THE CITY OF Edmonton

The City of Edmonton

Cost Benefit Analysis & Cost Drivers Fire Stations

May 23, 2025

S2ARCHITECTURE

June 25, 2025 - Speical Infrastructure Committee | IIS02537rev

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THE CITY OF EDMONTON
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1.0 Executive Summary

Executive Summary

Introduction

This report is to serve as a basis for an Administration Report to the City of Edmonton Executive Committee to broadly address the following requests:

- Establish baseline operational and capital costs for the selected Fire Station and Recreation Centre projects;
- Provide the incremental cost and expected operational efficiencies associated with each cost driver including Functional Program, Market Factors, Risk Tolerance, and Design Context (Codes, Policies, Bylaws, Administrative Standards & Directives).

Background and Purpose

At the June 11/12, 2024 City Council meeting, the following motion was passed:

> *"That Administration provide a report with a cost benefit analysis and cost drivers that influence comparative capital projects including Codes, Policies, Bylaws, Program or other factors, with a focus on Facilities and Renewal Projects; including a direct cost breakdown comparison of current fire hall and recreation centre projects completed in Edmonton and within regional municipalities."*

On November 27, 2024, at Executive Committee, Administration provided a third party high level analysis of cost drivers and comparisons. At that meeting, council requested further detail, specifically the motion below:

> *"That the November 27, 2024, Integrated Infrastructure Services reports IIS02537 – Cost Benefit Analysis and Cost Drivers on Comparative Capital Projects and IIS02538 – Capital Project Planning and Design – Processes and Resources be referred back to Administration to: establish baseline operational and capital costs for the selected projects outlined in the November 27, 2024, Integrated Infrastructure Services report IIS02537 (include as attachment); provide the incremental cost and expected operational efficiencies associated with each cost driver outlined in Attachment 2 (include as attachment) of the November 27, 2024, Integrated Infrastructure Services report IIS02537"*

It was agreed that an effective way to address the motion was to conduct a comparison of two theoretical fire station designs. This involved evaluating two stations:

- One – a "Basic Civic Station" which is defined in this report as a station designed to meet the minimum code requirements and an industry standard design which focuses on little to no policy add-ons which would complicate the design and add cost while achieving energy, environmental and climate benefits. This station also is to minimize capital costs.
- Two – a "Full Policy Station" which is designed in accordance with The City of Edmonton's full range of codes, bylaws, and policies, incorporating associated cost drivers.

The analysis used in this report identified and contrasted differences between these two designs. The goal of the analysis was to determine which City policies influenced specific Capital and Construction Costs and their resultant operational cost impacts and compare these to a theoretical, capital cost-driven fire station. The City of Edmonton's Integrated Infrastructure Services engaged S2 Architecture (S2), a Prime Consultant having experience with over 80 fire stations, one of which is Windermere Fire Station, to collaborate with The City in developing this report. S2 was seen as having a broad knowledge of capital cost focused stations and policy-focused station designs.

The purpose of this report is to provide The City with the necessary details to assess the cost-benefit of The City's bylaws, policies, and other requirements. Specifically, the report compares the associated capital, project, and potential operational costs between a fire station designed in full compliance with The City's requirements to one designed with a focus on low capital costs.

The two designs are completed as two distinct approaches and developed to a concept schematic design level. The scope of work for this exercise includes the following:

- Project background and purpose.
- Description of site.
- Description of goals for the specific design, Basic Civic and Full Policy.
- Architectural
  - Building code summary and occupant load calculation
  - Zoning bylaw compliance review.
  - Area and space comparison table showing deviations from functional programme.
  - Drawings that show schematic floor plans, schematic building sections, and envelope assemblies.
- Structural
  - Foundation system, structural system, and any materials used.
  - Drawings or text indicating foundation and preliminary framing with proposed lateral restraint locations with estimated sizing.
- Mechanical
  - Description of design criteria and mechanical systems for heating, cooling, ventilation, plumbing, fire protection, controls.
  - Drawings or text indicating systems listed above.
  - Drawing or text indicating the mains and major equipment locations.
  - Describe major equipment to be preliminarily sized.
- Electrical
  - Description of proposed electrical systems including lighting, power, fire alarm, security, A/V.
  - Preliminary service size calculation, description of generator size.
  - Drawings or text indicating single line diagram routing, mains and major distribution equipment located and preliminarily sized.
- Energy
  - Assess the impact on energy because of minimal code compliance (Basic Station) and all City of Edmonton policies (Full Policy Station).
  - Develop an appropriate building envelope for both.
- Costing
  - Develop Class C level Capital, Project and 25-year Operational cost analysis for both station designs.
  - The methodology was to incorporate annual energy costs, maintenance costs and periodic equipment / system replacement costs over the space of the lifetime. Some maintenance costs (FMS) and some predicted element lifespans (LCM) provided by the City.

Both stations were schematically designed for architectural, structural, mechanical, and electrical compliance. An energy modeler was engaged to establish energy targets and climate impacts and a cost consultant was engaged to establish Capital, Project and Operational Costs based on a 25-year projected time frame.

Station Naming Convention

For clarity and ease of reference, the designs were named:

- Basic Civic Station Design

  This fire station was the station designed to minimum code compliance with a primary focus on low construction and project cost.
- Full Policy Station Design

  This fire station was the station designed to comply with The City's full range of codes, bylaws, and policies.

Selection and Assumptions

The team selected one site within the city limits for both station design. One site was selected for both designs to reduce or obviate any variations between sites which might have impacted the costs. In this way, the site size, topography, location, utilities, access, soils and other site specific items were identical for both station designs. This allowed the team to focus on only those items affected by The City's specific bylaw, policy and other regulations.

Site costs were not considered. The following assumptions were made:

- Site Location – the site selected was on Ellerslie Road in an AG zoned open area. This site is very near to the recently completed Windermere Fire Station. This site was selected because it would allow easy access to major roadway connectors, was near an existing station meaning that response and capture areas were not in question and would not complicate any costing or building needs.
- Site Costs – no site costs, purchase costs, levies or other are assumed for this report.
- Site – the site is 2.0 acres which is the typically ideal site size for Edmonton Fire Rescue Services (EFRS).
- Topography – the site is fairly flat and for the purposes of this report, is considered to be virtually flat and requires only typical civil works grading for stormwater capture.
- Soils – soils can and always are a very important element in costing as they dictate the type of foundation and slab required. For this report, it is assumed that the soil is good resulting in a simple and cost effective foundation and slab design.
- Utilities – the utilities are assumed to be within the road and therefore easy and cost effectively available.
- Road Access – road access is assumed to be easily approved by the planning department and assumed not to require any control or traffic lighting.
- All Turns – although there is an existing road medium immediately east of the site on Ellerslie Road, for the purposes of this report, it is assumed that the fire response will use an all-turns from the site and upon return to the site. Therefore no special cost considerations for road work or traffic lights or queuing are necessary.

Overview

The two designs start similarly but diverge when the implications of City requirements begin to influence the design:

	Basic Civic Design	Full Policy Design
Site Selection	<----- Same for both designs ------->	
Functionality	<----- Same for both designs ------->	
Site design	<---- Almost the same for both ------>	
Floor plan	<---- Almost the same for both ------>	
Massing	<---- Designs diverge somewhat ---->	
Systems	<---- Designs diverge significantly --->	
Aesthetics	<---- Designs diverge significantly --->	
Materials	<---- Designs diverge significantly --->	

Schedule

Execution schedules between a Basic Civic Design and a Full Policy Design are quite different with the Basic Civic Design requiring less time for design, approvals, and construction. This is NOT universal but it is more typical than the reverse. A more fulsome set of examples are shown in Sections 2.0 and 3.0 of this report, but two examples:

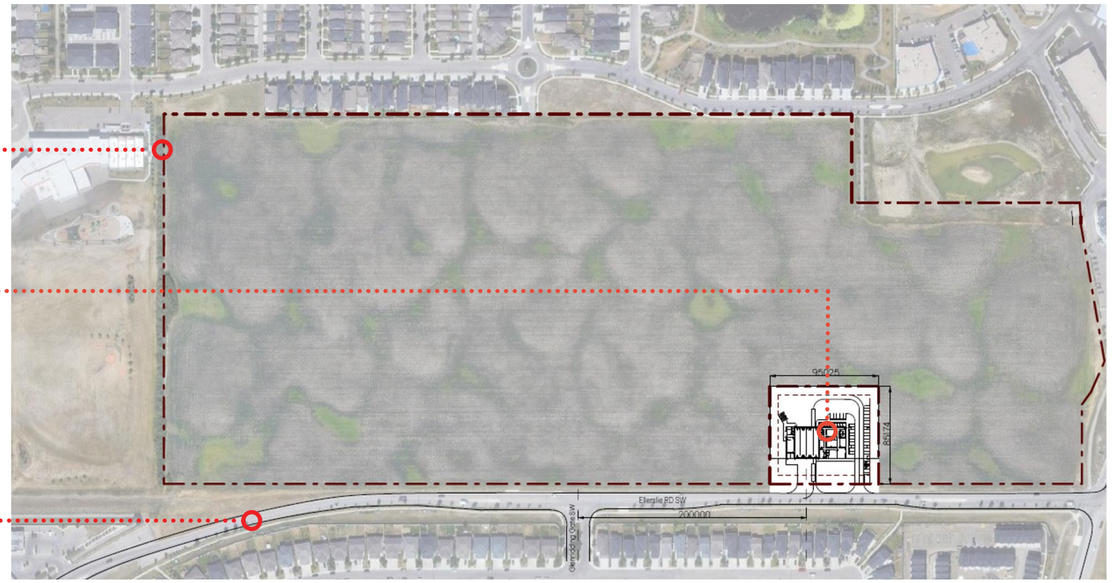
- Studies – Basic Civic Designs – virtually 100% of clients pursuing a Basic Civic Design for their fire station would require a geotechnical report and a Schematic Design report and no others. A Full Policy Design requires many more such as Climate, Energy Models at Pre-Design, Schematic Design, Design Development stages, oftentimes traffic, and others.
- Construction – Basic Civic Designs are designed with simple, structures, easily obtainable (but less efficient) equipment, and spec grade materials whereas the Full Policy Designs requires commercial grade, more complex, more efficient, equipment and materials to meet the energy requirements.

North

Property Line
The selected 2.0-acre parcel is zoned AG, Agriculture.

Concept Site Location
Selected site for both Basic Civic and Full Policy Station designs.

Ellerslie Road



Context Plan

Site Location
Approximate in 'Street View'

Google Street View from Ellerslie Road

The table below captures general findings of this report. Utilities – the utilities are assumed to be within the road and therefore easy and cost effectively available.

ITEM	BASIC CIVIC DESIGN	FULL POLICY DESIGN
Site Location	Ellerslie Road	Ellerslie Road
Building Area	1,479 sq. m. (15,636 sq. ft.)	1,657 sq.m. (17,824 sq. ft.)
Mezzanine (in Apparatus Bays):	149 sq. m. (1,603 sq. ft.)	221 sq. m. (2,378 sq. ft.)
Building Capital Cost (incl. Landscaping)	13,347,500 (+/-10%)	$21,039,300 (+/-10%)
Cost per Meter Estimate	$9,025 / sq. m.	$12,697 / sq. m.
Cost per Foot Estimate	$854 / sq. ft.	$1,180 / sq. ft.

ITEM	BASIC CIVIC DESIGN	FULL POLICY DESIGN
Required Energy Standard	NECB 2020	NECB 2020 + NECB 2017 (with additional energy requirements)
Energy Performance	Exceeds NECB 2020 by 6.8%	Meets City requirements (design exceeds NECB 2020 by 46.1%)
Structural System	Conventional steel with concrete slab on grade	Conventional steel with concrete slab on grade
Envelope System	Metal panels with concrete block sill	Thermally broken and articulated masonry
Mechanical System	Conventional fossil fuel based systems	Highly efficient all electric based systems with geo-thermal and PV
Electrical System	Standard Electrical System with main distribution of 400A, 600V	Standard Electrical System with 800A, 600V 300 kW genset with Solar PV

Regulation and Policy

The approach taken for this report:

- Basic Civic Station – the regulations typically seen in most average to smaller sized regions. These would include minimum building code and energy code compliance and bylaw zoning and setbacks (if any). These requirements are very often seen in many regions of Alberta including counties, small to medium sized municipalities, on Crown land and the like.
- Full Policy Station – the additional or more impactful bylaws, regulation, and policies in place for the City of Edmonton at the time of writing of this report (Q2, 2025). These requirements are virtually always encountered when designing for the City of Edmonton as a client, in the City of Edmonton.

