steer davies gleave

Réseau électrique métropolitain (REM)

REM Summary Forecasting Report
November 2016

CDPQ Infra Inc

Our ref: 22951101
Client ref: BC-A06438

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1 Introduction

1.1 Steer Davies Gleave was appointed by CDPQ Infra Inc. to develop investment grade forecasts for the Réseau Electrique Métropolitain system (REM), a 67 kilometre light rail network in metropolitan Montréal. This report represents the summary of the Forecasting Report dated November 2016.

Report Structure

1.2 Following this introduction, this report includes the following:

- Section 2 describes the proposed REM project and plans for reorganising the bus and rail services in the REM corridor including proposed P&R sites at REM stations;
- Section 3 presents the current transport situation in Montréal and defines the 3 in-scope markets for REM: South Shore (Rive-Sud); West Island; and, Montréal-Trudeau Airport;
- Section 4 explains our modelling approach, the existing models and bespoke models prepared for this study;
- Section 5 describes how we have constructed the 2015 base year demand for the existing in-scope ridership, historic growth of public transport ridership in Montréal and future demand growth models;
- Section 6 presents the model calibration, that is, how well the model simulates reality in terms of demand by transport mode and travel times in 2015;
- Section 7 shows the REM reference case forecasts for 2015 (assuming the system was in place today), 2021 and 2031;
- Section 8 describes the identified risk and the results of sensitivity tests undertaken on the forecasts; and

Disclaimer

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This document contains projected information and data (financial and otherwise), and other forward-looking information, that may or may not occur or prove to be accurate. Such projected and forward-looking information is based on current expectations and projections about future events, many of which are beyond the control of the Company, the Client or any other participant in the Project, and such projections and forward-looking information can be affected by inaccurate assumptions. The projections and forward-looking information were prepared in good faith, but no assurance can be given as to the accuracy or adequacy of such projections and forward-looking information, or the assumptions underlying such projections and forward-looking information.

This document speaks only as of the date thereof and the Company does not undertake any responsibility for updating this document for any reason, including as a result of new information, future events or otherwise.

2 Project Definition

Alignment and Stations

2.1 REM will be a fully automated transportation system, 67 km long, which will provide access to 24 stations. Figure 2.1 shows the extent of the REM network.

Figure 2.1: REM Network

2.2 With a frequent and reliable service running from 5:00 am to 1:00 am – 20 hours a day, every day – REM will provide a significantly enhanced travel experience for commuters and non-commuters in the Montréal metropolitan region.

2.3 REM will provide services to those stations currently served by the Deux-Montagnes AMT Line and it will substantially increase rail coverage with new stations in Rive-Sud, Sainte-Anne-de-Bellevue and Aéroport Pierre-Elliott-Trudeau areas. Moreover, the dedicated tracks will allow for quick and

uninterrupted travel and passengers will enjoy substantial travel time savings. The location of the stations and the travel times between stations are shown in Table 2.1.

Table 2.1: REM stations and travel times

Station	Station	Distance (m)*	Travel time (mins)	Speed (km/h)
DEUX-MONTAGNES				
Gare Centrale	Canora	5,410	05:05	64
Canora	Mont-Royal	820	01:30	33
Mont-Royal	Correspondance A40	1,470	01:58	45
Correspondance A40	Montpellier	940	01:37	35
Montpellier	Du Ruisseau	1,460	02:00	44
Du Ruisseau	Bois-Franc	1,720	02:07	49
Bois-Franc	Sunnybrooke	6,390	05:13	73
Sunnybrooke	Roxboro-Pierrefonds	2,170	02:50	46
Roxboro-Pierrefonds	Île-Bigras	3,450	02:58	70
Île -Bigras	Sainte-Dorothée	930	01:42	33
Sainte-Dorothée	Grand-Moulin	2,700	02:47	58
Grand-Moulin	Deux-Montages	2,200	02:33	52
Total		**29,660**	**32:20**	**55 (average)**
RIVE-SUD				
Gare Centrale	Île-des-Soeurs	5,050	04:57	61
Île-des-Soeurs	Panama	5,410	04:36	71
Panama	Du Quartier	3,670	03:20	66
Du Quartier	Rive-Sud	1,030	01:34	55
Total		**15,570**	**14:27**	**65 (average)**
SAINTE-ANNE-DE-BELLEVUE				
Bois-Franc	Autoroute 13	4,440	03:58	67
Autoroute 13	Des Sources	3,780	03:25	66
Des Sources	Pointe-Claire	4,130	03:42	67
Pointe-Claire	Kirkland	2,580	02:49	55
Kirkland	Sainte-Anne-de-Bellevue	4,280	03:45	68
Total		**19,210**	**17:39**	**65 (average)**
AÉROPORT PIERRE-ELLIOTT-TRUDEAU				
Autoroute 13	Technoparc Saint-Laurent	2,500	02:55	51
Technoparc Saint-Laurent	Aéroport Pierre-Elliott-Trudeau	2,780	02:53	58
Total		**5,280**	**5:48**	**55 (average)**
TOTAL		**67,200**	**70:14**	**60 (average)**

Note: Dwell time assumed is 30 seconds for all stations except for Gare Centrale and Panama where it is 40 seconds

**The total distance accounts for double tracking*

2.4 REM will provide enhanced frequencies to the Deux-Montagnes corridor (services every 12 minutes) compared to the existing AMT rail service. It will also introduce very frequent services to the Rive-Sud area (every 2 minutes and 40 seconds) replacing the existing express bus services on the Champlain Bridge. It will also include new rail services to the Aéroport Pierre-Elliott-Trudeau and Sainte-Anne-de-Bellevue (every 12 minutes respectively), which will provide an alternative to the existing express bus services and other local services feeding the Orange Metro line. Table 2.2 shows the key frequency assumptions.

Table 2.2: REM Operating Assumptions

Route	Headway (mins)		Travel time (mins)
	AM (6am-9am)	Inter Peak (9am-3pm)	
Deux-Montagnes to Rive-Sud	12	15	46:47
Roxboro-Pierrefonds to Rive-Sud	12	-	36:47
Sainte-Anne-de-Bellevue to Rive-Sud	12	15	46:23
Aéroport Pierre-Elliott-Trudeau to Rive-Sud	12	15*	38:30
Correspondance A40 to Rive-Sud**	20	-	23:00
Peak Headways per period	2mins 40sec. From Correspondance A40 to Rive-Sud	5 mins From Gare Centrale to Rive-Sud	-

**Inter Peak service from Aéroport Pierre-Elliott-Trudeau is express from Bois-Franc to Gare Centrale*

*** In the AM peak it is assumed a new additional service from Correspondance A40 to cover the demand alighting from the Mascouche Line service*

2.5 In summary, REM will not only provide an additional service to critical corridors in the Métropolitan area (Deux-Montagnes, Rive-Sud, Sainte-Anne-de-Bellevue and Aéroport Pierre-Elliott-Trudeau), but it will also provide a new alternative to the Métro Orange Line to access Downtown Montréal.

Park and Ride

2.6 Another change brought about as a result of the introduction of the REM network is changes to the Park & Ride provision. Table 2.3 provides a summary of the current and future Park & Ride provision for the REM network.

Table 2.3: Park and Ride Assumptions

Stations	Current Capacity	REM Capacity
Gare Centrale	0	0
Canora	0	0
Mont-Royal	0	0
Correspondance A40	-	0
Montpellier	0	0
Du Ruisseau	1,063	1,060
Bois-Franc	742	740
Sunnybrooke	515	400
Roxboro-Pierrefonds	918	1,040
Île-Bigras	65	45
Sainte-Dorothée	1,101	975
Grand-Moulin	304	230
Deux-Montagnes	1,256	1,160
Île-des-Soeurs	-	0
Panama	962	700
Du Quartier	-	0
Rive-Sud	-	3,000
Autoroute 13	-	500
Des Sources	-	500
Pointe-Claire	-	700
Kirkland	-	500
Sainte-Anne-De-Bellevue	-	2,000
Technoparc Saint-Laurent	-	0
Aéroport Pierre-Elliott-Trudeau	-	0
TOTAL	**6,926**	**13,550**

Rail Network Reorganisation

2.7 The introduction of REM will result in the following changes to the rail network:

- Deux-Montagnes existing rail service will cease to operate and will be replaced by the REM
- Mascouche Line service will be terminated at Correspondance A40 station and will cease to provide service to Gare Centrale. An additional REM service from A40 has been introduced in the operating plan in order to cover this demand and ensure full integration and capacity of the system (see Table 2.2).

Bus Network Reorganization

2.8 The introduction of REM will be complemented with a full reorganization of the transit network in the South Shore/A10 and the West Island/Deux-Montagnes Corridors. The extent of the bus reorganization has been defined by the Agence métropolitaine de transport (AMT) in collaboration with the various Conseil intermunicipal de transport (CITs) and Société de transport de Montréal (STM) in order to optimize the system by avoiding duplication of services, and increasing the network coverage and service levels. This section summarizes the future bus network reorganization assumptions.

A-10 Corridor/South Shore

2.9 The South Shore bus network reorganisation is based on assumptions developed by AMT in February 2016. The main objective of the reorganization is to truncate all express bus services that currently cross the Champlain Bridge, in order not to duplicate services and eliminate bus traffic on the Bridge. The approach adopted by AMT was to terminate these services in the most accessible REM station.

West Island/Deux-Montagnes Line

2.10 Assumptions regarding the West Island bus network reorganisation are based on the preliminary assumptions provided by STM in September 2016. The approach was to develop a new feeder bus system for the West Island that avoids duplication of services and is better integrated with the REM.

2.11 The following summarizes Steer Davies Gleave's understanding of the STM proposed bus network reorganisation:

- Most routes are maintained with some alignment modifications that better serve existing communities and feed the REM service.
- 17 services are deleted (8 of them are express services) and 14 new services are created. These new services directly feed REM.
- For most of the remaining services, levels of service during peak periods increase and stay relatively the same during the inter peak.
- Levels of service for the new routes during the peak period are high and similar to current express services headways (lower than 12 minutes and average of 8 minutes).

2.12 STM also operates 747 Express Airport Shuttle. However, it has not provided any assumption for the level of service when the REM starts operation, which will have a significant impact in

ridership on the Aéroport Pierre-Elliott-Trudeau branch. For the base case, as requested by the client, it has assumed that this service will be eliminated from service.

Fare Assumptions

2.13 It is expected that the current fare structure will remain in place and the REM will be fully integrated into Greater Montréal's fare structure.

2.14 The only major modification would be related to the REM airport branch, where fares have been assumed to be $5 higher compared to the current 747 average fare.

3 Current situation

Background

3.1 The REM project will transform the transit offer in the Greater Montréal Area, by providing a new efficient, frequent and reliable service between the South Shore, Downtown Montréal, the West Island, City of Deux-Montagnes and the Aéroport Pierre-Elliott-Trudeau (ADM).

3.2 Although REM will be fully integrated, it will service three very different markets:

- **South Shore/A10**: clearly dominated by a commuting demand which is very high in the AM peak in the Montréal direction. This demand is currently served by express bus services that cross the Champlain Bridge using dedicated bus lanes.
- **West Island/Deux-Montagnes Line**: similar to the above, this is a very strong commuting market. However this demand is served by a variety of services, including rail services and express and local bus services that feed the Orange Line into Montréal.
- **Airport**: very specific demand driven by the Aéroport Pierre-Elliott-Trudeau activity, with a flatter daily profile and peak in the afternoon between 3pm and 6pm.

South Shore/A10 Market

3.3 The REM will provide a frequent and reliable rail link between the South Shore and Downtown Montréal (as well as the rest of the West Island corridor and the airport corridor).

3.4 There is a very strong commuter-driven demand between the South Shore and the Montréal downtown area, with high peaks in the AM peak towards Montréal and in the PM peak towards the South Shore. Given the natural barrier of the Saint Lawrence river, the river crossing alternatives are limited and as a result the A10 is one of the highest demand corridors in the region for auto and transit users. We describe the existing auto and transit users and current transport provision in the following sections.

Auto Users

3.5 Figure 3-1 shows the most important five crossings from the South Shore.

Figure 3-1: St Lawrence River Crossings

3.6 The Champlain Bridge carries approximately 28% of the total traffic crossing to/from South Shore. Although there is a strong component of commuting traffic heading to Downtown Montréal during the AM period, Table 3-1 also shows significant demand levels in the Inter Peak period.

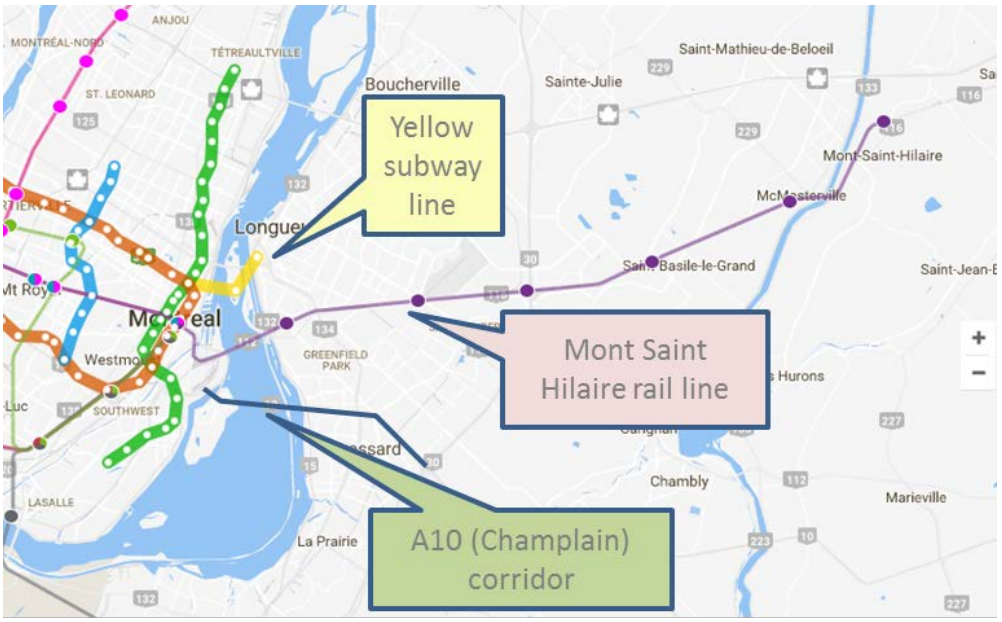
Table 3-1: 2013 St Lawrence River crossing traffic volumes

Screenline Num.	Name	Direction	6:00 to 9:00 am (3 hours)	9:00 am to 15:00 pm (6 hours)
1	Louis Hippolyte Lafontaine tunnel (A25)	To Montréal	13,364	19,939
		From Montréal	11,450	20,830
2	Jacques Cartier Bridge (R134)	To Montréal	12,757	13,863
		From Montréal	5,530	12,663
3	Victoria Bridge (R112)	To Montréal	6,765	4,043
		From Montréal	-	3,697
4	Champlain Bridge (A10)	To Montréal	17,046	17,956
		From Montréal	6,750	18,003
5	Honoré Mercier Bridge(R138)	To Montréal	7,285	9,040
		From Montréal	3,152	8,803
	TOTAL	**To Montréal**	**57,217**	**64,841**
		From Montréal	**26,882**	**63,996**

Transit Users

3.7 Transit options are also limited to the limited crossings along the St Lawrence River. The key existing transit options are shown in Figure 3-2.

