G Green Line LRT

Update to the 2020 Business Case

October 2021

Calgary Alberta Government Canada

Contents

1.0 Introduction

The city of Calgary is regarded as one of North America's best places to live, visit and do business. It is one of Canada's largest cultural and economic centres and it has undergone significant population and employment growth over the previous decades and the population is forecast to double by 2076.

Investment in infrastructure is essential to maintaining a high quality of life, a prosperous and competitive economic advantage and a sustainable environment. Stage 1 of the Green Line LRT is a key infrastructure investment to meet this need.

The 2020 Business Case for Stage 1 summarized the key infrastructure investment of the Green Line LRT Stage 1 program and was analyzed using Canadian and international best practices for business case analysis. This approach used a four-dimension analysis to identify the benefits, costs, trade-offs and risks of Stage 1.

The economic and financial cases from the 2020 Business Case are not included in this update as the program remains committed to delivering the full Stage 1 project within the committed $4.903B funding envelope. The City is currently undertaking active procurements for key program elements and therefore the details of any updated capital or operating cost estimates are commercially confidential.

This document was prepared to provide updated information on phasing, delivery and benefits of the Green Line LRT Stage 1 program based on the new procurement strategy; as well as an update to the program governance since Council approved the 2020 Business Case. It is anticipated that a further update will be prepared in 2024 after the financial close of the main Design-Build-Finance (DBF) procurement when final bidder costs are known.

The investment in the Green Line LRT will expand mobility choices to improve travel times and journey reliability by connecting the southeast and downtown to meet the needs of the City's present and future population and serve as the basis for future extensions of the Green Line.

Stage 1 of the Green Line LRT Program from Shepard to 16 Avenue N is a strategic investment that will build the core of the project while preparing for the future, allowing for incremental expansion of the LRT north and south and providing best value for tax dollars.

The city of Calgary is regarded as one of North America's best places to live, visit and do business.

In May 2021 the Green Line Board announced a redefined procurement strategy and phased construction following an extensive project review with the Government of Alberta. The 2020 Council-approved alignment will now be constructed through a two phased procurement strategy, with the first phase building the LRT from Shepard to Eau Claire, connecting the southeast to downtown and into the existing Red/Blue lines.

This document provides updated information based on the redefined procurement strategy.

Phase 1 is ready for construction and will build the LRT from Shepard to Eau Claire, connecting the southeast to downtown and into the existing Red and Blue lines.

Phase 1 will build:

- 13 stations
- 18 km of total LRT track
- 3 park and ride facilities at Shepard, Douglas Glen and Lynnwood/Millican stations
- 1 km of elevated track between 26 Avenue S.E. station and Inglewood/Ramsay station
- 1.5 km tunnel under Beltline and Downtown (6 Street S.E. along 11 Avenue to 2 Street S.W. at the planned Eau Claire Promenade)
- Elbow River LRT bridge between Inglewood and Beltline
- 1 LRV maintenance and storage facility at Shepard station

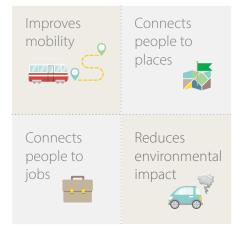**This document provides updated information based on the redefined procurement strategy.**

Stage 1 Map

2.0 Strategic case

The Strategic Case describes how the Green Line LRT will generate benefits for Calgarians.

The Strategic Case evaluation examines the main benefits of the Green Line LRT Stage 1 investment across The City's broader policy goals of improving the transportation network, improving the quality of life for Calgarians, creating economic prosperity and environmental sustainability.

Improves mobility

Connects people to places

Connects people to jobs

Reduces environmental impact

These are summarised in Table 2.1 and the remainder of this chapter includes:

» **2.1 Transportation benefits**

» **2.2 Quality of life benefits**

» **2.3 Economic prosperity benefits**

» **2.4 Environmental sustainability benefits**

Ten key benefits of the Stage 1 Green Line LRT investment

Transportation	Quality of Life	Economic Prosperity	Environmental Sustainability
Provide new rapid transit connections that generate new ridership 1	**A more accessible city** 5	**Connecting people to jobs and to catalyse economic development** 8	**Reducing emissions to mitigate climate change and provide cleaner air** 10
Stage 1 will serve 55,000-65,000 transit users a day with a fast, frequent, reliable, and direct transit service including attracting approximately 15,000 new transit riders	Over 70,000 people will live within walking distance and nearly 100 community, educational, social service, recreational, or commercial activity centres can be reached using the Green Line LRT	Nearly 200,000 jobs will be within walking distance of the Green Line LRT	By taking cars off the road, Stage 1 will save up to 30,000 tonnes of GHG emissions a year in support of municipal, provincial, and federal environmental goals
Provide capacity for today and tomorrow 2	**A safer and healthier city** 6	**Generating employment and economic activity** 9	
Stage 1 will provide capacity to meet demand and provide customers an exceptional customer service with opportunities to expand capacity without significant expenditure into the future	The Green Line LRT will take cars off the road leading to 2,300 fewer collisions and an additional 1.6 million km walked per year	12,000 direct and 8,000 supporting jobs are forecast to be created by Stage 1 alone	
Faster travel times for Calgarians 3	**Support the development of mixed-use communities** 7		
Travellers who use the Green Line LRT will save up to 20-25 minutes while auto users will benefit from reduced journey times of up to 10%, due to decongestion	Direct connections to six high priority development areas that will offer a range of lifestyles for Calgarians		
Financial efficiency 4			
Stage 1 will increase the financial efficiency of the Calgary Transit network			

2.1 Transportation benefits

The Green Line LRT aims to deliver significant transportation benefits to Calgarians by expanding mobility choice and providing rapid and direct connections between employment and population centres in southeast, downtown, and north Calgary.