Public Art

The implications of the Public Art Policy are captured in the report by providing the Policy required 1% of the cost of construction allocated outside of the listed construction budget. Therefore it is recognized but does not add to the cost of the construction value.

Public Engagement

The implications of Public Engagement are not factored in – this does not affect nor is applicable to a fire station however would be applicable for any rezoning. As this report assumes the property is zoned appropriately, there is no impact.

Edmonton Design Committee (EDC)

The Edmonton Design Committee is part of the City's approval and development process and factors into all City owned projects, including fire stations. This report:

- For the Basic Civic Station design, assumes an Edmonton Design Committee does not exist and therefore plays no role in the costing of the Basic Station
- For the Full Policy Station design, assesses subjectively what is considered and required through EDC during their review process and these are then included in the design and estimated in the costs.

Introductory Notes for Each Section

1.0 Executive Summary

- This section.

2.0 Basic Civic Station Description and Systems' Design

- The Basic Civic Station design shown in this section, is based on common design factors seen in many municipalities
- The design follows applicable building, safety, energy, electrical, OH&S, and other codes
- The design captures the needs of the fire department
- The design focuses primarily on, in order of importance:
  - Code Compliance
  - Cost
  - Fire department functionality
  - Schedule
  - The impact on traffic, utilities, and other basics
- The design aesthetic is a very low priority; however, might become a more important factor in some locales (i.e. Banff and Canmore)
- The gist is the design is what would be "typically" provided by a generic municipality – meet code, then lowest cost, then meet the fire department's needs – the image, focus on sustainability, impact on the environment, etc., are only important if the budget can sustain them – it's important for the client to be able to say they were sustainable, but only if it's achievable within their budget.
- This section describes the area programming, zoning, site design, architectural, structural, mechanical, and electrical systems used in this design complete with an energy model to confirm code compliance. There is also a life cycle cost analysis contained within the energy section.

3.0 Full Policy Station Description and Systems' Design

- The Full Policy Station design shown in this section takes into account the impacts of codes, policies, standards, and guidelines used within the City of Edmonton
- The design follows all applicable building, safety, energy, electrical, OH&S, and other codes as well as the City's policies, guidelines, processes, standards and other construction and capital project elements
- The design would focus primarily on, in order of importance:
  - Code Compliance
  - Policy Compliance (especially sustainability compliance)
  - Contextual Aesthetics
  - Standards and Guidelines (City Design / Process)
  - Fire department functionality
  - Fire Design and Construction Standards
  - Public Opinion
  - Cost
  - Schedule
- The gist is that the design is what would result after following the City's policies, guidelines, standards, and applicable building and safety codes. While cost and schedule are important, meeting or exceeding policy, (especially sustainability compliance) are more far more important and impactful
- This section describes the area programming, zoning, site design, architectural, structural, mechanical, and electrical systems used in this design complete with an energy model to confirm code compliance. There is also a life cycle cost analysis contained within the energy section

4.0 Comparative Analysis

- Compares which policy, guideline, standard, and other City requirement applies to a Basic Civic station and a Full Policy station. Specifically this section gives a high level comparison of the two stations. It then goes though all the major Codes and City policies and indicates which ones are relevant to which station. The section then includes a listing of all the City polices and standards and a summary description of each. Finally the section includes a written comparison of the architectural, structural, mechanical and electrical systems used in the two different stations.

5.0 Cost Comparisons

- Compares and describes the cost differences between a Basic Civic station and a Full Policy station. Specifically this section includes a high level written cost comparison highlighting construction cost, service life data and utility costs. This is followed up by a detailed Class C construction cost estimate. Then a Service Life Data Cost comparison table is included which shows expected equipment lifespans for the equipment used in the two stations and also the periodic replacement costs. This information is used in the life cycle costs analysis included in the previous sections.
- All of the costs shown in this report do not include soft costs, internal city costs, furniture, fixtures, or equipment costs – the costs shown are for the hard construction costs only.

6.0 Comparative Analysis Summary

- Compares and describes systems differences between a Basic Civic station and a Full Policy station. Specifically this section contains a table that lists the architectural, structural, mechanical, or electrical system in the first column. The table then lists the relevant type of system for each of the stations in the next two columns. This is followed up by a column listing applicable polices or standards expected to be causing the difference and then a column giving the expected cost premium associated with that difference. Finally the last column includes some notes around the difference or further explanation.

Findings

The Full Policy Station was designed in compliance with the City of Edmonton's applicable policies, directives, standards, and bylaws, whereas the Basic Civic Design Station did not adhere to these same requirements. The study focused on policies that directly impacted capital construction costs, rather than on soft costs and administration costs and a comparative analysis between the two fire station designs highlights notable differences in both capital and life cycle costs. Although the list of policies considered in this study is extensive, these differences are primarily driven by key policy-related cost drivers. The most significant of these include the Climate Resilience Policy (C627), City of Edmonton's Facility Consultants Manual - Volume 2, Edmonton Design Committee (Bylaw 20673) and the Fire Rescue Service Delivery Policy (C523). The Climate Resilience Policy (C627) represents the largest share of the cost premium in the Full Policy Station design. Refer to Policy Cost Premiums & Percentage Table in this section.

Policy Cost Premiums & Percentage Table

This table indicates the assumed costs resulting from each policy, standard, guideline, etc.

Reg. / Code	Policy Name	Cost Premium FULL Policy Design ($)
C627A	Climate Resilience	$3,750,000
C588	Winter Design	$24,000
C523A	Fire Rescue Service Delivery	$1,738,000
C602	Accessibility for People with Disabilities	$34,000
Bylaw 20673	Edmonton Design Committee	$876,000
Reg. / Code	Administrative Directives	
Reg. / Code	Administrative Standards	
Zoning Bylaw 20001	Zoning Requirements	$34,000
COE-IM-GUIDE-0002	Facility Consultant Manual - Volume 2	$1,192,000
Reg. / Code	Risk Tolerance	
	Low Impact Development (LID)	$44,000

Note 1: Cost premiums account for General Contractor (GC) fee, general requirements, design contingency, cost contingency and permits.

Note 2: Costs associated with any "risk factors" which may affect the construction timing are not captured in these or any budgets in this report. These include possible risk delays impacting cost escalation.

Note 3: Costs for Public Art is 1% of eligible capital projects and are not included in the costs shown in these summaries in this report as the cost for Public Art is outside of the construction costs.

Key Cost Drivers

The Comparative Analysis Summary Table in Section 6.0 provides a detailed overview of the design differences between the Basic Civic and Full Policy Stations, including the impact of relevant policy compliance and cost premiums associated with each item. Below is a short description of policies identified as cost drivers with indication of design items that affect cost premium for the policies.

- The Climate Resilience Policy requires an Emission Neutral, LEED silver certified, climate ready building. Full Policy cost premiums for this policy is attributed to several measures implemented into the design, including the use of an electric based mechanical system, geothermal ground source heat pump, photovoltaic panels, structure designed to support the mechanical and electrical systems and a thermally broken envelope, including triple paned glazing.
- The Facility Consultants Manual Volume 2 is a technical guideline to follow when designing new buildings or major renovations for the City of Edmonton. It provides detailed standards and requirements that influence project costs. It sets out detailed standards across multiple disciplines, including requirements for items such as Closed-Circuit Television (CCTV), Uninterruptible Power Supply (UPS) system and requirements for the backup generator.
- Edmonton Design Committee's mandate is to improve the quality of the City's urban design. Cost premiums for Full Policy considers the design's architectural approach including massing, materials and required detailing to be consistent with the level of design quality and design aesthetic of the whole of the city. The Full Policy introduces cladding material, geometry and form consistent with an architectural intent suited for a Full Policy fire station in Edmonton.
- Fire Rescue Service Delivery Policy strives to meet or exceed National Fire Protection Association standards and outlines the Edmonton Fire and Rescue Services' commitment to deliver an essential public service, helping to make Edmonton a safer place to live, work and play. Cost premiums include standards like lightning protection and other fire-safety-related requirements.

Energy Model and Life Cycle Cost Analysis

An energy modeling and lifecycle cost analysis was conducted to compare the Full Policy Station and the Basic Civic Station designs. The results show that the Full Policy Station consumes less energy, largely due to its enhanced building envelope, which significantly improves overall energy efficiency.

Over a 25-year period, however, the life cycle cost analysis reveals higher operational costs for the Full Policy Station. This is primarily because it uses high-performance, all-electric mechanical systems to meet emissions-neutral goals outlined in the Climate Resilience Policy. In contrast, the Basic Civic Station relies on gas and other fossil fuel-based systems. Electricity is more expensive than gas, and this contributes to the higher long-term operational costs for the Full Policy design. Although carbon tax was not included in the cost comparison, the analysis notes that its inclusion would raise the Basic Civic Station's costs further.

The integration of on-site renewable energy—specifically solar photovoltaic (PV) systems—helps reduce the difference in first-year annual energy cost intensity between the two designs. When solar PV is incorporated, the difference in energy costs between the Basic Civic and the Full Policy station is notably smaller than it would be in the absence of on-site renewable energy at the Full Policy station

In terms of performance, the Full Policy Station surpasses the Basic Civic Station in energy efficiency and thermal energy demand intensity, especially due to its advanced envelope design. Its all-electric system allows it to fully utilize the energy generated on-site by the solar PV system. As a result, the Full Policy Station achieves carbon neutrality, significantly reducing CO_2 emissions compared to the Basic Civic Station.

Final Remarks

In summary, while the Full Policy Station meets higher goals for energy savings, environmental responsibility, design quality, and safety, it also requires more upfront investment and has higher long-term operating costs than the Basic Civic Station. This is due to the higher price of electricity over natural gas and higher system replacement costs throughout the lifecycle of the facility.

The Full Policy Station complies with all of the City of Edmonton policies, standards, and guidelines outlined in this study. The largest proportion of the cost premium for the Full Policy Station is attributed to the City of Edmonton's Climate Resilience policy. This policy, in addition to the Fire Rescue Service Delivery Policy C523A, Edmonton Design Committee Bylaw 20673, and City of Edmonton Facility Construction Standard, represent 98 percent of the cost difference between the two station designs.

2.0| Basic Civic Station Description and Systems' Design

Architectural

Description of Goals for the Basic Civic Station

The goal of the Basic Civic Station design is to design a fire station which is identical in function to the Full Policy Station design and is to:

- Be as cost effective as reasonably possible. The design would be based on low cost first, then function, and then robustness.
- Meet the minimum building code compliance.
- Meet the minimum National Energy compliance.
- Provide standard mechanical and electrical equipment (i.e. a series of roof-top mechanical units in lieu of a central plant).
- Design for available mechanical equipment in lieu of appropriately high efficiency units which may require additional cost and delivery schedule time.
- Provide for no additional energy considerations such as solar panels, heat pumps, ground source heat exchange, geothermal, and similar.
- Use easily and quickly sourced materials, rarely if ever would long-lead, upgraded aesthetic, upgraded performance, or custom materials or design functions be used - this in consideration of low costs.
- Use the simplest and easiest provision of utilities, including gas - never electric only.
- Use the simplest of forms, sizes and materials to reduce waste, and hence reduce cost - use standard panel materials (i.e. 4'-0" wide metal panels in lieu of custom sized panels), flat roofs (i.e. staying away from special cuts and additional labour required for sloped or curved roofs), standard 3'-0" x 7'-0" doors (i.e. in lieu of custom height doors), and many very similar considerations.

