

Welcome to the Airport Transit Study Phase 2 Open House



At this Open House you will be able to learn about:

- the **technology options** considered and recommended
- the **alignment and station location options** considered
- the **recommended plan** and provide feedback on it

Team members are available to answer your questions.

Thank you for attending!



Study area



- Proposed stations
- Approved alignment
- Study area for alignment and station locations
- - - Future Green Line extension
- - - Future Blue Line extension
- /// Future Station



Study process and outcomes

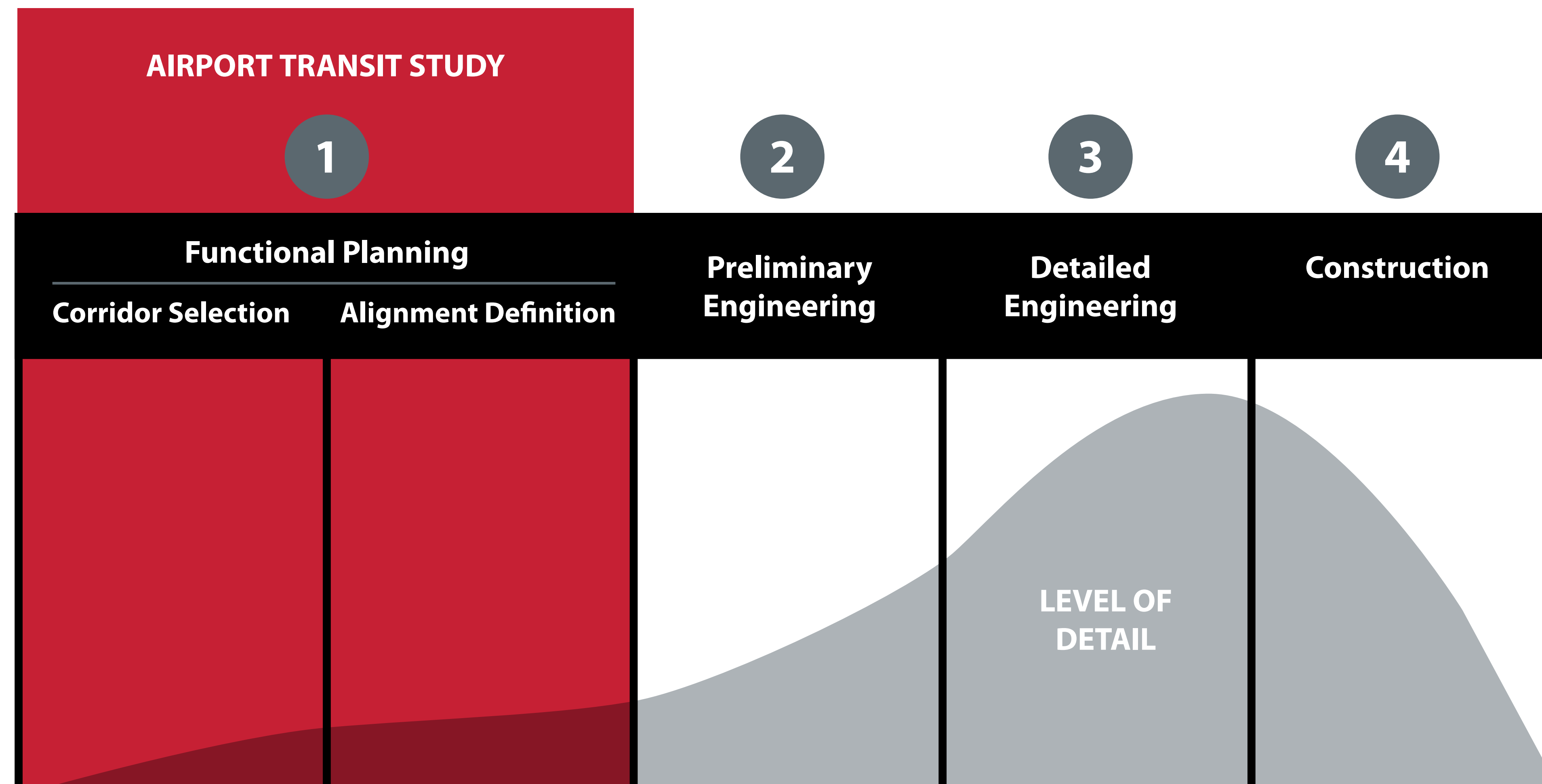
The City of Calgary is undertaking a corridor study for a cross-town transit connection between the Green Line and Blue Line, with a connection to the Calgary International Airport (YYC). **There is currently no funding for the design or construction of this connection.**

The Airport Transit Study will provide recommendations for:

- A transit technology
- The alignment and stations between the future 96 Avenue N.E. Green Line station and 19 Street N.E.
- Location for a maintenance and storage facility
- Land requirements
- A staging plan and cost estimates

We are conducting this study now to ensure the future airport connection is:

- Coordinated with the pre-design planning for the Blue Line extension (ongoing)
- Aligned with the updated functional plan for Green Line
- Accommodated in the Aurora Business Park Outline Plan update
- Included with the Airport Authority Master Plan update (ongoing)



Engagement Phases





How options were evaluated

The options that were considered as part of the study were evaluated using a set of technical, financial, economic, environmental, and community-focused criteria based on public input from Phase 1 as well as City policies. A **multiple account evaluation (MAE)** process was developed to understand, evaluate, and compare the relative benefits, opportunities, challenges, and trade-offs between the options. The graphic at right explains what was considered in each of the accounts.



What we heard in Phase 1

We asked participants what The City should consider when making decisions about the future technology, alignment and station locations. Participants were also asked to share their concerns and ideas on these topics. Each of the topics identified have been included in the MAE evaluation.

	Accounts (equal importance)	What we heard was important to citizens in Phase 1	City Evaluation Criteria
Technology	Community well-being	<ul style="list-style-type: none"> Speed Fast travel time to downtown Frequent service to/from airport Operates same hours as YYC employees Provide parking 	Convenient travel times and frequency
		<ul style="list-style-type: none"> Connect to Green Line Connect to Blue Line Accessible Accommodates people with disabilities Accommodates luggage 	Convenient, reliable, safe and accessible transfers to/from transit network
	Feasibility and Deliverability		Code and regulatory considerations
		<ul style="list-style-type: none"> Integration with existing Transit system Integration with existing Transit system Construction timeline 	Ability to leverage or integrate into planned facilities or infrastructure Alignment constraints Implementation (civil construction and systems)
	Financial Capacity	<ul style="list-style-type: none"> Fares/ticket cost considerations Value for money 	Branding and fare revenue Anticipated capital, operating & maintenance, and lifecycle costs
	Sustainable Environment	<ul style="list-style-type: none"> Preserve green space Low impact to environment Use green energy 	Reduced impacts to environmentally sensitive areas
		<ul style="list-style-type: none"> Low impact to environment Use green energy Sustainable 	Protects local air and water quality
	Transportation	<ul style="list-style-type: none"> Flexibility to accommodate demand fluctuations Frequent service to/from the airport 	System capacity
		<ul style="list-style-type: none"> Reliability 	Service reliability
		<ul style="list-style-type: none"> Look at other cities' systems/technology (e.g. Skytrain) Proven track record 	Proven technology
Urban & Neighbourhood Development	<ul style="list-style-type: none"> Calgary-wide access 	System expansion to connect to existing and future land use	
	<ul style="list-style-type: none"> Safety Low impact to traffic 	Urban Realm impacts (grade separations/barrier effect/noise impacts)	