The key transportation benefits generated by this project are:

» **Benefit 1:**
Provide new rapid transit connections that generate new ridership

» **Benefit 2:**
Provide capacity for today and tomorrow

» **Benefit 3:**
Faster travel times for Calgarians

» **Benefit 4:**
Financial efficiency

Benefit 1

Provide new rapid transit connections that generate new ridership

Benefit overview

The Green Line LRT will provide a new rapid transit link between southeast Calgary and the downtown core through to 16 Avenue in the north, providing new and existing users with a fast, frequent, and reliable transit service. Ridership is reviewed from two perspectives: total boardings (i.e. all customers who use the Green Line LRT) and new transit riders (i.e. users that are either making new transit trips as a result of the improved connectivity of the Green Line LRT or those that have switched from auto to transit for existing trips).

Benefit analysis

Table 2.1 outlines the anticipated boardings in the opening year for the Green Line LRT split by total boardings and new transit riders for the Phase 1 project as well as for the full Stage 1 program.

A range of ridership is presented in this document which reflects the potential variability in end-to-end runtime and station access arrangements – both of which can influence the attractiveness of the service within the transportation forecasting models.

The details of both will be confirmed through the final, detailed design, however, the low-end numbers have been used and present a conservative estimate of likely ridership.

Table 2.1: Green Line LRT ridership

	Phase 1	Stage 1
Daily Boardings	46,000 - 56,000	55,000 - 65,000
New Transit Riders	15,000 - 18,000	16,000 - 19,000

Benefit analysis findings

An analysis of the Green Line Phase 1 and Stage 1 ridership forecasts indicates that:

- Phase 1 of the Green Line will provide an improved rapid transit service for 46,000-55,000 riders each day, increasing to 55,000-65,000 with the completion of the full Stage 1 program (*Table 2.2*);

- Both Phase 1 and Stage 1 generate approximately 30% new transit riders from a combination of new trips made and changing travel choices (*Table 2.2*);

- The five busiest stations are 7 Avenue S.W. and 2 Avenue S.W. (both in the downtown); Shepard and Douglas Glen (the first two stops in the southeast) and 16 Avenue N. across the Bow River;

- 45% of ridership comes from mid-day, evening and weekend travel demonstrating how Calgarians will use the Green Line LRT for a wide range of their travelling needs; and

- The Green Line will increase total Calgary Transit LRT network boardings by 13.5%.

How is the benefit realized?

This benefit is realized by:

- Delivering a positive customer experience and designing stations to maximize accessibility along the corridor, including connections with bus, MAX BRT, and active modes (i.e. walking and cycling);

- Providing seamless connections to the Red and Blue Lines downtown and further enhancing the rapid transit network by providing integrated connections to the four MAX BRT routes;

- Creating further connection opportunities by adding 11 transit hubs that will connect transit customers to major activity centres and urban main streets across the City; and

- Ensuring that travel times, frequency, and reliability are optimised along the corridor, including providing competitive travel times with the existing bus network and maintaining a five to eight-minute frequency in the peak period.

Benefit 2

Provide capacity for today and tomorrow

Benefit overview

This benefit focuses on the LRT's ability to provide effective capacity for a growing city and manage passenger crowding. Benefit 2 explores this issue by assessing the ability of the Green Line LRT to provide capacity to meet demand on opening day and well into the future.

Benefit analysis

Forecasts show that demand on the line at its busiest point during the day will be 3,700 (low demand) to 4,400 (high demand) passengers per hour per direction. These forecasts were then compared to the design for the Green Line LRT. Initial operating plans for the system are for two-car trains operating at five to eight-minute headways but with infrastructure designed so that it can be easily expanded to provide three-minute headways with three-car trains.

Table 2.2 provides a summary of the capacity that the various headways and train configurations could provide highlighting the flexibility of the Green Line LRT design.

Table 2.2: **Flexible and adaptable design capacity of the Green Line LRT**

Service Frequency	2-car train Hourly Capacity*	3-car train Hourly Capacity*
3-minute headway	8,280	12,420
5-minute headway	4,970	7,450
8-minute headway	3,105	4,660

* Capacity is calculated by multiplying the capacity of a generic vehicle (276 passengers) by the 'planning capacity' of the vehicle (i.e. 75% of maximum capacity) to reflect the spread of demand over an hour and within the vehicles.

Benefit analysis findings

An analysis of the Green Line ridership forecasts shows a peak load of approximately 3,700 for both Phase 1 and Stage 1 (a.m. Peak Northbound). *Table 2.2* demonstrates that the Green Line LRT can accommodate demand on opening day, with additional flexibility to increase capacity by running more frequent and/ or longer trains to provide a high level of service over future decades without the need for major capital expansion.

In addition, the Green Line LRT is expected to draw demand from the Route 301 on Centre Street and the Red Line, both of which experience significant peak crowding. This additional capacity will improve the user experience of travellers on these services and provide room for growth over time.

How is the benefit realized?

This benefit is realized by delivering an initial Stage 1 system that can accommodate 80 metre (2 x 40 metres) light rail vehicle (LRV) train sets at a five to eight-minute headway in the peak period with stations designs for simple, cost effective expansion in the future.

Flexible design ensures the Green Line LRT will provide capacity on opening day and well into the future.