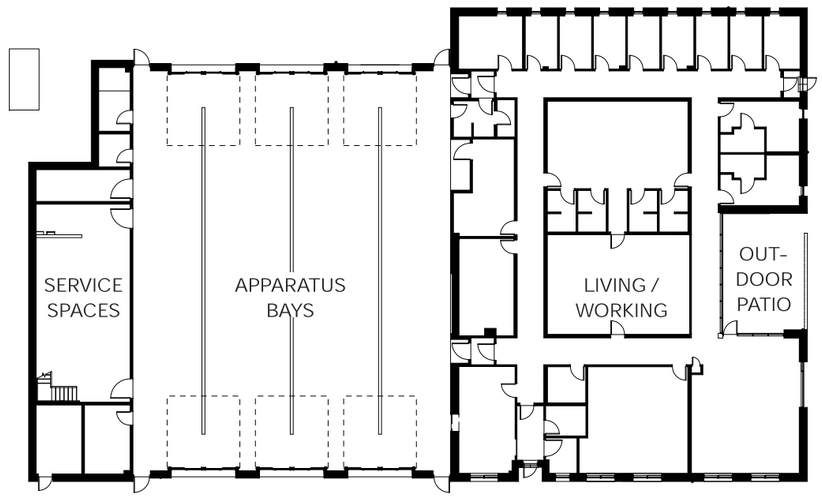
Basic Civic Station Building Front Elevation

Programme

The programme used for the Basic Civic Station design is a very typical 3-bay station and includes for a full time fire department. For the purposes of this report, the programme used for both the Basic Civic and the Full Policy Station designs are as identical as possible. There are differences, namely the Basic Civic Station has most mechanical on the roof, therefore meaning that the mechanical room is smaller. As well, the Basic back-up generator is outside the building in its own enclosure, whereby the Full Policy generator is located inside the building.

Firefighter washrooms are provided in the locker room area and are uni-sex. Washrooms are provided at a ratio of 1 washroom per two dorms except in the Captain's dorms where they are 1 per dorm. Each washroom contains a shower, a vanity, a toilet, and bench and clothes hooks. There are other washrooms provided in the facility but they are provided for the convenience of the firefighters (i.e. in the apparatus bay area).

All spaces (dorms, washrooms, locker rooms, fitness room, Captains' dorms) are all unisex.



Basic Civic Station Floor Plan

Basic Civic Station Project Information Highlights

Site Area:	0.81 Hectares (2.0 Acres)
Building Floor Area:	1,479 sq. m. (14, 843 sq. ft.)
Number of Storeys:	1 + mezzanine
Number of Apparatus Bays:	3
Number of Dorms:	10
Number of Parking Stalls:	28 Fire Fighters / Staff
	3 Visitor (includes barrier-free)

City of Edmonton - Cost Benefit Analysis Fire Stations

BASIC CIVIC STATION DESIGN – Area Programme

Description	Qty.	Comments	Proposed (Net) Area
LIVING / WORKING AREA			
Vestibule	1	Sightlines to Captain's Office. Exterior mailbox. Exterior flag pole. Near bf washroom. Pre-alert button recessed in wall in view of entry.	9 sq.m. 97 sq.ft.
Front Entry + Corridor	1	Area included in General Circulation.	0 sq.m. 0 sq.ft.
Station Captain's Office (3 - wk sta.)	1	Full sight glass to view occupants at exterior main door. 3 work spaces + file cabinets.	35 sq.m. 377 sq.ft.
Public Washroom (Barrier-free)	1	Adjacent to front entry. Locate within Vestibule.	6 sq.m. 65 sq.ft.
Community Storage Room	1	Storage space for station supplies, public donations. Adjacent to delivery area. Locate within Vestibule.	6 sq.m. 65 sq.ft.
Watch Box	1	Near front entry. Pull down murphy bed. Near main hallway. Room for desk.	10 sq.m. 108 sq.ft.
Day Room / Lounge (10 persons)	1	Accommodate 10 firefighters. Adjacent to kitchen. Noise and light control. Millwork canteen for 4 platoons.	50 sq.m. 538 sq.ft.
Kitchen/Eating Area (14 persons)	1	Large commercial fridges/freezers / commercial gas stove / clean up/broom closet/storage near kitchen and lounge to store cleaning supplies. Adjoining pantry. Door to outside patio w/ view of pkg.	65 sq.m. 699 sq.ft.
Captains Dorm + W/R & Shower	2	Additional Captain's Dorm + Washroom. 5 lockers @ 2' x 2' each. Captain style millwork beds c/w 4 under bed individual storage drawers.	36 sq.m. 387 sq.ft.
Study	1	2 work stations. Also include space for 2-3 murphy beds (may be flex dorm area).	21 sq.m. 226 sq.ft.
Dorm (8 rooms x 7 sq m.)	8	Captain style millwork beds c/w 4 under bed individual storge drawers. Close access to washrooms. Easy access to apparatus floor.	72 sq.m. 775 sq.ft.
Men's Washroom & Locker Room	1	Shower and change room area. Individual ceramic tile shower stalls - open to top, Seating/change benches. Option for shared Locker Room required.	95 sq.m. 1,022 sq.ft.
Women's Washroom & Locker Room	1	Shower and change room area. Individual ceramic tile shower stalls - open to top, Seating/change benches. Option for shared Locker Room required.	20 sq.m. 215 sq.ft.
Fitness	1	600 square feet minimum. 10' high ceilings. Exercise room flooring. Easy access to apparatus floor. Lots of natural light but not in view of public.	68 sq.m. 732 sq.ft.
TOTAL AREA LIVING/WORKING			**493 sq.m.** **5,305 sq.ft.**

Description	Qty.	Comments	Proposed (Net) Area
APPARATUS BAYS			
Apparatus Bays - Bays 2	1	Drive-thru bay. Double doors (air-locks) between apparatus floor and living quarters.	224 sq.m. 2,410 sq.ft.
Apparatus Bays - Bays 1 and 3	2	Wider Bay 1 and 2 for exterior ped door and movement along walkway at quarters. Drive-thru bays. Double doors (air-locks) between apparatus floor and living quarters.	375 sq.m. 4,035 sq.ft.
Washroom (off Apparatus Bay - no shower)	1	Single unit washroom with locking door off apparatus bay floor. In proposed design this space is combined with Washroom - Deluge Shower.	5 sq.m. 54 sq.ft.
Gear Storage	1	Off apparatus Bay 3. Room for 48 sets of in-service gear + 42 stowed spare sets. Quick dry area with mobile drying rack system - minimum 6 sets of turnout gear.	81 sq.m. 872 sq.ft.
Washdown - Deluge Shower	1	In proposed design this space is combined with Washroom (off Apparatus Bay - no shower).	6 sq.m. 65 sq.ft.
Workshop (inluding Utility/Laundry/Janitor)	1	Room for a large wooden and stainless steel workbench. Large stainless steel clean up sink with sprayer. Commercial grade pre rinse w cold & hot assembly. Towel dispensers. Battery charging.	28 sq.m. 29 sq.ft.
Decon Laundry / Washroom Space	1	Room for shower, laundry, and washroom for decontamination of dirty to clean areas	19 sq.m. 204 sq.ft.
Staff Entrance	1	Adjacent to staff parking. Storage of winter boots. Primary door to be used by firefighters, 42" wide. In-floor boot mat (non-mechanical).	0 sq.m. 0 sq.ft.
TOTAL AREA APPARATUS BAYS			**738 sq.m.** **7,669 sq.ft.**

Description	Qty.	Comments	Proposed (Net) Area
SERVICE SPACES			
General Circulation	1	Air lock vestibules to apparatus floor / general interior corridors / space andwidth for movement in dispatch call situations. The area indicated here is actual area, not a gross-up factor.	129 sq.m. 1,388 sq.ft.
Mechanical Room	1	To be designed specific to each station design (base versus Policy)	80 sq.m. 861 sq.ft.
Generator	1	Exterior in generator enclosure	0 sq.ft.
Electrical/IT/Data	1	Low-tension room for data, telephone, fire alarm, security system, Station Alerting, SCADA, dispatch paging system, stack lights, dispatch printer, etc.	28 sq.m. 301 sq.ft.
Custodial / Janitor / General Storage	1	Janitor Room at living quarters. Open shelf space for access to cleaners. Janitorial storage and mop sink.	4 sq.m. 43 sq.ft.
Outdoor Storage - Hazardous Materials	1	Storage for Hazardous materials/outdoor equipment.	7 sq.m. 70 sq.ft.
TOTAL AREA SERVICE SPACES			**248 sq.m.** **2,663 sq.ft.**
TOTAL NET BUILDING AREA			**1,479 sq.m.** **15,636sq. ft.**

Plus Mezzanine above service area in Apparatus Bays: 149 sq. m.
1,603 sq. ft.

EXTERIOR SPACES			
Patio Area	1	Large enough to accommodate 10 people, out of the view of the public. Natural gas line for BBQ. Fenced in. Accessible from kitchen.	37 sq.m. 398 sq.ft.
Staff Parking	28	28 stalls, 9' wide with receptacles and wheel stops. In proposed design parking area does not include drive isles.	432 sq.m. 4,643 sq.ft.
Visitor Parking	3	Include 2 barrier-free stall. In proposed design parking area does not include drive aisles.	59 sq.m. 635 sq.ft.
Garbage & Recycling	1	Lockable containment areas. Hazardous Material Pick-up.	59 sq.m. 635 sq.ft.

Zoning Bylaw Compliance Review

The applicable zoning bylaw is The City of Edmonton | Zoning Bylaw 20001 passed by Council on October 23, 2023, effective January 1, 2024.
The site selected for both the Basic Civic Station and Full Policy Station designs is theoretical and therefore not truly impactful on the design of the building.

However the site selected is on a large parcel of land zoned AG, Agriculture. The building function on this site (in red below) will be assumed, for the purposes of this report, to be a permitted use, in full compliance with the Bylaw.

Vehicular parking requires no minimum or maximum however 28 stalls are provided.

Building Code Summary and Occupant Load Calculation

The building falls under the National Building Code of Canada 2023 - Alberta Edition (NBC 2023-AE). The applicable energy code is the National Energy Code of Canada for Buildings 2020 (NECB 2020).

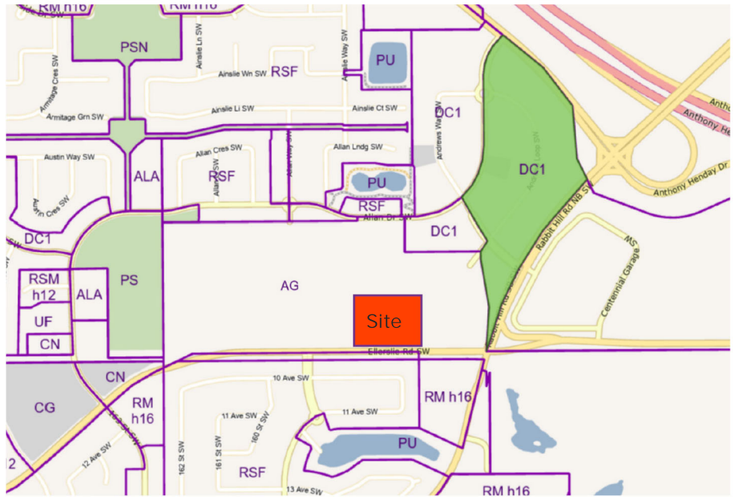
This code analysis describes the construction of a new fire station (Basic Civic Station) including apparatus bays, living quarters and offices. NBC 2023-AE Parts 3, 4, 5, And 6 Of Division B applies to the facility (Division A 1.3.3.2)

Building Occupancy and Major Occupancies:

- Group C – Residential Occupancy – Dormitories & Subsidiary Spaces
- Group D – Business & Personal Services Occupancy – Offices
- Group F, Division 3 – Low-Hazard Industrial Occupancy – Apparatus Bays

Building Height:

2 Storeys Above Grade (1 storey plus Mezzanine which is considered a storey)



City of Edmonton Zoning Map. Project site is located in parcel zoned AG.