Figure 3-2: St Lawrence River crossing transit alternatives



A10 corridor

3.8 These 48 routes provide a combined frequency over the Champlain bridge of approximately 200 services in the AM peak hour. However, this frequency drops to approximately 21 services in the Inter Peak period (9am–3pm), which clearly shows that the service is driven by the commuter needs of residents of the South Shore.

3.9 These express bus services provide very competitive travel times in the peaks (despite high levels of congestion on Champlain Bridge) as transit services use segregated bus lanes across the bridge. As a result, travel times only increase from 19 minutes in the Inter Peak direction to 24 minutes in the peak direction.

3.10 The competitiveness and convenience of the South Shore/A10 transit corridor has encouraged the use of transit, presenting very high transit market share compared to other corridors. Table 3-2 presents the demand in the corridor per transit agency and for those bus routes that cross the Bridge to access Downtown Montréal.

Table 3-2: South Shore/A10 corridor/Champlain Bridge demand (October weekday in 2015)

Transit agency	Peak (6am-9am)	Off-peak (9am-3pm)
RTL	9,557	6,399
AMT	2,768	783
Ville de Saint-Jean-sur-Richelieu	1,336	958
CITLR	2,025	476
CITVR	149	64
CITCRC	1,577	286
CITROUS	875	214
OMITSJU	481	20
total	**18,287**	**9,180**

3.11 Within the South Shore/A10 transit corridor, Park & Ride facilities are provided at the critical transit interchange stations. Currently Panama and Chevrier stations have a total capacity of 3,275 spaces (see Table 3-3). These facilities are currently free of charge and are typically at full capacity from early in the AM peak which suggests that there is unsatisfied demand due to parking capacity constraints.

Table 3-3: South Shore Park & Ride spaces and occupancy (2015)

Location	Size	Occupancy
Panama	962	100%
Chevrier	2,313	89%
Total	**3,275**	**92%**

West Island/Deux-Montagnes Line Market

3.12 The REM will provide a frequent and reliable rail link between the West Island/Deux-Montagnes Line and Downtown Montréal (as well as the South Shore/A10). It will not only improve the service currently provided by the Deux-Montagnes Line, but it will also extend its alignment to the Point Claire and Sainte-Anne-de-Bellevue areas.

3.13 As a result, there is a very strong commuter-driven demand between the West Island/Deux - Montagnes corridor and the Downtown Montréal area, with high peaks in the AM towards Montréal and in the PM in the reverse direction.

Auto Users

3.14 The REM line will operate in parallel with the A40 and the A20. Total traffic volumes from the two screenlines by direction are detailed in Table 3-4. The location of the screenlines is shown in Figure 3-3.

Figure 3-3: West Island auto screenlines

3.15 Traffic volumes peak between 6am to 9am heading into the Montréal area, as a result of the high proportion of commuting traffic. Screenline 2, which lies closer to Downtown Montréal displays significantly higher traffic volumes (approximately twice as high) as Screenline 1.

Table 3-4: West Island corridor traffic demand (2013)

Direction	Screenline 1		Screenline 2	
	6:00 to 9:00 am	9:00 am to 15:00 pm	6:00 to 9:00 am	9:00 am to 15:00 pm
To Montréal	21,893	26,476	43,385	55,860
Towards West	10,489	23,818	19,424	42,008

Transit Users

3.16 The West Island of Montréal covers a very large area. To cater for this demand, there is an extensive transit network of; commuting rail (Deux-Montagnes Line and Vaudreuil-Hudson Line) and bus services, that provide access to Downtown Montréal either directly or via the Orange Line.

Rail Network

3.17 Figure 3-4 shows the rail and Metro line alignments and stations on the West Island.

Figure 3-4: West Island rail and Metro network

3.18 Currently, the Deux-Montagne line (DM) has the highest ridership, with almost 32,000 daily riders. Table 3-5 shows that most of the rail services have a strong component of commuting demand, with majority of demand in the peak periods.

Table 3-5: AMT average ridership (2015)

AMT commuter rail	6am-9am	9am-3pm	Daily
Deux-Montagnes Line	14,371	4,580	31,835
Vaudreuil-Hudson Line	8,450	1,238	17,588
Mascouche Line	2,421	199	4,905
Saint-Jérôme Line	6,792	1,068	13,709

Source: Agence Métropolitaine de Transport

Bus Network

3.19 STM is the main bus service provider on the West Island. It operates 53 in-scope bus services, which cover both express and local services with frequencies vary depending on the route

3.20 Table 3-6 presents the demand for each type of bus route and for an average weekday in October 2015. The express routes have higher demand in the peak period, as expected, while the non-express routes have higher demand in the off-peak period due to shorter trips on these services.

Table 3-6: West Island Bus Demand (October 2015 weekday)

	Peak (6am-9am)	Off-peak (9am-3pm)	DAILY
Express routes in scope	12,580	10,611	41,403
Non-express routes in scope	42,392	50,902	174,782
747	493	1,730	5,304
Total	**55,465**	**63,242**	**221,490**

Park and Ride Facilities

3.21 In the West Island/Deux-Montagnes Corridor, many of the rail stations currently have Park & Ride facilities. Stations on the Deux-Montagnes Line provide a total capacity of 5,964 spaces (see Table 3.7). These facilities are currently free of charge and are typically at full capacity from the early peak hour period (average occupancy of 91%), which suggests that there is unsatisfied demand due to the capacity constraints of the car parks.

Table 3.7: West Island/Deux Montagnes Park & Ride sites

Deux-Montagnes Line	Size (and occupancy)	Occupancy
Du Ruisseau	1,063	82%
Bois-Franc	742	91%
Sunnybrooke	515	98%
Roxboro–Pierrefonds	918	92%
Île-Bigras	65	99%
Sainte-Dorothée	1,101	92%
Grand-Moulin	304	96%
Deux-Montagnes	1,256	92%
Total	**5,964**	**91%**

Aéroport Pierre-Elliott-Trudeau Market

3.22 The REM will provide frequent and reliable access to/from Aéroport Pierre-Elliott-Trudeau for air passengers and staff travelling from the South Shore, Downtown Montréal, the West Island and Deux-Montagnes. At the moment, the majority of people drive and park at the airport. There is also a significant number of people who are driven to the airport either by a friend/family member or in a taxi.

3.23 The only current public transport option is the 747 bus route operated by STM. The 747 service runs 24 hours a day, 7 days a week, between Aéroport Pierre-Elliott-Trudeau and Berri/UQAM Métro station, east of Downtown Montréal. Frequencies vary through the day, from one bus every 7-10 minutes to two buses per hour.

3.24 The total end to end travel time ranges from 45 minutes to 60 minutes, depending on traffic conditions. Travel times particularly vary on the A20 and on René-Lévesque, the main road through Downtown Montréal.

Demand

3.25 Demand for travel to the Aéroport Pierre-Elliott-Trudeau includes:

- Aéroport Pierre-Elliott-Trudeau passenger demand; and
- Aéroport Pierre-Elliott-Trudeau staff demand

3.26 Aéroport Pierre-Elliott-Trudeau passenger demand is based on the actual number of air passengers flying into or out of Aéroport Pierre-Elliott-Trudeau using information directly from Aéroports de Montréal (ADM).

3.27 The total passenger demand for the airport is estimated to be 15.5 million passengers in 2015. Clearly not all airport passengers could use REM for their journey to/from the airport. Some passengers were excluded from our analysis for the following reasons:

- Passengers who are using Aéroport Pierre-Elliott-Trudeau to connect to another flight and do not leave the Airport (18%).
- Passengers who were arriving/leaving the Aéroport Pierre-Elliott-Trudeau while REM is not in operation (e.g. in the middle of the night) (7%).

3.28 Airport staff demand has also been calculated using information from ADM. ADM also provided details of roles and working patterns, which showed that in 2015, 41% of staff worked 'normal hours', 46% worked long shifts and 13% were pilots or cabin crew.

3.29 In order to convert the number of employees in to the number of trips to/from the airport, we made a number of assumptions and estimated that airport staff made over 8.8 million staff trips per year in 2015 (our model base year). However, many of those trips are out of the scope of the REM, and it is estimated that around 1.5m of staff trips are using currently the airport staff parking facilities.

Distribution of demand

3.30 The airport model includes a number of different levels of segmentation. This allows us to have different profiles for different types of people. The profiles determine how likely someone is to switch to REM given their current travel time (which includes walk time, wait time, in vehicle travel time and fare (if they use public transport).

3.31 Table 3.8 provides a summary of total airport passengers demand by market segment airport passengers demand by market segment in the AM Peak and Interpeak periods.

Table 3.8: 2015 In-scope airport passenger demand by market segment- AM peak and Interpeak periods

		Bus	Taxi	Car Park & Fly	Car Kiss & Fly
Time of Day	AM peak (6am-9am)	493	1,362	1,072	1,973
	Inter peak (9am-3pm)	1,730	3,234	1,502	4,456
Journey purpose	Business	509	1,824	1,007	922
	Non Business	1,715	2,772	1,567	5,507
Residency	Non-resident	342	966	57	686
	Resident	1,881	3,630	2,517	5,743
Group size	Alone	1,917	2,868	1,814	3,743
	In a group	306	1,728	760	2,687
Total		**2,223**	**4,596**	**2,574**	**6,429**

3.32 The main transit access to the Aéroport Pierre-Elliott-Trudeau is the 747 shuttle service. This service registered an average daily demand of 5,300 passengers for an average weekday in October 2015 (493 passengers in the AM peak and 1,730 in the interpeak). The peak demand for this service occurs between 2pm and 5 pm, which partially overlaps with the commuting PM peak.

Existing Fares

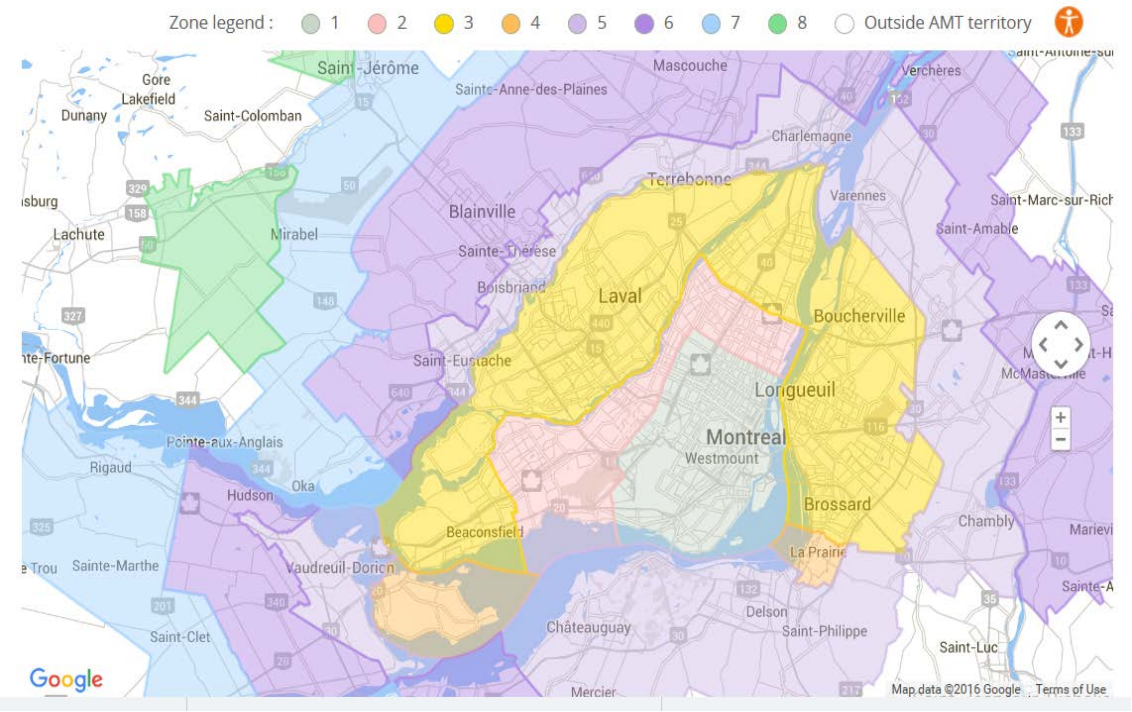
3.33 The REM area of influence is covered by Greater Montreal's integrated ticketing structure, which allows passengers to use the whole transit network in the Montréal Region. Transit operators offer a wide variety of products and concessions with fares differentiated by:

- Zones
- Type of user: regular (*ordinaire*), reduced (*réduit*) and student (*étudiant*)
- Mode: for example AMT offers TRAM (Commuter rail, bus and Métro) and TRAIN (Commuter rail only) tickets
- Products: Tickets are available for different frequency users; daily, weekly and monthly

3.34 In order to estimate the average assumptions are required on the number of trips per ticket type.

3.35 AMT fares are classified according to a zoning system of 8 zones. Figure 3.5 shows the fare zone map.

Figure 3.5: AMT Fare Zone Map (August 2016)



3.36 Table 3.9 shows the average fare estimated for each zone for adults and students.

Table 3.9: AMT Average Fares (2015 $)

ZONE	AVERAGE ADULT	AVERAGE STUDENT
1	$2.01	$1.66
2	$2.38	$1.95
3	$2.77	$2.34
4	$3.02	$2.52
5	$3.47	$2.92
6	$4.14	$3.49
7	$5.19	$4.00

3.37 On the **South Shore/A10,** more than 50% of the total transit demand that cross the Champlain Bridge has an origin or destination within AMT fare zone 3. However, for other areas, in addition to AMT products, there are a number of agencies that also provide products for users that only use that specific transit agency service (products are not integrated with AMT or STM services). These are shown below.

Table 3.10: Average Fares per trip – CIT (2015 $)

AV FARE	CITCRC		CITVR		OMIT-SJU		CITROUS		CITLR	
Zone	ADULT	STUDENT	ADULT	STUDENT	ADULT	STUDENT	ADULT	STUDENT	ADULT	STUDENT
4									2.65	2.24
5	3.23	2.78	3.71	2.78	3.42	2.78	2.90	2.58	2.71	2.29
6	3.48	3.28	4.25	3.28	3.69	3.27	3.04	2.99	2.75	2.60

3.38 **Table 3.11** shows the average fare estimated for the whole Montréal Island and by ticket type.

