Gateway with access to China and the Pacific Rim).

Air access to and from CentrePort is provided by its anchor tenant, the James Armstrong Richardson International Airport. This airport, which offers all-weather service 24 hours a day seven days per week, is ranked as Canada's top airport for scheduled freighter flights [4]. Compared to other Canadian cities, Winnipeg's airport offers a certified transshipment point enabling cargo to be transshipped between foreign carriers, with truck and rail carriers, and with Canadian air carriers [4]. Air cargo service enables shippers to take advantage of the 07:00 p.m. deadline for sending parcels for next day delivery to major cities throughout North America. By comparison, in other cities, deadlines are set at 04:00 p.m. or earlier. Essentially, this later deadline allows employees to work an entire work day and then deliver the product to the airport for next day delivery.

Rail access at CentrePort is provided by three Class 1 rail carriers—Canadian National (CN), Canadian Pacific (CP), and Burlington Northern Santa Fe (BNSF)—and a short line railway, Prairie Rail Solutions.

Finally, CentrePort tenants are served by an extensive highway network, including direct access to Canada's National Highway System. This network offers fluid connections through each of the four major gateways and destinations inside the City of Winnipeg. CentrePort's location enables investors to access effectively all major North American markets within a 48-hour driving window. Moreover, Winnipeg is home to two of the largest truck carriers in Canada (TransX and Bison Transport) as well as many other major carriers [4]. Subsequent sections provide further details about the highway network serving CentrePort.

Figure 1: Major Highway and Rail Routes Servicing CentrePort (2010) [3]
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CentrePort Canada Inc. recently released its 2015 business plan, which envisions the development of land as depicted in the map shown in Figure 2. This plan identifies five strategic priorities for 2015-2016. These include [5]:

1. enhancing CentrePort's tri-modal transportation options with the phased-in development of the 700-acre Rail Park;

2. working with companies to establish new operations at the CentrePort Canada Rail Park and within other CentrePort-based industrial developments;

3. preparing CentrePort Canada lands for development, investment and revenue generation;

4. developing and refining investment promotion and targeted marketing for investors, tenants and site selectors; and

5. championing a “live, work, play, learn” approach to inland port development, working towards financial self-sufficiency, and demonstrating a strong value proposition to government and the community.

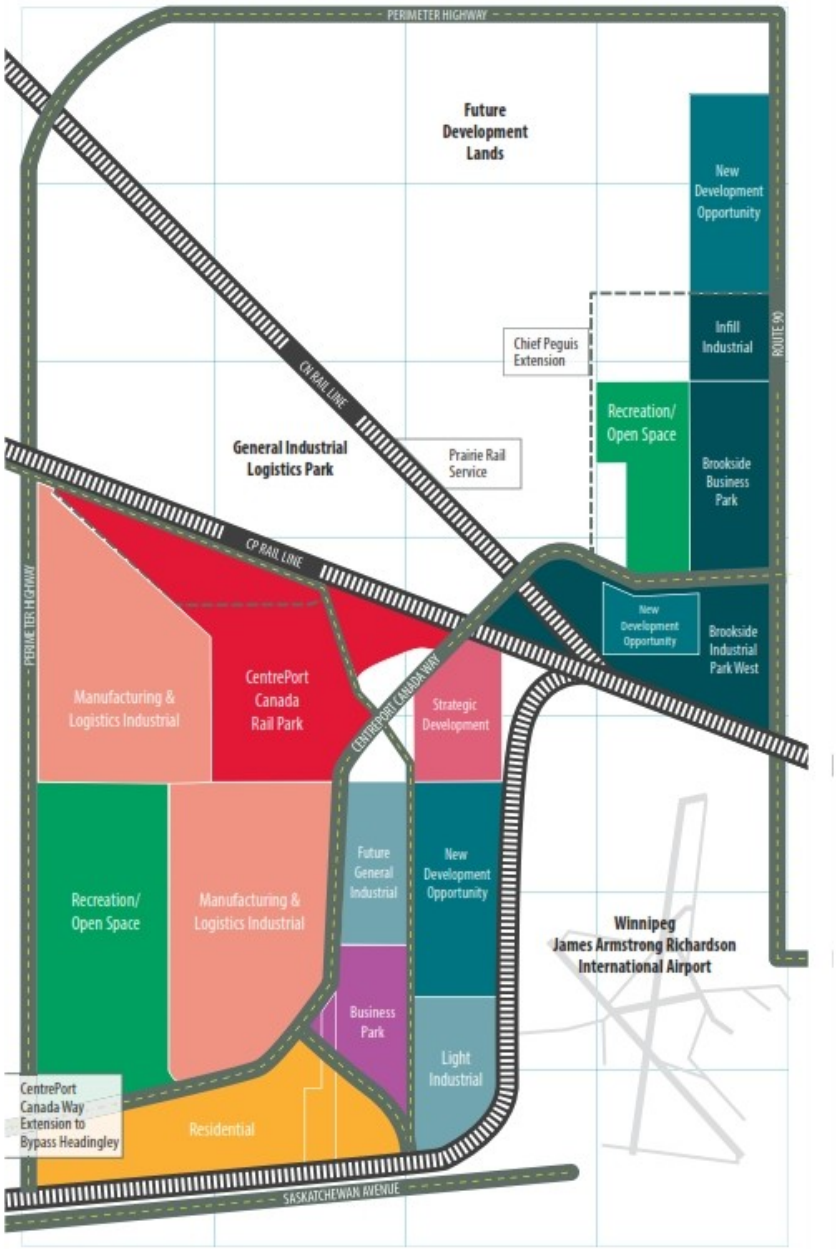

Figure 2: CentrePort Development Plan (2015) [6]
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3. Highway and Rail Network Planning for CentrePort

This section outlines unique planning considerations that have influenced the provision of highway and rail infrastructure for CentrePort. It contains three sub-sections. The first sub-section characterizes current and future demand for CentrePort's land and services. The second and third sub-sections describe the current characteristics and future planning considerations for the highway and rail highway networks serving CentrePort, respectively.