	Accounts (equal importance)	What we heard was important to citizens in Phase 1	City Evaluation Criteria
Alignment	Community well-being	<ul style="list-style-type: none"> Safety and security Easy to use Reliable service Accessible/easy to get to Ease of transfer 	Safety, security and emergency access Accessibility
		<ul style="list-style-type: none"> Construction timeline Construction timeline No impact to traffic 	Constructability Construction impacts
	Feasibility and Deliverability	<ul style="list-style-type: none"> Construction timeline Reduce impact to adjacent businesses 	Impacts to residences and businesses
		<ul style="list-style-type: none"> Value for money Cost-effectiveness Concern about expropriation of land Cost-effectiveness 	Capital cost Land impacts Operating and maintenance cost
	Sustainable Environment	<ul style="list-style-type: none"> Preserve green space, wildlife and Nose Creek Parkway 	Impact on existing natural environment
		<ul style="list-style-type: none"> Accommodate weather in Calgary 	Adaptability to extreme climate conditions
		<ul style="list-style-type: none"> Consider environmental impact Reduce noise impact on adjacent community 	Environmental soil conditions and contamination Noise and vibration impacts
	Transportation	<ul style="list-style-type: none"> Speed Be competitive with other modes (e.g. car trips) 	Ride time
		<ul style="list-style-type: none"> Reliable service 	Transportation network reliability
		<ul style="list-style-type: none"> Connect with Green Line Connect with Blue Line Connect with future high speed rail 	Integration with existing and future Transit service
<ul style="list-style-type: none"> Reliable service 		Transit service reliability	
<ul style="list-style-type: none"> Stations in high density areas 		Catchment area	
Urban & Neighbourhood Development	<ul style="list-style-type: none"> Accommodate bikes Bike lockers 	Complete Streets: multi-modes, connectivity and accessibility	
	<ul style="list-style-type: none"> TOD opportunities Development opportunity on west side & 19 Street N.E. 	TOD and development potential	

What we considered: Technology

A number of different technologies used around the world were considered for the Airport Transit connection. The goal of the technology analysis was to identify the ultimate technology for the route. The following technologies were evaluated in detail within the context of the proposed alignment and service characteristics:

Recommended

Light Rail Transit (LRT)



Light Rail Transit (LRT), *Calgary*

Vehicles are either the same as those operating on the existing Red and Blue Lines (*High Floor*), or proposed for the future Green Line (*Low Floor*).

Key Characteristics/Evaluation Outcomes:

- Manually operated, requiring very frequent turnaround due to configuration with 3 terminals within 10km route
- Train frequency is limited due to turnaround time, increasing cost for capacity (longer trains and larger stations required)
- Service is under pressure to reduce operating cost, lowering off-peak level of service
- LRT requires significant investment in fixed infrastructure including rails, power and signals increasing capital and maintenance costs; but, has a lower operating cost than BRT

Operating and maintenance cost: \$\$\$

Capital cost: \$\$\$\$

LRT requires more fixed infrastructure (rails, power distribution) but is benefitted by use of larger vehicles that carry more passengers. Operating costs are reduced as one train can move more passengers than a bus.

Best meets the following MAE criteria:



Automated People Mover (APM)



Automated People Mover (APM), *Canada Line*

Canada Line. InTransitBC. 2018. <http://thecanadalineline.com>

Vehicles are likely to be similar in nature to Canada Line, which services the Vancouver International Airport.

Key Characteristics/Evaluation Outcomes:

- Automated operation reduces turnaround time at dead-end stations (88 Avenue, 96 Avenue, and YYC)
- Train frequency is only limited by boarding/alighting times allowing for more frequent operation of smaller vehicles
- Limited pressure to reduce off-peak service due to low operating cost
- APM requires significant investment in fixed infrastructure including rails, power and signals increasing capital and maintenance costs; but has lowest operating cost due to avoidance of operator labour expense

Operating and maintenance cost: \$\$

Capital cost: \$\$\$\$

Additional costs for automation and safety systems are offset by reduced station sizes and related infrastructure. Operating costs are lower than LRT.

Best meets the following MAE criteria:



Bus Rapid Transit (BRT)



Bus Rapid Transit (BRT), *Calgary*

Vehicles are standard or articulated Transit buses equipped with luggage racks and are either CNG or electrically powered.

Key Characteristics/Evaluation Outcomes:

- Manually operated vehicles, requiring significantly more operators to move the same number of passengers as LRT or APM
- Turnaround infrastructure is significant for dedicated guideway systems
- Capacity is limited at terminals due to small vehicle sizes and slow boarding/alighting. Technology is not well aligned for major network connections between larger vehicles (Green Line LRT and Blue Line LRT)
- Significant pressure to reduce service hours during off-peak hours
- Reduced capital investment relative to APM and LRT, although operating cost is high

Operating and maintenance cost: \$\$\$

Capital cost: \$\$\$

BRT can be built for less. Operating costs for BRT tend to be higher for similar levels of service as vehicles are smaller and require more operators per passenger.

Best meets the following MAE criteria:





Multiple Accounts Evaluation summary: **Technology**

A technical review of the three short-listed technologies was conducted by the project team using the multiple account evaluation.

Account	LRT	APM	BRT
Sustainable Environment			
Urban and Neighbourhood Development			
Financial Capacity			
Transportation			
Community Well-being			
Feasibility and Deliverability			
		Recommended	