Table 3.11: Average Fare – STM (2015 $)

Av Fare	Monthly	Hebdo	single	2 trips	10 trips	TOTAL
Adult	$1.58	$2.10	$3.21	$2.93	$2.35	**$1.93**
Student	$1.02	$1.29	-	-	-	**$1.03**

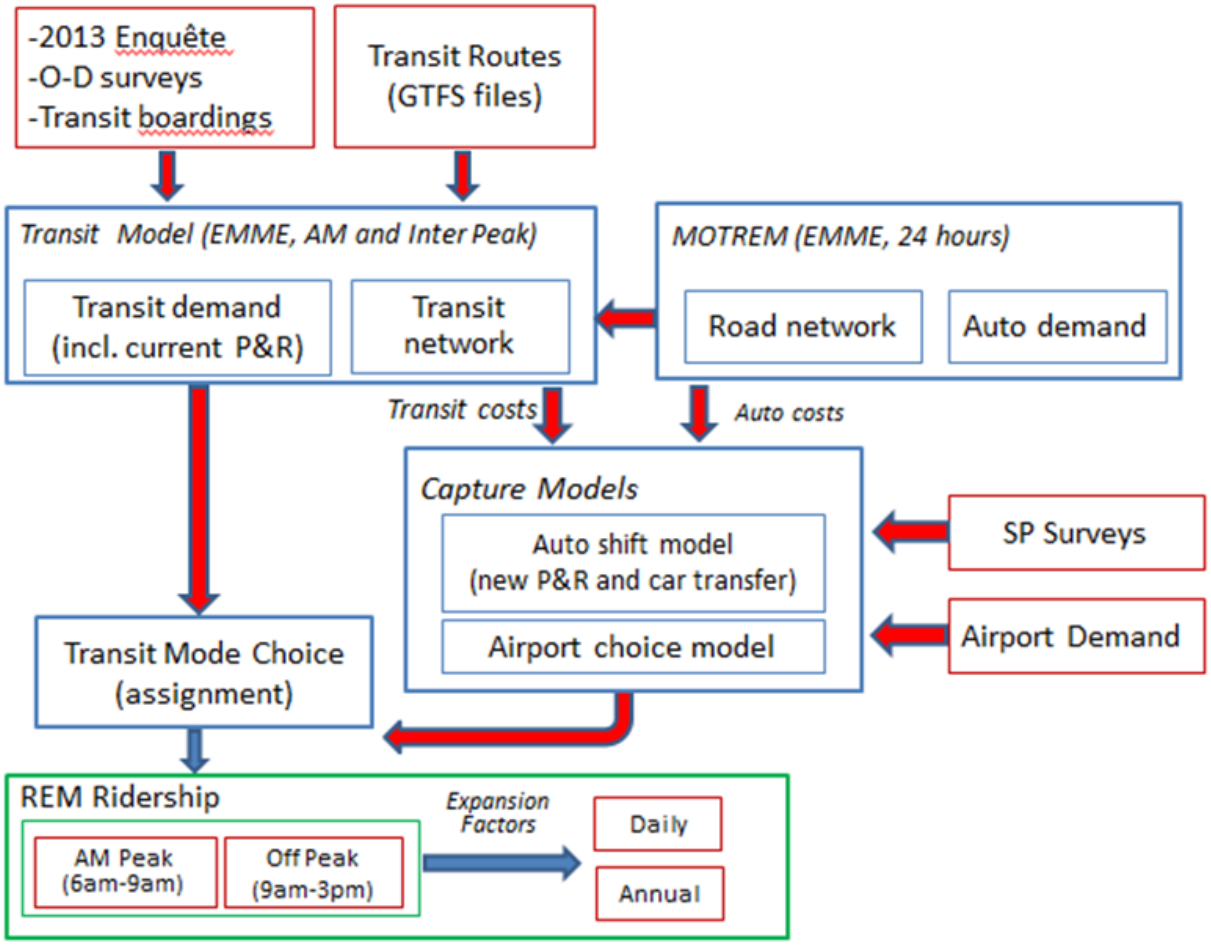
3.39 The STM 747 service is the only service that has a different fare structure. The average fare is $3.15, which has been calculated based on ticket type sales and usage data provided by STM.

4 Modelling approach

Model overview

4.1 An overview of the forecasting model framework is shown below.

Figure 4.1: Forecasting Model Overview



4.2 To support all models, a road and transit network has been developed including the following features:

- Base year (2015) and two future years (2021 and 2031)
- Two time periods
  - AM Peak: 6 to 9am
  - Inter Peak: 9am to 3pm

Network development

Road Network

4.3 In order to characterize the existing road network, the team has used the MOTREM model, a road transportation model developed for the Montréal region, using the EMME software platform. MOTREM is owned and maintained by MTQ and it was provided to CDPQ for the purposes of this study.

4.4 MOTREM is disaggregated geographically into 1,766 traffic zones. MOTREM includes auto Origin-Destination (OD) demand matrices for the zones identified above for the base and future years (2008, 2016, 2021 and 2031). The demand matrices are split into four vehicle types; cars, commercial cars, light goods vehicles and heavy good vehicles.

4.5 The model road network is represented as nodes, links and zones. Links contain network information such as the number of lanes per direction and the volume delay function (vdf). This function estimates the average speed on that particular link depending on the volume of traffic- and could be different depending on the road characteristics, maximum speed limit, etc.

4.6 MOTREM assigns auto and goods vehicle demand to the road network via a series of iterations designed to reach convergence or equilibrium based on the Generalized Costs which account for travel time, operating costs and tolls (on the A25 and A30 and not very relevant to REM).

Future Road network

4.7 MOTREM includes a number of road network changes. Of particular interest to this project are the following:

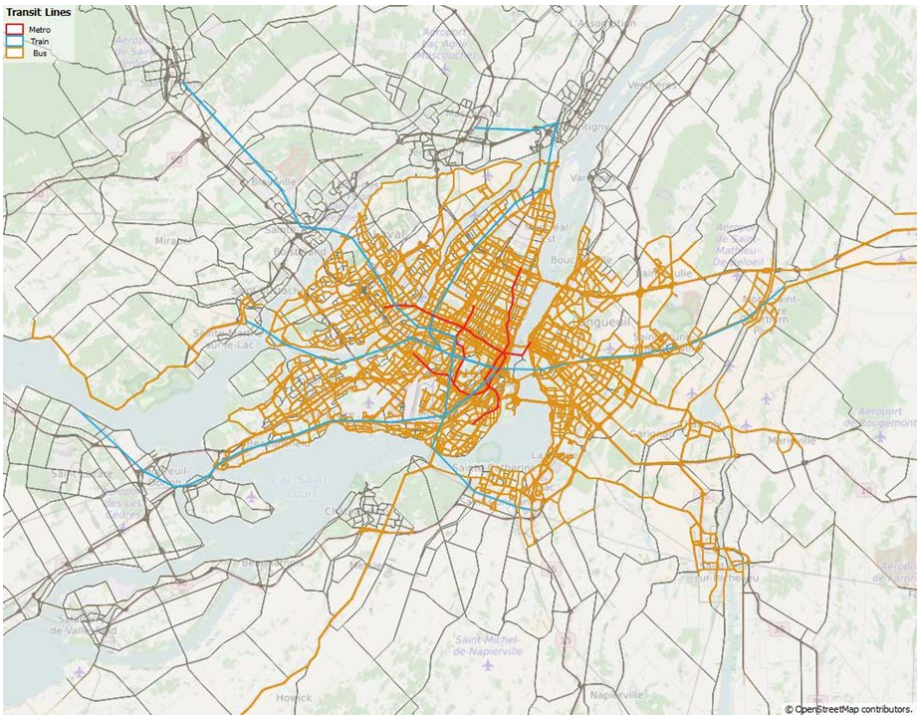
- Champlain Bridge replacement: construction of new 6 lane bridge across the St Lawrence River and access roads to replace existing bridge (currently under construction)
- Turcot Interchange: reconstruction of the interchange for Highways 15, 20 and 720. This includes the introduction of reserved bus lanes along Highway 20 (between the St-Pierre and Turcot Interchanges), inside lane of the Ville-Marie in the eastbound direction and the new Pullman Boulevard.

Transit Network

4.8 MOTREM only represents the road network relevant to auto users and it has been necessary to incorporate all the transit network links (rail and Métro) and transit services. Rail and Métro lines have been coded as separate links and stations have been 'connected' to the street network as required.

4.9 Transit service route GTFS files were downloaded from the different transit agencies in the Montréal region and imported as transit routes to EMME. 852 transit routes were coded into EMME.Figure below shows a plot with the transit services by mode.

Figure 4.2: Transit services coded by mode



Corridor Demand Choice Models

Model Overview

4.10 In order to estimate REM, future demand and capture from alternative modes for the "corridor" demand, two separate choice models have been developed.

- ***Auto shift model***: estimates the demand that shifts from auto to REM
- ***Transit mode choice model***: estimates the redistribution of demand between the different transit modes (bus, rail, Métro and REM).

Generalized Cost

4.11 The key attributes for ***transit users*** include:

- Fare of the trip (in Canadian Dollars)
- In-vehicle travel time (in minutes)
- Access/egress time (in minutes)
- Waiting time (in minutes)
- Transfer time (in minutes)

- Perceived quality of the service: There are intrinsic and intangible benefits perceived by passengers between rail-based modes and conventional bus related to the quality and reliability of the service.

4.12 The attributes included to estimate the Generalized Costs of ***P&R users*** are the same parameters as those described for transit users, but it also includes the auto travel times and costs associated with accessing the P&R station. The monetary costs include fuel and parking costs (if applicable).

4.13 The attributes used to estimate the Generalized Costs of ***Auto users*** include travel time, fuel, parking and tolls.

4.14 Given that some of the Generalized Cost components are measured in time and others in monetary values, the ***value of time*** (VoT) is used to homogenize the different costs in the same units (minutes or CAD$). The value of time provides an indication of how much an individual is prepared to pay in order to save a given amount of journey time.

Generalized Cost Parameters

4.15 In order to assess the specific model parameters (values of times, weights and mode preference) associated with the different users in the corridor, a number of Stated Preference surveys were carried out by Steer Davies Gleave in May and June 2016.

4.16 Respondents were presented with 8 cards with different hypothetical scenarios where REM was compared to other modes. These scenarios were designed for each individual respondent based on their existing trip patterns (Origin/Destination, mode used and existing trip travel time). The behaviour parameters and value of time for each type of user were estimated based on the responses to these scenarios.

4.17 Table 4.1 shows the behaviour parameters extracted from the SP analysis.

Table 4.1: Corridor SP results

Parameter	Transit Users	Car Users
VoT Work	$7.37	$14.85
VoT Non-work	$7.91	$14.85
Access time factor	1.6	2.7
Wait time factor	1.6	1.8
Transfer Penalty	+4 min	
Mode penalties	REM vs Rail/Métro: +11 min REM vs Bus: +6 min	REM with transit access (vs Car): +21 min REM with Park & Ride (vs Car): +4 min

Airport model

Model Overview

4.18 The airport model is a standalone spreadsheet model, which estimates the level of demand that will switch to REM from each of the existing modes (Bus, Car Park and Fly, Car Kiss and Fly and Taxi).

4.19 REM capture is calculated by comparing the Generalized Cost for travel using the existing mode with the Generalized Cost for travel using REM. Generalized cost includes:

- Walk time
- Wait time (which for transit includes any interchange time)
- In-vehicle time
- Fare or parking charge

4.20 Airport passenger and staff demand has been estimated and distributed by market segment using the assumptions in Section 3, (see Table 3.8 for the distribution of in-scope demand by market segment). A binary choice model is then used to understand how each market segment reacts to the change in Generalized Cost when comparing their existing mode to REM. The greater the Generalized Cost advantage of REM compared with the existing mode, the more capture is likely to be abstracted.

4.21 REM capture is calculated for an average hour in the AM peak (6-9 am) and an average hour in the Inter Peak (9-3pm).

Generalized Cost components

4.22 Table 4.2 shows the Generalized Cost components for each mode and their source.

Table 4.2: Generalized Cost components for existing modes

			Source
Walk Time	Bus	Varies for each trip	Estimated in Transit Mode Choice model
	Taxi	0 minutes	
	Car (Park & Fly)	10 minutes	Based on data on car parks on ADM website.
	Car (Kiss & Fly)	0 minutes	
Wait Time	Bus	Varies for each trip	Estimated in Transit Mode Choice model
	Taxi	0 minutes	Assumed no wait time.
	Car (Park & Fly)	10 minutes	Based on data on car parks on ADM website.
	Car (Kiss & Fly)	0 minutes	Assumed no wait time.
In-vehicle Time	Bus	Varies for each trip	Estimated in Transit Mode Choice model
	Taxi	Same times for all of these modes.	Estimated in Network Model
	Car (Park & Fly)		
	Car (Kiss & Fly)		
Fare	Bus	Varies for each trip	Estimated in Transit Mode Choice model
	Taxi	$40 fixed downtown fare $4.86 + $1.7 per km	Based on *Steer Davies Gleave* online research of standard taxi fares in Montréal
	Car (Park & Fly)	$140 parking charge for passengers $0 for staff	Passenger charge based on an assumed average 9 nights stay at the Aéroport Pierre-Elliott-Trudeau (using 2016 SP survey data) and average $16 per night from *Steer Davies Gleave* online research of Aéroport Pierre-Elliott-Trudeau car park charges.
	Car (Kiss & Fly)	$0	Assumed no charge for drop off at the Aéroport Pierre-Elliott-Trudeau.

Generalized Cost Parameters

4.23 In order to assess the specific model parameters (values of times, weights and mode preference) associated with the different type of airport users, Stated Preference interviews were undertaken with passengers in the departure lounge of Montréal-Trudeau Airport in the summer of 2016.

4.24 Respondents were presented with eight cards with different hypothetical scenarios where REM was compared to the current mode used to access the airport (Park & Fly, Dropped-off, Taxi or 747 bus). These scenarios were designed for each individual respondent based on their existing trip patterns (Origin/Destination, mode used and existing trip travel time). The behaviour parameters and value of time for each type of user were estimated based on their responses to these scenarios.