Building Size and Construction Relative to Occupancy

- Group C, Sprinklered - 3.2.2.54 (Most Restrictive Of 3.2.2.54, 3.2.2.63 & 3.2.2.86, Per 3.2.2.4 & 3.2.2.6)

Construction: Combustible Or Non-combustible - Building is Non-Combustible

Floor Assemblies: Fire Separations With A Fire-Resistance Rating Of 45 Minutes

Mezzanines: 45 Minute Fire Resistance for Combustible Construction

Load bearing Walls, Columns and Arches Rating Equal To Supported Assembly

Major Occupancy and Extents

- Group C & Group D: 1 Hour Fire Separation. Table 3.1.3.1
  - Closures – 45 Minutes. Table 3.1.8.4
- Group C & Group F, Div 3: 1 Hour Fire Separation. Table 3.1.3.1
  - Closures – 90 Minutes. Table 3.1.8.4
- Group D & Group F, Div 3: No Fire-Resistance Rating Required. Table 3.1.3.1
  - Closures – 0 Minute

Component Fire Separations and Closure

- Exits: 45 Minute Fire Separation – 3.4.4.1
  - Closures – 45 Minute – Table 3.1.8.4
- Janitor Rooms: 0 Minute Fire Separation, Smoke Separation Required. – 3.3.1.21 (3)
  - Closures – 0 Minute

Building Services Penetrations

- Penetrations Through Fire Separations Will Be Fire Stopped As Per The Requirements Of 3.1.9.1 (1) Through 3.1.9.6 (1)

Occupant Load

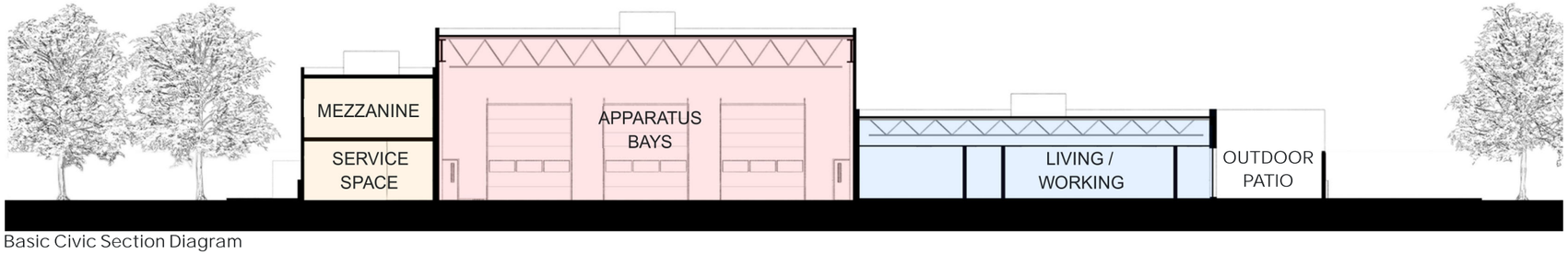
- Occupant Load: 20 Persons based on building function – code assumed to be 50% each Male / Female – actual estimated 15 (M) and 5 (F).

Exiting and Egress

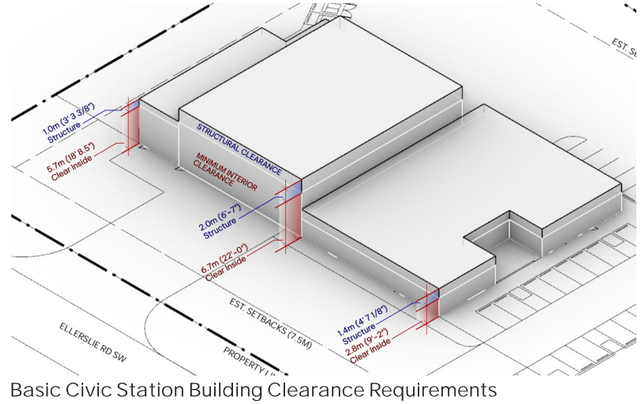
- Minimum Corridor Width – 1100mm – 3.3.1.9.(1)
- Maximum Travel Distance To Exit – 45m – 3.4.2.5
- Maximum Dead End Corridor – 3m – 3.3.1.9.(7)
- Doors Providing Access To Exit From A Room Or Suite With An Occupant Load Greater Than 60 Shall Swing In The Direction Of Travel To Exit – 3.3.1.11
- Two Means Of Egress Are Required For Floor Areas
- Maximum Travel Distance:
  - Group C Occupancy - Maximum Travel Distance: 25m
  - Group D Occupancy - Maximum Travel Distance: 25m
  - Group F(3) Occupancy - Maximum Travel Distance: 25m
- Doors Providing Access To Exit Not Less Than 800mm – 3.3.1.13

Barrier-Free Design Requirements

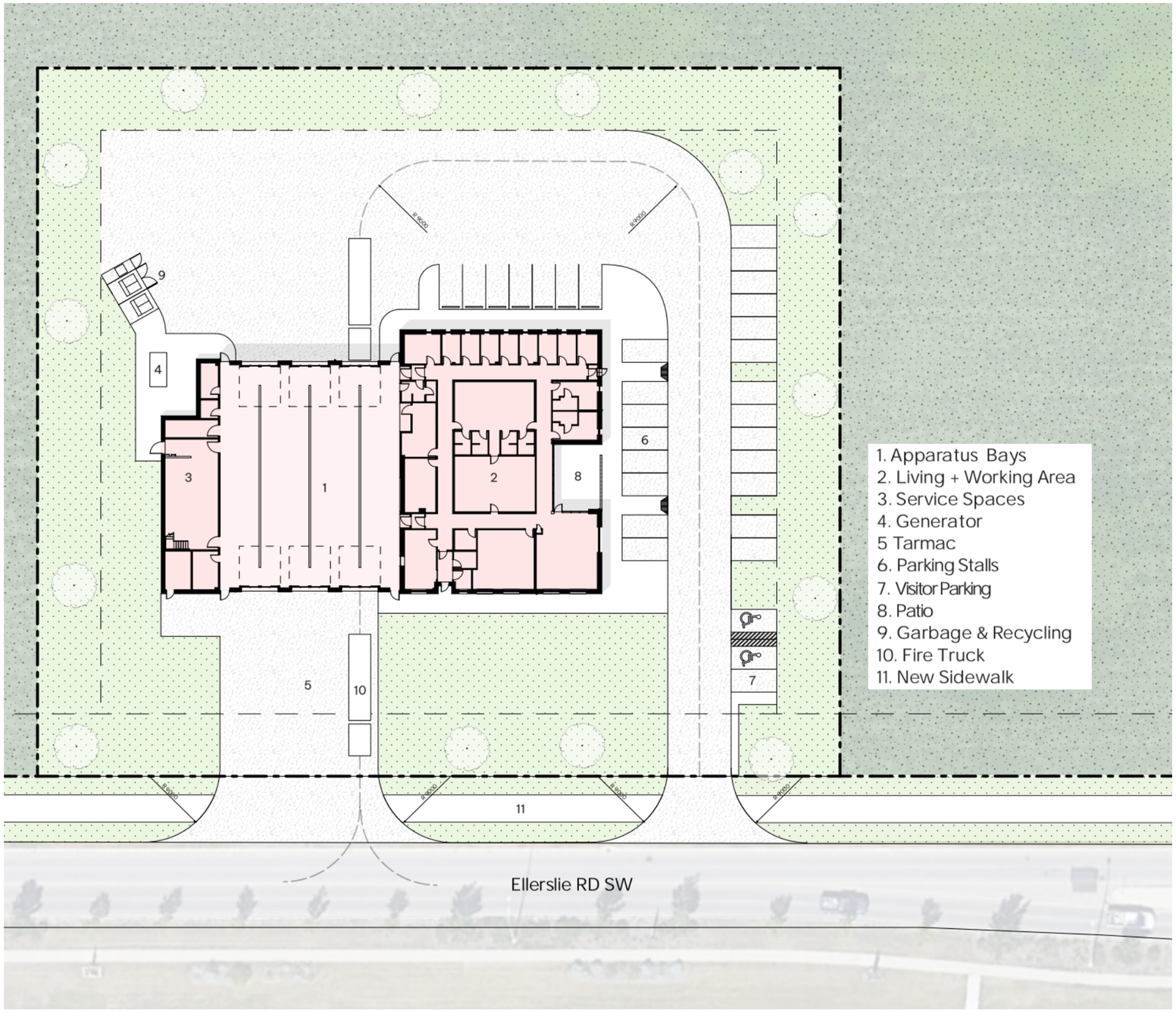
- Areas Of the Building Accessible by the Public Are To Be Designed In Accordance With Section 3.8. As is typical for a fire station, an Application For Relaxation Of Barrier-Free Requirements would be made.
- A barrier free washroom is provided in the vestibule for access to public if required by the public



Basic Civic Section Diagram



Basic Civic Station Building Clearance Requirements



Site Plan for Basic Civic Design

Washroom Fixture Calculations

- Calculations Based On A Total Occupant Load Of 15 Male And 5 Female
  - Males = 1 Fixtures Required
  - Females = 1 Fixtures Required
  - Barrier-Free Counts Vary Based On Washroom Layouts – Refer To 3.8
- Provided:
  - Males = 5 Fixtures Provided
  - Females = 5 Fixtures Provided
  - Barrier Free (Included In Above Counts) = 1 Fixtures Provided (Included In Above Counts)
  - Unisex = 1 Fixture Required and provided

Site Design

The site is theoretical therefore assumed to be flat, zoned appropriately, require 3.0m setbacks and be permitted by planning to have two curb-cuts onto Ellerslie Road- one for the tarmac and one for the parking lot access.

The building is located sufficiently north so that a full ladder truck can perform a 360 degree turn to back-up into the bays without having to enter onto Ellerslie. The building has three drive through bays and therefore the parking area drive aisle is designed to accommodate fire truck turning radii and sufficient width to allow any of the EFRS vehicles to drive through the parking area.

No security fence is provided. Storm water is managed on-site to city storm.

A total of 28 EFRS dedicated parking stalls are provide. A 2.0m wide sidewalk extends from the north tarmac area, eastward along the south face of the building and returns north and then west around the building within the secured area. Public access is typically not encouraged.

The landscaping is minimal hydro-seeded "grassed" areas without many trees.

Waste, recycling, and organics are located within the read area and accessible to waste vehicles through the back of the site tarmac. A back-up generator is provided on the concrete pad (sidewalk) on the same pad as the waste and recycling..

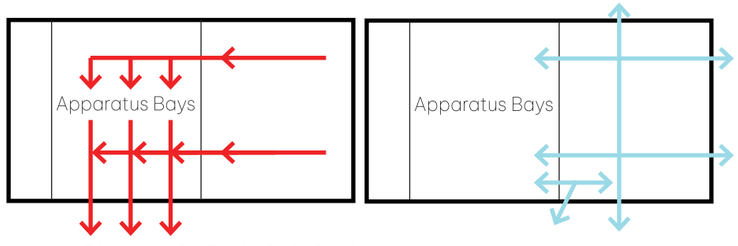
Heavy duty asphalt is designed for the north and south tarmacs and from the curb-cut into the parking area and along the drive aisle. All other asphalt is regular duty. Sidewalks are concrete with rolled curbs. Asphalt to landscaped areas do not have curbs, and parking stalls do not have any wheel stops.

Floor Plan Design

The principle design functional drivers are: response; and firefighter functionality. The circulation "parti" (red arrow diagram) shows the direct routing from the parking and from the dorms into the apparatus bay. This keeps the mandated 70 second turn-out time, visual cues to firefighters of the exterior is critical to firefighter orientation. The visual connections to the exterior (blue arrow diagram) show how firefighters can connect to the exterior - an important design element. The building floor plans are designed around these.

The Basic Civic Station design is virtually identical to the Full Policy Station design, certainly in function. The designs are based on a number of influences:

- The EFRS Standards' Space Programme as created by and maintained by EFRS.
- Data taken by S2 Architecture when programming Windermere Fire Station and as approved by EFRS during that project's programming phase.
- An occupancy summary spreadsheet was created and shown previously and is largely based on EFRS' Standards Space Programme.
- The floor plan incorporates EFRS refinements needed since the Standards were originally written. These refinements came about from earlier discussions with EFRS (separate from this report).
- The Area Summary spreadsheet was used as the Basis of Design for both designs.
- This Basic Civic Station design is slightly smaller than the Full Policy Station design because the amount of interior mechanical and electrical spaces and the location of the generator inside the building are not required in the Basic Civic Station design.



Circulation Diagrams for Basic Civic Station

The building's circulation is designed all around response. This focus on response is seen in the simplicity of the internal movement (red lines) and the clarity of the visibility corridors (blue lines). This singular focus predicated the building planning and design.

Building Massing

The building massing developed around two principles:

- Minimum clearances required within the functional spaces.
- Estimated ceiling height required for structural, mechanical and electrical services to be run throughout the building.