LEGEND

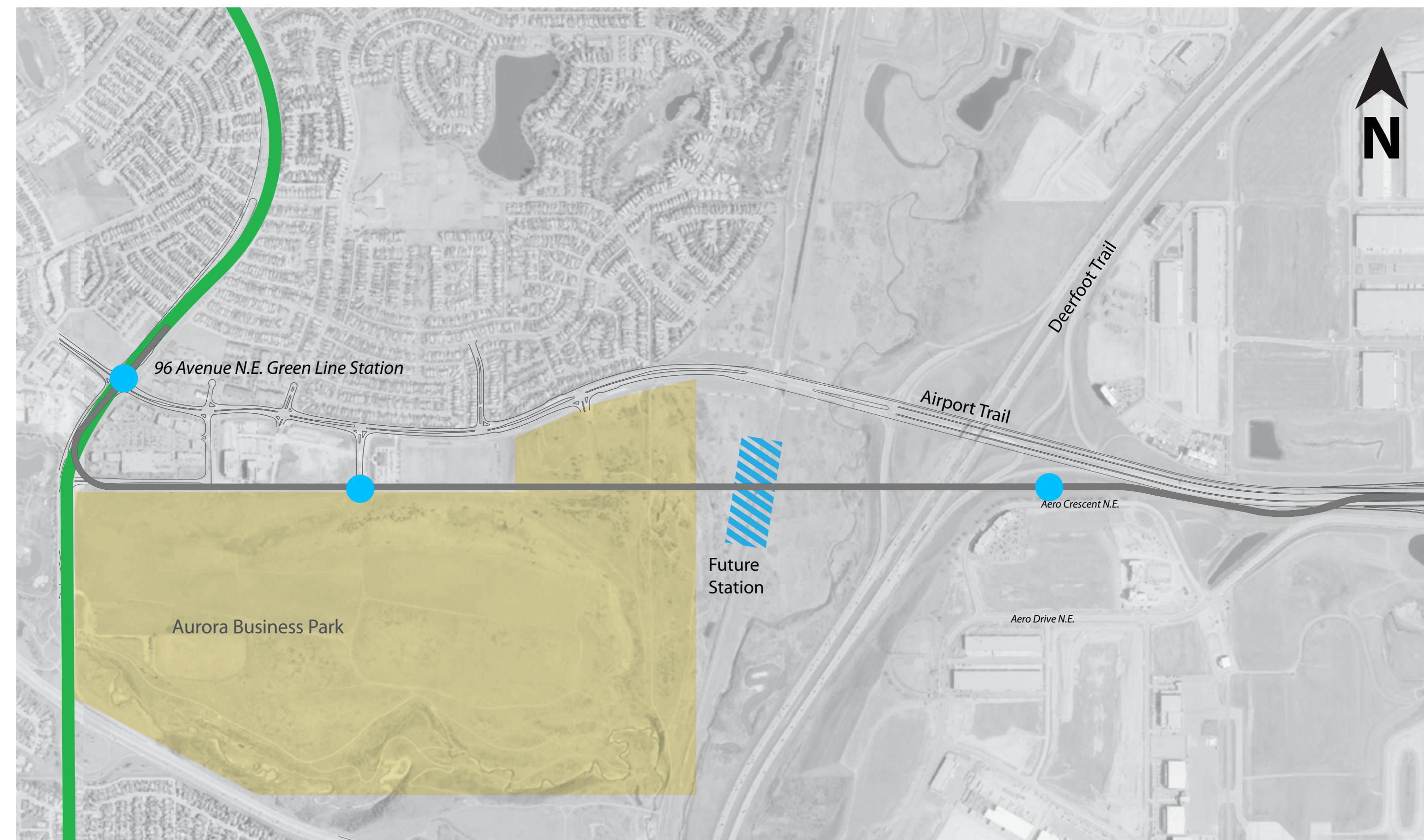
- Fully meets criteria
- Partially meets criteria
- Does not meet criteria

APM was evaluated as the highest-rated technology overall. The factors below also support APM as the preferred technology:

- Automation allows for flexibility of service permitting the service to match or exceed demand without major impacts to operating costs.
- A faster turn-around time at the airport station allows for more frequent service and savings of 25% in travel and wait times as drivers are not required to change ends at the station.
- Reduced round-trip travel times will provide a better quality of service for Transit customers.
- APM provides better customer experience with wider doors and accommodation of luggage.
- APM or LRT will guarantee no local emissions and reduce environmental impact from roadway maintenance.
- Rail will typically create less noise than roadway.
- APM is anticipated to have significant operating cost benefit compared to LRT and BRT for similar passenger capacities.

What we considered: Alignment and station locations

Option 1: Aurora South Road



Alignment:

- Travels south along Harvest Hills Boulevard, then heads east along South Road N.E.
- Requires deep tunnel station below 96 Avenue N.E. Green Line Station
- Sharp turn out of the station will slow speed in that area
- Challenge to construct independently from Green Line, so would require additional cost to the Green Line project to accommodate this service in the future
- The Aero Crescent alignment simplifies bridge construction over Deerfoot Trail; however, design of access to an at-grade station is challenging as passengers cannot cross the tracks (which are typically electrified) for APMs
- Bridge structure over Deerfoot Trail will need to be closely coordinated with existing northbound-to-eastbound interchange ramp and future westbound-to-southbound interchange ramp

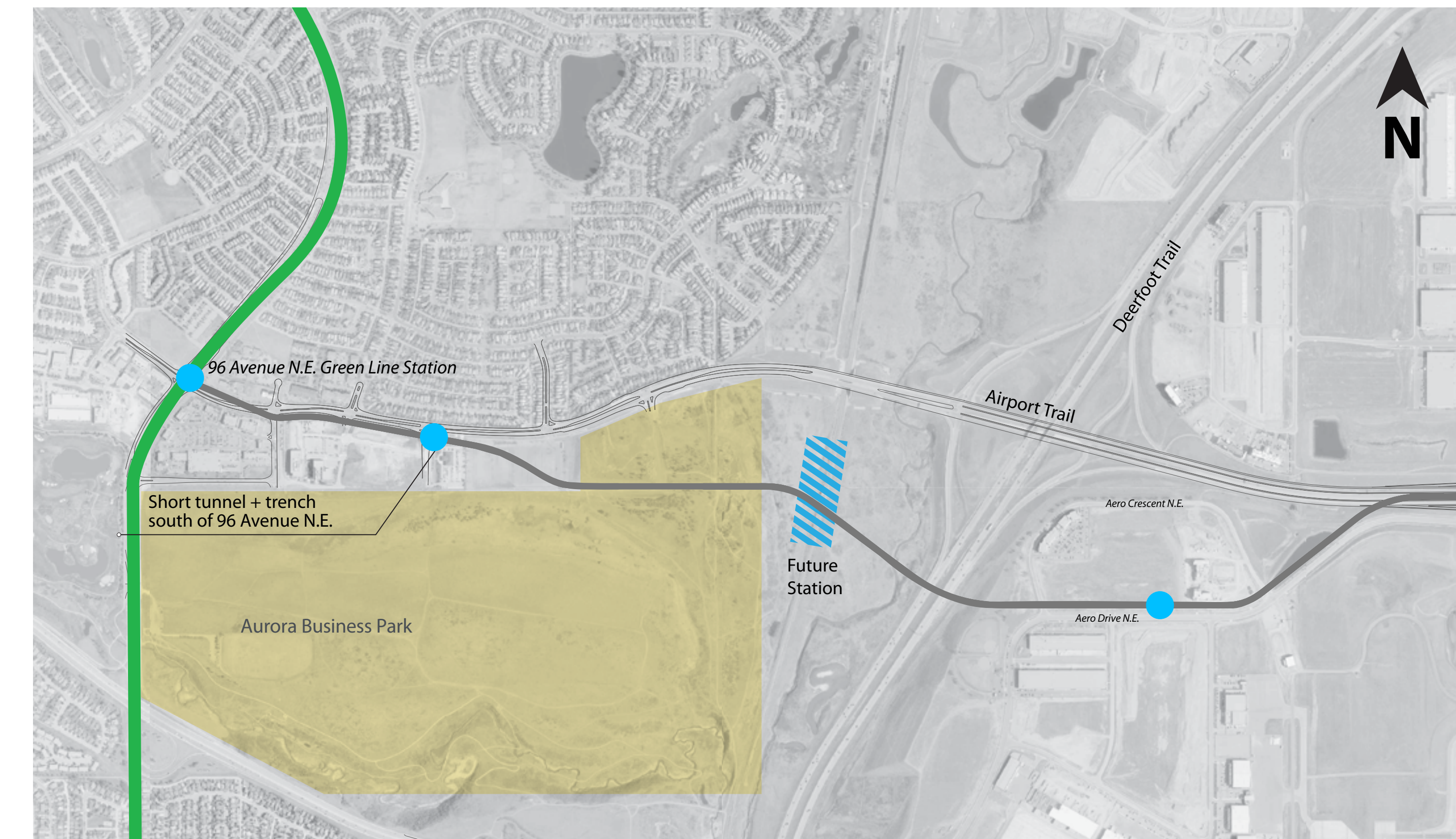
Station locations:

- Provides excellent connection to Aurora Business Park but not well connected to neighbouring communities
- Located very close to the future 96 Avenue N.E. station, so may not serve many additional riders and captures fewer residents of Harvest Hills

Best meets the following MAE criteria:



Option 2: Aurora Park Link N.E.



