

Mémo déposé par Peter McQueen
Pour
Le Conseil Communautaire Notre-Dame-de-Grâce

1. Introduction

Ce mémo concerne seulement la partie du train REM qui irait vers l'aéroport Pierre-Elliott Trudeau.

2. 1.The REM Airport Branch: Expensive, Ineffective, Circuitous

2.1. REM Airport Branch Issues & Impacts

There are numerous issues and potential impacts with the airport branch of the proposed REM:

- The routing via the airport is a big detour, which passes through Wetlands, and will encourage development in the Technopark area (a suburban office park in a natural area)
- This big detour means that during the peak, the train is slow (since it has to make all stops), during the off-peak, it maybe be possible to run it as an express, which may be faster - but then it will only stop at Gare Centrale and Bois-Franc, meaning any passenger who has to connect via another station will require another transfer. So depending on the time of day the train is either slow, or requires an extra connection. As service increases on the REM, all-day high frequency will make the airport express impossible.
- The airport branch is expensive - 320M for just the infrastructure, plus maybe another 150M\$ for 'material roulant et systeme' (based on the airport branch being 10% of the system, see DA-79 for a [cost breakdown](#)). This means the total cost of the airport branch will be around half a billion dollars.
- This compares to a daily ridership of only 2700 in 2022, and up to 4200 in 2041 under the optimistic scenario (based on August [ridership study](#) by CDPQInfra).
- This 110K\$ - 170K\$ cost per weekday trip would make the airport branch one of the most expensive transit projects in Canada (compare to the Orange line extension in Laval at 14K\$ per weekday trip).
- The business case for using the Gare Centrale as the terminus (as favored by the Aeroport de Montreal) rather than using the existing AMT line which terminates in Lucien L'Allier (in the past favored by the AMT), was based on higher expected ridership. The Gare Centrale routing was supposed to bring in 10,000 riders per day (22% more than the Lucien L'Allier alignment), which is also what the CDPQInfra used in their Media documents.
Their ridership study nevertheless only shows a ridership of 2700, which weakens the case Gare Centrale.
- The Caisse owns two of the four closest hotels to Gare Centrale, within walking distance: the Royal Elizabeth, and the Hotel W. The Caisse recently invested 140M\$ in the Royal Elizabeth. Both assets will undoubtedly benefit tremendously from an airport train within

200m/500m (Gare Centrale), but will benefit less if the airport train is 800m/1000m away (Lucien L'Allier).

The Caisse also owns the Eaton Centre, Montreal Trust, and has invested significantly in Place Ville-Marie.

All these assets will benefit from an airport train going to Gare Centrale, which represents a conflict of interest:

The Caisse is planning to build a transit line, using large amounts of public funding and infrastructure assets, while not maximizing public utility but apparently maximizing the benefits to their own assets instead.