The functional clearances required are:

- Offices: 2.7m inside clear (9'-0")
- Apparatus: 6.1m inside clear (18'-0")
- Duty Gear: 2.4m inside clear (8'-0")

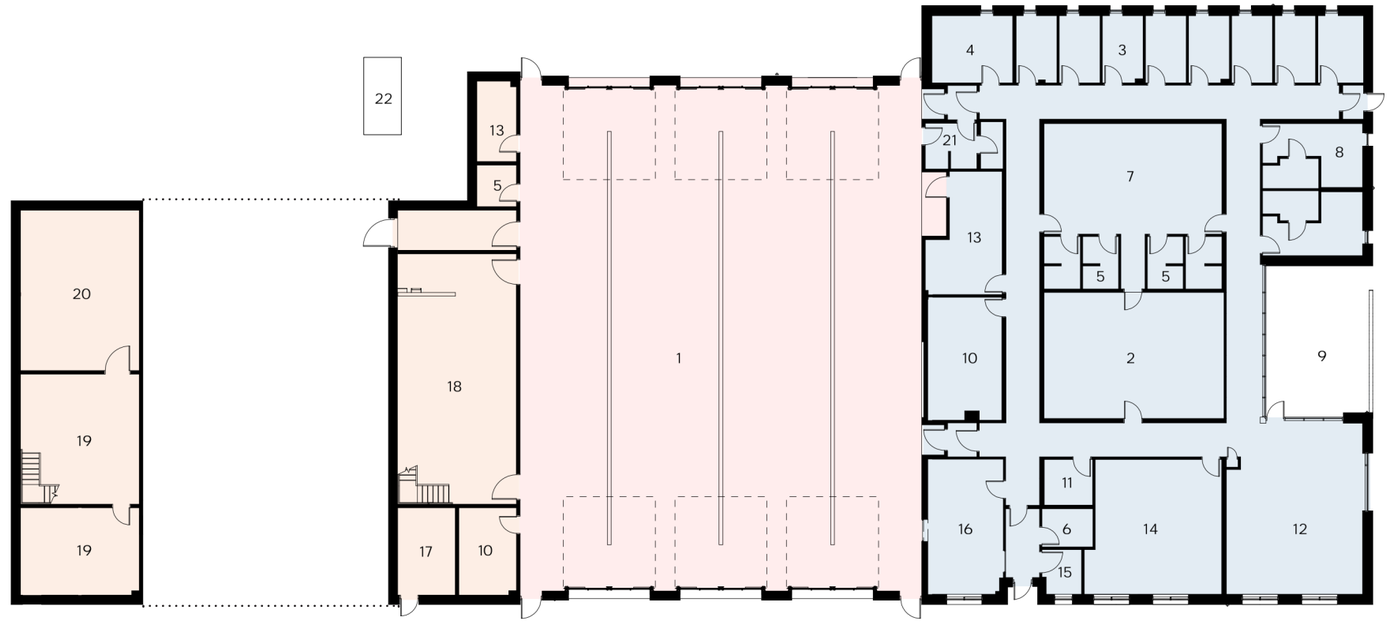
The estimated clearances required above the functional clearances noted above provides space for the structure, mechanical ducts, electrical lights, ceiling structure, and other elements. The estimated clearances are:

- Offices: 1.4m (4'-4")
- Apparatus: 2.4m (8'-0")
- Duty Gear: 1.2m (4'-0")

The minimum clearances are typical to both the Basic and the Full Policy Station designs and are also typical to best practice fire stations.

The dimensions and sizing shown in this report are based on averages and the structural assessment shown in the structural section of this report. The exterior profile and elevations of the roof in this Basic Civic Station design, significantly follows the profiles shown below. This is very typical for many station designs.

The profile of the design would change if the office component was two storeys but in the case of this theoretical design, sufficient space on the site exists to make it a one-storey facility. If space on the site exists, a one-storey build is typically less expensive than the same building area compressed into a two-storey solution.



Mezzanine Level

Main Level

1. Apparatus Bays
2. Fitness Room
3. Dorm
4. Study Room
5 Washroom
6. Barrier Free Washroom
7. Locker Room
8. Captain's Dorm
9. Outdoor Patio
10. IT/Electrical Room
11. Watch Box
12. Kitchen
13. Custodial & Maintenance Storage
14. Day Room
15. Community Room
16. Captain's Office
17. Meter Room
18. Duty Gear
19. Storage
20. Mechanical Room
21. Decon Laundry & Washroom
22. Generator

Legend

- Apparatus Bays
- Service
- Work + Living

Building Assemblies and Materials

Building materials typically selected are based on availability, price point, minimal energy performance, and robustness to withstand the rigours of firefighters. The composition of the building envelope is:

Exterior wall sill to 1000 AFF ~R-30:
- 90mm stack bond masonry concrete block veneer
- 25mm air space
- 100mm insulated metal panel system

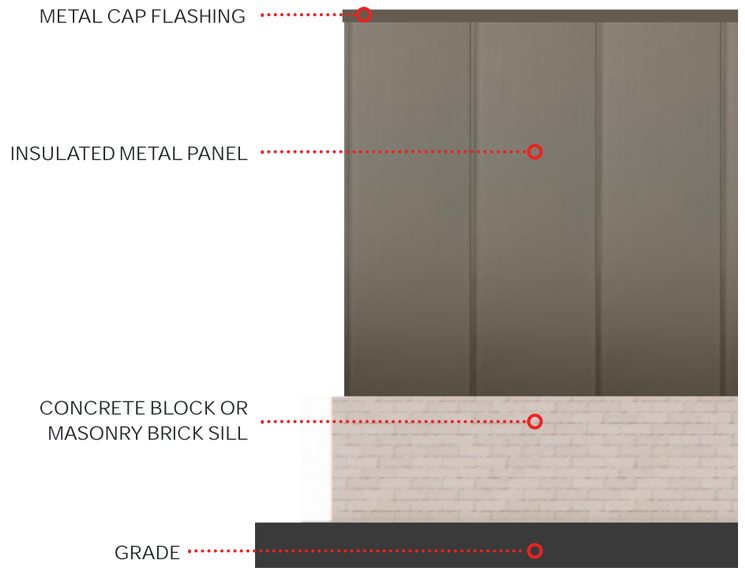
Exterior wall – above sill ~R-30 – Face Sealed System Design:
- 100mm insulated pre-finished metal panel (i.e. Kingspan)

Windows:
- Double Paned, Argon Filled, Thermally Broken

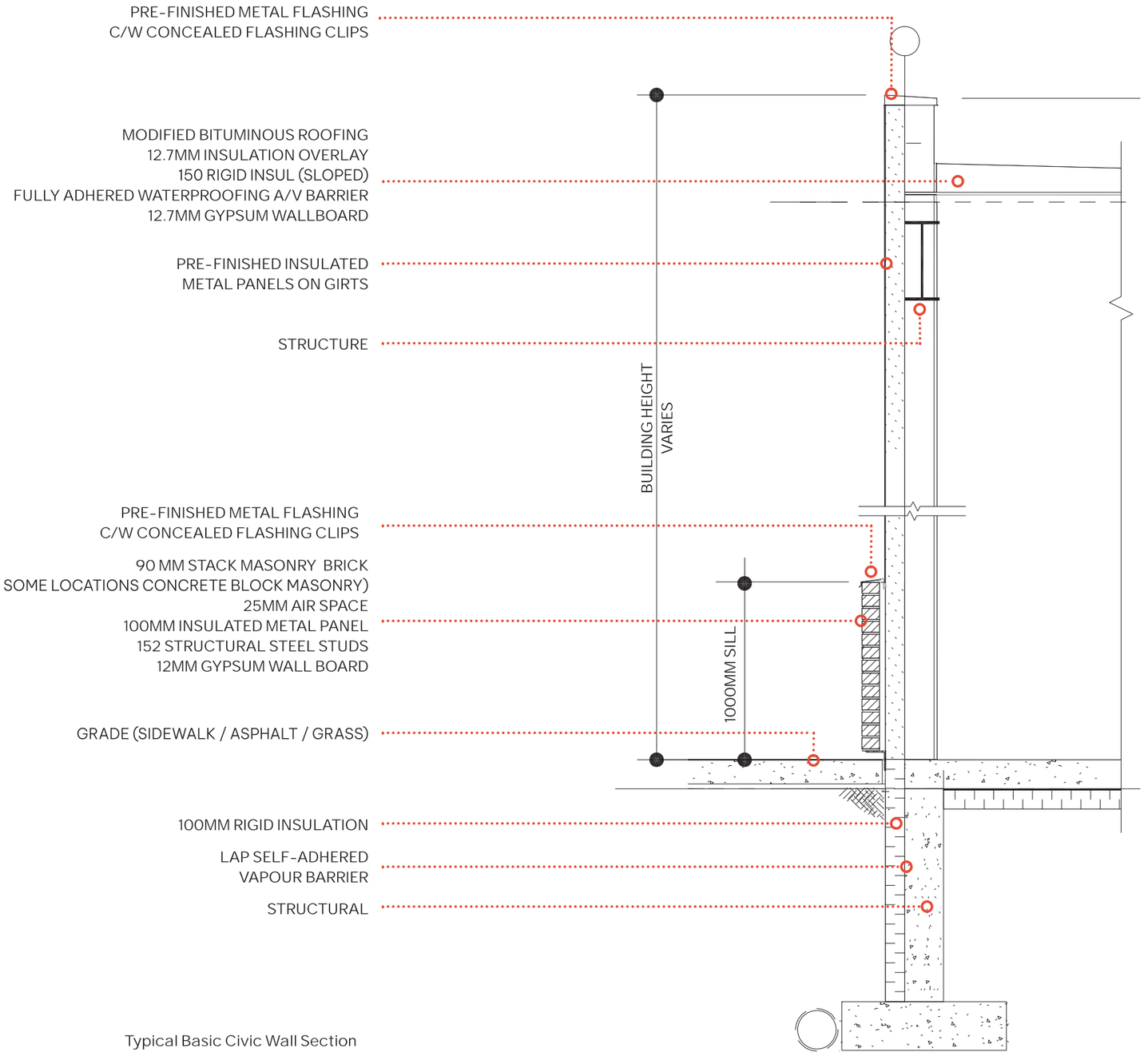
Exterior doors
- Exterior aluminum, dark bronze anodized
- Painted insulated metal door

Roof
- Modified Bituminous Roofing ~R32
- 12.7mm Insulation overlay
- 150mm Rigid insulation
- Fully adhered waterproofing A/V B
- 12.7mm Gyp board

Slab On Grade
- 10 mil Poly VB
- 5mm Hard Board
- 100mm Rigid insulation 1200mm around perimeter



Basic Civic Exterior Building Elevation Detail



Typical Basic Civic Wall Section

Structural

Structural Systems

Proposed Basic Civic Station Structural Systems

The structural system for the Basic Civic Station will be as follows:

- The structure will be a non-combustible building with a concrete foundation and conventional steel superstructure.
- The structural system was chosen as the most common non-combustible and cost-effective system for the required spans and loading.
- The roof structure will generally consist of 38mm deep by 0.76mm thick steel roof deck on open-web steel joists (1000mm deep over apparatus bay, 300mm to 500mm deep in other areas) spaced at 1200mm to 1600mm on center, supported by steel beams, ranging from 310 deep to 610 deep, and 125mm to 150mm square HSS columns. The OWSJ's at RTU locations and adjacent to the high roof will be spaced at 1200mm on centre.
- The main floor structure will consist of cast-in-place concrete slab and grade beams. It is assumed that a grade-supported slab will be suitable.
- Based on experience and common practice in this area, the foundations are assumed to be cast-in-place concrete CFA (Continuous Flight Auger) piles ranging in size from 400 diameter and 11m length to 750 diameter and 23m in length. The average size being 400 diameter and 22m in length, located under columns or at 6m under grade beams carrying load-bearing block walls.
- The lateral system will consist of concrete masonry shear walls around the apparatus bay and structural steel braces in three locations around the other areas.