Benefit 3 Faster travel times for Calgarians

Benefit overview

This benefit assesses how the Green Line LRT will improve travel experience for trips starting or ending in southeast Calgary. Travel experience is broadly defined as a combination of factors related to journey amenity, travel time on the LRT, time spent travelling to an LRT station, time spent waiting for the LRT to arrive and reliability. Combined, these factors are represented in transportation forecasting as Generalized Journey Time (GJT), which converts all elements of a passenger trip into units of time based on how travellers perceive each component of the trip.

This benefit uses changes in GJT for transit passengers and auto travellers to illustrate how the Green Line LRT will improve travel times for a range of travellers in the city.
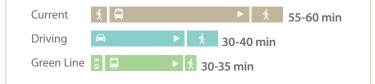
Benefit analysis

Figure 2.1 illustrates how the Green Line will improve customer experience and journey time for a set of example trips. *Figure 2.2* shows the change in average GJT by transit from geographic areas on the Green Line LRT corridor while *Figure 2.3* shows the change in average GJT for auto travellers.

Figure 2.1:

Example journeys on Green Line (Douglas Glen to 7 Avenue SW)

Today's challenge

- Unreliability: traffic, weather, delays due to Heavy Rail crossing
- Driving cost: gas, maintenance, parking

Current		55-60 min
Driving		30-40 min
Green Line		30-35 min

Benefit analysis findings

The analysis presented in *Figures 2.2 and 2.3* indicates that:

- Transit users on the corridor will save an average of 10 minutes per trip – equivalent to approximately 10,000 hours per day for Green Line LRT customers;

- Travellers using the entire Green Line from Shepard to the downtown core could save up to 25 minutes; and

- Drivers using Deerfoot Trail or other major roads could save up to 4 minutes (10% of a typical 40-minute commute) due to reductions in road congestion.
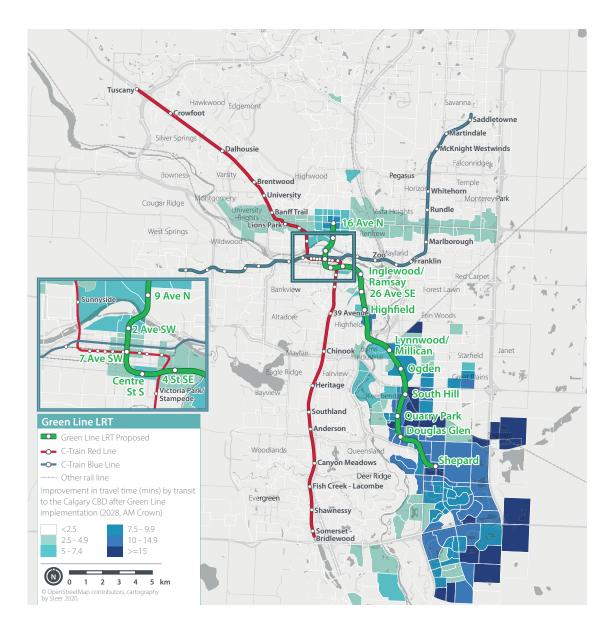
How is the benefit realized?

This benefit is realized by ensuring that travel times, frequency, and reliability are optimised along the corridor and ensuring that station access – whether by car, bus, bicycle or on foot – is as direct and convenient as possible for all customers.

Figure 2.2:
Change in journey time to downtown Calgary by transit after Green Line is implemented (opening year, a.m. peak hour)

Green Line LRT

- Green Line LRT Proposed
- C-Train Red Lne
- C-Train Blue Line
- Other rail line

Improvement in travel time (mins) by transit to the Calgary CBD after Green Line implementation (2028, AM Crown)

<2.5	7.5 - 9.9
2.5 - 4.9	10 - 14.9
5 - 7.4	>=15

0 1 2 3 4 5 km

© OpenStreetMap contributors, cartography by Steer 2020.

Figure 2.3:
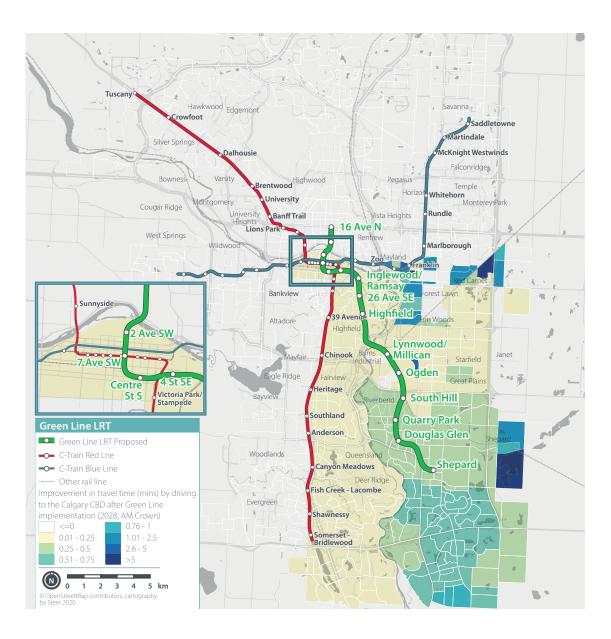**Change in journey time to downtown Calgary by car after Green Line is implemented (opening year, a.m. peak hour)**

Green Line LRT

- Green Line LRT Proposed
- C-Train Red Lne
- C-Train Blue Line
- Other rail line

Improvement in travel time (mins) by driving to the Calgary CBD after Green Line implementation (2028, AM Crown)

<=0	0.76 - 1
0.01 - 0.25	1.01 - 2.5
0.25 - 0.5	2.6 - 5
0.51 - 0.75	>5

0 1 2 3 4 5 km

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Benefit 4   Financial efficiency

Benefit overview

Calgary Transit targets a cost recovery ratio of between 0.40 and 0.45 meaning that it aims to recover approximately 40-45% of its operating costs through the farebox. One of the benefits of LRT is its ability to move more passengers with a lower operating cost per passenger trip. This benefit analysis section assesses the extent to which these cost efficiencies are realized by the Green Line LRT.