CentrePort Demand Characterization and Planning

Since CentrePort's inception, 200 of the 20,000 acres of available land have been sold and are under various stages up development. In total, 39 companies have located within the Brookside Business Park and Brookside Industrial Park West [3]. To date, all new development has occurred on un-serviced land; development is expected to progress quickly once water and wastewater servicing is available in 2016. The tenants that have located in CentrePort's business parks since CentrePort's inception comprise transportation and warehousing companies, manufacturing companies, rental and leasing companies, and companies involved in wholesale trade. Specific companies include: Avaal; Whiteriver Logistics; T & T Transport; Meyers Bros Trucking; DLM Wiens Cartage; Razir Transport; Cassidy Manufacturing Technology; Brofort Inc; Scheller Metal Fabricators; C & T Rentals; JEH Windows & Doors; Mobil 1; The Rosedale Group; Superior Forklift; EBD Enterprises; United Rentals; Searcy Trucking; Kaycan; Altima Cabinet Works; Oil Mart; Olexa; Goodman Manufacturing; SMS Equipment; Arctic Beverages; Fort Garry Fire Trucks; Trailer Wizards; Ridsdale Transport; Central Transport; Star Produce; EBD; and International Pallet. Additionally, several more companies with pending public announcements have located in CentrePort.

These developments complement more than 500 existing businesses along Brookside Blvd., in the Murray Industrial Park, and on the Airport Campus. Moreover, recent expansions have been announced for the following existing companies within CentrePort: Winpak, MacDon, Boeing, GE Aviation, StandardAero, and Bristol Aerospace [3].

Going forward, CentrePort Canada Inc. has focused on six priority sectors for attracting development: agribusiness, composites manufacturing, mining/energy, biomedical, regional distribution, and e-Commerce [5]. Specifically, CentrePort is interested in a variety of rail-intensive operations, including bulk transloading (e.g., unit train type bulk industries), bulk transloading into containers, providing common rail use facilities for container and heavy lay-down traffic, and accommodating rail-intensive industries (greater than 200 rail cars per month). To provide a contextual scale for these types operations, industry bulk unit trains have an average of 90 to 120 cars per train, merchandise trains have an average of 90 cars per train, and bulk mining operations typically comprise 100 cars per unit train. For illustrative purposes, a typical agricultural business may operate a unit train at a frequency of twice a week for a total of 180 to 240 cars per week.

Developing forecasts of truck and rail car movements for current and future tenants supports land use and infrastructure planning efforts at CentrePort. One forecasting example includes a frac sand mining company under development in Manitoba that will operate 100, 100-ton (91-tonne) rail cars for a total of 10,000 tons (9100 tonnes) per unit train. What is unique about this operation is that the sand will be hauled via truck to a 3600-ton (3300-tonne) storage facility and then loaded into unit trains for shipment [7]. With an average payload on an eight-axle B-train configuration of approximately 40 tonnes, this operation will potentially increase truck operations in CentrePort by 230 loaded trucks per train.

Highway Network Characterization and Planning

Manitoba's National Highway System is the principal highway network that serves CentrePort. This network includes Provincial Trunk Road (PTH) 1 (Trans-Canada Highway), PTH 16 (Yellowhead Highway), PTH 100/101 (Winnipeg's Perimeter Highway), PTH 75 (the major connection to the United States), PTH 6 (the major connection to northern Manitoba), and several key links inside the Perimeter Highway, including the newly constructed PTH 190 (CentrePort Canada Way). All these routes allow trucks to operate at full RTAC loadings, the maximum axle and gross vehicle weight allowances in the province. Key network characteristics and planned upgrades are discussed below.

- *PTH 190 (CentrePort Canada Way)*: PTH 190 is an expressway completed in November 2013 to enhance truck access to and from CentrePort by connecting Route 90 in the City of Winnipeg to PTH 101 (Winnipeg's Perimeter Highway to the west) (see Figure 2). Plans have also been announced to more than double the length of this expressway by extending it west of PTH 101 to bypass the community of Headingley. This extension will provide a direct highway link between CentrePort and PTH 1 (Trans-Canada Highway), which will create time and cost savings for truck carriers. This bypass project has been added to Manitoba's five-year capital program with preliminary design currently being undertaken to determine the best possible routing and required land acquisitions. The most notable hurdle to overcome will be the relocation of the Department of National Defence St. James Rifle Range. Negotiations are underway to reach a tentative agreement on relocation of this range. In addition to the bypass project, there are also plans for a future truck stop to be constructed on PTH 190 at the intersection of Sturgeon Road. CentrePort Canada Inc. is also investigating the possibility of installing a static weigh scale on their lands that would allow trucks to travel directly from Winnipeg to Calgary without having to be re-inspected at static stations along the Trans-Canada Highway.