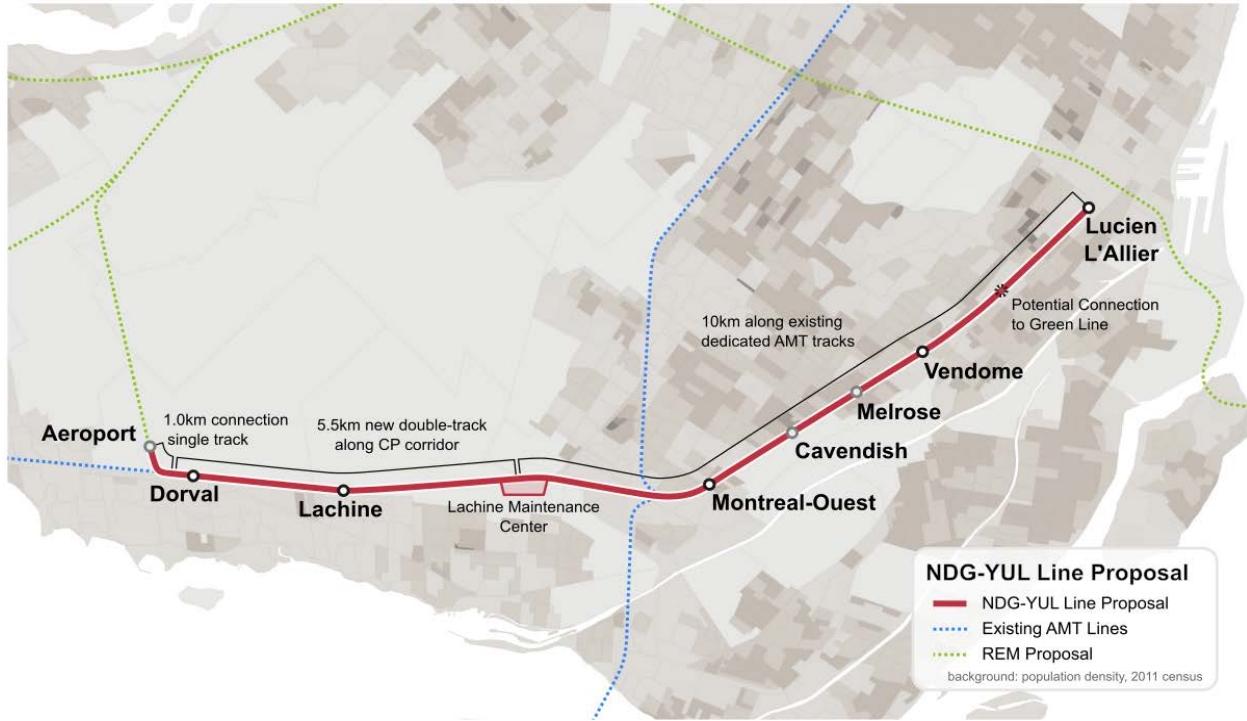
- The REM project overall will starve the VH (Vaudreuil-Hudson) line (see separate discussion). This may affect NDG and Lachine badly - the VH line could serve NDG and Lachine better if more station and service was added

2.2. Proposed Alternative: Use the Vaudreuil-Hudson line to connect to the Airport & add stations in NDG

Using the existing Vaudreuil-Hudson AMT line to connect to the airport would solve a lot of these issues. For a similar cost, it would be possible to serve much more ridership and strengthen the Vaudreuil-Hudson line rather than weaken it.

At the same time, it would avoid the Technoparc area altogether.

I call this line the "NDG-YUL" line, because it serves Notre-Dame-de-Grace and The Trudeau Airport, which has the code YUL.



NDG-YUL Line Proposal Overview (image by Anton Dubrau)

The following will outline this alternative project in detail:

2.2.1. Rolling Stock & Schedule

The REM will make the [MR-90](#) vehicles used on the Deux-Montagnes line obsolete. But they still should have 20 years of life in them (they are ~20 years old, rail vehicles generally are amortized over 40-45 years). These vehicles are electrified, they accelerate relatively quickly. They are fairly similar to metro vehicles, just heavier.



The MR-90 vehicles used on the Deux-Montagnes line. Source: wikipedia, Mtlfiredude

The AMT owns 58 such vehicles, which could be transferred from service on the Deux-Montagnes line to service on the NDG-YUL line as the REM starts operation.