Applicable Code Standards

- The following is a list of the major Codes and Standards that will be used in the structural design of this project, within these are referenced numerous other material standards (too many to list):
  - National Building Code: Alberta Edition 2023
  - CSA S16 – Design of Steel Structures
  - CSA A23.1, A23.2 and A23.3 – Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete/ Design of Concrete Structures
  - CSA S136– Design of Cold-Formed Steel Structural Members
  - CSA S304 – Design of Masonry Structures

Use and Occupancy Loads

The following occupancy loads will be used:

- Main Floor:
  - Apparatus Bays — 12 kPa live load (also wheel loads imposed trucks)
  - Mechanical Areas — 3.6 kPa live load plus 2.4 kPa dead load
  - All other areas — 4.8 kPa live load
- Second Floor:
  - Mechanical Areas — 3.6 kPa live load plus 2.4 kPa dead load
  - All other areas — 4.8 kPa live load or 9kN concentrated load
- Roof:
  - Construction Load — 1.0 kPa live load

Environmental Loads (Unfactored Loads)

The following environmental loads will be used:

- In general, this building is considered to be "Post-Disaster" as per the Alberta Building Code, with Importance Factors as shown in the following categories:
- Snow Load — IS = 1.25 (ULS), 0.9 (SLS)
Ss = 1.7 kPa
Sr = 0.1 kPa
- Wind Load — IW = 1.25 (ULS), 0.75 (SLS)
q10 = 0.36 kPa
q50 = 0.45 kPa
- Seismic — IE = 1.5 (ULS)
Sa(0.2) = 0.103
Seismic Site Classification assumed to be 'D'

Mechanical

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- This document has been prepared solely for the use of the City of Edmonton and its design team associated with Cost Benefit Analysis & Cost Drivers Fire Stations. The material contained in this document reflects Smith + Andersen's best judgment in light of the information available at the time of preparation. There is no warranty expressed or implied. Professional judgment was exercised in gathering and assessing information. The recommendations presented are the product of professional care and competence and cannot be construed as an absolute guarantee.
- Where expected or anticipated equipment life is provided it is based on ASHRAE Median Service Life statistics. Actual life of equipment may vary depending on variables such as operation, service and maintenance frequency.
- Where equipment sizing is provided it should be considered order-of-magnitude only as the project details that may affect systems (e.g. envelope quality, occupancy loads, equipment loading) sizing have not been established or finalized.

Introduction

- This section describes the mechanical design the Basic Civic Station.
- The goal of the Basic Civic Station design is to achieve minimum code compliance with a focus on minimizing capital cost. No City of Edmonton policies, guidelines, or manuals apply to this building.

Basic Civic Station

- The fire station is designed as a Group C Construction with Group D and F2 located in Edmonton, Alberta.
- The facility will be owned by the City of Edmonton.
- The building will be approximately 1,479 square metres (SM) or 15,636 square feet (SF) above grade and one story tall with a mezzanine. Approximate building height is 9.1 metres (30 feet) from average grade to the floor of the roof level.
- The mechanical systems for the Basic Civic Station provide heating and cooling through air systems which have a lower capital cost as opposed to water systems which are typically more efficient but have a higher capital cost.
- Variable air volume systems were chosen as a cost effective option to minimize the amount of rooftop mechanical equipment and electrical connections. Use of gas fired boilers are a cost effective way to provide hot water for heating to required mechanical equipment.

Design Standards

General

- Mechanical systems are designed to maximize usable space within the building while maintaining optimum service clearances for maintenance and repair.
- All equipment and materials are designed in a neat and orderly fashion. In finished areas all mechanical systems are concealed unless specifically exposed as part of the architectural design.

Codes and Standards

- Mechanical systems are in accordance with applicable codes and standards including, but not limited to:
  - Authority Having Jurisdiction is the City of Edmonton.
  - National – Applicable to all Jurisdictions:
  - Air Conditioning and Refrigeration Institute (ARI)
  - American National Standards Institute (ANSI)
  - American Standard for Testing and Materials (ASTM)
  - American Society of Mechanical Engineers (ASME)
  - American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
  - Canadian/American Air Balance Council (CAABC)
  - Canadian Standards Association (CSA)
  - Natural Gas Utilization Code
  - National Fire Protection Association (NFPA)
  - Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- Alberta
  - National Building Code – Alberta Edition
  - National Fire Code – Alberta Edition
  - National Plumbing Code of Canada (NPC)
  - Canadian Electrical Code (CEC)
  - National Energy Code for Buildings (NECB)

Outdoor Design Conditions

- The sizing of mechanical systems are based on the outdoor air conditions shown in the following table:

Location	**Dry Bulb Deg. C (Deg. F)**	**Wet Bulb Deg. C (Deg. F)**	**Code Reference**
Cooling Edmonton	28.0 (82.4)	19.0 (66.2)	NBC – AE 2.5%
Heating Edmonton	-33.0 (-27.4)		NBC – AE 1%

Ventilation for Acceptable Indoor Air

- Ventilation to meet acceptable indoor air quality is in accordance with ASHRAE Standard 62.1, and the applicable building code.
- Specific minimum outdoor air ventilation rates are identified in the following table and are equal to the sum of a per person rate and per SM (SF) rate:

	L/s (CFM) Per Person	L/s-SM (CFM/SF)	Comment
Kitchen (cooking)	3.8 (7.5)	0.6 (0.12)	
Break rooms	2.5 (5)	0.3 (0.06)	
Corridors	0 (0)	0.3 (0.06)	
Bedroom/living room	2.5 (5)	0.3 (0.06)	
Laundry rooms	2.5 (5)	0.6 (0.12)	
Occupiable storage rooms for dry materials	2.5 (5)	0.3 (0.06)	
Office Space	2.5 (5)	0.3 (0.06)	
Health club/weight rooms	10 (20)	0.3 (0.06)	

Indoor Design Conditions

- Indoor design conditions are in accordance with the occupant comfort requirements per ASHRAE 55.
- The indoor space conditions are in accordance with the following table:

	Summer		Winter	
	Temperature Deg.C. (Deg.F.)	Relative Humidity	Temperature Deg.C. (Deg.F.)	Relative Humidity
Offices, Dorms, and similar non-service spaces	22 (71.6) +/-1 Deg.C.	N/A	22 (71.6) +/-1 Deg.C.	N/A
Mechanical and Electrical Rooms	26 (78.8) +/-1 Deg.C.	N/A	18 (64.4) +/-1 Deg.C.	N/A
IT Rooms	22 (71.6) +/-1 Deg.C.	N/A	20 (68) +/-1 Deg.C.	N/A
Gym	24 (75.2) +/-1 Deg.C.	N/A	22 (71.6) +/-1 Deg C.	N/A
Apparatus Bay	N/A	N/A	18 (64.4) +/-1 Deg.C.	N/A

- During the programming stage, the equipment provided for each space are reviewed in order to establish required cooling but in all cases will be designed to assume the following minimum loads:

	Lighting W/SM (W/SF)	Equipment W/SM (W/SF)	Comments
Study, dorms, kitchens, break rooms, gym,	11 (1)	22 (2)	
Corridors, vestibules, washrooms, change rooms, apparatus bay, service areas	11 (1)	0 (0)	
IT/Comms Rooms	11 (1)	22 (2)	

Air Filtration Design

- The following air filtration levels are proposed for the new HVAC air handling systems indicated:
  - Exhaust air systems: None
  - Exhaust air systems c/w Heat Recovery None
  - Supply air systems (Pre Filters): MERV 8
  - Supply air systems (Final Filters): MERV 8

Noise Design Criteria

- All mechanical systems and components are designed with attention to reducing sound and vibration levels to meet noise criteria and provide a space that is comfortable, acoustically, for the occupants.
- Noise levels due to mechanical equipment, ductwork, grilles, registers, terminal devices, and diffusers are designed not to exceed the recommended ASHRAE limit or local noise by-law listed below for the areas indicated:

	NC (low)	NC (high)	Comments
All areas	30	35	
		dBA (high)	Comments
Property Line		60	Bylaw 14600 Overnight decibel level – non-residential

- The identified noise criteria resulting from the operation of mechanical systems assumes a finished room with all the final architectural finishes (e.g. ceilings and floor finishes) and furniture in place.

Flammable and Combustible Materials

- The storage and use of flammable and combustible materials is regulated by Authorities having Jurisdiction (e.g. Part 4 of the National Fire Code – Alberta Edition) and will limit and control the use of such materials.

System Redundancy

- There is an N+1 redundancy (Components - N - have at least one independent backup component +1) applied to the following systems:
  - Heating water pump system;
  - Storm sump pumps;
  - Sanitary sump pumps;
  - Diesel fuel pumps

HVAC

General

- The heating, ventilation and air conditioning (HVAC) design and installation conforms to applicable codes and standards and are sized by recognized computation procedures referenced in ASHRAE.
- Distribution pumps are duplex, duty/standby systems (two pumps sized at 100%of the peak design circulation rate) to provide redundancy during times of service.
- Variable flow distribution systems use variable frequency drives (VFD) on the distribution pumps and two-way control valves at the terminal devices. Minimum system flow rates are maintained either by including three-way control valves at a sufficient number of terminal devices or by installing a two-way (bypass) control valve across the supply and return mains modulated by a differential pressure controller.

Heating Systems

- The central boiler plant consists of two condensing, gas-fired, forced draft boilers each sized for approximately 60% of the total heating water requirement. Each boiler are sized for approximately 110 kW (374,400 Btu/hr) input.
- The heating plant is sized to serve:
  - Perimeter envelope losses.
  - Building air handling unit heating coils.
  - Reheat.
  - Snow melting.
  - Entrance heating.
- The heating water pumping system is variable primary.
- The primary system shall consist of pumps: one dedicated to each boiler.
- The heating plant including boilers and distribution pumps are on back-up power.
- Heating coils not subjected to below freezing conditions are serviced by the heating water system.
- Heating coils subjected to below freezing conditions are serviced by a glycol heating system complete with plate and frame heat exchanger and glycol distribution pumps. Glycol are 50% ethylene glycol by volume.
- All vestibules, entrances and service spaces are heated by electric force flow heating water cabinets or unit heaters complete.
- Snow melting system is provide and consists of high density cross-linked polyethylene tubing embedded into the structure/system. System are complete with distribution manifolds, circuit isolation and balancing valves, and controls. Tubing are rated for not less than 82.2 deg. C. (180 deg. F.) working temperature and 100 psig working pressure. Glycol are 50% ethylene glycol by volume.
- Chemical treatment systems including pipe line filters are provided for all heating water systems.
- Hydronic unit heaters provide heating to the Apparatus Bay.

Cooling Systems

- Cooling is generated by direct expansion (DX) cooling coils located in roof mounted air conditioning units with air-cooled condensers located on the roof. Refer to Air Handling Units section.

Refrigeration Systems

- Refrigeration systems are in accordance with CSA B52 or ASHRAE Standard 15.
- Refrigerant piping passing through different fire zones (e.g. vertical pipe shaft between floors) are in a fire rated enclosure that is vented to the outdoors.

Dehumidification

- No "active" dehumidification is provided. All cooling systems "passively" dehumidify by lowing supply air temperature and, consequently, dehumidifying the supply air.

Humidification

- No humidification is incorporated in the rooftop air handling units.

Air Handling Systems

- Variable Air Volume Units AHU-1 & AHU-2
  - Variable air volume (VAV) units are roof mounted and shall recirculate air from the space to the air handler unit, mix with outdoor air, filter, heat or cool and supply to the space. The unit are capable of 100% outdoor air for free cooling (economizer mode) when the ambient conditions permit.
  - Units shall consist of dampers, mixing section, filters, DX cooling coil, gas fired heating section, supply fan with variable speed drive, and separate return fan with variable speed drive.

- System capacities are as follows:

	Airflow L/S (CFM)	Cooling kW (Ton)	Heating kW (Btu/hr)	Comments
AHU-1 Living and Working Area	3,715 (7,877)	35.2 (10)	53.1 (181,100)	
AHU-2 Service Spaces	1,260 (2,673)	0 (0)	19.3 (65,800)	
Note 1:				

  - The DX conditioning shall have more than one stage of cooling for control over supply air temperature. It shall also be equipped with hot gas bypass.
  - The ceiling space shall form a return air plenum. Return air is through light fixtures, grilles, and additional perimeter architectural return air slots provided in the hung ceiling plenums. Return air is transferred into the compartment unit room via silencers.
  - Variable volume control is achieved using a variable speed drive (VSD) on the supply fan. A static pressure sensor in the discharge duct shall control the VSD. Supply and return fan air monitoring adjusts return fan VSD to maintain required airflow differential.
    - See Variable Air Volume Terminal Devices section.
    - Acoustical concerns are addressed as described in the Noise and Vibration Control Section.
- Variable Air Volume (VAV) Terminal Devices
  - Terminal room control fans are powered variable air volume boxes with electrically commuted motors (ECM) and hot water coils. Non-fan powered variable volume boxes may be used for interior zones without heating requirements.
  - Units shall have direct digital control.
  - Acoustical concerns are addressed as described in the Noise and Vibration Control Section.
- Make Up Air Units (three units are anticipated: MAU-1, MAU-2, and MAU-3)
  - Gas fired make up air units provide ventilation to the apparatus bay, gymnasium, and kitchen. The kitchen make up air unit provides 309 Ls of make up air
- Kitchen Systems
  - A kitchen exhaust system constructed in accordance with NFPA 96 and complete with gas fired make-up air unit, are provided for the kitchen space should it be equipped with an exhaust hood for collection of grease laden exhaust. Kitchen exhaust system are variable air volume.
- Apparatus Bay Ventilation and Vehicle Exhaust
  - The parking ventilation system are started and stopped by a carbon monoxide (CO) detection and nitric oxide (NO) system. Exhaust fans are interlocked with the supply fan. When any CO/NO sensor detects 50 ppm the lead exhaust fan starts and the supply fan operates at low speed. When any CO/NO sensor detects 100 ppm, the lag exhaust fan starts and the supply fan operates at high speed. Sensors are located 1,500mm (60 inches) above the finished floor. Sensors shall have an accuracy of 1 ppm and shall have a 0-100 ppm range.
  - Nederman vehicle exhaust rails and snorkel system are provided for each lane complete with magnetic disconnect system. The apparatus bay features parking for 6 fire department vehicles in three parking lanes. Each lane will be provided with 1 exhaust rail complete with 2 exhaust reels. Vehicle exhaust rails are connected to a central high static, flat blade centrifugal utility fan. Building automation system modulates supply and exhaust fan speeds to maintain apparatus bay pressurization when the vehicle exhaust system is in operation. Vehicle exhaust are directly vented to the outdoors.
  - Apparatus bays are negatively pressurized to adjacent spaces to ensure air contaminates and odours do not enter the station.
- Miscellaneous Systems
  - Separate washroom exhaust systems are provided for the washroom groups if they are not attached to heat recovery systems. The make-up are transferred from the adjacent corridors.
  - Ventilation systems, comprising filtered outdoor and an exhaust air fan, are provided for the mechanical and electrical rooms. Each system shall cycle the fan to maintain a space temperature.
  - Self-contained air conditioning units are provided for server/LAN rooms.
  - Exhaust systems of suitable construction are provided for dishwasher exhaust.
  - Laundry exhaust systems are provided for the laundry room. A variable volume laundry exhaust system complete with lint removal are provided.