- *PTH 100/101 (Winnipeg's Perimeter Highway)*: PTH 100/101 enable truck traffic to circumvent urban congestion in Winnipeg and provide connections between Winnipeg's urban routes (including PTH 190) and the rural portions of the National Highway System (e.g., PTH 1, PTH 75). All upgrades on PTH 100/101—many of which have been influenced by the development of CentrePort—are designed to withstand full RTAC loadings and to accommodate the operating characteristics of longer combination vehicles (LCVs). The reconstruction of the western portion of PTH 101 (from Selkirk Avenue to Portage Avenue) maintained its expressway/future freeway classification (similar to the rural freeway divided classification specified by the Transportation Association of Canada)[8] and was designed to allow for future expansion to six lanes for both roadways and structures.

- *PTH 75*: PTH 75 is the major connection between CentrePort and the United States and a key link in the north-south mid-continent trade corridor. The Emerson-Pembina border crossing provides 24-hour access along this corridor. Planned upgrades to PTH 75 include ongoing flood proofing by raising the embankment to protect against overland flooding from the Red River. Construction of a new bridge over the Morris River and a bypass around the town of Morris have also been identified.

Rail Network Characterization and Planning

Planning and design work has been completed for a new CentrePort Canada Rail Park, which will provide access to three class I rail carriers (CN, CP and BNSF). The Rail Park, situated on 700 acres south of the CP

mainline and adjacent to PTH 190 (CentrePort Canada Way), will be developed in four phases as shown in Figure 3. CentrePort Canada Inc. will continue negotiations with several potential tenants that are in non-disclosure agreements and will continue to plan for a common-use rail facility and adjacent industrial park for rail-intensive companies. Additionally, future rail plans include a diamond rail interchange in the Rural Municipality of Headingley where the CN and CP rail lines meet. This interchange will allow for trains to bypass the internal City of Winnipeg track network and proceed directly to the CentrePort Canada Rail Park.

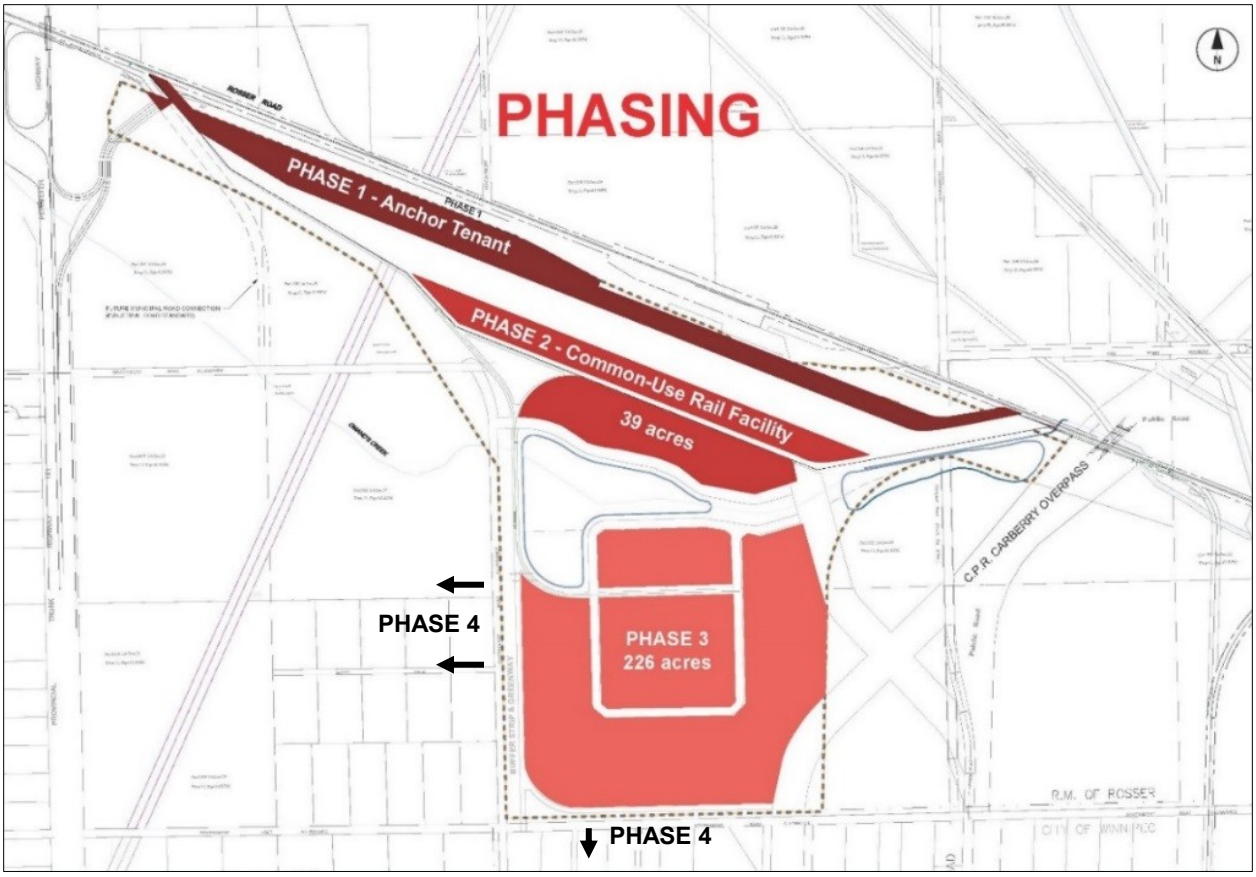

Figure 3: Rail Phasing Stages [3]