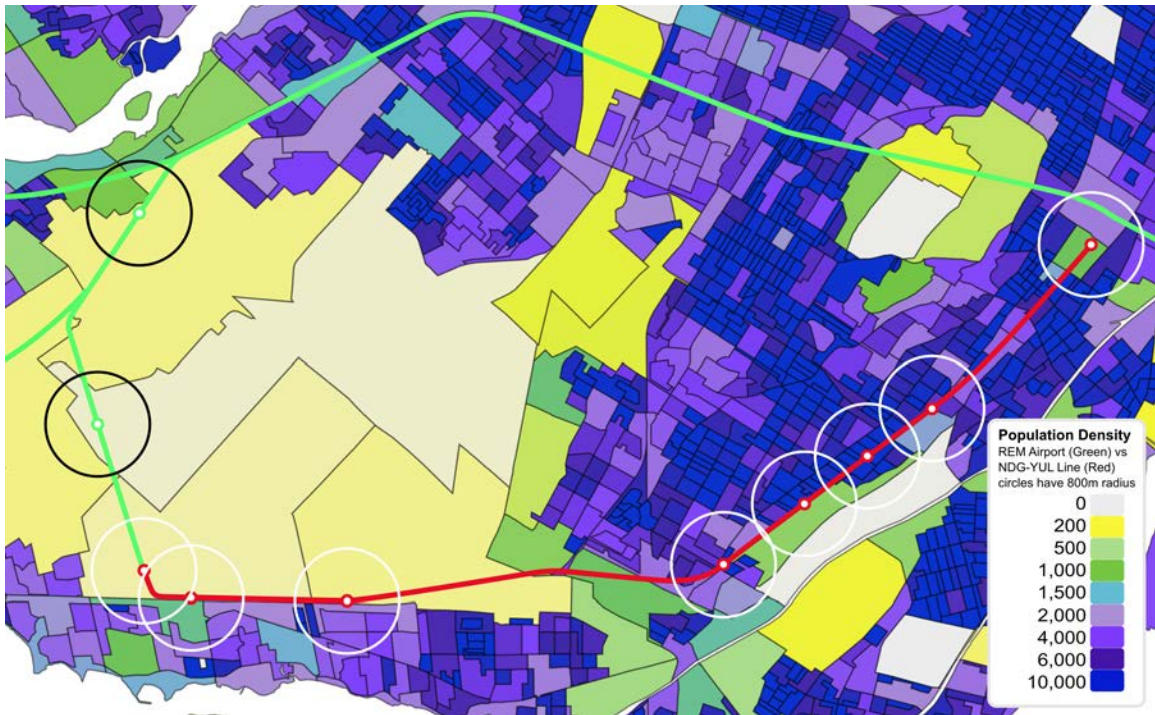
Service on the NDG-YUL line can be provided on a fixed-interval schedule exactly every 15 minutes, all day long. This requires 4 trains (one round-trip is 60 minutes). With 6-car trains, 24 vehicles + spares are required to operate the line. With 4-car trains, only 16 cars + spares are required.

With 6-car trains every 15 minutes provide a total capacity of 4800 people per hour per direction (PPHD). This may be increased up to 5500 PPHD by making seating more compact (or removing it), and changing the end-doors to be high-floor.

This means just on-peak capacity is about 25,000-30,000 trips per day (assuming $\frac{1}{3}$ ridership going in the reverse-peak direction), about twice the on- and off-peak ridership of the parallel 105 bus.

2.2.2. Nearby Population, Potential Ridership

There is much more population nearby the proposed NDG-YUL line than the REM airport branch. Note that the REM airport branch by itself, for the cost of half a billion dollars, only adds the Technoparc and Airport stations. The A-13 stations that is shared with the West-Island branch of the REM may be counted as part of the airport branch as well.



Population density of REM airport branch vs proposed NDG-YUL line. It is easy to see that the potential stations would serve a lot of population within walking distance, with more population only short bus trips away. Source: 2011 census.

There is no detailed ridership study available, but based off just the ridership of the buses in the area (90, 104, 105, 420, 109, 162, 747), 20,000 trips or more per day should be relatively easily attainable.

This would mean more than 5x the ridership of the airport branch of the REM, for a similar cost.



Bus lines parallel to NDG-YUL line corridor, (STM map, 2012)

Bus Line	2011 Ridership
90	10,842
104	2,293
105	14,723
420	1,269
109	2,395
162	3,196
747	2,693
sum	37,411

Ridership of parallel bus lines (extracted from Opus card data), 2011

2.2.3. Required Construction

2.2.3.1. Track & Electrification

The project would require the following track construction:

- 10km of dedicated passenger rail track already exists between the Lachine Maintenance centre and Lucien l'Allier (owned by CP). It is mostly triple tracked, adding a fourth track may improve operations.
- 5.5km of new double-track from Lachine Maintenance center to Dorval, along existing CP/CN freight railway. Since the MR-90 are 'heavy rail', the tracks can be built along the existing corridor without sharing issues.
- 1km of single track to reach the existing airport station shell..