Alignment:

- From the 96 Avenue N.E. station, travels east along 96 Avenue N.E. to Aurora, near Aurora Park Link N.E.
- Requires a shallow tunnel to connect with the 96 Avenue N.E. station
- The Aero Drive alignment is central to Deerfoot North Aviation Park and will encourage transit-oriented development.
- Improved travel time over Option 1

Station locations:

- Provides excellent connection to Aurora Business Park and adjacent communities
- Located further north than Option 1, so would serve more residents from the community
- Close proximity to 96 Avenue N.E. station

Best meets the following MAE criteria:

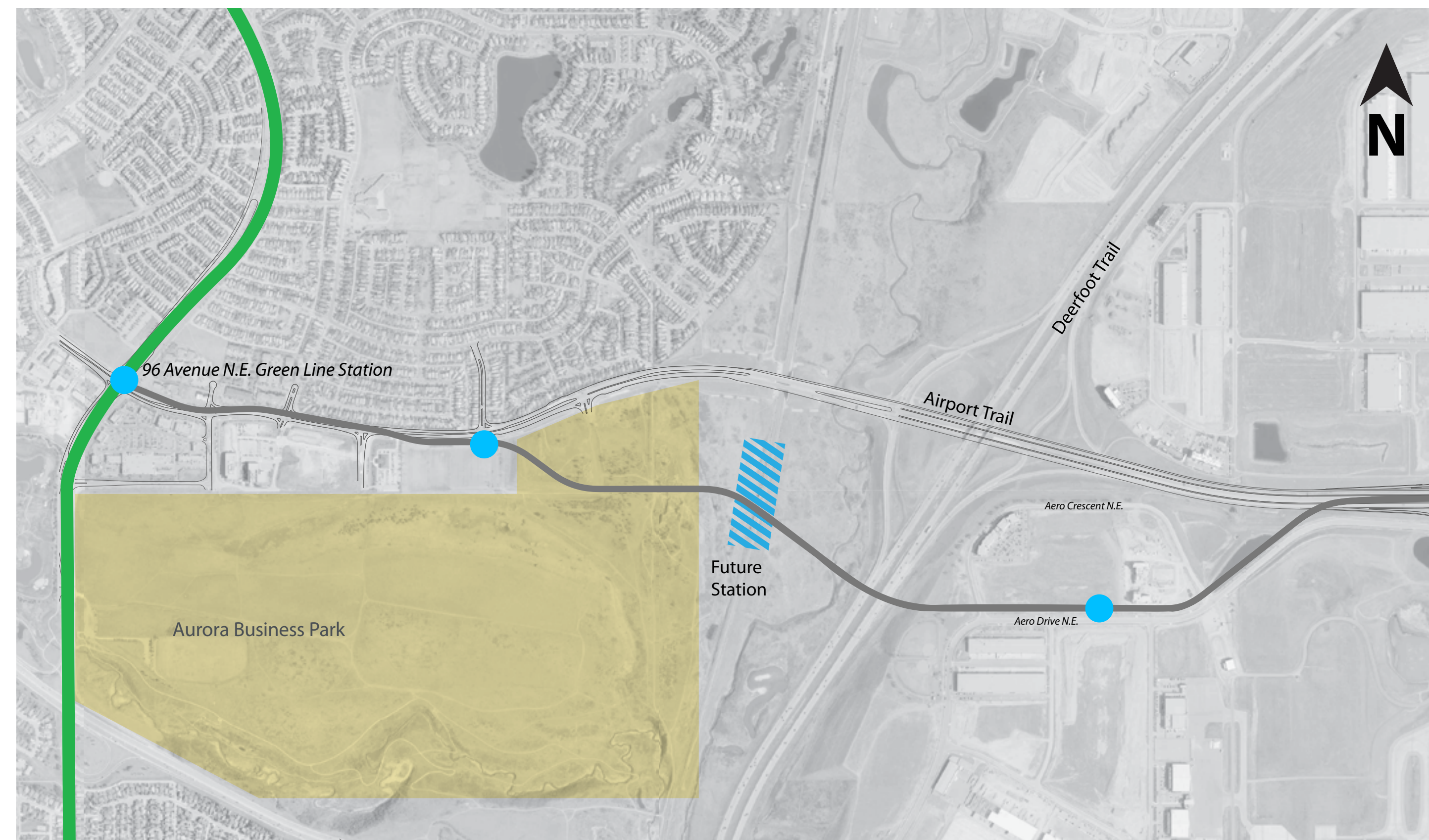




What we considered: Alignment and station locations

Recommended

Option 3: Harvest Hills Link N.E.



Alignment:

- From the 96 Avenue N.E. station, travels east along 96 Avenue N.E. to Aurora Business Park, near Harvest Hills Link N.E.
- Requires a shallow tunnel to connect with the 96 Avenue N.E. station
- The Aero Drive alignment is central to Deerfoot North Aviation Park and will encourage transit-oriented development.
- Improved travel time over Option 1