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4. Highway Design Considerations for CentrePort

The development of CentrePort and the future demand for truck traffic activity on the highway network servicing CentrePort give rise to the application of proactive highway design considerations. This section outlines these considerations within the specific context of the design and construction of PTH 190 (CentrePort Canada Way or CCW). CCW construction started in 2009 as a design-build project funded by Manitoba and the Government of Canada at a total of $212 million. The 9.1 km connection between Route 90 (in the City of Winnipeg) and PTH 101 (Winnipeg's Perimeter Highway) was officially opened to traffic in November 2013. Table 1 identifies the principal design controls applied to CCW. This section outlines how these design controls influenced design considerations for highway geometry, bridge structures, and pavement.

Table 1: CentrePort Canada Way Design Controls

Control	Criteria
Functional Classification	Semi-urban expressway
Design Speed	90 km/h
Design Vehicle	WB-36 (Turnpike Double)
Projected AADTT (2030)	4590
Bridge Loading	AASHTO LRFD and HSS30

Geometric Design Considerations

CentrePort Canada Way is classified as a semi-urban expressway with a design speed of 90 km/h and a posted speed of 90 km/hr. It is a four-lane divided highway with a rural cross-section, as illustrated in Figure 4.

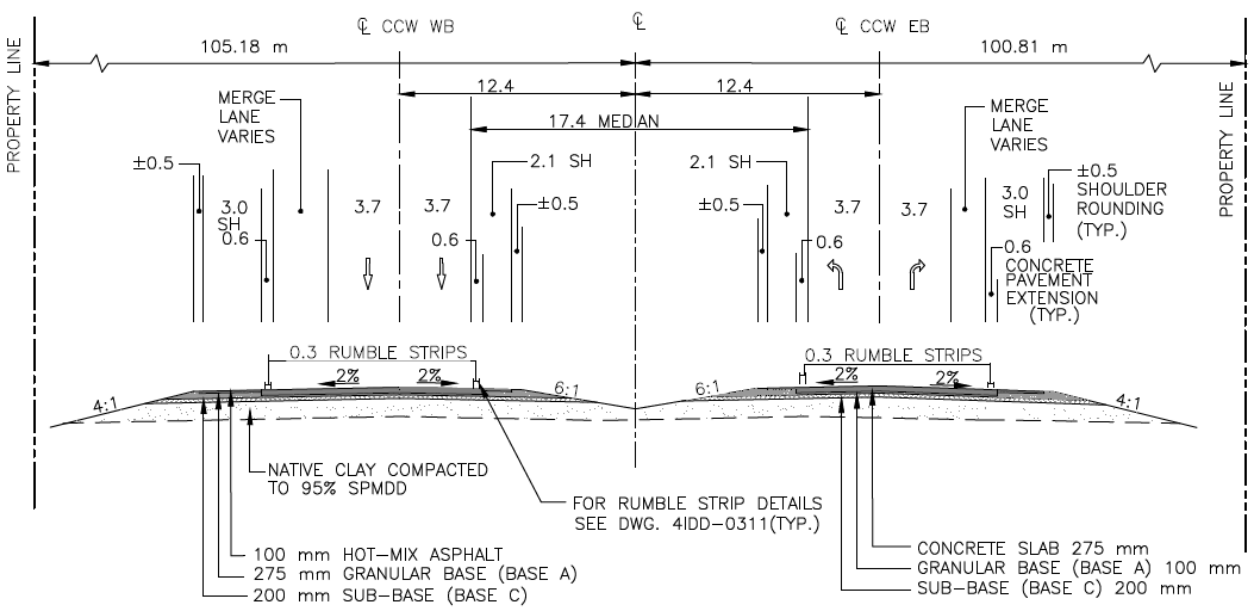

Figure 4: Typical CCW Roadway Cross Section [9]
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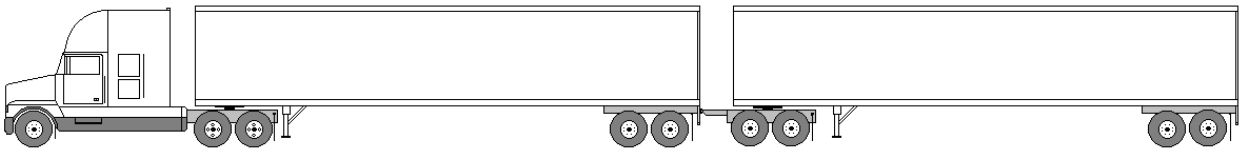
Based on the industry demand and truck configuration types used in the area of CentrePort, it was important to design the network to accommodate both RTAC vehicle weights and LCV configurations. Specifically, CCW's intersections and interchange ramps were designed geometrically to accommodate a WB-36 (Turnpike double) truck configuration. Figure 5 provides an illustration of this configuration and its dimensions.