Noise and Vibration Control

- All mechanical equipment are equipped with vibration isolation control measures to reduce the transfer of vibration generated noise into the building structure.
- All supply, return and exhaust air system are equipped with silencers to reduce the duct borne equipment noise in the occupied spaces to acceptable NC levels. Attenuators are acceptable on variable air volume (VAV) boxes and fan powered VAV boxes provided acceptable to the acoustic consultant.

HVAC Systems Insulation

- Insulation for HVAC systems are in accordance with the National Energy Code for Buildings.

Plumbing and Drainage

General

- The Plumbing System shall conform to the National Plumbing Code (NPC).
- Above floor storm drains, sanitary drains and vents, 65 mm (2-1/2 inch) and larger are cast iron.
- Above floor sanitary drains and vents, 50 mm (2 inch) and smaller are hard temper DWV copper drainage tubing.
- Buried storm piping within the building are PVC.
- Buried sanitary piping within the building are PVC.
- Domestic water piping are copper type L.
- Valves are Crane or equal of type and construction to suit service and working pressures.
- For all services 50 mm (2 inch) and smaller 4,136 kPa (600 psig) WOG ball valves are used.

Storm Systems

- A complete system of roof drains and storm drainage piping are provided.
- The "Civil" consultant prepares the storm water management (SWM) approach for the site, which determines that a retention storm cistern is required.

Sanitary Systems

- A complete system of plumbing fixtures and sanitary drainage and vent piping are provided.
- New above grade drains are collected and drained by gravity to site sanitary sewers. Drains below the municipal services invert elevations are collected in sump pits complete with duplex submersible pumps. Pits are pumped into the gravity drainage piping. Sump pumps are on back-up power (if available).

Grease Interceptors

- Grease interceptors, complete with an alarm to indicate when pump out, is required. Grease interceptor are complete with piped pump-out, maximum 30 m (100 ft) to permit remote draining.

Plumbing Fixtures

- The following plumbing fixtures are anticipated for the project:

	Group	Description	Comments
W-1	Water Closet	Wall mounted, manual flush valve	
W-2	Water Closet	Wall mounted, barrier free, manual flush valve	
U-1	Urinal	Wall hung, manual flush valve	
L-1	Lavatory	Counter mounted, electronic “no touch” 100 mm (4 inch) centre set.	
L-2	Lavatory	Counter mounted, barrier free, electronic “no touch” 100 mm (4 inch) centre set.	
S-1	Sink	Counter mounted, single bowl, stainless steel, 200 mm (8 inch) centre set.	
S-2	Sink	Counter mounted, double bowl, stainless steel, 200 mm (8 inch) centre set.	
SH-1	Shower	Pressure balanced mixing valve, floor or trench drain.	
SH-2	Shower	Pressure balanced mixing valve, barrier free with three fixed showerheads mounted at different heights with diverter valve, floor drain.	
DF-1	Drinking Fountain	Wall mounted, barrier free, non-refrigerated with bottle filler.	

- Plumbing fixtures are standard type:

	Metric	Imperial	Comments
Water Closets	6.0 Litres per flush	1.6 Gallons per flush	
Urinals	3.8 Litres per flush	1.0 Gallons per flush	
Lavatories (Public)	1.9 LPM @ 414 kPa	0.5 GPM @ 60 psig	
Lavatories (Private)	5.7 LPM @ 414 kPa	1.5 GPM @ 60 psig	
Kitchen Faucet	6.7 LPM @ 414 kPa	1.75 GPM @ 60 psig	
Showerheads	7.5 LPM @ 550 kPa	2.0 GPM @ 80 psig	

Domestic Cold Water

- A 150 mm (6 inch) domestic water service are brought into the building for domestic water and fire services. The domestic water and fire services are isolated from the municipal water supply by approved backflow prevention devices.

Domestic Hot Water

- Domestic hot water are generated by two 492 Litre (130 USgallon) gas fired storage water heaters each sized at 50% of the building load and located in the mechanical room. Each water heater are complete with storage tank and double-walled heat exchanger capable of using raising incoming domestic water 55.6 deg.C. (100 deg.F.).
- A replaceable bladder expansion tank suitable for domestic hot water are installed on the domestic hot water system to accommodate thermal expansion A thermal/pressure relief valve are installed to accommodate thermal expansion.
- A recirculation loop and recirculation pump shall maintain flow in the domestic hot water system to maintain hot water at the fixtures at all times.

Natural Gas

- Natural gas are distributed to the kitchen, and boiler room as required. All gas piping are schedule 40. Piping 64 mm (2-1/2 inch) and larger are welded. All gas piping are painted yellow in its entirety including concealed areas.
- A high pressure riser 34.5 kPa (5 psig) shall serve the mechanical penthouse. A low pressure PRV station at approximately 1,744 to 2,740 Pa (7 to 11 in. WC.) are provided to serve the kitchen.

Insulation

- Insulation for plumbing systems are in accordance with the National Energy Code for Buildings.
- All exposed insulation are complete with PVC jacket or canvas lagging suitable for painting.

Fire Protection and Life Safety Systems

General

- The Fire Protection System conforms to the National Building Code – Alberta Edition.

Sprinkler

- A wet pipe, hydraulically sized sprinkler system is installed for the building. Sprinkler design are to NFPA 13.
- Sprinkler heads are:
  - Upright brass type where no ceiling exists.
  - Concealed type where ceilings occur.
  - Provided with guards in exposed areas where heads are susceptible to damage.
  - Sidewall or concealed in suites.
- All piping 65 mm (2-1/2 inch) and larger are schedule 40with Victaulic fittings.
- All piping 50 mm (2 inch) and smaller are screwed.
- The following sprinkler zones and coverage is anticipated.

Area	Type	Hazard	Remarks
Apparatus Bay	Dry	Ordinary GR2	Galvanized piping
Offices and Multi-Purpose	Wet	Light	
Gymnasium	Wet	Ordinary GR 1	Guards on heads
Generator Room	Dry	Ordinary GR 2	Galvanized piping
Mechanical Rooms, Storage Rooms	Wet	Ordinary GR 1	Guards on heads

- All supervised valves shall have end switches. Division 16 shall wire valves and switches into the main fire alarm panel.

Standpipe Systems

- At this point the building is not expected to require a fire standpipe system complete with fire hose cabinets. An independent code review will confirm this at a later date.

Portable Fire Extinguishers

- General areas will be covered by multi-purpose, dry chemical powder type portable fire extinguishers. Fire extinguisher rating will be sized for the type of hazard present. Mechanical rooms, electrical rooms and similar spaces are provided with chemical fire extinguishers.

Additional Measures For Building Fire Safety

Diesel Generator systems

- A complete, looped diesel fuel storage system are provided for the emergency diesel generators.
- The fuel system shall consist of:
  - Exterior generator
  - Supply and return piping;
  - A set of duplex pumps for each generator. Pumps are on back-up power;
  - Supply and return piping to the auxiliary day tank;
  - High-Low level pump controls and alarm;
  - Over-Flow alarms.
  - Ventilation, combustion intake and relief air ductwork complete with dampers are provided for the indoor diesel generator.
- Main storage tank are sized for minimum 24 hour generator run-time at maximum power.
- The mechanical division installs the diesel muffler and discharge (using Schedule 40 black steel piping) to exterior. Termination are away from building intakes.
- The back-up generator is a pre-packaged, exterior unit complete with all required ventilation and integral fuel storage.
- The genset's capacity sized for full building load

Seismic Requirements

- The Architect and Structural Engineer have advised that as per Part 4 (Structural Design) of the Building Code, the mechanical system components described in the Building Code and their connections to the building structure do not require a seismic force resisting system (SFRS) however they do require Post-Disaster restraint systems.

System Controls

General

- Building Automation System (BAS) is provided
- A microprocessor system incorporating direct digital control are installed to control and monitor the mechanical systems. The BAS are BACNET or Echelon compliant where possible.
- The BAS shall control and monitor air handlers, exhaust fan, heating and cooling equipment, and terminal units. The BAS shall interface boilers.
- The building operator's terminal are located in the building operator's room.

Air and Water Balancing

General

- All air and water systems are balanced prior to building turn-over. Balancing reports are submitted for review by the consultant and owner.

Contractor Commissioning

- The contractor performs equipment testing (piping, ductwork) and obtain sign-offs, equipment start-up and check sheet (with manufacturers), arrange for training on equipment (provided to owner) and coordinate with independent commissioning agent.

Independent Commissioning

- Not provided.

Testing of Integrated Fire Protection Fire Protection and Life Safety Systems

General

- The owner may hire a professional to act as the Integrated Testing Coordinator (ITC) and to prepare the multi-discipline Integrated Testing Plan (ITP) for the project.
- The ITP testing is in accordance with CAN/ULC-S1001 "Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems."

Mechanical and Electrical Coordination

General

- Motor starters are supplied and installed by Electrical Division. Starters are grouped into motor control centres or starter racks where feasible. Power wiring (line side and load side) are by Electrical Division.
- Variable speed drives are supplied and installed by Mechanical Division. Power wiring (load and line) are by Electrical Division.
- Control wiring are by Mechanical Division.
- All fire alarm wiring are by Electrical Division. All smoke detectors including duct-mounted smoke detectors, integral with the fire alarm system, are supplied and installed by Electrical Division.

Electrical

Introduction

The outline of the electrical systems and facilities contained in this report describe the Basic Civic Station design.

A basic outline of the perceived strategies for power distribution, low-tension systems, communication systems and life safety systems for the proposed fire station have been included to summarize discussions and concepts developed to date.

Main electrical service and distribution will be 400A, 600V.

Light sources will be LED luminaires and selected to meet IES and Industry standards. These lighting standards would not and do not meet LEED or other higher sustainable standards.

A generator will provide backup power for the entire electrical needs for the facility. The size of generator is sized to accommodate the whole station loading and is estimated at 150kW.

A new horizontal structured cabling communication system is provided. A dedicated telecommunications room is provided to house communication equipment and act as the telecommunication utility demark.

New card access security system is not provided.

Firefighter alerting infrastructure and devices to be provided connected via external cabling to a Station Alerting System (SAS).

Basic Civic Station Description and Systems' Design

Design Criteria

The electrical design is based on the following standards:

- ANSI, IEEE, EEMAC Standard for High and Low Voltage Switchgear.
- Latest adopted Canadian Electrical Code – Part I.
- Regulations of the Alberta Electrical Protection Branch – Safety Codes Act.
- Latest Alberta Building Code.
- National Energy Code of Canada for Buildings 2011
- Latest Alberta Fire Code.
- CSA Standard B651-95 Barrier Free Design.
- Latest CSA Fire Alarm Standards and ULC Standards.
- Latest Illuminating Engineering Society of North America (IESNA) Standards.