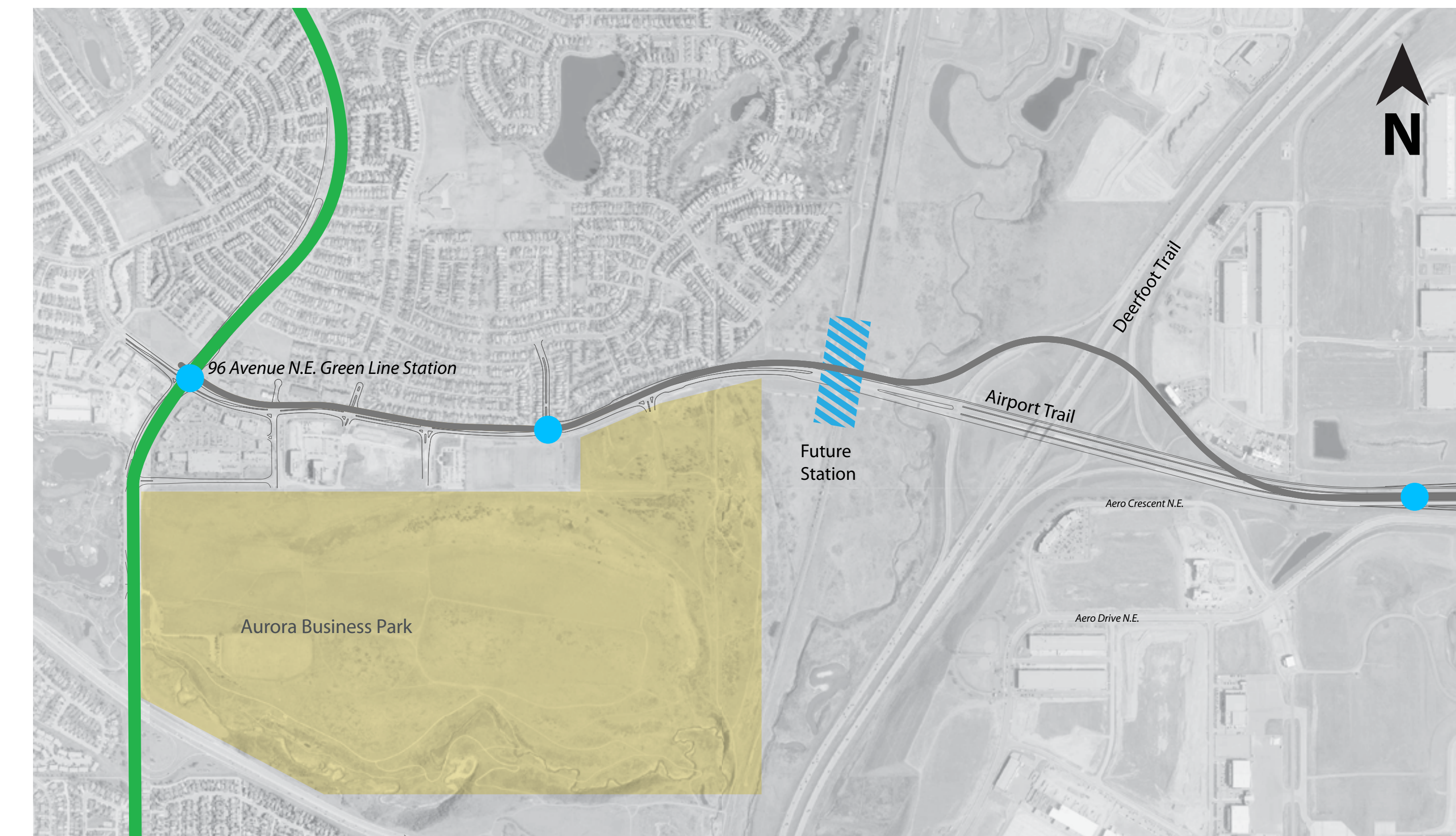
Station locations:

- Provides excellent connection to Aurora Business Park
- Station located adjacent to 96 Avenue N.E. to provide improved access for buses and pick-up/drop-off area
- Less overlap of catchment areas, so would serve more riders

Best meets the following MAE criteria:



Option 4: 96 Avenue N.E.



Alignment:

- From the 96 Avenue N.E. station, travels east along 96 Avenue N.E.
- Requires long route to the north of the Deerfoot Trail/Airport Trail interchange, with no access to the south of the interchange
- Poor connectivity to the future regional rail station
- The future upgrade to the Deerfoot Trail/Airport Trail interchange requires the alignment to be located quite far north of Airport Trail
- Forces the regional rail connection into a challenging site
- Improved travel time over Option 1

Station locations:

- Located under, or to the north of, 96 Avenue N.E.
- More costly station construction
- Future connection to regional rail is very challenging
- Station location within Airport Trail right-of-way is undesirable as it provides a poor customer experience and does not support TOD

Best meets the following MAE criteria:



LEGEND

- Alignment
- Proposed Green Line alignment
- Future Station
- Proposed Station
- Aurora Business Park

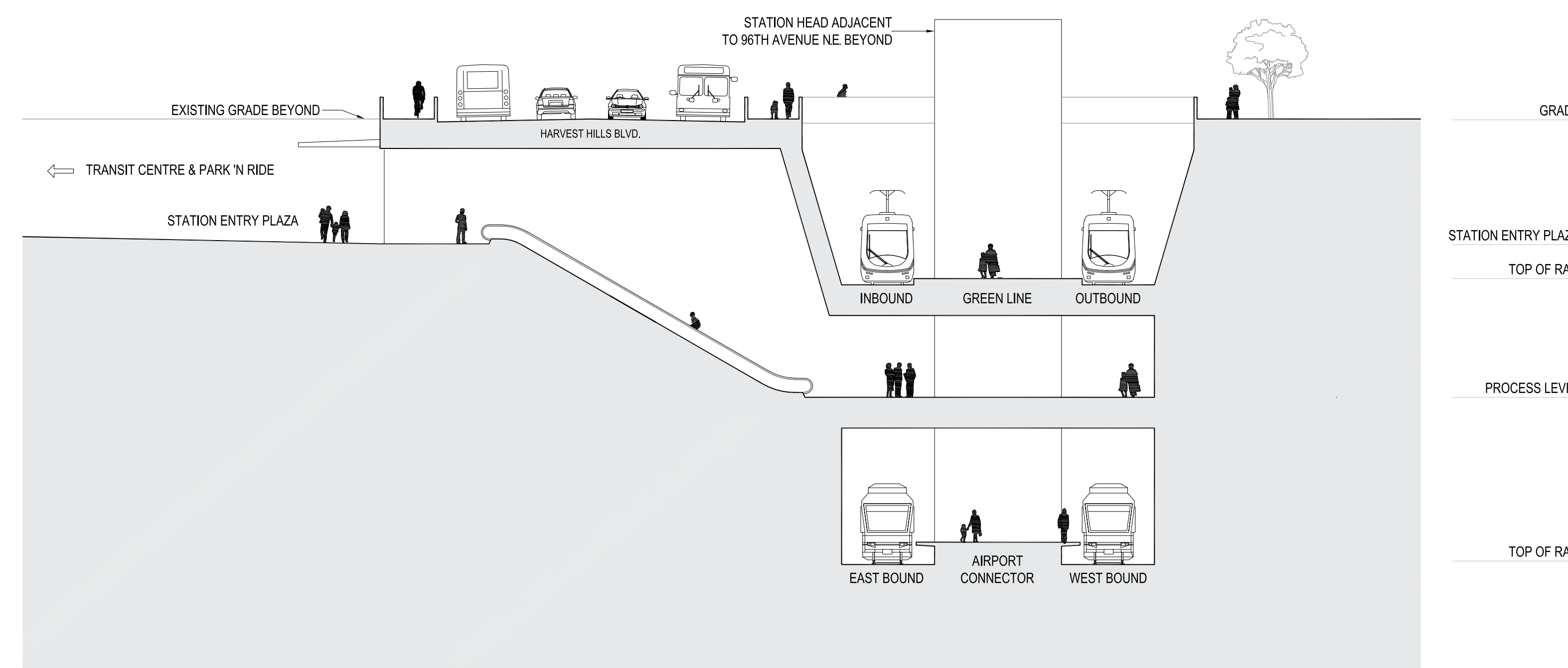


What we considered: Integration with 96 Avenue N.E. Green Line station

Two station layout options were explored to join the Airport Transit Connector to the 96 Avenue N.E. station. Both options provide for a bus terminal on the northwest side of the station.