4.25 Table 4.3 shows the behaviour parameters extracted from the SP analysis:

Table 4.3: Airport SP results summary

Parameter	Car Park & Fly	Car Kiss & Fly	Taxi	747 Bus	Airport Staff
VoT Business	$166.6	$37.5	$52.80	$13	$65.00
VoT Non-business	$58.3	$35.3	$28.10		
Access time factor	x1.0	x1.3 (Business) x1.4 (Nonbusiness)	x2.8	x1.0	x1.0
Wait time factor	x1.0		x 5.6	x4.4	x1.0

Expansion factors

4.26 The demand modelling has been carried out for the AM peak period (6am-9am) and the Inter Peak period (9am-3pm). In order to translate into daily and annual ridership, we have estimated the following factors:

- Weekday factor: translates AM peak and Inter Peak demand into an average week day, using the following:
  - AM Peak to Total Peak factor
  - Inter Peak to Total Off Peak factor
- Annual factor: translates average weekday demand into annual demand.

4.27 In order to estimate the potential annualization factors to apply to the REM forecasts, Steer Davies Gleave has reviewed the most recent factors for the most relevant services in the corridor.

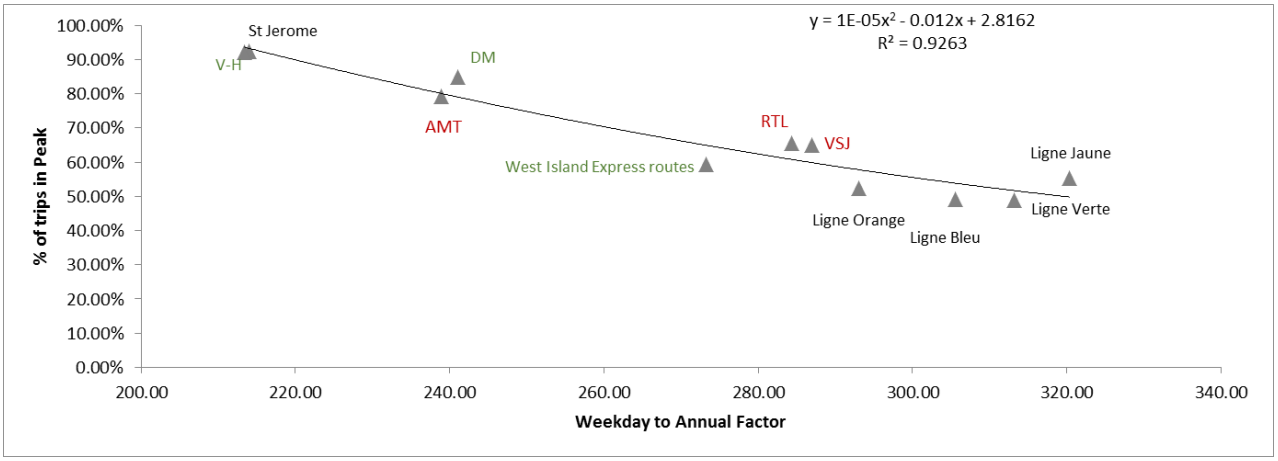
Table 4.4: Expansion Factor Analysis

West Island/Deux-Montagnes	AM PEAK TO PEAK	INTER PEAK TO OFF PEAK	WEEKDAY TO ANNUAL	%PEAK
DM	1.88		241	85%
Express routes	1.95	1.59	273	59%
Orange Line	2.18	1.78	293	52%
ESTIMATED REM	**1.94**	**1.63**	*	*
South Shore/A10	**AM PEAK TO PEAK**	**INTER PEAK TO OFF PEAK**	**WEEKDAY TO ANNUAL**	**%PEAK**
RTL	1.98	1.55	284	66%
AMT	1.83	1.70	239	79%
Ville de Saint-Jean-sur-Richelieu	2.09	1.58	287	65%
CIT	1.90	2.15	192	81%
Total	**1.94**	**1.63**	**258**	**70%**
ESTIMATED REM	**1.94**	**1.63**		

4.28 The annual factor reflects the multiplier that should be applied to convert weekday demand into annual demand. This incorporates weekend, public holidays and seasonality (with commuter service demand reducing over the Christmas and summer holidays).

4.29 There is normally a correlation between the level of service provision/demand in the Peak period of a weekday and that over the weekend and low season. Figure 4.3 plots the correlation between the percentage of demand in the peak periods over the average weekday, and the annual factor for some of the key services in the corridor.

Figure 4.3: Weekday to Annual Expansion Analysis



4.30 The 747 bus service has a very different hourly profile, since it reflects the airport demand based on flight schedules, instead of commuting demand. Based on the 747 bus data the following 747 expansion factors have been estimated:

- AM peak + Inter Peak to weekday: 2.38
- Daily to annual: 277

Ramp up

4.31 Ramp up is the reduction in potential ridership during the first years of operation as users gradually become fully aware of the alignment, service patterns and benefits of the new system. The extent of the ramp up depends on the type of user captured and is unique to every transport infrastructure project. While users from the existing transit system are expected to transfer almost immediately if the existing rail/bus routes are removed, shifts from competing transit modes or from car will take longer to be implemented.

4.32 We have applied the following ramp up factors for the REM system.

Table 4.5: Ramp Up Factors

Year	West-Island/Deux-Montagnes Line Corridor		Airport Corridor		South Shore/A10 Corridor	
	Existing DM	New	New	New	Existing Express (eliminated)	New
2022	100%	60%	80%	60%	90%	60%
2023	100%	80%	90%	80%	95%	80%
2024	100%	90%	95%	90%	100%	90%
2025	100%	100%	100%	100%	100%	100%

5 Demand Development

5.1 The existing and future demand is incorporated in the model in the form of an OD matrix, which defines the demand between each origin and destination, and in some cases segregated by type of user. Different sources have been used in order to define the base matrices, which in some cases have been complemented with data collection (described in the Data Collection report).

2015 Base Year Demand

Auto demand

5.2 The MOTREM model auto demand OD matrix was used as the basis to estimate auto demand. MOTREM was calibrated to the Enquête 2013 and matrix developed for 2016 which is summarized in Table 5.1.

Table 5.1: MOTREM Demand Total (2016)

	AM (6am-9am)	Inter Peak (9am-3pm)	24 hours
Auto	1,166,657	1,350,718	4,800,628
Auto Commercial	146,799	664,107	1,057,953
Light Goods Vehicles	61,210	141,535	308,561
Heavy Goods Vehicles	20,272	55,763	127,309
TOTAL	**1,394,938**	**2,212,122**	**6,294,451**

5.3 The MOTREM auto demand was reviewed and auto calibration is presented in Section 6.

Demand development

Data sources

5.4 Demand matrices were developed by combining data from the sources indicated above and following an extensive process to review and check the accuracy and validity of each data source. The matrices were developed into:

- 3 demand segments (Work, Student and Other)
- 2 time periods: AM peak from 6am-9am and inter peak from 9am-3pm

5.5 Table 5.2 summarizes the data sources by mode and period.

Table 5.2: Demand data source summary

Mode	Period	Direction	Source
AMT Rail	AM peak	All	2015 AMT OD survey
	Inter Peak	All	2013 Enquête origine-destination
Express 90 Chevrier	AM peak	To Montréal	2015 AMT OD survey
		To Chevrier	2013 Enquête origine-destination
	Inter Peak	To Montréal	2015 AMT OD survey
		To Chevrier	2013 Enquête origine-destination
West Island/Deux-Montagnes Line and South Shore/A10 in-scope buses	AM peak and Inter Peak	All	2016 Steer Davies Gleave OD surveys and 2013 Enquête origine-destination
Métro and other	AM peak and Inter Peak	All	2013 Enquête origine-destination

Airport demand

5.6 The spatial distribution of Montréal resident air passenger trips were distributed according to an aggregated version of the EMME Transit Mode Choice Model zones and 68 zones were created in the airport model where each station is assigned to an individual zone.

5.7 The distribution of staff demand has been taken from the ADM staff survey of 2008. This survey contains staff postcodes, which have been mapped to the airport model zoning system. This distribution has then been applied directly to the total annual staff trips. 3% of staff trips were found to be from areas outside of our zoning system and have thus been excluded.

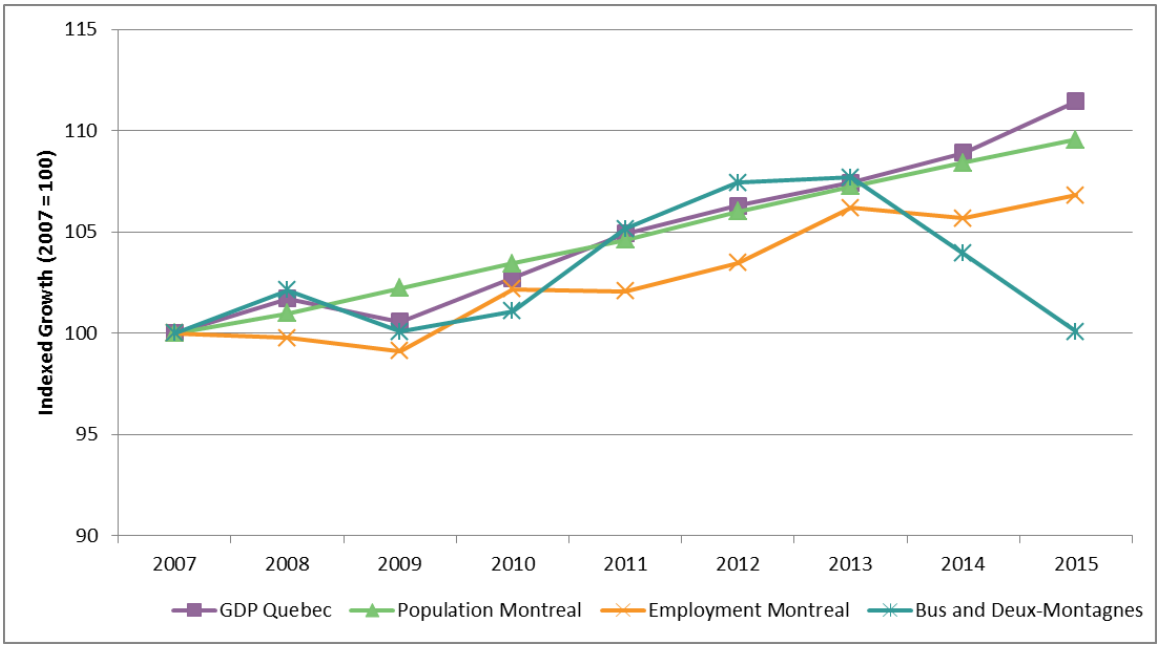
Demand Growth

West Island Transit Growth

Historical Growth

5.8 Steer Davies Gleave has analysed how transit demand has grown in the West Island corridor since 2007 and this has been compared to a range of socioeconomic parameters and shown in Figure below.

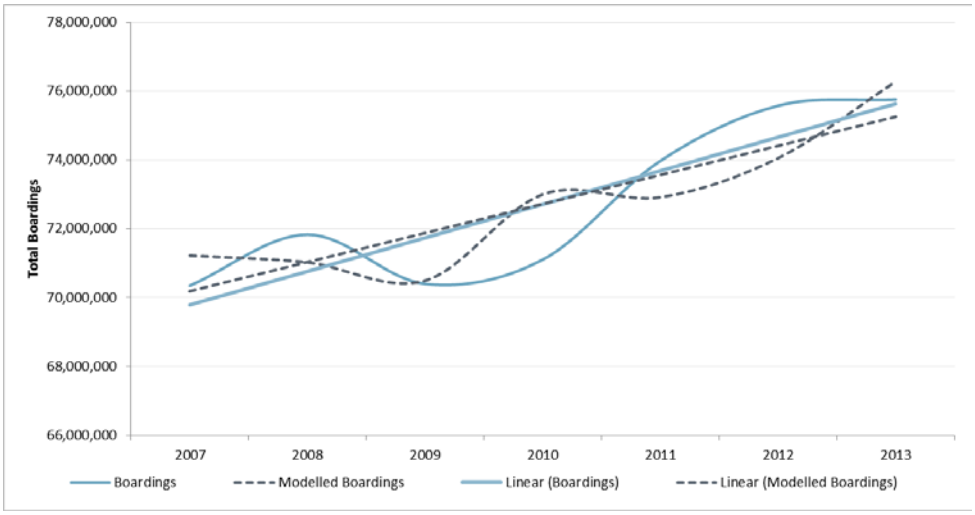
Figure 5.1: West Island/Deux-Montagnes Line transit ridership and socio-economic parameters growth



Growth Model

5.9 Based on the relationship observed between transit boardings and the socio-economic indicators, a regression model was developed. Figure 5.2 shows the comparison of observed and modelled boardings for reference and the considerable year-to-year variations. We have also presented the growth as linear between 2007 and 2013 and this shows a close growth match.

Figure 5.2: West Island/Deux-Montagnes Line Growth Model Results

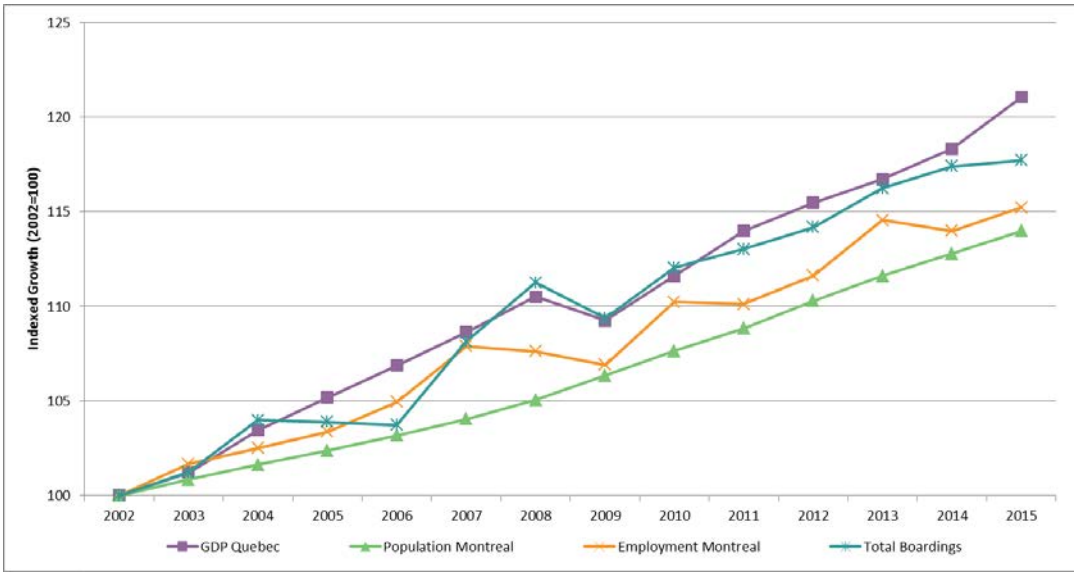


South Shore Transit Growth

Historical growth

5.10 Figure 5.3 shows a close correlation between boardings (for buses) and the various socio-economic parameters.

Figure 5.3: South Shore/A10 boardings and socio-economic parameters growth

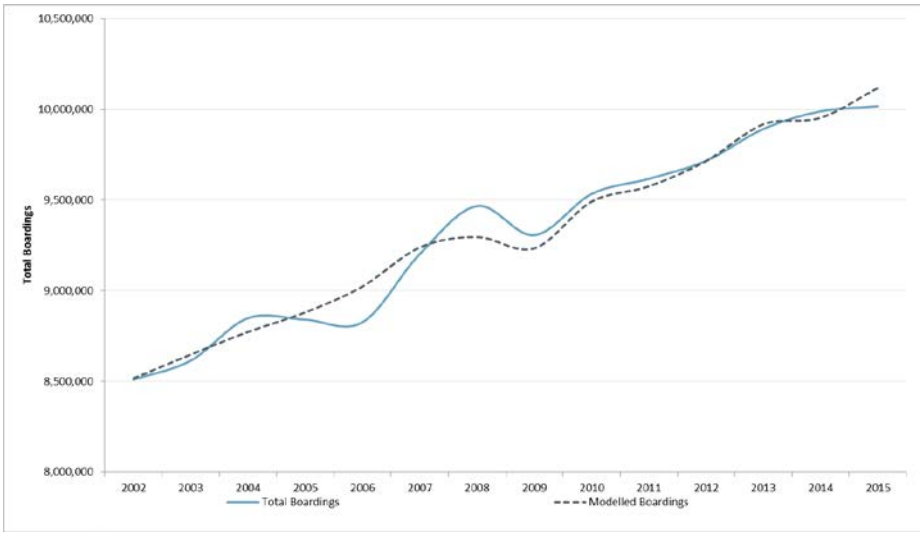


Growth Model

5.11 As with West Island/Deux-Montagnes Line passenger travel, a regression model has been developed between historical boardings and socio-economic indicators. Quebec GDP and Greater Montréal's population and employment provided the best fit and the R^2 of the modelled versus observed ridership based on these parameters was estimated to be 0.97, which indicates a very close correlation of these parameters to transit demand.