DIMENSION	A Train
Overall Length	Max 41.0 m
Lead Semi-trailer	
Length	Min 12.2 m Max 16.2 m
Wheelbase	Min 9.5 m Max 14.0 m
Hitch Offset: Trailer length 12.2 to 13.7 m	Max 1.8 m
Trailer length > 13.7 m	Max 2.8 m
Converter Dolly	
Drawbar Length	Not controlled
Max No of Axles	2
Second Semi-trailer or Full Trailer	
Length	Min 12.2 m Max 16.2 m
Wheelbase	Min 9.5 m Max 12.5 m
WEIGHT LIMIT	
Maximum Gross Vehicle Weight	Max 63,500 kg

Figure 5: WB-36 (Turnpike Double) Base Vehicle Dimensions [10]
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Structural Design Considerations

The Winnipeg Airports Authority has subjected the construction of one of the CentrePort overpasses (CP Carberry Overpass) to a height restriction, as shown in Figure 6. This restriction was put in place because the structure is in the direct flight path of the Winnipeg Airport 13-31 runway. The limited height of the structure necessitated the use of low mast lighting in the structure area. This restriction protected the sight lines of the runway flight path. This overpass was also subjected to restrictions from CP for height and width, to allow for double stacking container capabilities and capacity expansion in the form of a second track. Additionally, the structures on PTH 101 were designed for future expansion to six-lanes, with construction of the substructure to accommodate the expansion.

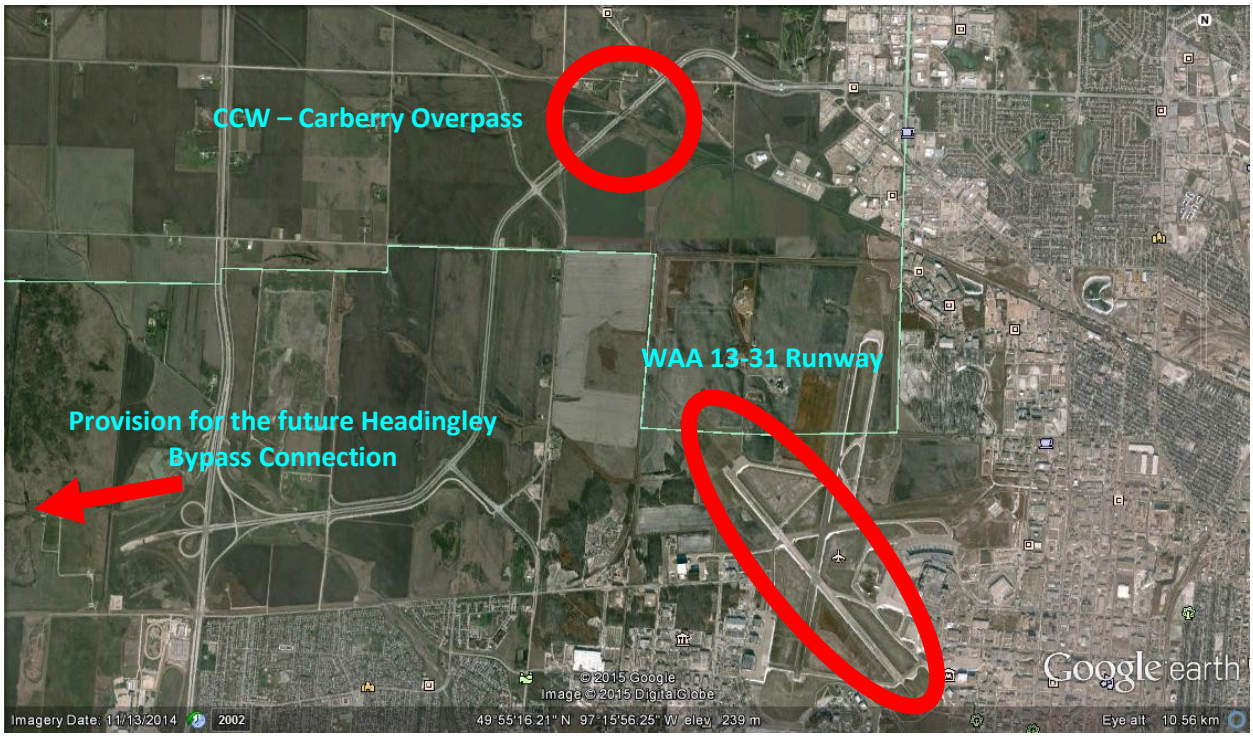

Figure 6: CP Carberry Overpass & WAA 13-31 Runway [11]

Pavement Design Considerations

With an increasing demand for longer and heavier trucks, it was important for Manitoba's pavement designers to be conscious of this demand when considering the structural aspects of the CCW road network. Ongoing land development within CentrePort is expected to lead to rapid increases in truck traffic volume. The projected design AADTT (2030) for CCW is 4590 trucks per day. To provide context from the Manitoba perspective, this AADTT is roughly double the truck traffic volume currently experienced on any provincial highway in Manitoba.

For construction, CCW was divided into two sections. Section 1 was the design-build of the grade separations along with upgrades to PTH 101 that were required for the project; these grade separations are highlighted in orange in Figure 7. Section 2 was the connecting roadways tying all the interchanges together, from Route 90 in the City of Winnipeg to Summit Road just east of PTH 1010, as shown in green in Figure 7. Section 2 was completed as a conventional design-bid-build project by Manitoba Infrastructure and Transportations (MIT) Regional Highway Operations.