Parallel station

The parallel station option is used in alignment Option 1 as the stations are positioned above one another, both in a north-south arrangement.



OPTION 1G - SECTION 1:200 - FACING NORTH
For discussion purposes only

PARALLEL STATION

BENEFITS	CHALLENGES
Simple vertical connection between platforms simplifies wayfinding	Requires very deep tunneling for Airport Connector line
Facilitates use of alignment Option 1 which provides a station in the middle of the Aurora Business Park	Structures must be built at the same time as the 96 Avenue N.E. Green Line station
	Longer route to airport

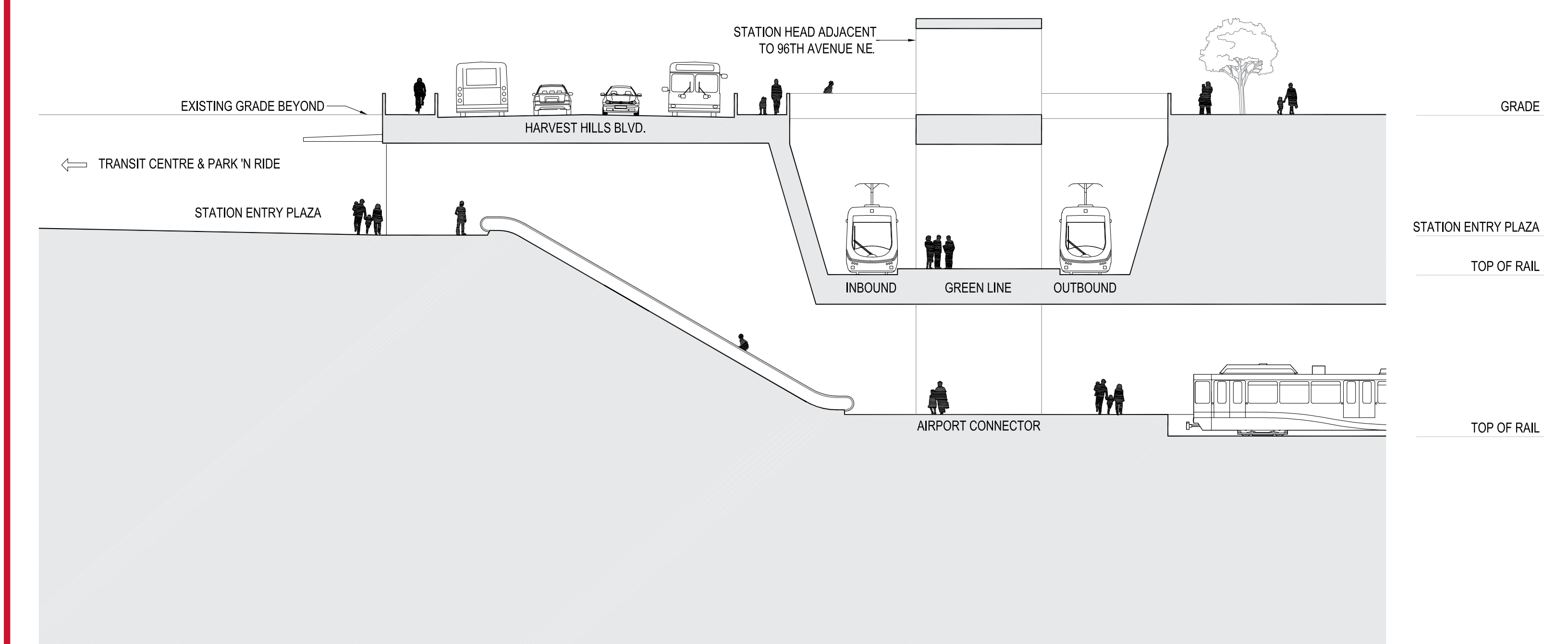
Best meets the following MAE criteria:



Recommended

T-in station

The T-in station option was used in alignment Options 2, 3 and 4 as the LRT and APM tracks intersect at 90 degrees.



OPTION 1A - SECTION 1:200 - FACING NORTH
For discussion purposes only

T-IN STATION

BENEFITS
Shallow tunnel relative to the parallel station option, reducing cost
Provides flexibility for construction staging
More direct route to airport

The T-in station is the preferred layout as it meets all the MAE criteria, allows for more flexibility in construction staging, and provides a more direct route to the airport.

Best meets the following MAE criteria:





Multiple account evaluation: Alignment and station locations

The project team reviewed the four alignment and station location options using the multiple account evaluation.

Account	Option 1	Option 2	Option 3	Option 4
Community Well-being				
Feasibility and Deliverability				
Financial Capacity				
Sustainable Environment				
Transportation				
Urban and Neighbourhood Development				
			Recommended	

LEGEND

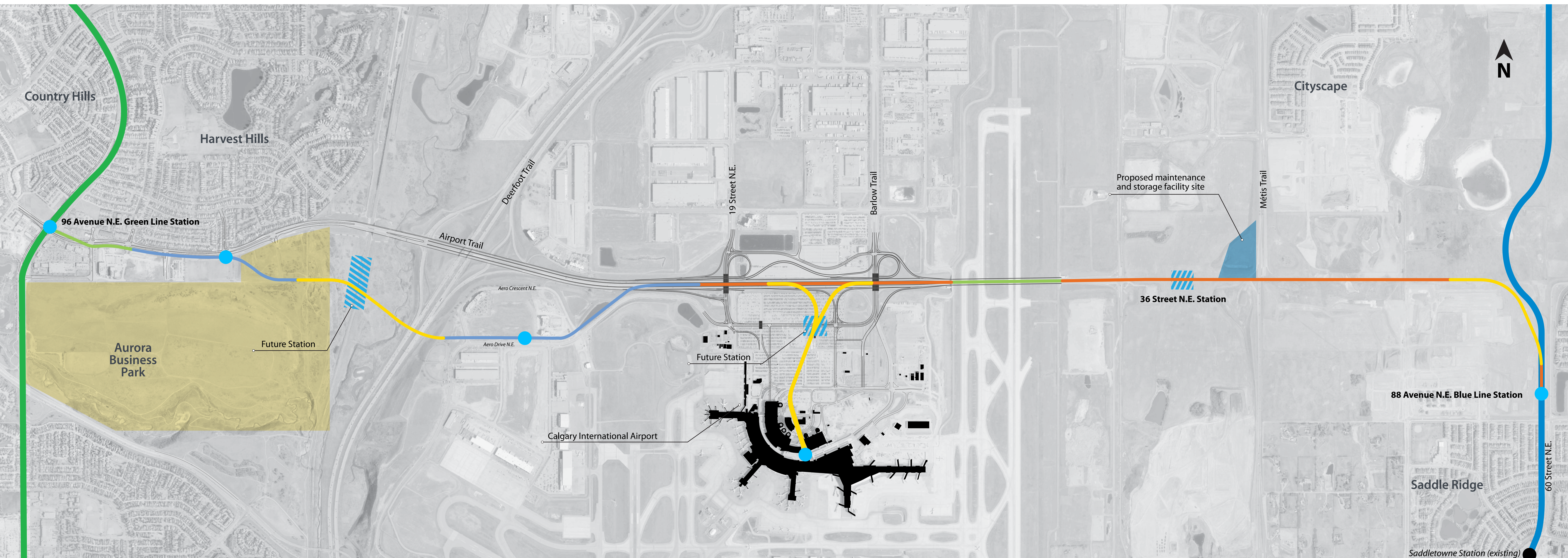
- Fully meets criteria
- Partially meets criteria
- Partially meets criteria
- Does not meet criteria

Option 3 is the preferred alignment and provides the preferred location for the Aurora station as it is adjacent to 96 Avenue N.E. and serves both residents and businesses. It also provides development options around the Aero Drive station.