Benefit analysis

Table 2.3 provides a summary of the revenue, operating costs, and cost recovery for the Green Line LRT for Phase 1 and Stage 1. The Green Line LRT operating concept also assumes some bus services operated in the business as usual (BAU) scenario will no longer be required after the Green Line LRT begins operations. This reduced expenditure is also presented to calculate a cost recovery including bus operating cost savings.

Benefit analysis findings

The analysis presented in *Table 2.3* suggests that the Green Line LRT Stage 1 and Phase 1 can recover nearly 60% of its costs and, if avoided or reduced bus costs are considered, the revenue recovery ratio increases to approximately 70% per Green Line user.

How is the benefit realized?

This benefit is realized by:

- Providing customer service, travel times, frequency, and reliability that attracts and retains transit ridership;

- Ensuring fare collection (including potential changes to contactless technology) and enforcement systems are deployed to reduce any fare evasion; and

- Periodically reviewing operating costs and service delivery to maximize efficiency and mitigate unforeseen operating expenditures.

Table 2.3: Annual Green Line LRT fare revenue and operating costs – first year of operations (2021 $M)

Annual Values	Phase 1	Stage 1
Fare Revenue*	$18.4M	$19.6M
Green Line LRT Operating Costs	$31.1M	$34.0M
Cost Recovery for the Green Line LRT	59%	58%
Bus Savings (reduced bus expenditure)	$5.5M	$5.5M
Cost Recovery for Green Line LRT Including Bus Savings	72%	69%

* This analysis assumes that a portion of Green Line LRT revenue is shared with the supporting bus network.

2.2 Quality of life benefits

As the Calgary's population continues to grow, so too will transportation demand. Without new transportation options, demand will outpace supply leading to an increase in transportation network congestion. As a result, quality of life may be negatively impacted.

To ensure The City can provide and maintain transportation infrastructure that contributes to a high quality of life for its growing population, it is imperative that the transit and road networks provide high quality connections, as well as safe, fast, convenient, frequent, and reliable services.

The Green Line LRT will help to transform Calgary's transportation system by accommodating its current and projected population while contributing to a high quality of life for citizens. It will do so by realizing three benefits:

» **Benefit 5 -**
A more accessible city

» **Benefit 6 -**
A safer and healthier city

» **Benefit 7 -**
Support the development of mixed-use communities

Benefit 5 — A more accessible city

Benefit overview

Without the Green Line LRT investment, Calgary is not fully equipped to serve the needs of its current and future populations. Southeast Calgary is currently underserved by rapid transit, while demand frequently exceeds capacity in the north. In particular, buses travelling on the southeast road network are often delayed due to the high volume of vehicles commuting on this route. The Green Line LRT will support improved quality of life on the corridor by offering travellers alternatives to the bus and road network, which are measured by:

- The number of destinations that can be reached using the Green Line LRT; and

- The number of people who live near the Green Line LRT.

Benefit analysis

Figure 2.4 provides an estimate of the number of people who could walk or cycle to a Green Line LRT station based on typical access distances and *Table 2.4* shows the range of key destinations (such as schools, museums, parks, social services, health care, and shopping centres) that can be readily reached on the Green Line.

Combined, these demonstrate the range of uses and total number of people who can make use of the Green Line LRT for their day-to-day travel including visiting friends and family, trips for educational purposes, and recreational travel.

The Green Line LRT will support improved quality of life on the corridor by connecting more people to more places across the city.

Benefit analysis findings

Figure 2.4 shows that the Green Line LRT will greatly improve connectivity in Calgary with more than 70,000 people living within a 10-minute walk of a Green Line station and 190,000 thousand living within a 10-minute bicycle ride.

Table 2.4 lists the nearly 100 key destinations that will be within a 10-minute walk of a Green Line station and over 200 key destinations within a 10-minute bicycle ride.

Combined, these benefits demonstrate how the Green Line LRT will transform accessibility and mobility for Calgarians.

Figure 2.4:

Number of people living within 10 minutes of the Green Line LRT

More than

70,000 people

live within a 10-minute walk of a Green Line LRT station.

190,000 people

live within a 10-minute bicycle ride of a Green Line LRT station.

How is the benefit realized?

This benefit is realized by:

- Providing safe, direct and convenient walking and cycling routes to Green Line LRT stations;

- Providing frequent and accessible local bus transit connections to Green Line LRT stations; and

- Integrating Green Line LRT stations with residential and commercial developments and communities.

Table 2.4:

Key destinations accessible by the Green Line LRT

Category	Counts - 10min walking (0.8km)	Counts - 10min cycling (2km)
Park	12	37
School	19	56
Cultural Facilities	23	28
Recreation Facilities	13	31
Major Medical AHS Facilities	1	2
Police and Fire Protection Stations	5	10
Community Association	4	20
Post Secondary Institutions	3	5
Library	3	3
Main Street	5	7
Industrial - Employee Intensive	2	3
Major Activity/City Centre	1	1
Community Activity Centre	3	4

Benefit 6   A safer and healthier city

Benefit overview

The Green Line LRT can help improve the health of residents by providing a safer transportation network that sees a reduction in accidents by decreasing the number of automobile trips and by enabling more people to travel safely using active modes such as walking and cycling.