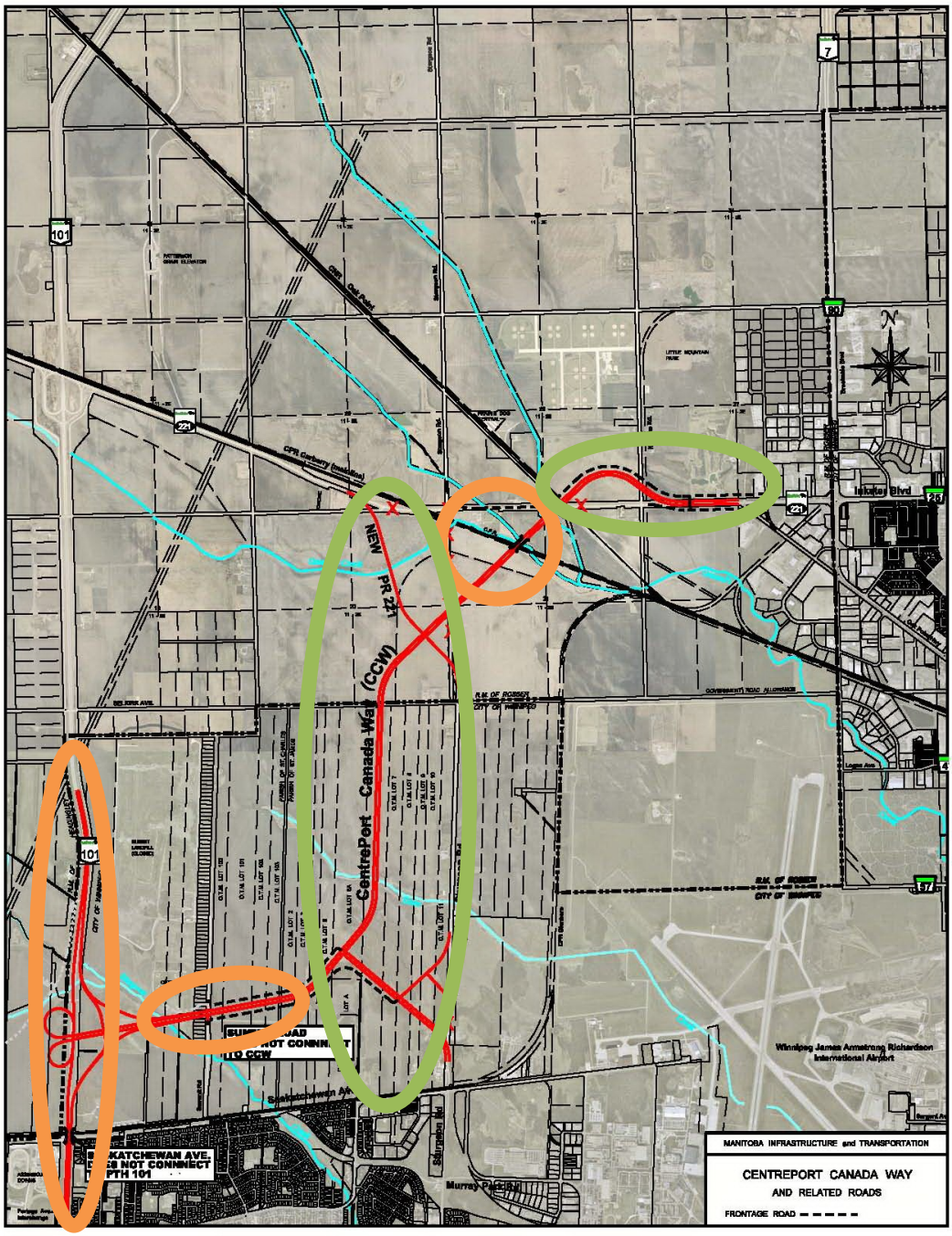

Figure 7: CentrePort Canada Way Functional Plan [12]
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Along with the construction of two separate sections of CCW, there were also two separate pavement designs as illustrated in Table 2. The PTH 101 component of the design-build project was constructed with the same pavement structure as CCW – Section 1 to accommodate the future projected truck traffic growth.

Table 2: CentrePort Canada Way (CCW) Pavement Design Criteria [12]

	CCW – Section 1	CCW – Section 2
Annual ESALs	2,400,000	2,400,000
20-yr Rigid ESALs	79,500,000	53,000,000 (ACCESALs)
Projected traffic (2030)	30,000 (AADT)	4,590 (AADTT)
Base Course	200 mm C-Base 100 mm A-Base	150 mm Minus Crushed Rock 50 mm Minus Crushed Rock 200 mm A-Base
Riding Surface	275mm Concrete	250mm Concrete
Shoulder Design	300 mm C-Base 175 mm A-Base 100 mm Bituminous B Surface	150 mm Minus Crushed Rock 50 mm Minus Crushed Rock 350 mm A-Base 100 mm Bituminous B Surface
Lane Width	4.3 m (3.7 m Painted)	4.3 m (3.7 m Painted)
Type of Construction	Plain Concrete with dowelled transverse joints	Plain Concrete with dowelled transverse joints
Joint Spacing	4.5 m	4.5m
Dowel Bars	Automatic DBI / Baskets Epoxy Coated 40M (38 mm) Dowels 14 per lane width	Dowel Baskets 35M (35 mm) Stainless Steel Dowels 4 in each wheel path (8 total)
Tie Bars	20M Epoxy Coated Bars 1000 mm spacing on Tangents 1000 mm spacing on Curves	20M Stainless Steel Bars 750 mm spacing on Tangents 500 mm spacing on Curves

To monitor the truck traffic on CCW, a quartz weigh-in-motion (WIM) station has been installed in the westbound travel lane along with automatic vehicle classifiers in the remaining three lanes. The installation of these devices, from what was essentially opening day, will allow Manitoba to track the type, size, and weight of trucks using CCW. This will provide comprehensive data for use in future planning and upgrades that may be required to the CentrePort area.