- Option 3 provides the best balance of connectivity to other transit modes, the adjacent residential community, and development opportunity in Aurora Business Park.
- T-in station is more cost effective than the parallel option due to shallower excavation and reduced overall route length.
- Aero Drive Station is most supportive of Transit Oriented Development opportunities.
- A direct route from east to west will reduce travel time and increase average travel speed.

Recommended plan

The recommended plan reflects the alignment and station locations in Option 3 and supports the use of APM as the preferred technology.



- | | | | |
|--|----------------------|--|----------|
| | Proposed Station | | Trench |
| | Future Station | | Tunnel |
| | Future Green Line | | Elevated |
| | Future Blue Line | | At-grade |
| | Aurora Business Park | | |



The Transit Network

When the Green Line and Blue Line are constructed, there will be multiple ways to get to the Airport Transit Connector line. The line will require a connection from either the 96 Avenue N.E. Green Line station or the 88 Avenue N.E. Blue Line station. A separate line is planned as it is more cost-effective and provides a better customer experience.



Cost Effective:

- Service planning and operations are flexible and scalable to meet demands
- Allows for stations to be sized to meet Airport Transit Connection demands. A spur forces the Airport Transit Connection station platforms to accommodate 4-car-trains

Customer Experience:

- The frequency of service is maintained for the communities north of Airport Trail on both Green Line and Blue Line
- The frequency of service for the Airport Transit Connection is not limited to mainline service
- The system is easy-to-understand as it reduces customer confusion about which train to take at the mainline stations
- The recommended APM technology will allow for frequent service reducing the impact of transfers at the mainline stations



Airport Transit ridership (today and future projections)