5.12 Figure 5.4 shows the comparison of observed and modelled boardings for reference.

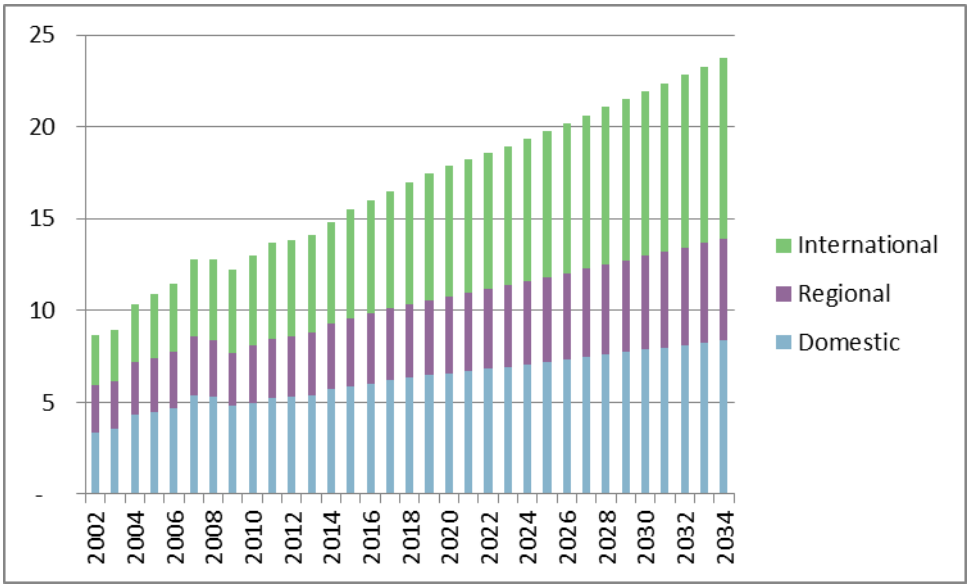
Figure 5.4: South Shore/A10 Growth Model Calibration



Airport demand growth

5.13 The airport demand growth has been based on the forecasts provided by ADM as shown in Figure 5.5.

Figure 5.5: ADM airport growth forecast



Future Transit Matrix Development

Corridor Transit Growth

5.14 A transit growth base case scenario was developed using the models described above based on the identified key demand drivers - the independent variables. Socio-economic growth forecasts have been collected from different reliable sources and summarized in Table 5.3.

Table 5.3: Socio-economic variables and forecasts

Annual Growth	2016	2017	2018	2019	2020	2021	2021-2031
GDP	2.2%	1.8%	1.9%	2.0%	2.0%	1.9%	0.7%
Population	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.6%
Employment	0.8%	1.1%	1.0%	0.9%	0.8%	0.8%	0.6%

5.15 The application of the input parameters identified in Table 5.3 results in the following transit growth estimates as shown in Table 5.4.

Table 5.4: Transit ridership growth estimates

CAGR	2015-2021	2021-2031
South Shore/A10 corridor	1.4%	0.9%
West Island/Deux-Montages Line corridor	1.0%	0.7%

Future Transit Matrix Development

5.16 These growth forecasts represent an estimate of overall average growth in the corridor. However, growth per Origin and Destination will vary based on more localized growth patterns. The resulting transit demand totals for 2021 and 2031 are shown below.

Table 5.5: Transit demand matrices by forecast year

Period	Purpose	2015	2021	2031
AM	Work	207,734	221,944	239,027
AM	Study	132,500	141,963	153,366
AM	Other	24,223	26,068	28,170
AM TOTAL		**364,457**	**389,975**	**420,563**
Inter Peak	Work	84,073	90,195	97,569
Inter Peak	Study	93,151	99,953	108,139
Inter Peak	Other	289,974	311,037	336,420
Inter Peak Total		**467,198**	**501,185**	**542,128**

Auto Future Matrix Development

5.17 Future auto matrices have been based on MTQ's forecast growth as contained in MOTREM. This distribution represents an in-depth analysis of land use and population changes across Greater Montréal.

6 Model Calibration

6.1 Calibration refers to the process undertaken to compare observed against modelled travel data to ensure the model represents current travel demand patterns in Greater Montreal accurately. The calibration process is iterative and involves a review of network coding and demand levels.

Traffic Model

6.2 MOTREM is a 24-hour traffic forecasting model. However, the focus of our work has been on the AM Peak (6:00am-9:00am) and Inter Peak (9:00am-3:00pm) periods and these were calibrated to a 2015 fall weekday base year.

6.3 The calibration was carried out for he two screenlines shown previously. This allows us to understand the main auto demand on the REM corridors across each major screenline.

6.4 Tables below show the resulting AM Peak and Inter Peak auto traffic flow calibration. Note that calibration to individual road links can be challenging and ensured we captured the overall traffic crossing the various screenlines to ensure a good match between modelled and observed screenline flows across screenlines and time periods (between -17% and +14% is the range of differences for all the screenline totals).

Table 6.1: Bridge Crossing Auto Screenline

AM PEAK	Direction	Observed Counts	Modellel Counts	Abs. Diff	% Diff
Champlain Bridge	To Montréal	18,275	17,558	-717	-4%
Champlain Bridge	From Montréal	7,961	7,255	-706	-9%
Honoré Mercier Bridge	To Montréal	9,801	10,273	472	5%
Honoré Mercier Bridge	From Montréal	3,735	4,496	762	20%
Victoria Bridge	To Montréal	7,120	7,472	352	5%
Victoria Bridge	From Montréal	One way only		-	-
Jacques Cartier Bridge	To Montréal	13,276	16,307	3,031	23%
Jacques Cartier Bridge	From Montréal	5,847	7,197	1,350	23%
Louis Hippolyte Lafontaine tunnel	To Montréal	14,652	14,978	327	2%
Louis Hippolyte Lafontaine tunnel	From Montréal	13,124	13,217	92	1%
Subtotal	*To Montréal*	*63,123*	*66,588*	*3,465*	*5%*
Subtotal	*From Montréal*	*30,668*	*32,166*	*1,498*	*5%*
TOTAL		**93,791**	**98,754**	**4,963**	**5%**
INTER PEAK	**Direction**	**Observed Counts**	**Modellel Counts**	**Abs. Diff**	**% Diff**
Champlain Bridge	To Montréal	20,807	18,397	-2,410	-12%
Champlain Bridge	From Montréal	20,584	21,231	647	3%
Honoré Mercier Bridge	To Montréal	11,882	12,164	282	2%
Honoré Mercier Bridge	From Montréal	11,280	14,795	3,515	31%
Victoria Bridge	To Montréal	3,815	2,028	-1,787	-47%
Victoria Bridge	From Montréal	3,887	1,148	-2,739	-70%
Jacques Cartier Bridge	To Montréal	14,664	16,110	1,446	10%
Jacques Cartier Bridge	From Montréal	13,594	20,169	6,575	48%
Louis Hippolyte Lafontaine tunnel	To Montréal	20,366	19,059	-1,308	-6%
Louis Hippolyte Lafontaine tunnel	From Montréal	20,799	22,959	2,160	10%
Subtotal	*To Montréal*	71,534	67,757	-3,777	-5%
Subtotal	*From Montréal*	70,144	80,303	10,159	14%
TOTAL		**141,678**	**148,060**	**6,382**	**5%**

Table 6.2: West Island Auto Screenline

AM PEAK	Direction	Observed Counts	Modelled Counts	Abs. Diff	% Diff
Pointe-Claire	EB1	11,316	14,374	3,058	27%
Pointe-Claire	EB2	10,741	12,046	1,305	12%
Pointe-Claire	WB	10,567	8,504	-2,064	-20%
Des Sources	WB1	7,357	6,226	-1,131	-15%
Des Sources	WB2	12,213	10,346	-1,867	-15%
Des Sources	EB1	12,718	13,686	967	8%
Des Sources	EB2	12,721	12,855	134	1%
Des Sources	EB3	18,270	14,872	-3,398	-19%
Subtotal	To Montréal	65,766	67,833	2,067	3%
Subtotal	From Montréal	30,137	25,076	-5,061	-17%
TOTAL		**95,903**	**92,909**	**-2,995**	**-3%**
INTER PEAK	**Direction**	**Observed Counts**	**Modelled Counts**	**Abs. Diff**	**% Diff**
Pointe-Claire	EB1	15,522	15,157	-365	-2%
Pointe-Claire	EB2	10,954	10,433	-521	-5%
Pointe-Claire	WB	23,818	23,302	-516	-2%
Des Sources	WB1	14,942	12,661	-2,281	-15%
Des Sources	WB2	27,066	28,511	1,445	5%
Des Sources	EB1	28,229	11,486	-16,743	-59%
Des Sources	EB2	13,734	11,486	-2,248	-16%
Des Sources	EB3	13,897	24,891	10,994	79%
Subtotal	To Montréal	82,336	73,452	-8,884	-11%
Subtotal	From Montréal	65,826	64,474	-1,352	-2%
TOTAL		**148,162**	**137,926**	**-10,236**	**-7%**

Transit Model

Rail Loadings

6.5 AMT provided the loading profiles for all the rail lines in Montréal. A comparison of modelled versus observed rail loadings for Deux Montagnes line are shown below. Note that the loading profile calibration focussed on the AM peak direction towards Montréal (as very limited services out of Montreal in the AM peak) and the inter peak.