5. Planning and Design Insights Related to CentrePort Canada

Appropriate planning and design of transportation infrastructure for an inland port such as CentrePort requires understanding of factors that may not normally be considered in other planning and design initiatives. This section describes three broad insights—concerning trade-related incentives, truck regulations, and accommodating trucking and industry demand—drawing on experiences gained in Manitoba related to the development of CentrePort. These insights are transferrable to other jurisdictions undertaking similar work.

Insight Concerning Trade-Related Incentives

Tenants of CentrePort have access to FTZ programs designed to incentivize trade through CentrePort. The FTZ concept for CentrePort is essentially a cash management program for businesses by providing qualifying businesses with expedited, single window access to all the federal FTZ programs. The programs available to businesses include the following [3]:

- *Duty deferral*: This program allows duties to be waived up front or rebated later. Duty deferral is for materials that are received into Canada to create new products. The new materials are not charged duty. Duty is only charged on the finished manufactured product whose destination is outside of Canada.

- *Sales tax relief*: This program provides exemption from federal and provincial sales taxes. Sales tax relief applies to manufacture products whose destination is within Canada. Sales tax is not charged on any of the shipped products.

- *Customs bonded warehouse*: This program permits use of sales tax exempt and duty-free storage/distribution facilities. Customs bonded warehouses are warehouses in which products can be stored, changed, or undergo a manufacturing process without paying sales tax or duty fees. There are currently three tenants that have established customs bonded warehouses through the CentrePort FTZ single window. One of these facilities also has a cross-dock warehouse, which allows for commodities to be transferred between rail and truck.

Understanding how these programs work and the types of business they attract enable better planning and design for future truck traffic demand.

Insight Concerning Truck Regulations

A development as large and truck-intensive as CentrePort will become an origin and destination for truck trips with extensive geographic reach—potentially including all parts of North America. While the demand for freight crosses jurisdictional boundaries, the trucks that carry this freight are subject to complex regulatory requirements that sometimes impose regulatory boundaries and impede truck productivity. These regulations govern truck size and weight, safety requirements, and vehicle and driver credentials.

To illustrate these effects, consider a trip from CentrePort to a destination in the United States. While CCW, Winnipeg's Perimeter Highway, and PTH 75 (connecting Winnipeg to the U.S. border) can all accommodate Turnpike doubles at 63,500 kg, this vehicle would not be permitted to cross the border configured as a Turnpike double. To cross the border, the carrier may disassemble the Turnpike double into two standard five-axle tractor semitrailers. At this point, consideration would also need to be given to the gross and axle weight limits in all states (and potentially urban jurisdictions) through which these trucks would travel. The outcome of these issues is that carriers may choose to operate two five-axle tractor semitrailers beginning from CentrePort, even though the Manitoba highway network can accommodate a more productive configuration.

Ongoing initiatives are underway to harmonize truck regulations across jurisdictions. A principal example is the recent work by western provinces to harmonize special permit requirements (including those pertaining to truck size and weight, operations, and various other elements) for Turnpike doubles [13]. Despite these harmonization efforts, the industry continues to evolve to continue to improve truck productivity. A relevant comparison in this regard is the parallel development of Regina's Global Transportation Hub, which has an internal road network designed to accommodate so-called "Turnpike triples" (i.e., configurations with three 53-ft trailers) and has pursued permitted operations of these vehicles on specified networks [14] at certain times.

Insight Concerning the Accommodation of Trucking and Industry Demand

Understanding current and forecasting future demand is a critical yet challenging component of planning and designing transportation infrastructure—including the networks serving CentrePort. Within the context CentrePort's development and ongoing growth, three particular issues are evident.

- *Integrating freight forecasting and truck traffic characteristics*: Forecasting future freight transport demand related to CentrePort involves developing models that predict future freight flow as a function of one more explanatory variables (e.g., land use, economic indicators). While freight demand forecasts may provide estimates of future expected tonnages for various commodities and modes of transport, these forecasts do not always provide the detailed truck traffic characteristics required for highway design (i.e., geometry, bridges, pavements). Numerous questions may arise: What type of truck will be used to carry a load? How many axles will it have? What is its payload capacity? While imperfect, freight forecasts may be linked more closely with truck traffic characteristics through better knowledge of truck body type (e.g., van, flat deck, tanker) and the truck configurations that optimize productivity for various types of products and business practices. As an example, of the businesses already located in CentrePort, some focus on manufacturing and may utilize van or flat deck trucks while others deal with fresh produce and may utilize refrigerated vans. Integrating WIM technology with video monitoring or new inductive loop sensors [15] are two options for developing a better understanding of truck body types and their loading characteristics.