Calgary's Route 100



Toronto UPE



Vancouver Canada Line

Timeline
Daily Ridership



Bus with Transit Priority Measures

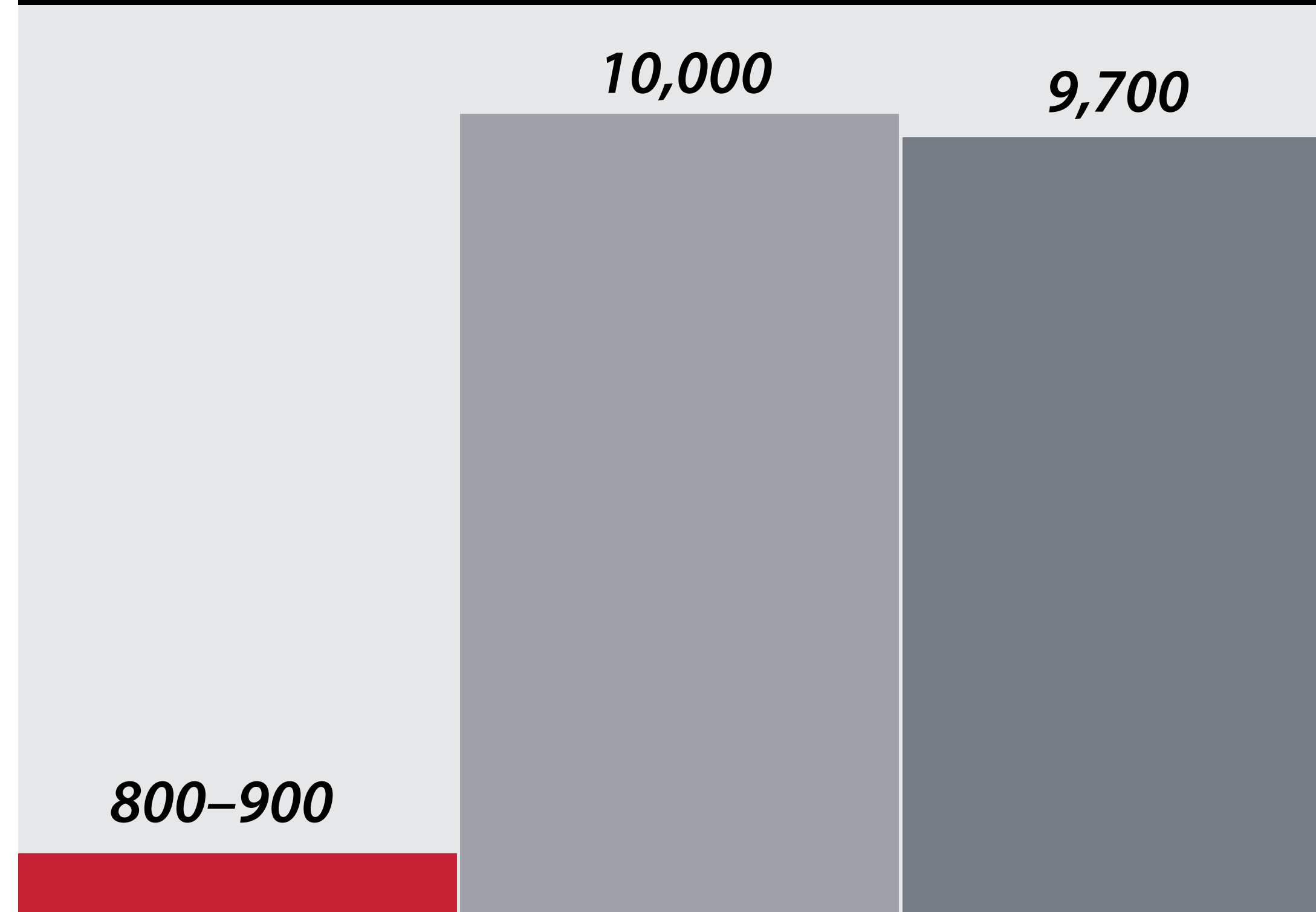
Blue Line – YYC – Green Line

Rail Connection

Stage 1:
Blue Line to YYC

Stage 2:
Green Line to YYC

CURRENT DAILY RIDERSHIP — BOARDINGS

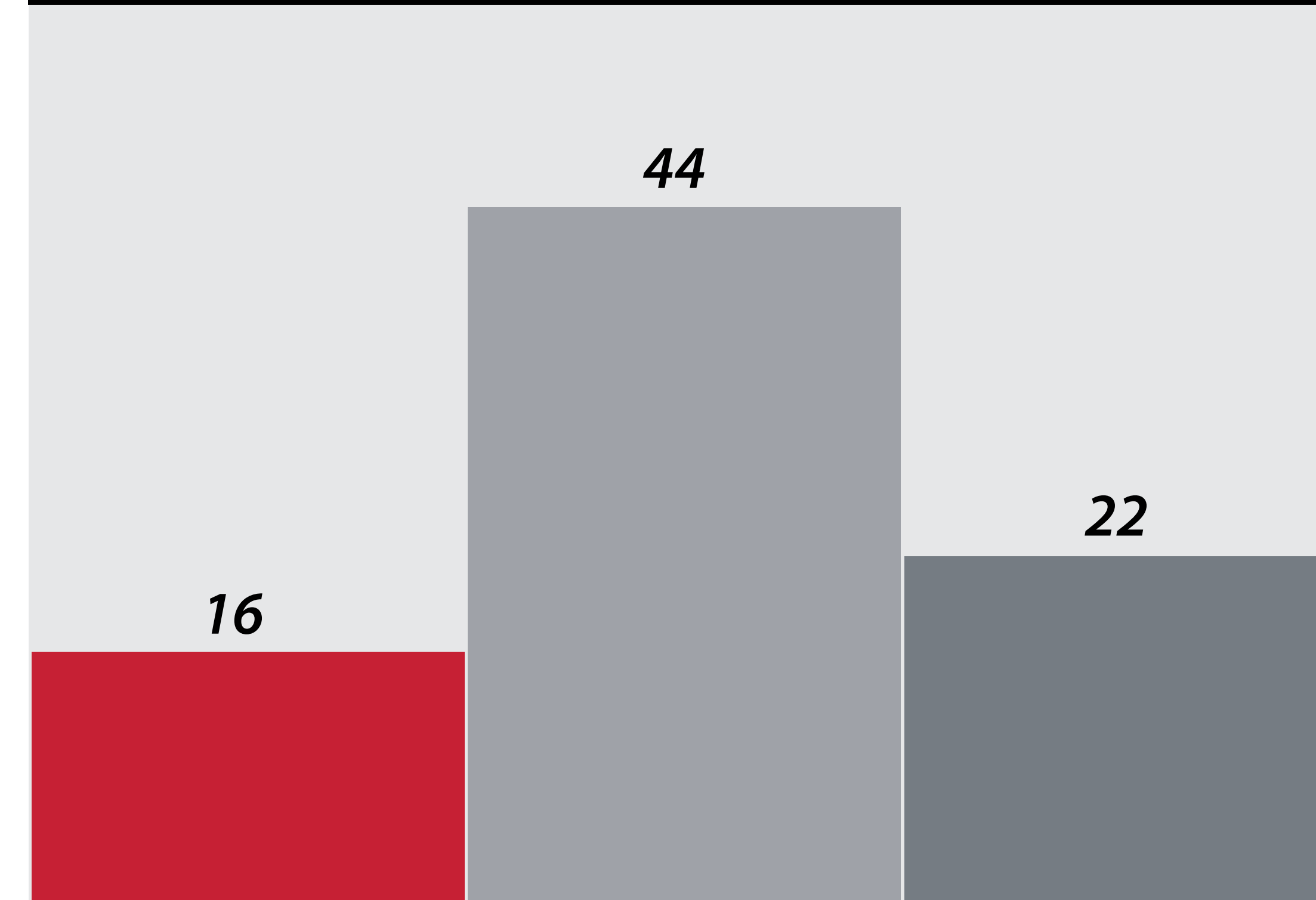


Calgary
(Bus Route 300)

Toronto
(UP Express —
entire line)

Vancouver
(Canada Line —
Airport section)

ANNUAL AIRPORT PASSENGER VOLUME MILLIONS (2016)



Calgary

Toronto

Vancouver

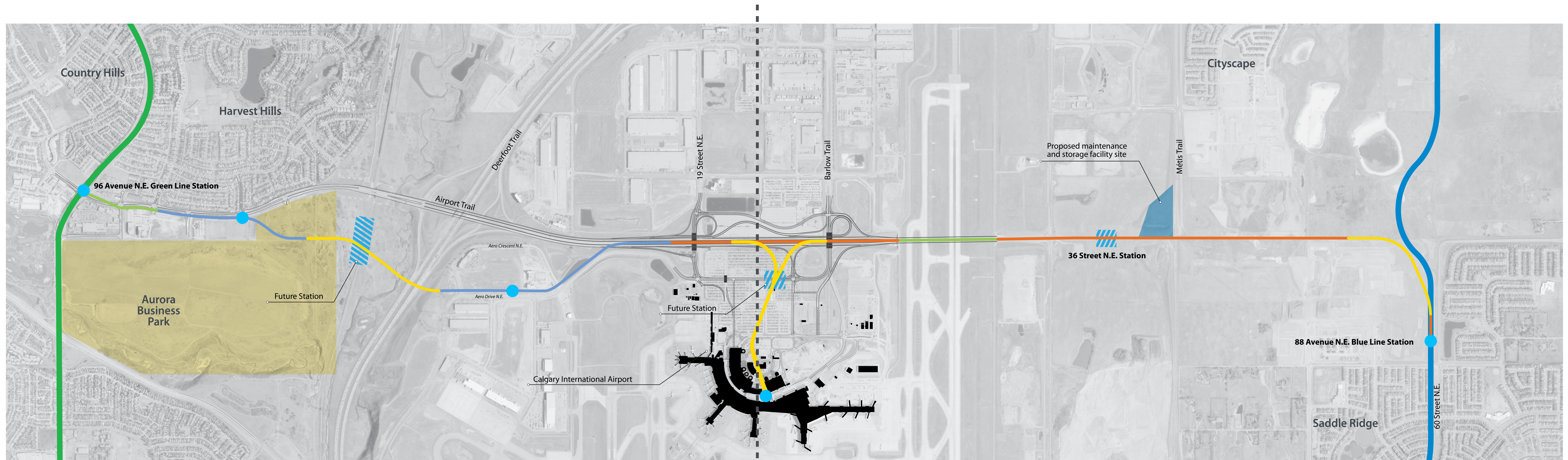
Rail connection staging plan and high level cost estimate

- Proposed Station
- ▨ Future Station
- Future Green Line
- Future Blue Line
- Aurora Business Park
- Trench
- Tunnel
- Elevated
- At-grade

The recommended staging plan is to construct the connection from the Blue Line to the airport first.

- The 88 Avenue N.E. station on the Blue Line will be completed prior to the 96 Avenue N.E. Green Line station
- Stage 1 is less expensive to construct
- Runs in approved and protected right-of-way
- Supportive of ridership forecasts

As there is currently no funding for the design or construction of this connection, there is no timeline associated with the staging plan.



Stage 2: YYC to Green Line (west leg of connection)

- Approx. \$500M to \$1B capital cost
- Approx. \$20.5M annual operating cost
- Estimated peak service frequency: every 4.5 minutes

Stage 1: Blue Line to YYC (east leg of connection)

- Approx. \$400M to \$800M capital cost
- Approx. \$14.5M annual operating cost
- Estimated peak service frequency: every 4 minutes

Estimates provided are Class 4 costs which are accurate to within -30% to +50%.

Thank you for participating!

Based on the feedback received here and through the online tool, the project team will refine the recommended plan.

The final plan will be presented to the public and City Council in Fall/Winter 2019.

For more information:

Visit calgary.ca/AirportTransitStudy