Transit users, on average, walk approximately 300m per trip in major metropolitan areas. Increased walking has a net health benefit compared to driving which, in turn, allows travellers to have healthier lives and reduces expenditures on health care.

Benefit analysis

Table 2.5 provides an overview of the collision reduction potential of the Green Line LRT program and *Table 2.6* provides an estimate of the level of increased walking that results from people making new trips on transit.

Benefit analysis findings

The analysis in *Tables 2.5 and 2.6* suggests that the Green Line LRT can contribute significant benefits to the health and wellbeing of Calgarians, including:

- Over 2,000 fewer auto collisions which means reduced deaths, injuries, and property damage as well as reduction in related health and auto insurance claims; and

- Approximately 1.5 million more kilometres walked a year which supports improved health and wellbeing.

How is the benefit realized?

These benefits are realized by:

- Ensuring the Green Line LRT travel times remain competitive with the automobile to encourage travellers to choose transit over their car; and

- Delivering station infrastructure that is well-integrated with residential and commercial developments to make walking to stations easy, safe and convenient.

Table 2.5: Annual reduction in auto collisions (first year of operations)

	Fatal Collision	Injury Collision	Property Damage Only	TOTAL
Phase 1	-5	-315	-1,750	-2,070
Stage 1	-5	-350	-1,945	-2,300

Table 2.6: Annual health benefits from increased transit use and walking (first year of operations)

	Phase 1	Stage 1
Annual Net New Transit Trips (shift from Auto)	4,800,000	5,350,000
Annual Increase in Walking	1.4 million km	1.6 million km

Benefit 7   Support the development of mixed-use communities

Benefit overview

LRT can be used as a catalyst for increased development, either through increasing the total volume of development or by accelerating the delivery of new development along the corridor. This benefit explores how the Green Line LRT can help create high quality transit connections between communities and sites targeted for development in southeast Calgary.

Benefit analysis

The City's Municipal Development Plan (MDP) clearly articulates the growth plans for Calgary including focussing growth in mixed-use, complete communities with access to rapid transit. *Figure 2.5* is taken from the MDP and shows the alignment of land use planning and the Green Line LRT corridor.

Benefit analysis findings

The Green Line LRT will support the delivery of The City's MDP land-use strategy, including:
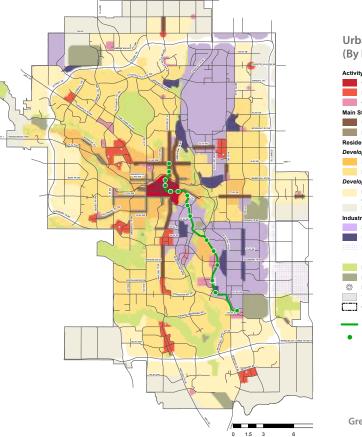
- Providing direct connections to planned transit-oriented development (TOD) sites at Ramsay/Inglewood, 26 Avenue S.E., Ogden, 16 Avenue N., Lynnwood/ Millican and South Hill;

- Catalysing residential development, retail, and office development; and

- Connecting to the 16 Avenue N. station area which has the highest number of people and jobs within walking distance of the station (outside of the downtown) making it an ideal location for further development and densification.

How is the benefit realized?

This benefit is realized by:

- Developing partnerships with private sector developers and stakeholders to co-deliver Green Line LRT infrastructure and new developments;

- Designing Green Line LRT stations and infrastructure to integrate into the community and support longer term regeneration; and

- Developing and updating Area Redevelopment Plans (ARPs) and Station Area Plans (SAPs) to provide the rules and guidance for future developments along the Green Line LRT.

Figure 2.5: Integrated land use and transit planning in the Green Line corridor

Urban Structure (By Land Use Typology)

Activity Centres
- Centre City
- Major Activity Centre
- Community Activity Centre

Main Streets
- Urban Main Street
- Neighbourhood Main Street

Residential
Developed
- Inner City
- Established

Developing
- Planned Greenfield with Area Structure Plan (ASP)
- Future Greenfield

Industrial
- Standard Industrial
- Industrial - Employee Intensive
- Industrial Greenfield

- Major Public Open Space
- Public Utility
- Major Institutions
- Transportation/Utility Corridor
- City Limits

— Green Line LRT
● Green Line LRT Station

2.3 Economic prosperity benefits

As outlined in the City's ten-year economic development strategy, a public transit network that connects Calgary's major employment and residential areas is crucial in attracting the world's best entrepreneurs and maintaining high levels of economic productivity,

With over 150,000 new jobs expected in communities in the north and southeast, The City must ensure that these communities and activity centres are well connected with a fast, frequent, and reliable transportation network.

This will further help to ensure that this expected growth is realized by attracting investment and talent and that people can access employment opportunities across the region.

The Green Line LRT will support The City's ability to both accommodate employment growth and increase prosperity by:

» **Benefit 8 -** Connecting people to jobs to catalyse economic development; and

» **Benefit 9 -** Generating employment and economic activity.

Benefit 8

Connecting people to jobs to catalyse economic development

Benefit overview

Today, workers from southeast Calgary are dependent on either their car or the bus network to access the downtown and other job centres on transit. One of the benefits of the Green Line LRT is that it will provide customers with direct access to high employment areas either using just the LRT or using the LRT as part of a complete transit network. This benefit assesses the ability of the Green Line LRT to connect workers to existing and potential jobs in support of a more productive economy.

Benefit analysis

Figure 2.6 shows the number of jobs that can be accessed by walking and cycling from Green Line LRT stations.