- *Understanding modal advantages and multimodal interactions*: Related to the foregoing point, there is a particular need for transportation planners and engineers to understanding the type of activity and how this activity influence shippers' mode choice. The three modes—highway, rail, and air—providing service at CentrePort each have distinct advantages that influence mode choice. For example, trucks offer service via a high density network and can handle a wide range of commodities; rail service tends to be most productive when hauling bulk or containerized commodities; air is well-suited for high-value, time-sensitive goods. Transloading is an effective solution to maximize the use of available modes in an inland port by enabling transfers between modes (e.g., from rail to truck). At CentrePort, both warehouse transloading and cross-docking facilities (i.e., facilities that enable transloading without intermediate storage) will be provided to facilitate cost-effective, flexible, and reliable transloading opportunities.

- *Accommodating oversize and overweight trucks*: The freight-intensive nature of CentrePort necessitates careful consideration of accommodation of oversize and overweight trucks. From the public highway perspective, such consideration has focused on routine issuance of permits to LCVs across the Canadian Prairie Region. More locally, special accommodations for oversize and overweight trucks have also been integrated into the design of CentrePort's internal road network. This network will allow LCVs and vehicles that exceed basic weight limits. These provisions will accommodate train-to-factory delivery of products and materials on CentrePort lands. Exact details of the allowable weights and dimensions of oversize and overweight trucks have yet to be determined by CentrePort Canada Inc.

6. Conclusion

Jurisdictions across North America—including Winnipeg, Manitoba; Regina, Saskatchewan; and Calgary, Alberta—have developed inland ports in response to rising demand for efficient freight transportation systems. As part of its value proposition, Manitoba's inland port, CentrePort Canada, offers tri-modal (air, rail, truck) access to worldwide distribution networks and enables companies to take advantage of numerous FTZ programs via a single window.

A freight-intensive development such as CentrePort poses planning and design challenges for agencies responsible for providing the transportation infrastructure required to meet current and future demands. From a planning perspective, these challenges involve responding to the varying needs of public and private sector stakeholders, understanding current and forecasting future transportation demand, and strategically prioritizing network improvements across modes. These planning considerations influence numerous design decisions. Based on experiences gained from the design and construction of CentrePort Canada Way, key design considerations include selecting an appropriate design vehicle (a Turnpike double in the case of CCW), addressing various constraints associated with meeting the needs of multiple modes within a small geographic area, and predicting future truck traffic volume.

Useful insights arise from the process of addressing these planning and design challenges. First, the importance of having a thorough understanding of the inland port's value proposition is evident. For CentrePort, this includes knowledge of FTZ programs and how industries may take advantage of the incentives offered by these programs. Second, when aiming to become a freight transportation hub within an international supply chain, it is critical to be aware of the many and varied regulations that govern vehicle movements through this supply chain. Finally, there is an ongoing need to understand the complexities of current and future industry demands across all freight transportation modes so that the provision and operation of transportation infrastructure appropriately meets these demands.

As other jurisdictions encounter similar challenges, these and other insights provide a foundation for collaborative efforts aimed at improving transportation productivity, reducing costs for suppliers and consumers, growing local opportunities, and ultimately benefiting Canada's economy.

Acknowledgement

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References

[1] S. Leitner and R. Harrison, "The Identification and Classification of Inland Ports," The University of Texas at Austin, 2001.

[2] Global Transportation Hub Authority, "GTH | Global Transportation Hub - Saskatchewan's Gateway to the World," 2015. [Online]. Available: http://www.thegth.com/.

[3] CentrePort Canada Inc., "CentrePort Canada," 2015. [Online]. Available: http://www.centreportcanada.ca.

[4] Economic Development Winnipeg Inc., "Winnipeg: Transportation & Distribution," Economic

Development Winnipeg, 2014.

[5] CentrePort Canada Inc., "Business Plan 2015-2016," CentrePort Canada Inc., Winnipeg, 2015.

[6] CentrePort Canada, Winnipeg: CentrePort Canada, 2015.

[7] Claim Post Resources Inc., "Symourville Frac Sand Project in Manitoba (Canada)," Claim Post Resources Inc., 2014.

[8] Transportation Association of Canada, Geometric Design Guide for Canadian Roads, Ottawa, ON: Transportation Association of Canada, 1999.

[9] Manitoba Infrastructure and Transportation, *CentrePort Canada Way Grade Separations Design Build Project As-Built Civil Drawings,* Winnipeg, 2015.

[10] Government of Manitoba, "Memorandum of Understanding: Harmonization of Special Permit Conditions for Operation of Turnpike Double Long Combination Vehicles in Western Canada," 2012.

[11] Google Earth, 2015.

[12] Manitoba Infrastructure and Transportation, Winnipeg: Manitoba Infrastructure and Transportation, 2014.

[13] Government of Canada, Memorandum of Understanding: Harmonization of Special Permit Conditions for Operation of Turnpike Double Long Combination Vehicles in Western Canada, 2012.

[14] G. Rempel, J. Montufar, J. D. Regehr, A. Clayton and D. Middleton, Truck Lanes in Urban Areas, Ottawa, ON: Transportation Association of Canada, 2012.

[15] S. Hernandez, A. Tok and S. G. Ritchie, "Multiple-Classifier Systems for Truck Body Classification at WIM Sites with Inductive Signature Data," Transportation Research Board, Washington, D.C., 2015.