Figure 6.1: Deux-Montagnes Line Load Profile – AM Peak towards Montréal

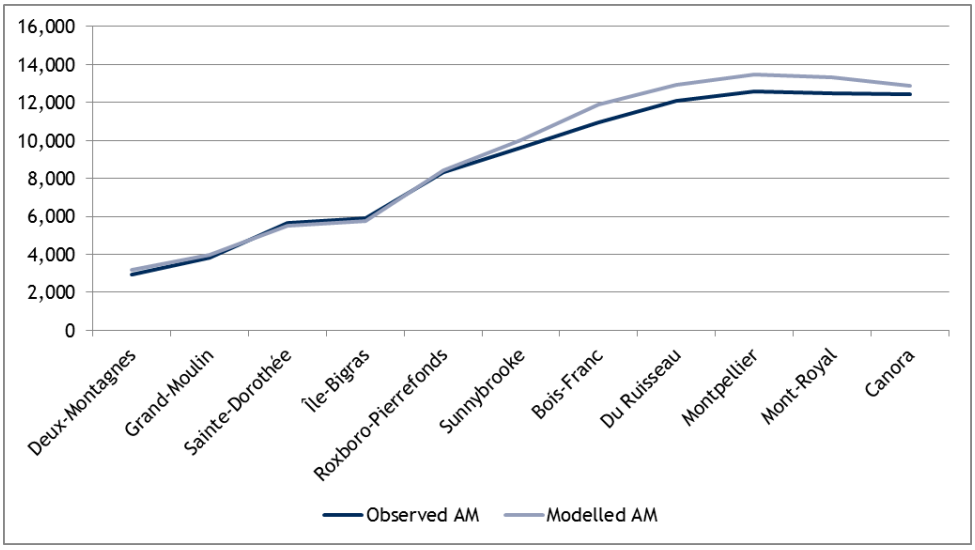


Figure 6.2: Deux-Montagnes Line Load Profile – Inter Peak towards Montréal

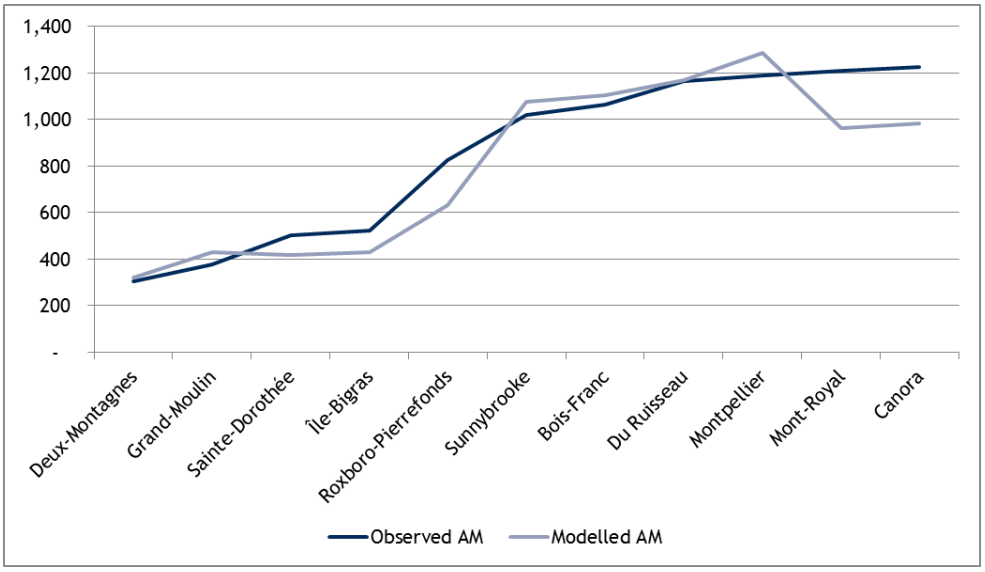
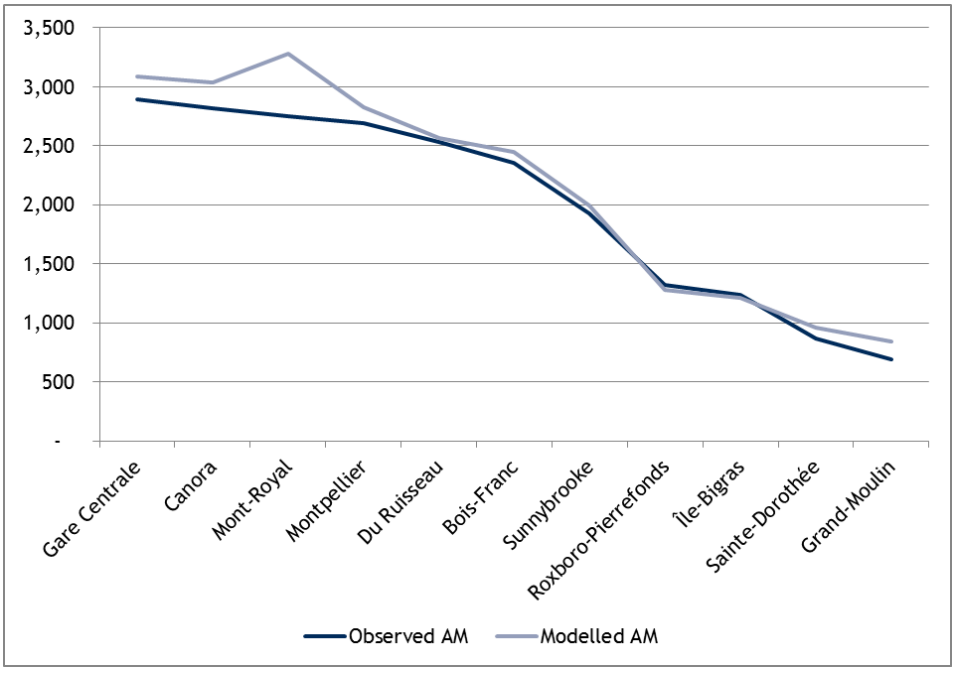


Figure 6.3: Deux-Montagnes Line Load Profile – Inter Peak from Montréal



West Island Transit Boardings

6.6 A scatter plot comparing modelled and observed results presented below.

Figure 6.4: West Island Transit boarding calibration – AM Peak Average Hour

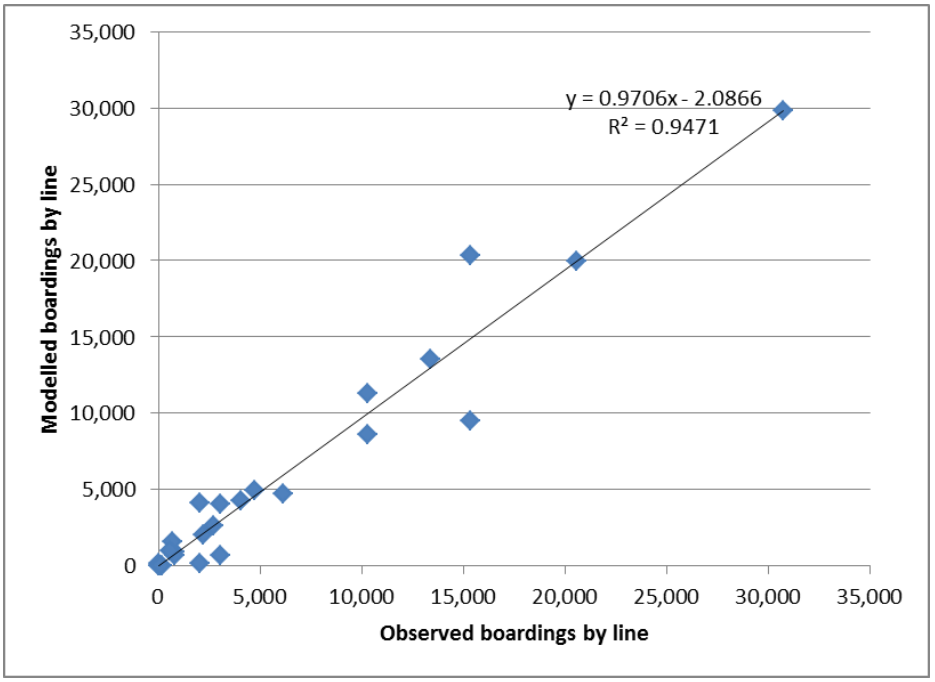
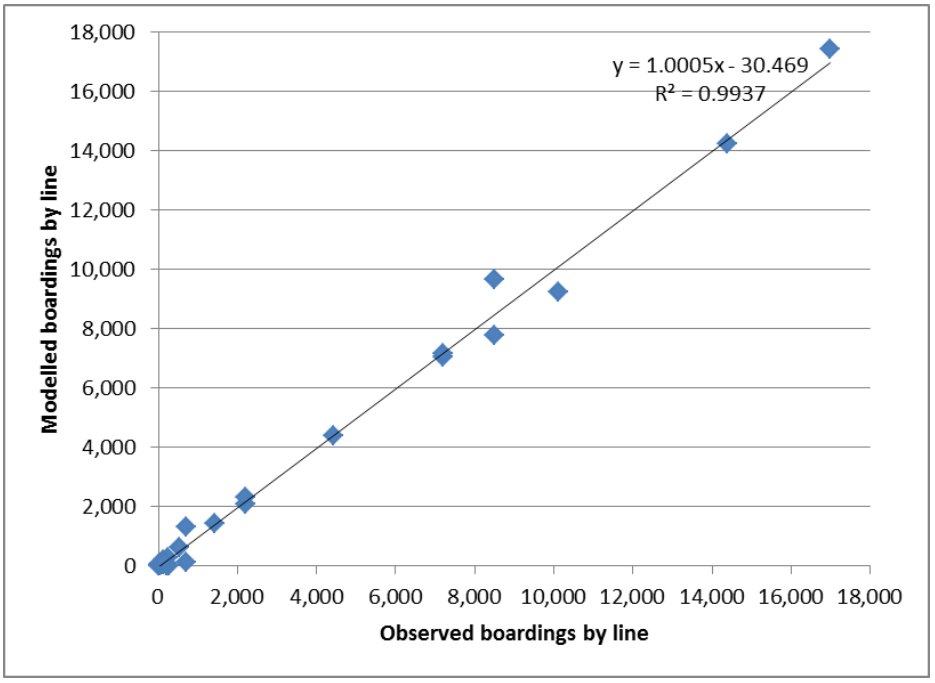


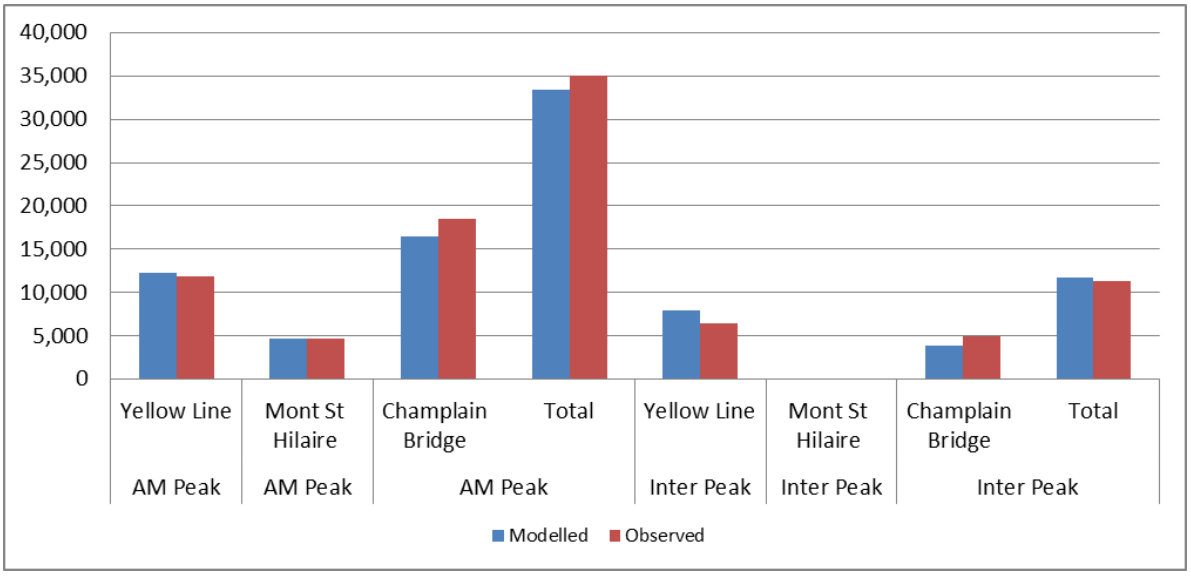
Figure 6.5: West Island Transit boarding calibration – Inter Peak Average Hour



South Shore Screenline

6.7 The South Shore/A10 screenline comparison is shown in Figure 6.6 and it shows the model is predicting total transit demand across the St Lawrence accurately (within 5%) for the AM and Inter Peak periods, and just as importantly, with the correct assignment to each transit link across the river.

Figure 6.6: South Shore/10 Transit Calibration



7 REM Forecasting

Sponsor Case Definition

7.1 REM competitiveness and resulting ridership forecasts will depend to a large extent on the various assumptions undertaken. These relate not only to the REM service itself, but also to the bus network services and fares.

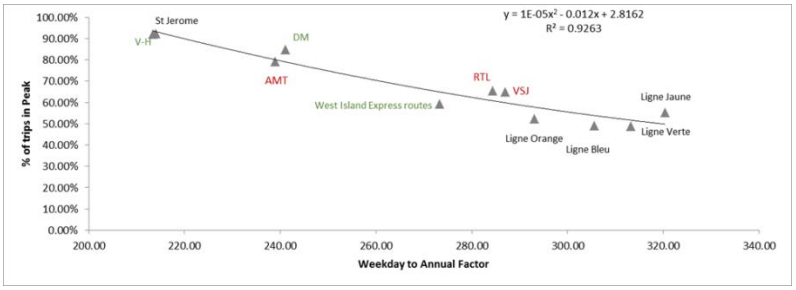
7.2 Table 7.1 describes the Sponsor Case Project Definition. This reflects the Sponsor assumptions of the most likely scenario, given the current engineering and operations analysis to date as well as discussions with a range of organizations (AMT, STM, Aeroport de Montréal) regarding bus restructuring and fare integration.

Table 7.1: Sponsor Case Project Definition

	Description	Assumption
Travel times	Deux-Montagnes to Rive-Sud	46:47
	Roxboro-Pierrefonds to Rive-Sud	36:47
	Sainte-Anne-de-Bellevue to Rive-Sud	46:23
	Aéroport Pierre-Elliott-Trudeau to Rive-Sud	38:30
	Correspondance A40 to Rive-Sud	23:00
Headways (AM Peak)	Deux-Montagnes to Rive-Sud	12
	Roxboro-Pierrefonds to Rive-Sud	12
	Sainte-Anne-de-Bellevue to Rive-Sud	12
	Aéroport Pierre-Elliott-Trudeau to Rive-Sud	12
	Correspondance A40 to Rive-Sud	20
Headways (Inter Peak)	Deux-Montagnes to Rive-Sud	15
	Roxboro-Pierrefonds to Rive-Sud	-
	Sainte-Anne-de-Bellevue to Rive-Sud	15
	Aéroport Pierre-Elliott-Trudeau to Rive-Sud	15
	Correspondance A40 to Rive-Sud	-
Fares	As per current fares	-
Fare Airport	Current average airport fare ($3.15) with $5 premium	$8.15
Bus Re-Structuring	South Shore services re-directed to REM stations STM West Island bus network reconfigured (see Section 2 for further details)	-
747	Eliminated from service	-

7.3 In addition to the REM, bus service and fare assumptions identified above, there are a number of other model assumptions included in the Sponsor Case and these are detailed in Table 7.2.

Table 7.2: Sponsor Case Model Assumptions

<table>
<tr><th>Model Assumptions</th><th>Sponsor Case</th></tr>
<tr><td>Users perception of REM</td><td>REM mode constant defined as 3 minutes (lower than Métro and rail).</td></tr>
<tr><td>Corridor growth</td><td>
<table>
<tr><th>CAGR</th><th>2015-2021</th><th>2021-2031</th></tr>
<tr><td>South Shore/A10</td><td>1.4%</td><td>0.9%</td></tr>
<tr><td>West Island/DM</td><td>1.0%</td><td>0.7%</td></tr>
</table>
</td></tr>
<tr><td>Aéroport Pierre-Elliott-Trudeau growth</td><td>
<table>
<tr><th>CAGR</th><th>2015-2020</th><th>2020- 2034</th></tr>
<tr><td>Aéroport</td><td>2.9%</td><td>2.1%</td></tr>
</table>
</td></tr>
<tr><td>Expansion Factor
(see Figure 4.3)</td><td>Varies depending on the AM Peak and Inter Peak demand breakdown.
 
</td></tr>
<tr><td>Ramp up</td><td>See below</td></tr>
</table>

Year	West-Island/Deux-Montagnes Line Corridor		Airport Corridor		South Shore/A10 Corridor	
	Existing DM	New	Existig 747	New	Existing Express (truncated)	New
2022	100%	60%	80%	60%	90%	60%
2023	100%	80%	90%	80%	95%	80%
2024	100%	90%	95%	90%	100%	90%
2025	100%	100%	100%	100%	100%	100%

Sponsor Case Forecast Overview (2015)

7.4 REM is expected to start operation in 2021 (first full year of operation). However it is good practice to understand the impacts of REM in the base year (2015) to compare demand levels directly with the current situation and therefore assess and understand the robustness of the results.

7.5 REM will provide the Greater Montréal region with a new, fast and reliable transit service with an enhanced level of service in the peak and the off peak periods. As a result, it is expected that the new mode will capture demand not only from existing transit users, but also from other competing transit modes. Table 7.3 shows the total REM demand and where the trips have transferred from.