Benefit analysis findings

The analysis presented in *Figure 2.6* notes that in 2028 over 200,000 jobs will be accessible within a 10-minute walk of a Green Line station and 305,000 thousand within a 10-minute bicycle ride which allows transit to be used for commuting and business purposes alike.

This analysis highlights the Green Line LRT's role in supporting movement of workers to help develop a robust municipal and provincial economy.
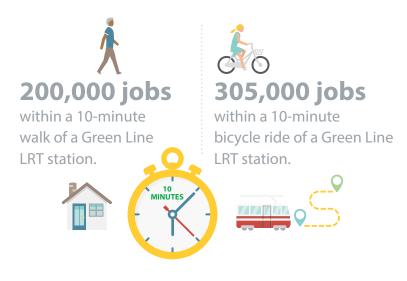
Over 300,000 jobs are accessible within 10-minutes of a Green Line LRT station.

How is the benefit realized?

This benefit is realized by:

- Delivering the stations as planned and ensuring service is delivered within the planned travel times and frequencies;

- Providing direct walking and cycling links as well as local transit connections between Green Line LRT stations and major employment centres;

- Connecting directly to the activity centres and main streets that are identified in *Calgary's MDP*; and

- Supporting private sector partners in the delivery of new commercial developments near Green Line LRT stations.

Figure 2.6: Jobs within 10 minutes of walking and cycling from Green Line LRT stations

200,000 jobs within a 10-minute walk of a Green Line LRT station.

305,000 jobs within a 10-minute bicycle ride of a Green Line LRT station.

10 MINUTES

Benefit 9

Generating employment and economic activity

Benefit overview

This benefit reflects the level of employment and economic activity generated during the construction and operation of the Green Line LRT. This benefit is used to understand how investing in the Green Line LRT can create new jobs, support the development of new industries, and support the economic prosperity of Calgary.

Benefit analysis

Calgary Economic Development conducted input-output modelling to determine the level of employment generated to deliver the Green Line LRT program. This modelling estimates the number of jobs major infrastructure projects can generate based on historic changes in employment from comparable projects.

Benefit analysis findings

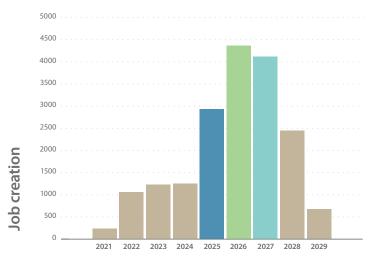The input-output modelling suggests that:

- 12,000 jobs will be generated based on direct investment in the program (jobs related to the construction and operation of the line).

- 8,000 indirect jobs will be generated in parallel and supporting industries.

These jobs are anticipated to be generated in a range of disciplines including construction, engineering, architecture, and professional services and they will support the diversification of the economy, which is a key goal of the Calgary Economic Development Strategy.

It is worth noting that, based on comparisons to other mega-projects in Canada, the 20,000 jobs estimated by the input-output modelling is likely conservative and that the actual number could be up to 50-100% higher. *Figure 2.7* is included to illustrate the likely profile or distribution of the jobs through the design, construction and commissioning phases of the program.

How is the benefit realized?

This benefit is realized through the delivery and operation of the Green Line LRT based on the assumed capital and operating profiles used in this document. Exact employment levels and timing of the new jobs generated will vary based on the detail of the final construction approach and schedule.

Figure 2.7: Green Line LRT – job creation profile

2.4 Environmental sustainability benefits

As a major source of greenhouse gas (GHG) emissions, The City's transportation network is one of the largest climate change contributors. Additionally, maintaining the transportation network is resource intensive with fuel, materials, and electricity needed every day for operations.

The Green Line LRT realizes a key sustainability benefit – moving more people while reducing the transportation-related environmental footprint through a reduction in GHG emissions, energy spent, and resources extracted.

» **Benefit 10 -**
Reducing emissions to mitigate climate change and provide cleaner air.

Benefit 10

Reducing emissions to mitigate climate change and provide cleaner air

Benefit overview

This benefit assesses how the Green Line LRT can reduce the transportation network's impact on air quality and climate change. It is assessed by estimating the number of vehicles that will be taken off the road as more customers choose public transit after the Green Line LRT is delivered. This in turn will reduce the total vehicle kilometres travelled in the region and the GHGs produced which contribute to climate change.

It is worth noting that the LRT system is electrically powered and therefore generates zero, point-of-use emissions. In addition, Calgary Transit purchases wind-powered electricity to power the LRT network further reducing any impacts from transit operations.

Benefit analysis

Table 2.7 outlines the reduction in GHG forecast for the Green Line LRT.

Benefit analysis findings

Table 2.7 notes that the Green Line LRT will support Council's broader environmental policy goals by removing between 800,000-900,000 tonnes of GHGs over the first 30 years of operations.

How is the benefit realized?

This benefit is realized by:

- Delivering the required travel times, service frequency and system reliability on the Green Line LRT and connecting bus service to reduce automobile use; and

- Continuing to utilize wind power or other green sources of energy to power the LRT system.

Table 2.7: GHG reductions

Description	Phase 1	Stage 1
GHGs Removed Annually	26,750 tonnes	30,000 tonnes
GHGs Removed Over First 30 Years	802,500 tonnes	900,000 tonnes

3.0 Deliverability and operations case

The Deliverability and Operations Case provides an overview of the approach used to procure the program and realize its intended benefits.