The total line length is 16.5km. In order to use the MR-90 vehicles, the line has to be completely electrified.

Electrification and dedicated tracks between Dorval and Lucien l'Allier will benefit the VH line, which will be faster on that segment (using the AMT's dual mode trains) and there won't be freight contention. In the future, dedicated tracks can be expanded further West, especially together with VIAs plan to build dedicated passenger tracks, shared with commuter rail, from Montreal to Toronto.

2.2.3.1.1. Schedule Conflicts

There would be a conflict between AMT trains and the proposed NDG-line train at Lucien L'Allier, because every 15 minutes it has to cross the AMT's tracks going in the other direction. This may block the tracks for 2 minutes or so, which should not be an issue (Union Pearson in Express operates similarly).

There is a conflict at Montreal-Ouest station with 10 downtown-bound trains per day of the St-Jerome line, which have to cross all tracks to reach the downtown-bound tracks.

There is also a conflict at Montreal-Ouest station with 9 outbound trains per day of the Cadiac line, which have to cross all tracks to reach the outbound tracks.

On the other end of the proposed NDG-YUL line at Dorval, the connection should be built using a fly-over, so trains going different directions don't have to cross each other.

The signalling system on the line may have to be updated to support this operation.

2.2.3.2. Stations

There would be the following stations:

- Airport Trudeau (YUL) - use the existing station shell
- Dorval
- Lachine
- Montreal-Ouest
- Cavendish - new station along existing road underpass
- Melrose (Saint-Raymond) - new station on existing pedestrian tunnel
- Vendome
- Lucien L'Allier

High platforms at All stations will allow quicker turn-around time, and will reduce operating costs by allowing single-person operation. That is, no conductor is required if the boarding is level. The driver (engineer) can open and close the door while observing the platform via mirrors/monitors, like is done for the Montreal Metro.

2.2.3.3. Level Crossings

There are two level crossings at Montreal-Ouest. For 15 minute service, they don't *have* to be removed, but it should definitely be done if service becomes more frequent.

2.2.3.4. Downtown Connection

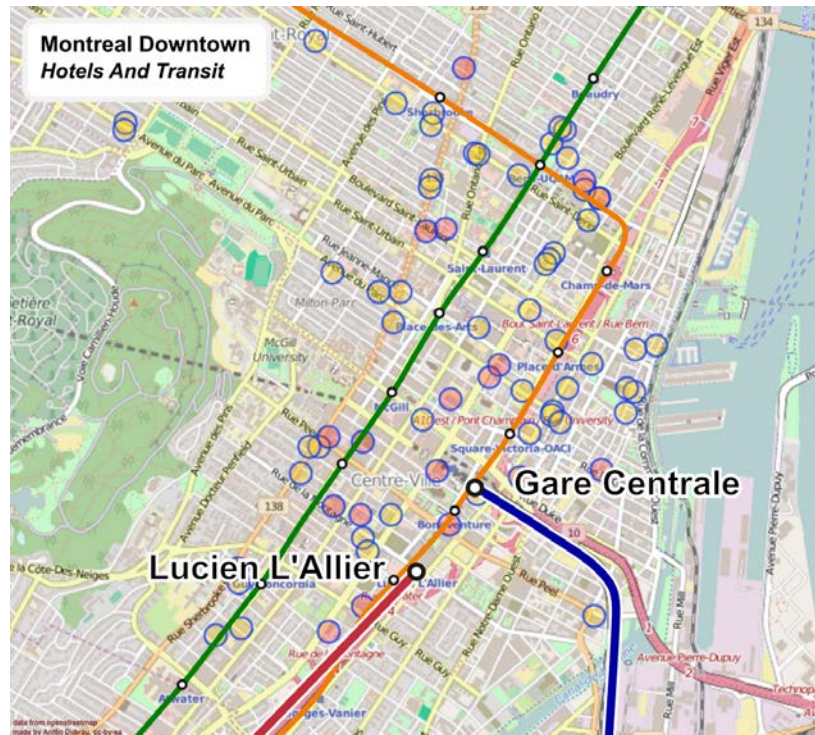
Note the use of Lucien L'Allier instead of Gare Centrale as a downtown terminus. Aeroports de Montreal has insisted on using Gare Centrale, explaining that an airport express would receive 10,000 riders per day if Gare Centrale was used, whereas Lucien L'Allier would receive 22% less ridership.