Table 7.3: REM Demand captured by Market(2015)

	AM Peak		Inter Peak		AM Peak + Inter Peak	
	Passengers	Percentage	Passengers	Percentage	Passengers	Percentage
Airport Capture	1,022	2%	1,974	8%	2,997	4%
Auto Capture	5,520	10%	-	0%	5,520	7%
Transit Capture	47,924	88%	21,750	92%	69,673	89%
TOTAL	54,466	100%	23,724	100%	78,189	100%

7.6 Most of the REM demand is captured from existing ***transit services***. This is particularly the case from those services that are replaced (Deux Montagnes rail service) or truncated (South Shore/A10 express bus services) in order to be fully integrated with the REM. Table 7.4 shows that over 60% of the total transit demand are currently using the A10 and Deux Montagnes services.

Table 7.4: REM transit shift capture (2015)

	AM Peak	Inter Peak	AM Peak+ Inter Peak
A10 Express services*	16,458	8,262	24,721
Deux Montagnes*	14,371	4,802	19,173
Other	17,094	8,685	25,779
Transit Capture	**47,924**	**21,750**	**69,673**
% Existing	64%	60%	63%

* Data includes boardings at Gare Centrale

7.7 Similarly, most of the airport demand captured by REM is expected to be transferred from existing transit demand currently using the 747, as the service will not be operational as shown in Table 7.5.

Table 7.5: REM Airport Demand Capture (2015)

AM Peak and Inter-Peak	Passengers	Proportion
Existing 747	1,896	63%
Other modes	1,101	37%
Total	2,997	100%

7.8 Demand shift from car to REM has been estimated with the auto shift model which estimates the user choice between auto, REM with transit access and REM with Park & Ride access. While the

model shows a higher demand for P&R access, this demand is constrained by the capacity of existing facilities in most of the corridor. The only exceptions are the new or extended facilities in the South Shore/A10 area and in some locations in the West Island (mostly along the Sainte-Anne-de-Bellevue branch). Table 7.6 shows the car shift demand estimates.

Table 7.6: REM Car shift capture (2015)

Auto capture	AM peak boardings
Park & ride access	4,360
South Shore/A10	2,600
Other	1,760
Transit access	1,160
South Shore/A10	420
Other	740

7.9 In summary, the following table shows the estimated number of boardings in the AM and Inter Peak periods should the REM have been implemented in 2015. The number of boardings have been aggregated for all the stations located in the South Shore/A10 and West Island/Deux-Montagnes corridor. Gare Centrale has been included separately.

Table 7.7: 2015 AM Peak and Inter Peak REM Boardings

REM section	AM Peak	Interpeak
South Shore/A10 stations*	22,614	5,281
West Island/Deux-Montages stations*	30,328	10,723
Gare Centrale	1,524	7,720
Total	**54,466**	**23,724**

* Data does not include boardings at Gare Centrale

- The South Shore/ A10 corridor incremental demand is moderate and in part driven by the additional Car Park and Ride capacity.
- However, it is the West Island/Deux-Montages corridor where the REM captures more additional demand, not only from Car Park and Ride users, but mainly from transit users.

Sponsor Case Forecasts (2021 and 2031)

Sponsor Case Ridership Forecasts

7.10 The 2021 and 2031 REM demand captures are similar to the 2015 estimation presented above, however, the demand has been modified to account for the expected socioeconomic growth in the region (and specific to the corridor) and to account for the future road and transit network changes.

7.11 Table 7.8 shows the AM and Inter Peak REM demand for 2021 and 2031. The REM annual growth is expected to be very similar to that estimated for the whole corridor

Table 7.8: AM Peak and Inter Peak REM Boardings

Period	REM section	Demand by period			CAGR	
		2015	2021	2031	2015-2021	2021-2031
AM PEAK	South Shore/A10 stations	22,614	24,262	26,269	1.2%	0.8%
	West Island/Deux-Montages stations	30,328	31,909	33,875	0.9%	0.6%
	Gare Centrale	1,524	1,611	1,727	0.9%	0.7%
	Total	**54,466**	**57,782**	**61,871**	**1.0%**	**0.7%**
INTER PEAK	South Shore/A10 stations	5,281	5,741	6,253	1.4%	0.9%
	West Island/Deux-Montages stations	10,723	11,713	13,059	1.5%	1.1%
	Gare Centrale	7,720	8,208	8,804	1.0%	0.7%
	Total	**23,724**	**25,663**	**28,117**	**1.3%**	**0.9%**

7.12 The resulting boardings and alightings for each station for 2021 and 2031 (AM and Inter Peak) are shown below.

Table 7.9: AM and Inter Peak Station Boardings and Alightings (2021 and 2031)

	2021				2031			
	AM Peak Boards	AM Peak Alights	Inter Peak Boards	Inter Peak Alights	AM Peak Boards	AM Peak Alights	Inter Peak Boards	Inter Peak Alights
Île-des-Soeurs	153	553	22	121	162	593	25	132
Panama	13,739	344	3,464	2,370	14,977	388	3,797	2,603
Du Quartier	3,787	241	642	587	3,991	252	688	631
Rive-Sud	6,583	-	1,614	112	7,138	-	1,744	122
Technoparc Saint-Laurent	2	166	13	71	3	178	14	76
Aéroport Pierre-Elliott-Trudeau	816	583	1,160	1,115	952	706	1,397	1,608
Autoroute 13	338	376	104	125	360	402	116	134
Des Sources	818	282	697	541	880	298	749	575
Pointe-Claire	1,944	539	794	411	2,065	575	853	437
Kirkland	1,276	-	172	79	1,356	-	183	84
Sainte-Anne-de-Bellevue	1,053	99	309	26	1,120	106	354	27
Deux-Montagnes	3,431	138	489	1,044	3,590	149	533	1,127
Grand-Moulin	866	5	114	128	892	5	122	136
Sainte-Dorothée	1,661	77	64	491	1,684	83	68	489
Île-Bigras	456	71	55	94	490	77	84	104
Roxboro-Pierrefonds	3,597	190	448	856	3,782	202	511	910
Sunnybrooke	1,773	94	476	554	1,859	99	509	589
Bois-Franc	4,913	910	2,409	1,375	5,243	989	2,736	1,358
Du Ruisseau	1,475	339	82	297	1,517	368	87	317
Montpellier	2,586	1,435	985	1,273	2,779	1,540	1,105	1,292
Correspondance A40	2,851	1,805	1,419	240	3,085	1,961	1,540	267
Mont-Royal	803	3,059	1,192	3,114	866	3,285	1,305	3,338
Canora	1,250	2,719	732	420	1,352	2,914	793	458
Gare Centrale	1,611	43,756	8,208	10,219	1,727	46,702	8,804	11,303
TOTAL	**57,782**	**57,782**	**25,663**	**25,663**	**61,871**	**61,871**	**28,117**	**28,117**

7.13 The peak loads for all scenarios and time periods are observed at the link between Correspondence A40 and Mont Royal. The specific peak loads are:

- 2021 AM Peak: 26,120 passengers
- 2021 Inter Peak: 7,613 passengers
- 2031 AM Peak: 27,595 passengers
- 2031 Inter Peak: 8,513 passengers

7.14 The following table shows the specific loads for all the line sections.

Table 7.10: Demand loads per line section

Section	2021 AM Peak	2021 Inter Peak	2031 AM Peak	2031 Inter Peak
RIVE-SUD-DU QUARTIER	6,583	1,614	7,140	1,744
DU QUARTIER-PANAMA	10,370	2,256	11,130	2,431
PANAMA-ILE-DES-SOEURS	24,064	5,626	26,058	6,128
ILE-DES-SOEURS-GARE CENTRALE	24,063	5,634	26,055	6,138
AUTOROUTE 13-TECHNOPARC SAINT-LAURENT	744	1,180	879	1,678
TECHNOPARC SAINT-LAURENT-AÉROPORT	583	1,115	706	1,608
BOIS-FRANC-AUTOROUTE 13	1,800	2,350	2,001	2,918
AUTOROUTE 13-DES SOURCES	795	1,056	846	1,124
DES SOURCES-POINTE-CLAIRE	638	516	680	549
POINTE-CLAIRE-KIRKLAND	99	105	106	112
KIRKLAND-SAINTE-ANNE-DE-BELLEVUE	99	26	106	27
GARE CENTRALE-CANORA	5,124	7,129	5,563	7,662
CANORA-MONT ROYAL	4,288	7,281	4,670	7,831
MONT ROYAL-CORRESPONDANCE A40	3,373	6,543	3,675	7,081
CORRESPONDANCE A40-MONTPELLIER	2,755	7,490	3,016	8,150
MONTPELLIER-DU RUISSEAU	2,516	6,546	2,765	7,217
DU RUISSEAU-BOIS-FRANC	2,465	6,260	2,711	6,914
BOIS-FRANC-SUNNYBROOKE	357	3,099	385	3,283
SUNNYBROOKE-ROXBORO-PIERREFONDS	325	2,578	351	2,729
ROXBORO-PIERREFONDS-ÎLE BIGRAS	253	1,728	273	1,825
ÎLE BIGRAS-STE-DOROTHÉE	219	1,634	237	1,721
STE-DOROTHÉE-GRAND MOULIN	143	1,172	155	1,263
GRAND MOULIN-DEUX-MONTAGNES	138	1,044	149	1,127
GARE CENTRALE-ILE-DES-SOEURS	939	3,083	1,018	3,371
ILE-DES-SOEURS-PANAMA	541	2,975	591	3,255
PANAMA-DU QUARTIER	240	699	253	753
DU QUARTIER-RIVE-SUD	0	111	0	123
AÉROPORT-TECHNOPARC SAINT-LAURENT	816	1,160	952	1,397
TECHNOPARC SAINT-LAURENT-AUTOROUTE 13	813	1,168	949	1,405
SAINTE-ANNE-DE-BELLEVUE-KIRKLAND	1,053	309	1,120	354
KIRKLAND-POINTE-CLAIRE	2,330	481	2,476	536
POINTE-CLAIRE-DES SOURCES	4,274	1,276	4,541	1,390
DES SOURCES-AUTOROUTE 13	4,967	1,973	5,289	2,139
AUTOROUTE 13-BOIS-FRANC	6,003	3,233	6,473	3,642
DEUX-MONTAGNES-GRAND MOULIN	3,431	489	3,590	533

Section	2021 AM Peak	2021 Inter Peak	2031 AM Peak	2031 Inter Peak
GRAND MOULIN-STE-DOROTHÉE	4,297	603	4,482	655
STE-DOROTHÉE-ÎLE BIGRAS	5,957	638	6,165	692
ÎLE BIGRAS-ROXBORO-PIERREFONDS	6,375	692	6,615	776
ROXBORO-PIERREFONDS-SUNNYBROOKE	9,854	1,134	10,272	1,280
SUNNYBROOKE-BOIS-FRANC	11,565	1,578	12,067	1,755
BOIS-FRANC-DU RUISSEAU	21,880	6,656	23,120	7,487
DU RUISSEAU-MONTPELLIER	23,066	6,726	24,323	7,564
MONTPELLIER-CORRESPONDANCE A40	24,454	7,382	25,811	8,307
CORRESPONDANCE A40-MONT ROYAL	**26,120**	**7,613**	**27,595**	**8,513**
MONT ROYAL-CANORA	24,780	6,430	26,171	7,230
CANORA-GARE CENTRALE	24,146	6,588	25,502	7,395

7.15 The model estimates ridership for the AM peak (6am-9am) and the Inter Peak (9am-3pm) periods. In order to translate this into weekday and annual figures, specific expansion factors by market have been applied according to the methodology described above. The following table shows the (weighted) average expansion factors applied to the REM demand

Table 7.11: REM Station Boardings (Daily and Annual)

	AM to Total Peak	Inter Peak to Total Off Peak	Weekday to Annual
2021	1.95	1.64	255
2031	1.95	1.64	256

7.16 The resulting daily and annual demand for each station are shown below.

Table 7.12: REM Daily and Annual Boardings (no ramp up)

	Daily		Annual	
	2021	2031	2021	2031
Île-des-Soeurs	804	862	183,779	197,334
Panama	18,413	20,116	4,627,687	5,060,300
Du Quartier	4,905	5,191	1,176,460	1,248,228
Rive-Sud	7,792	8,446	1,832,264	1,985,210
Technoparc Saint-Laurent	232	249	60,478	64,614
Aéroport Pierre-Elliott-Trudeau	4,106	5,148	1,137,358	1,425,996
Autoroute 13	862	929	208,662	225,226
Des Sources	2,075	2,223	652,018	697,789
Pointe-Claire	3,391	3,612	876,176	934,606
Kirkland	1,442	1,533	328,274	348,939
Sainte-Anne-de-Bellevue	1,390	1,500	331,208	360,691
Deux-Montagnes	4,712	4,980	1,191,501	1,266,472
Grand-Moulin	1,042	1,080	246,852	257,083
Sainte-Dorothée	2,138	2,168	516,192	522,415
Île-Bigras	633	703	150,198	170,690
Roxboro-Pierrefonds	4,736	5,022	1,156,047	1,232,189
Sunnybrooke	2,651	2,795	701,626	742,414
Bois-Franc	8,746	9,396	2,394,114	2,578,122
Du Ruisseau	2,067	2,155	473,692	494,974
Montpellier	5,741	6,144	1,525,359	1,628,658
Correspondance A40	6,431	7,051	1,640,798	1,808,594
Mont-Royal	7,250	7,808	2,271,671	2,448,214
CANORA	4,788	5,159	1,140,604	1,231,145
Gare Centrale	58,466	62,777	14,676,856	15,816,417
TOTAL	**154,812**	**167,045**	**39,499,876**	**42,746,320**

Sponsor Case Passenger Kilometre Forecasts

7.17 With the ridership data extracted from the Transit Mode Choice model we can then estimate the passenger kilometres on REM by factoring individual link loads by the corresponding distance. The passenger kilometre estimates are shown in the table below.

Table 7.13: REM Annual Passenger-Kilometres (no ramp up)

	2021	2031
TOTAL	597,225,258	645,937,430

7.18 The highest passenger kilometres are observed on links with high ridership and long length. These include Gare Centrale to Canora (5.4 kilometres), Bois Franc to Sunnybrooke (6.4 kilometres), Ile des Soeurs to Gare Centrale (5.4 kilometres) and Panama to Ile des Soeurs (5.4 kilometres).

Ridership and Passenger Kilometre annual profile

7.19 The application of the ramp up has been based on the estimation of the split between existing demand and new demand, as different ramp up rates have been assumed to reflect the fact that

existing users are more likely to adopt and use the REM at a faster rate. The following table shows the resulting ramp up for the base case.

Table 7.14: Ramp up

Ramp up	2021	2022	2023	2024
Annual Demand	78%	89%	96%	100%
Annual Pax-Km	75%	87%	94%	100%

7.20 Table 7.15 shows a summary of the ridership and passenger kilometre totals for the first full year of operation (2021), 2026 and 2031 with the ramp up applied.