This chapter includes the following sections:

» 3.1 Socio-economic and environmental considerations

» 3.2 Risk management

» 3.3 Procurement strategy and approach

» 3.4 Program governance

» 3.5 Operations and maintenance

3.1 Socio-economic and environmental considerations

The Green Line LRT Stage 1 program will have a number of key socio-economic and environmental considerations that will be managed through the contracting, construction and delivery process. This includes the allocation of responsibility for regulatory issues including managing environmental assessments, certificate compliance and permitting.

It also includes key considerations around the assignment of responsibility for managing external relations including consultation with Indigenous communities and public engagement processes.

Environmental management

The Green Line LRT Stage 1 program team continues to manage numerous environmental disciplines and will do so for the life of the program. These include:

- Tracking both the federal and provincial assessment processes;

- Obtaining required federal, provincial and municipal environmental permits, licenses and approvals;

- Comprehensive construction environmental management to achieve compliance;

- Production of GHG Mitigation Assessments, Climate Lens and Resilience Reports;

- Management of contaminated sites and application of sustainability processes; and

- Maintaining a risk registry and conducting work required within specific environmental disciplines.

Both federal and provincial reporting will continue alongside internal, program team reporting.

Indigenous relations

To maintain continuity throughout the life of the Green Line LRT program, consultation and engagement activities with Indigenous communities will continue to satisfy both federal and provincial requirements. The City will maintain the lead role in identifying the requirements and responsibilities to consult during the program, and these will also be identified during the contracting process. In addition, The City continues to explore ways to maintain ongoing relationships and create employment and contracting opportunities with Indigenous communities.

Community relations

With a mandate to help stakeholders prepare for and manage the impacts of construction, the desired outcome of all communication and community relations activities is to ensure transparency, timely access to project and construction-related information and responsiveness to citizen needs and concerns. Clear roles and responsibilities will be assigned to ensure that both contractor and City staff are focused on achieving these outcomes.

3.2 Risk management

Risk management protects taxpayer dollars and supports proactive management and decision making for capital projects. Based upon the risk assessment completed to date, the Green Line LRT Stage 1 program risk exposure is trending downwards but still remains at the high end of the typical range of other major LRT projects at this stage of development.

The program holds risk in all of the typical categories of an LRT megaproject and current efforts are focused on managing the following risks:

- Filling vacancies within the leadership team;

- Competitive pressure in the marketplace in Canada is creating limited available capacity for the required proponent expertise;

- Time delays and anticipated cost escalation are resulting in increased budget pressure; and

- Continued delays in moving the program forward continuing to erode stakeholder confidence.

The Green Line LRT Stage 1 program team is acutely aware of the need to continue to prioritize efforts on proactively mitigating these and other risks. There are significant actions that have been taken to reduce the program's risk exposure, including adjustment to the procurement strategy to initially focus on Phase 1 (Shepard to Eau Claire). Additional actions are also being taken to respond to the above noted risks, including:

- Recruitment is underway to fill leadership team positions;

- Procurement strategies are under development to address competitive pressure;

- Further refinement of cost estimates and risk understanding is underway to address increased budget pressure; and

- Green Line LRT Stage 1 program team is in regular communication with stakeholders to provide updated information as it becomes available.

Monitoring and updating risks and risk response strategies will continue as the program progresses. With team effort directed toward managing and controlling risk on the Green Line LRT, the risk profile should continue to reduce over time. The risk assessment will be refined and updated to accurately reflect the evolution in affordability, schedule and program risks as key milestones are reached.

3.3 Procurement strategy and approach

Procurement principles

The Green Line LRT Stage 1 procurement strategy is based on a foundational set of principles that are intended to drive towards positive commercial outcomes for the program (See *Table 3.1*). These principles have been used to develop an approach to procurement that is best suited to program circumstances and requirements. They will also be applied throughout the contracting process to ensure the commercial success of the program.

Table 3.1: **Procurement strategy principles**

Schedule – Cost of Delay: the procurement process will seek to minimize the risk of schedule delays and increase opportunities for earlier involvement of prospective contractors in the design process.	**Cost Certainty:** the design of the procurement process will seek to create cost certainty and minimize potential financial risks wherever possible.	**Risk Management:** consistent efforts will be made throughout the procurement process to pro-actively identify risks and optimize risk allocation.
Market Attractiveness: efforts will be made throughout the procurement process to involve contractors early in planning and design to help increase the market attractiveness of the program.	**Contractor Opportunity for Innovation:** the procurement process will incentivize contractor innovation, particularly as it relates to design.	**Impact on Lifecycle Cost:** contractor expertise is a valuable asset in designing a system with minimized lifecycle costs. The procurement process will create opportunities for that expertise to be integrated earlier in the process to allow contractors to work collaboratively with City representatives throughout the design process.

Industry capacity to deliver

Assessments of market feasibility have been conducted at various stages of the program to ensure that the procurement model is strategically aligned with key market considerations.

Preliminary procurement models for the program took into consideration the market assessment findings and the initial model – a single Design-Build-Finance (DBF) contract, with a separate contract for light rail vehicles (LRVs), and multiple smaller contracts for enabling works – was proposed as an attractive option for the market.

Although the levels of competition have not lessened since initial market feasibility assessments, the evolution of the LRT market has added further complexity to the assessment of market feasibility. These factors have been critically influential in the development of the current procurement model.