The ridership study by CDPQInfra only shows 2,700 trips per day. This appears to weaken the case for the necessity of Gare Centrale - the ridership is so low that the terminus should be chosen based on maximizing overall ridership of the line. Since the NDG-YUL line can capture many more riders, for the cost of just the airport branch of the REM proposal, Lucien L'Allier overall provides better cost benefit.

The main importance for the downtown terminus is a good metro connection, and a taxi stand.

Most population travelling to/from the airport will most likely not travel from downtown, necessitating the connection to the metro. The connection at Vendome will facilitate better connections than the REM to the Western and South-Western portion of Montreal.

Most international/business travellers will want to travel to hotels. These are spread relatively evenly throughout downtown, which means these travellers will also either connect to the metro, or use a taxi to make the final connection.



Hotels (yellow and red circles), relative to Gare Centrale & Lucien L'Allier. Source: openstreetmap

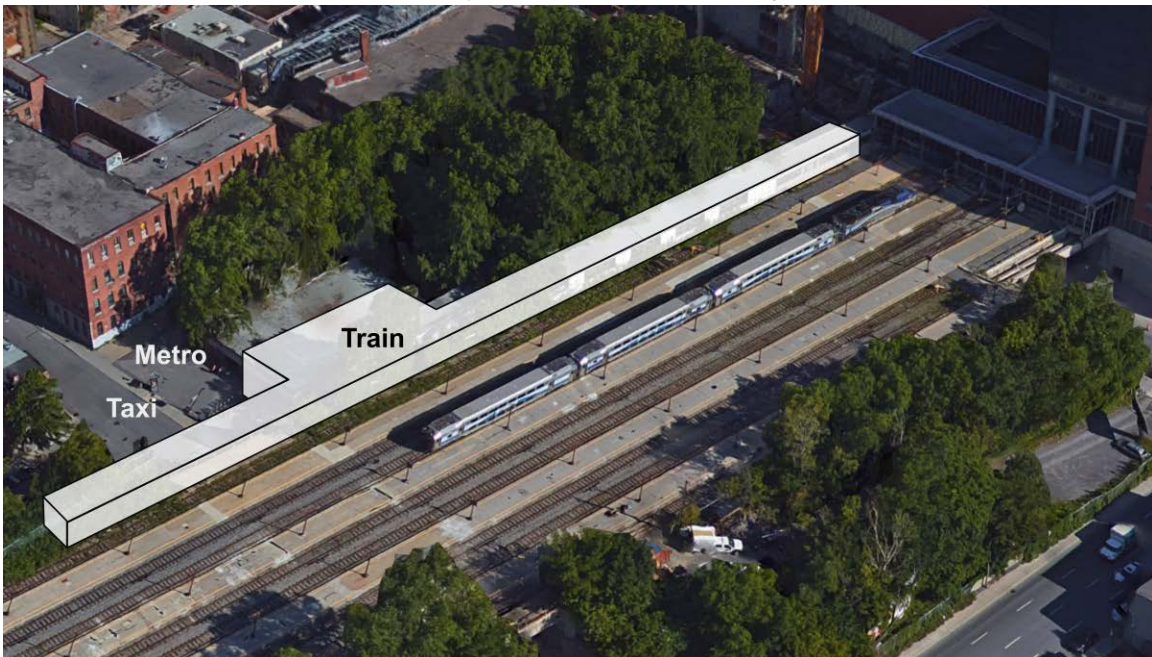
A taxi stand would be more convenient at Lucien L'Allier, due to shorter distance to reach the street.