Table 7.15: REM Ridership and Passenger Kilometre Summary (with ramp up)

	2021	2026	2031
Daily			
Boardings	120,441	160,796	167,045
Passenger kilometre	1,750,240	2,430,558	2,524,216
Annual			
Boardings	30,657,333	41,086,677	42,746,320
Passenger kilometre	446,567,748	621,058,891	645,937,430

7.21 The figures below show the resulting ridership and passenger kilometre forecast profiles accounting for ramp up. This explains the high growth estimated in the 2021 to 2024 period when the ramp up is applied as the REM starts operations and it becomes an integral part of Montreal's transit network.

Figure 7.1: Annual Ridership Profile (with ramp up)

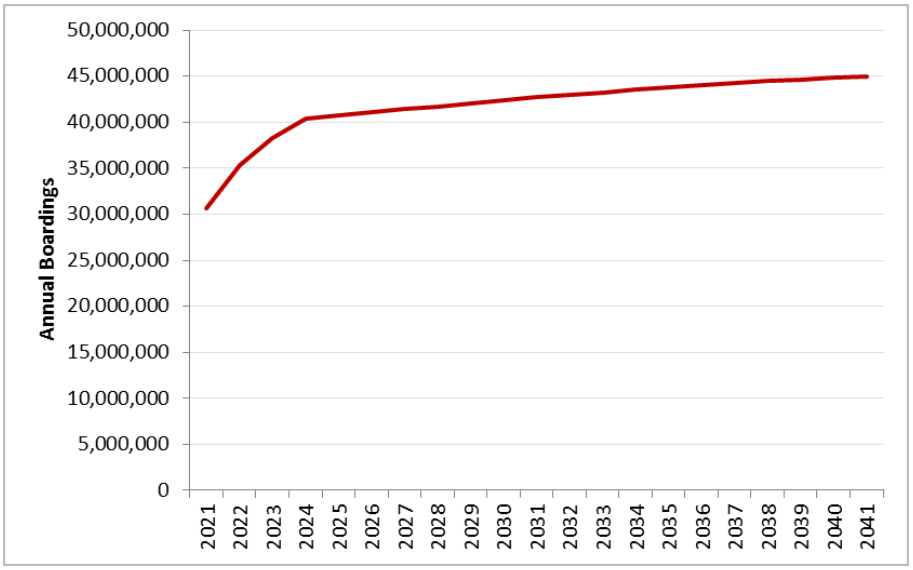
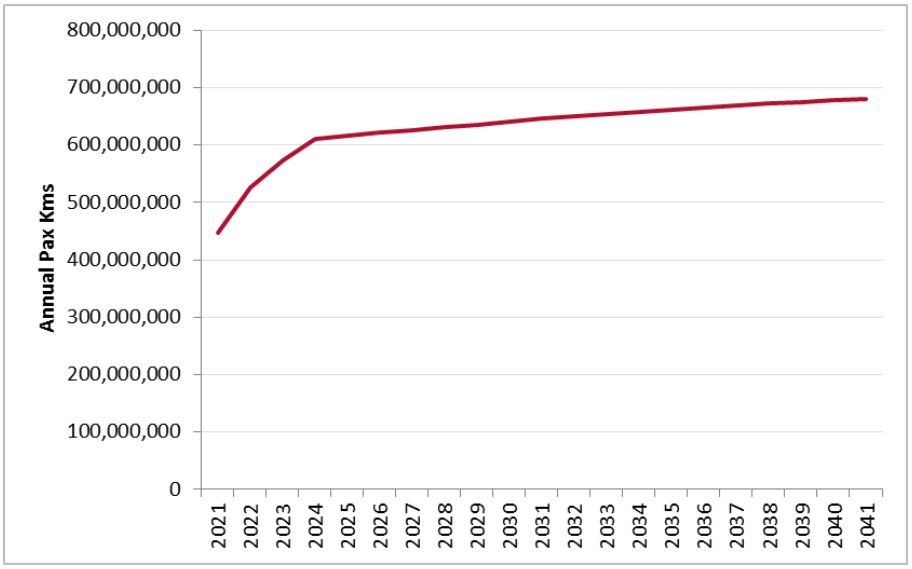


Figure 7.2: Annual Passenger Kilometre Profile (with ramp up)



8 Sensitivity Tests

Identified risks

8.1 REM underlying projects (Champlain LRT, Train de l'Ouest and Aerotrain projects) have been priorities for a long time.

8.2 The Sponsor Case reflects the sponsor assumptions of the most likely scenario, given the current engineering and operations analysis to date and latest discussions with a range of organizations. It also includes the consultant base assumptions for the model parameters and expected transit growth. However, there are a number of risks in any transit project and these need to be clearly identified to understand their potential ridership and operational impact. These include:

- Transit network: transit agencies (AMT, STM and CITs) are cooperating with CDPQ to develop an integrated transit network. However there is a risk on the level of transit integration and/or level of service to be implemented.
- Fare: there is some uncertainty with regards to the fare that will be charged on REM. The Sponsor Case assumes the REM fare will be similar to the current fare structure in Greater Montreal. However if different fares assumed e.g. STM fares applicable on REM stations in Montréal Island will reduce overall fares and will increase REM ridership at the expense of express buses and Métro lines
- Demand growth: there are some concerns with regards to the recent decline in transit ridership observed in the last couple of years (especially on STM bus services). This may be a temporary effect (particularly cold recent winters, employment reductions and low gas prices) or a more fundamental shift like competition from alternative modes (taxi industry transformation, car sharing, cycling) or changes in travel patterns (working from home, online shopping, etc).
- Model parameters: this study has included a substantial data collection exercise and development of forecasting model. However every model requires a number of assumptions related to the behaviour of passengers and how they value the different travel components and REM perceptions compared to other modes (bus, rail and Métro).

Low and High Case Definition

8.3 We developed Low and High cases to understand the combined effect of various assumptions and enable to understand the range of ridership on the Sponsor Case.

8.4 Table 8.1: presents the assumptions adopted for the Sponsor Case, compared to the High and Low Cases. Each case includes the combination of all the different assumptions adopted for each variable.

Table 8.1: Sensitivity test definition

	Description	Sponsor Case	Low Case	High Case
Travel times	Deux-Montagnes to Rive-Sud	46:47	51:28	Same as sponsor
	Roxboro-Pierrefonds to Rive-Sud	36:47	40:28	Same as sponsor
	Sainte-Anne-de-Bellevue to Rive-Sud	46:23	51:01	Same as sponsor
	Aéroport Pierre-Elliott-Trudeau to Rive-Sud	38:30	42:21	Same as sponsor
	Correspondance A40 to Rive-Sud	23:00	25:18	Same as sponsor
Fares	South Shore fares	As per current fares	Same as sponsor	Same as sponsor
Fares	West Island fares	As per current fares (REM as AMT in Montreal Island)	STM fares on REM in Montreal Island	Same as sponsor
Fare Airport	Current average airport fare ($3.15) with premium	$8.15 ($5 premium)	$5.65 ($2.50 premium)	Same as sponsor
Bus Re-Structuring	South Shore services	South Shore services re-directed to REM stations	Same as sponsor	Same as sponsor
Bus Re-Structuring	STM West Island services	Bus network reconfigured	Bus network reconfigured with 20% reduction in frequency	Bus network reconfigured with 10% increase in frequency (if wait time is 10 mins or lower no reduction applied)
747	Eliminated from service	Removed	Remains as current	Same a sponsor
REM perception	Transit users mode constant vs bus	3 minutes	0 minutes	5 minutes
Growth		As modelled	-50% modeled	+30% modeled
Ramp up		See Table 8.3 below	See Table 8.3 below	See Table 8.3 below
Car shift		Auto Shift Model	30% reduction	30% increase

Table 8.2: Ramp Up Assumptions – Low and High Case

Year	West-Island/Deux-Montagnes Line Corridor		Airport Corridor		South Shore/A10 Corridor	
	Existing Deux Montagnes Rail	New	Existing	New	Existing Express (eliminated)	New
SPONSOR CASE						
2021	100%	60%	80%	60%	90%	60%
2022	100%	80%	90%	80%	95%	80%
2023	100%	90%	95%	90%	100%	90%
2024	100%	100%	100%	100%	100%	100%
2024	100%	100%	100%	100%	100%	100%
LOW CASE						
2021	100%	55%	55%	55%	85%	55%
2022	100%	75%	75%	75%	90%	75%
2023	100%	85%	85%	85%	95%	85%
2024	100%	95%	95%	95%	100%	95%
2025	100%	100%	100%	100%	100%	100%
HIGH CASE						
2021	100%	70%	85%	70%	95%	70%
2022	100%	85%	95%	85%	100%	85%
2023	100%	90%	100%	90%	100%	90%
2024	100%	100%	100%	100%	100%	100%
2025	100%	100%	100%	100%	100%	100%

Ridership Forecasts

8.5 The full profile for ridership and passenger kilometres for the low and high cases are shown in Figure 8.1: and Figure 8.2. Note that ramp up has been applied to these forecasts and hence the steep growth during the first few years of REM operations.

Figure 8.1: Annual boardings – Low and High Cases (with ramp up)

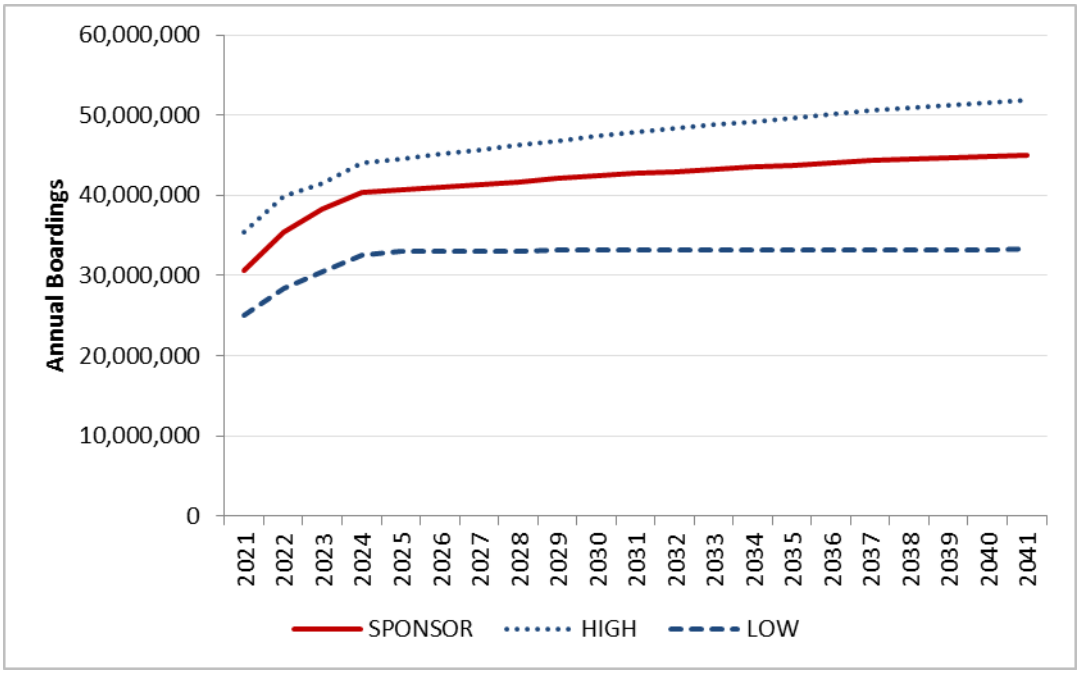
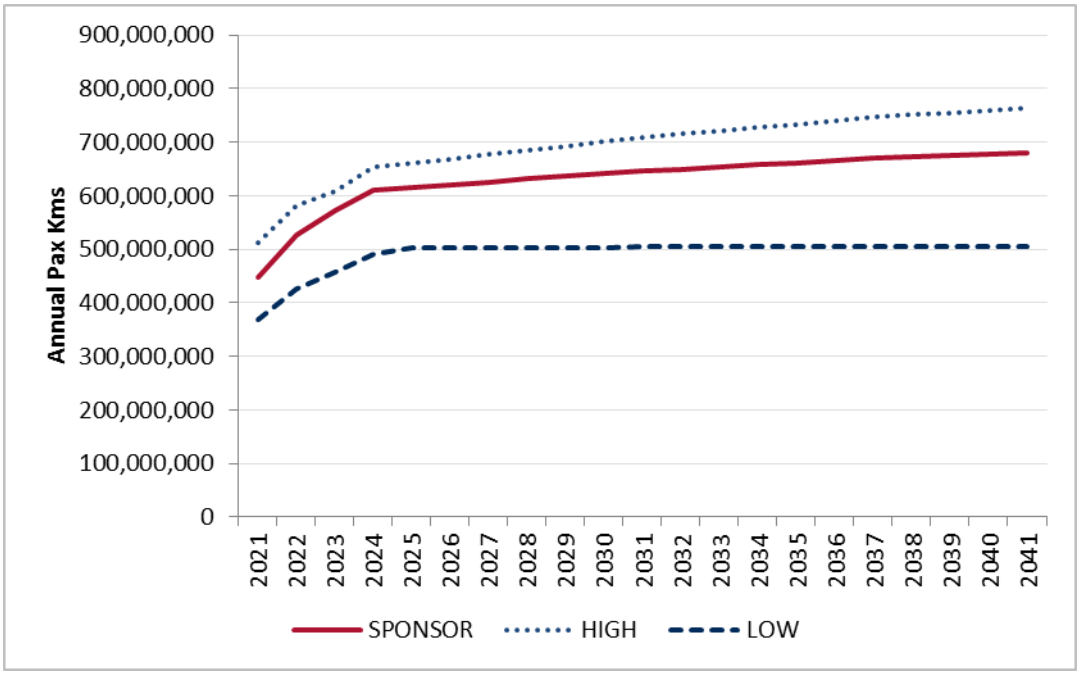


Figure 8.2: Annual Passenger Kilometres – Low and High Case (with ramp up)



8.6 The table below compares the results for 2021 and 2031. The larger difference observed in 2021 is due to the ramp up impact. Note that the change in boardings and passenger kilometres are closely aligned.

Table 8.3: Low and High Case Comparison

	Boardings		Passenger Kilometres	
	2021 (with ramp up)	2031	2021 (with ramp up)	2031
Sponsor	-	-	-	-
Low	-18%	-22%	-17%	-22%
High	+16%	+12%	+15%	+10%

8.7 Finally, we have reviewed the peak loads for the various cases to understand the impact on REM operations. The peak loads are detailed below.

Table 8.4: Low and High Case Peak Loads

	AM Peak Load (no ramp up)		Difference from Sponsor Case	
	2021	2031	2021	2031
Sponsor	26,120	27,595	-	-
Low	22,689	22,950	-13%	-17%
High	28,614	31,113	10%	13%