Procurement approach

The procurement strategy principles have been applied to design a procurement model that will maximize positive commercial outcomes for The City. The procurement model proposed for the program has evolved over time as the program scope has been refined, the need for alignment of all funding partners and in response to changes in the market. The current phased procurement model has been adapted to mitigate many of the major project financial and technical risks and includes:

- DBF contract for:

  - Phase 1 infrastructure including the tunnel, stations, track, systems and the maintenance facility;

  - Optional extension to include all Phase 2 infrastructure including all LRT related infrastructure and the new Bow River Bridge crossing;

- Design Build (DB) contract for the LRVs including two options for additional vehicle purchases – one during the initial order/ assembly phase and one for later in the procurement process; and

- Design Bid Build (DBB) contract for enabling infrastructure work such as utility relocation.

In addition, The City is progressing the design and procurement processes for the BRT improvements in the north.

3.4 Program governance

An effective system of project governance is integral to the success of the Green Line LRT Stage 1 program. Over the course of the implementation, the program team will abide by all relevant federal, provincial and industry legislation, regulations, and codes and leverage industry standards where applicable. In addition, it will comply with any Municipal bylaws, policies, or standards that may apply, requesting exemption if appropriate.

To ensure that the governance systems and structures incorporate leading best practice in project governance while also meeting the unique needs of the program, a governance review was undertaken by Technical Risk Committee (TRC) in 2020. The outcomes of that review were presented and approved by Council in June 2020 and are now reflected in the governance and organisational structure shown in *Figure 3.1*.

The governance and delivery model includes a dedicated program team reporting to a program CEO who, in turn, reports to the Green Line Board. The Green Line Board then reports to the Mayor and City Council.

In addition, a Program Management Plan (PMP) and Program Charter are under development at the time of writing.
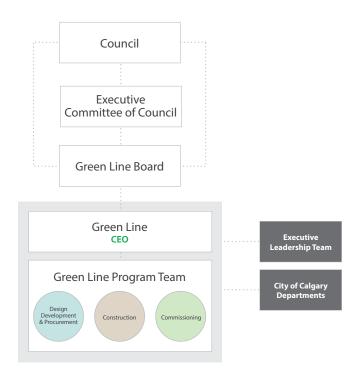
Green Line Board

In July 2020, Council approved bylaw 21M2020 establishing the Green Line Board, with a mandate to carry out Council direction, govern and oversee the successful delivery of the Green Line LRT Stage 1 program.

Board recruitment ran from August 28 to October 12, 2020, with Boyden selected as the successful firm to lead the process. With over 300 potential candidates, The City engaged in an extensive evaluation process.

On December 15, 2020, Council appointed seven Board members as recommended by City Administration in a closed session of Council.

Reporting quarterly through the Executive Committee, formerly known as the Priorities and Finance Committee, the Board improves Green Line decision making and governs the successful delivery of the program while ensuring that it meets the interest of all stakeholders and funding partners.

Figure 3.1: Green Line program governance model

3.5 Operations and maintenance

As The City is not pursuing a long-term public-private-partnership (PPP/P3) model for the program, operations and maintenance components have been excluded from the procurement model at this time. Upon completion of constructing and commissioning the program, Calgary Transit will take over operation and maintenance responsibilities of the system. This will include:

- **LRV and BRT operation** – operating LRVs on the Green Line alignment and BRT vehicles in the north (Route 301);

- **LRV and bus vehicle maintenance** – regular and ongoing maintenance including safety checks, mechanical maintenance, and system maintenance;

- **Track, right-of-way, and other system infrastructure maintenance** – overseeing and providing necessary seasonal, and periodic, recurring maintenance and upgrades;

- **Station upkeep** – including lighting, landscaping, snow removal, and ongoing maintenance of bus and LRT station shelters;

- **Maintenance facility upkeep** – ensuring appropriate building maintenance and upgrades to the facilities where the LRVs and BRT vehicles are stored; and

- **Signalling and traffic management** – managing the LRT signalling system and any interfaces with road traffic at at-grade traffic intersections.

For the BRT component of the program, the road right-of-way will continue to be maintained by the City of Calgary's Roads department. Roadway maintenance includes snow removal, tree clearing and foliage removal, general upkeep (paving, re-paving, re-surfacing), traffic management and safety management (such as vehicle speed designation and safety signage).

4.0 Summary

The Green Line LRT Stage 1 program draws on almost 10 years of planning, stakeholder engagement and design to present an optimized investment for the City of Calgary. This project was developed to achieve the following Project Vision:

A city shaping transit service that improves mobility in communities in north and southeast Calgary, connecting people and places, and enhancing the quality of life in the city.

This investment will have a significant benefit to mobility and urban development in Calgary including:

- **Improving mobility choices by providing a high-quality transit service that is fast, frequent, and reliable** – travellers will spend less time travelling for work, school, and recreation;

- **Laying the Green Line LRT foundations** – by delivering the most complex elements of the overall Green Line LRT program first, Phase 1 enables incremental future expansions;

- **Catalysing development** – the Green Line LRT serves many of the activity centres and urban main streets identified in Calgary's Municipal Development Plan (MDP) that have been identified as priorities for intensification;

- **Integrated and cost-effective transit service** – the Green Line LRT will connect people to where they want to go using a system that can be delivered and operated in a cost-effective manner; and

- **Connecting the city** – the Green Line LRT is the next step for completing Calgary's rapid transit network providing seamless connectivity with the existing Red and Blue LRT lines and four MAX transit lines.

Stage 1

Phase 2:
Eau Claire to 16 Avenue

Phase 2

16 Ave N
9 Ave N

Eau Claire

7 Ave SW   4 St SE

Centre St S   Ramsay/Inglewood

26 Ave SE

Highfield

Lynnwood/Millican

Ogden

South Hill

Quarry Park

Douglas Glen

Maintenance and Storage Facility

Shepard

Phase 1:
Shepard to Eau Claire

Phase 1