The connection at Gare Lucien-L'Allier could be done by rebuilding the Northern-most track of the station (track 1). The platform should be high-level and on the North side, along the current connection to the Metro -- this means the distance of the metro-transfer can be reduced.



Photo of track 1 (right) and track 2 (left) of Gare Lucien L'Allier. Note the passage on the right that connects to the Metro Station, which could be used to build the new platform.

There could be a single track for the NDG-YUL line at the Lucien L'Allier, which is a layout very similar to the Union Pearson Express in Toronto. There should be a taxi stand directly connected to the station, to make it possible to reach nearby hotels.



Schema of proposed Station. Note the more direct connection to the Metro (image: Google Earth, modified by Anton Dubrau)



Union Pearson Express downtown station (source: wikipedia, photo by TheTrolleyPole)

2.2.3.5. Cost Summary

I can not provide valid cost-estimates. But I can give general ideas based on the costs of similar projects.

Capital cost general guidelines of the YUL-NDG-line, see cost references below:

- 800m single-track connection to airport: 70M\$ [1]
- 6km of two dedicated tracks along CP/CN line: 90M\$ [2]
- 16.5km of electrification (~5M\$/km), signalling upgrades: 100M\$ [3]
- 12M for 7 stations each to build high platforms: 85M\$ [4]
- Modification of 20-30 MR-90 rail-cars (~0.5M): 15M\$
- optional: A fourth track from Montreal West to Downtown 7.9km: 60M\$ [2]
- optional: removing 2 level crossings at Montreal-West: 80M\$ [5]
- **total: 360M\$ - 500M\$**

Cost references:

1. Compare to Union Pearson bridge connection, 128.6\$ Million for 3.3km of elevated double track spur. [source](#)
2. AMt Westmount third track project (4.8km of track for 35.6M\$ -- 7.5M\$ per kilometre of track along existing ROW) [source](#)
3. The [Toronto Electrification Study](#) indicates a cost of ~5M/km for electrification

4. based on Fairmount line, 12.2-17.7M USD per 800ft station/platform added to existing line [source](#)
5. based on the AMT Jonction de l'Est grade separation project (60M\$ AMT [PTI 2014-2015-2016](#), page 74)

Depending on the detailed design of the line, it may have similar cost as the REM airport branch. Since the ridership potential is 5 to 10 times more (15K-30K vs 2.7K), the cost per rider is lower by the same factor.

Note that this project is a subset of the “train de l'Ouest” proposal by the AMT, in 2010. It envisioned creation of dedicated tracks from Lucien L'Allier to St-Anne-de-Bellevue along the Vaudreuil-Hudson line, and creating a connection to the airport. This project included almost triple the amount of new track, and new rolling stock, but no electrification. Projected cost was 768M\$.

2.2.4. Operating Costs & Profitability

Unlike the REM proposal, the NDG-YUL line would not be automated. It would be a conventional heavy rail line, except using single-person operation (like the O-train in Ottawa).

The potential for profitability is high for the following reasons:

- It is a relatively short surface line (16.5km)
- There is a lot of ridership potential along the line (especially relative to its length)
- The airport passengers pay a relatively high fare - they may only represent 10% of the ridership, but pay 10x the fare, so may double the revenue given the same capacity. So if the line would have a fare-recovery ratio of 60% without the airport passengers, then it may be over 100% with them.
- There is the chance to use a lot of existing infrastructure and rolling stock which allows keeping capital and operating costs low
- A lot of the infrastructure is shared with other lines which will reduce maintenance costs for each individual line
- The line would be electrified, lowering operating costs
- The line would have even, continuous service, instead of peaky service like traditional commuter rail, which increases productivity and reduces labour cost due the possibility to have normal shifts without gap-times and high utilization, and no dead-heading
- During the off-peak and weekend, trains can be shortened from 6- or 4-car trains to 4-car or 2-car trains.

A note on operator salaries:

With four trains, the salary for engineers (drivers) is about

$$5 \text{ driver/train} * 4 \text{ trains} * 100\text{K}\$/\text{driver} = 2\text{M}\$/\text{year}$$

This implies a cost of 7700\$/weekday. At only 1\$ per trip per day (2\$ per round trip), only 7,700 extra trips are needed per week day (and 0 on the weekend), relative to the automated REM airport branch proposal, which is easily achievable.

Since the capital cost per rider is much lower, every trip has to pay back less of the capital cost. Thus, less operational efficiency (due to having drivers) can still result in an overall higher return.

2.2.5. TOD Development Potential Along the Line

There is some opportunity for TOD (Transit Oriented Development) along the NDG-YUL line.

Unlike the REM proposal, the stations are in more urban areas that are closer to the city, and farther away from highways. They can be added to the existing city, and add to the urban fabric.

The station at Cavendish represents the largest potential. North of the potential station there are many dense high-rises already, but South of it there are low-density commercial/industrial areas that could be densified.



Proposed Cavendish station with potential TOD development area. The area represents about 170,00 m², 41.93 acres, 0.170km² (source: Google, modified by Anton Dubrau)

Station Montreal-Ouest may also have some development potential, although the amount of useable space is much smaller. The area can be increased if there is a grade separation project removing the level crossings before and after the station that would

place the tracks in a covered trench. Then the area on top of the station could be developed.

2.2.6. Funding Model

The PPP funding-model that the Quebec government and the Caisse de Depot have agreed to, which includes outright privatization of the infrastructure, is inappropriate for the proposed NDG-YUL line, since it requires sharing of infrastructure with the AMT. Most of the required infrastructure is currently owned by CP (Canadian Pacific).

A more traditional PPP model may be more appropriate, in which the capital costs are shared between the public and the private partner, and the private partner would receive a long-term concession to operate the line and receive profits.

Since NDG-YUL line would not be automated, it may require some subsidies.

It would be appropriate to find the private partner in a competitive bidding process, rather than offering this project to the Caisse de Depot by default.

2.2.7. Relevant similar Transit Line Projects in Canada

O-train Ottawa:

The O-train showcases the idea of operating two trains shuttling back and forth, providing a 15 minute service on a short 8km line, while being a very capital efficient project. Note the NDG-YUL-line would be almost exactly twice the length of the O-train, which explains the need for 4 trains to provide 15 minute service. The O-train does not use conductors, which is one reason for its relatively low operating cost of only 4-5M\$ during the initial project phase in 2001/2002 (Fact-sheet: <http://bit.do/otrain>).

Despite not directly connecting downtown, and not serving many population centers, the line generated 9,000+ riders per day in its first couple of years, and about 14,000 about ten years after the beginning of operation. This shows that users are willing to accept transit that is provided on a simple-to-remember, fixed 15-minute schedule.

Union Pearson Express:

A rail line in Toronto going to the airport, using an existing commuter rail line. Service is provided every 15 minutes, 7 days a week.

Note the project cost of 460M\$, 75M\$ of which were to purchase vehicles - this won't be necessary for the NDG-YUL line, because of the re-use of existing rolling stock. The connection to the airport at Toronto Pearson Airport is a 3km double-tracked bridge. The Montreal airport only requires 1km of single-tracked line.

The downtown station and airport stations of the Pearson express are relatively elaborate, the NDG-YUL-line could be a bit simpler. Also note that the airport station shell in Montreal already exists.

The Union Pearson was built as an airport-express only, without helping adjacent communities. Fare integration is poor. Transfer walks are long. This explains its relatively low ridership (8,200 as of July 2016) and makes the whole project somewhat capital-inefficient.

The Union Pearson Express uses no fly-overs when mixing into and out of existing commuter rail lines, but provides 15 minute service -- which shows that possibility.

The Union Pearson express uses Diesel trains and it uses conductors, so operating costs are relatively high.