SUSTAINABLE DESIGN CONSIDERATIONS

The fire station design will be based upon designing to NECB standards for new buildings.

Energy Conservation

Electrical energy comprises a small portion of the total energy consumed by a facility but when expressed in actual utility costs, the electrical system consumes approximately 20 to 40% of the total building's energy budget. The following initiatives are adopted in the design to reduce the building's energy consumption:

- Use the latest illumination technology including LED luminaire
- Measures that can further improve the baseline energy performance including:
  - use of occupancy sensors,
  - dimming controls,
  - photocells,
  - improved local controls.
- Lighting will comply with prescribed guidelines rather than using light levels that are on the high end of the IESNA (Illuminating Engineering Society of North America) standard. It is proposed that lower ambient lighting levels be employed in offices, dorms, circulation spaces, and corridors.

Energy Generation

A photovoltaic system will not be designed for this station.

ELECTRICAL SYSTEMS

Main Service

A new 400A, 600V, 3P, 4W main electrical service is to be provided. It is expected that the new electrical service is to be serviced by a new padmount transformer. A new enclosed second electrical room, containing only electrical equipment, will be provided. Based on historical precedent of similar facilities, the estimated connected load is 200kW.

Backup Power Distribution

A 150kW diesel-fired backup generator is to be provided for the facility. 24 hours of diesel fuel will be provided in a sub-base fuel tank. It is expected that the entire facility is to be backed up by generator power, except for life safety systems. The installation shall conform to CSA Standard C282, "Emergency Electrical Power Supply for Buildings".

Power Distribution System Design

A new 400A – rated main distribution board will be located in the main electrical room. A 400A – rated main distribution panel will be provided downstream of the automatic transfer switch to feed various branch circuit panelboards.

Grounding and Bonding

The grounding system will be designed to provide a low impedance path for ground fault currents to flow. The main electrical room and telecommunication room will have grounding busses connected to the building's main system ground, which in turn will be connected to the ground grid. All noncurrent carrying metal parts of the equipment will be bonded per the latest Canadian Electrical Code. A bonding conductor will be provided in each conduit.

General Wiring

New wiring will be installed in conduit for new electrical/mechanical. Aluminum wiring will be accepted for main service feeders and feeders over 100A. The use of cable tray systems will be limited to the main telecommunication room. Cabling for life safety systems such as fire alarm systems, etc. will be minimum two-hour fire rated.

Lighting

New lighting will be provided for the facility. The Illuminating Engineering Society of North America (IESNA) standards, National Energy of Canada for Buildings 2011, will be the key references used.

New exterior and interior lighting will be designed to provide integration of numerous lighting techniques to provide a vibrant and attractive atmosphere that is both inviting and engaging for the people around the space. The design will integrate the various aspects of the lighting system with the building's space functions, mechanical systems, and architectural elements.

Integration of natural light captured by the building will take on a key role in achieving desired illumination. The basis of design will include LED luminaires throughout the exterior and interior of the facility.

Lighting Control System

All building lighting will be controlled to decrease energy use, allow flexibility, and to meet the NECB requirements. The lighting control system will be a combination of line voltage and low voltage systems with a combination of local and automatic controls that will interface.

Controls will include:

- Occupancy sensors will be provided in all public areas including offices, corridors, social spaces, washrooms, and similar spaces.
- Storage rooms to be complete with local on/off combination occupancy sensor switch.
- Utility rooms to be manual on/off
- Central time clock control. All general building lighting, with the exception of suites and low usage areas will be controlled using a central time clock.

Emergency Lighting

New LED emergency lighting in the form of remote heads will be included for the facility.

Exit Signage

All exit signage to be green running man style as per Alberta Building Code.

Fire Alarm System

The fire alarm system will be a single stage, annunciated, class A -wired and electrically supervised system. Zoning of the fire alarm system will be based on smoke zone subdivision. System devices will be of the addressable type and will consist of manual pull station, products of combustion detectors, thermal detectors, and sprinkler flow valves.

The main fire alarm control (FACP) is to be located in the main telecommunication room. A fire alarm annunciator panel (FAAP) will be located in the vestibule. Dorm suites will be complete with in-suite notification devices with temporary silence functionality.

The network connection will be at the FACP, not the annunciator. The FAAP will be a standard transponder interface annunciator only. It will require a dedicated 120V circuit, and will consist of an 8 line display, and a spare tub for mounting a graphic. FACP will include the same functionality (display, switches, graphic, etc.).

LOW TENSION SYSTEMS

Security Systems

Security system head end equipment to be located in the proposed communications / IT room with security panels complete with 4ft x 8ft minimum clear space in front.

Access Control System

New access control system will not be provided throughout however a single card access will be provided at the main entrance only. Devices and head-end equipment will be located in the main telecommunication room.

CCTV System

CCTV is not provided.

Audio Visual and IT requirements

Rough in for audio-visual and IT connections provided (one location) to address the needs identified in the fire station programme. Power, data, and coax will be provided for devices required in specific areas, including in the fitness room with coax locations for TVs.

Communication Infrastructure

The overall infrastructure will be using conduit throughout the facility with zone boxes for distribution and future capacity.

Structured Cabling Pathways

Vertical communications cabling will be installed per industry standards. Flexible conduit will be used where code permitted. Data racks, floor-mounted four post and wall-mounted, will be located in the main telecommunication room. An Uninterruptible Power Supply (UPS) sized for the equipment in the room will be provided.

Copper

Certified Category 6 unshielded twisted pair structured data/voice cable will be utilized for horizontal distribution. The maximum cable run distance is 90m between terminating devices (additional 10m allowance for interconnecting patch cabling).

New communications outlets will be provided as required. New patch panels will be provided as required.

Wireless Local Area Network

New wireless infrastructure consisting of access points, network switches, servers, wireless local area network (WLAN) controllers and the necessary cabling infrastructure will not be provided.

Station Alert System

Firefighter alert infrastructure, including headend equipment, audio and visual devices to be provided and interconnected to the Station Alerting System, with the SAS cabinet located in the main telecommunication room will be provided by the City. Conduit and rough-in to be provided by electrical contractor.

Mechanical Systems

All motors 0.25kW and smaller will be single-phase 120V and all motors at 0.37kW and larger should be 208V, 3-phase. The supply and installation of all motor protection switches, starters, and disconnect switches for mechanical equipment will be provided by the electrical contractor. Time delay relays will be provided for all motors 18.65kW (25hp) and larger. A disconnect switch will be provided for and at each motor.

VFD controlled motor loads will be fed from Distribution Centres (CDP).

Project Summary

Project Name:	Fire Station - Basic Civic Station
Project Number:	25172-002-000
Date Issued:	2025-05-13
Purpose of Model:	Design Assistance

Project Address:	Edmonton, Alberta
Compliance Path:	NECB 2017 / NECB 2020
Software Used:	eQUEST v3.65-7175 DOE-2.3
Modelled By:	Mohammad AlMasri

Purpose of Model

This portion of the energy study and life cycle costing focuses exclusively on the Basic Civic Station. The Basic Civic Station is designed to meet minimum code compliance with a primary focus on low construction and project costs.

The study aims to analyze the anticipated energy performance of this Basic Civic Station Design, ensuring it achieves compliance with the National Building Code - 2023 Alberta Edition, as required for all new construction in Alberta. Compliance will be achieved by following the guidelines of Part 8 of the National Energy Code of Canada for Buildings 2020 (NECB 2020), which requires that the annual energy consumption of the proposed design must not exceed that of a reference building based on NECB 2020 prescriptive requirements.

The building energy model will estimate the anticipated energy cost performance and greenhouse gas emissions (GHG) following the City of Edmonton Climate Resilience Technical Specifications (COE-IM-GUIDE-0030). These estimated energy costs, along with other construction capital costs, maintenance, and replacement costs, will be used to complete a life cycle costing analysis over a 25-year period using net present value methodology.

The life cycle cost analysis outcome will be used to compare the financial performance of the Basic Civic Station against a station design that complies with full policy requirements (C-627 Climate Resilience Policy).

The Basic Civic Station design does not need to comply with C-627 Climate Resilience Policy performance requirements. However, the comparison was completed for demonstration purposes only and is provided in the appendix of the report.

Executive Summary

An energy modeling analysis was undertaken to quantify the energy performance of the Basic Civic Station design. Our analysis shows that the proposed design is compliant with the Alberta Building Code, demonstrating a **6.8%** reduction in energy consumption compared to the NECB 2020 reference building.

A life cycle costing analysis was completed, incorporating the estimated energy costs from the energy model, as well as capital costs, maintenance costs, and equipment/system replacement costs provided by the design team.

Table 1 below summarizes the key results of the energy modeling and life cycle costing analysis. Detailed performance results are provided in this reports and in the Appendix.

Table 1: Energy Modeling and Life Cycle Costing Analysis Summary Results

Model	Annual Energy Consumption (ekWh)	First Year Energy Cost ($)	First Year Net GHG Emissions (kg eCO_{2e}) [1]	25-Years Life Cycle GHG Emissions (TCO_{2e})	25-Years Energy Costing ($)	25-Years Total Lifecycle Costing ($) [2]
Basic Civic Design	514,268	36,421	75,903	1,898	699,455	17,291,085

[1] GHG emissions accounting reflects that the city currently procures 100% renewable electricity for all city operations

[2] Lifecycle costing does not account for carbon prices. Details are provided in the report

Building Summary

The station features a single above-ground level with a gross floor area of approximately 1,478.6 m², which is divided into three main sections: Living quarters and offices, Apparatus bays with higher ceilings, and Service spaces.

To meet the minimum compliance performance mandated by NECB 2020, the design incorporates several measures that outperform the energy performance required by the NECB 2017 reference model, including:

1) An estimated 17% fenestration & door area to gross wall area ratio (window-to wall- ratio of 5.7%)
2) Steel doors and overhead doors with thermal performance of R-2.9
3) LED lights to lower lighting power density by 25% compared to NECB 2017 values
4) VAV AHU (hydronic heating and DX coil) with heat recovery (minimum 65% effectiveness)
5) Variable speed pumps and fans
6) High-efficiency condensing boilers (rated efficiency of 96%)
7) High-efficiency domestic hot water system (rated efficiency of 96%)

Energy Performance Analysis

Table 2 below provides a summary of the Basic Civic Station performance in comparison to a reference model based on NECB 2020.

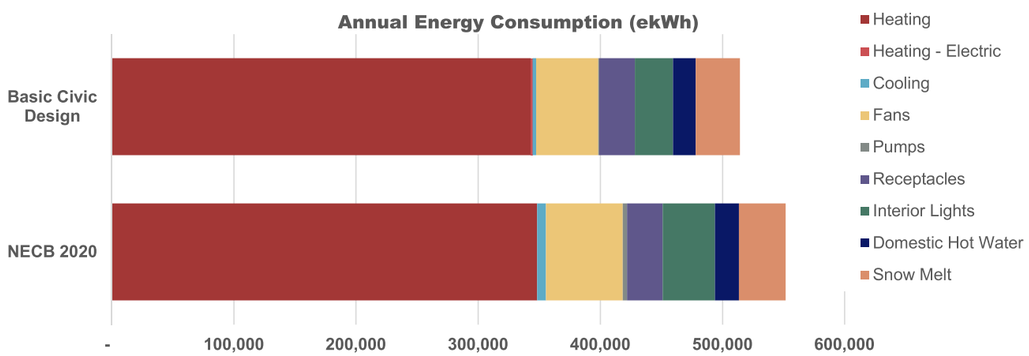
Table 2: Alberta Energy Code Compliance (NECB 2020)

Model	Electricity (kWh)	Natural Gas (ekWh)	Annual Energy (ekWh)	TEUI (ekWh/m²)	GHG Emissions (kg eCO2)	Code Compliant?
NECB 2020	145,672	406,155	551,827	380.5	77,491	-
Basic Civic Design	116,437	397,831	514,268	354.6	75,903	YES
Savings	20.1%	2.0%	**6.8%**	6.8%	2.0%	**-**

To comply with the code, the annual energy consumption of the proposed design must not exceed that of a reference building based on NECB 2020 prescriptive requirements. The energy analysis indicates that the proposed design meets the Alberta Building Code, achieving a **6.8%** reduction in energy consumption compared to the NECB 2020 reference.

The energy modeling results are derived from the information provided by the design team, along with reasonable assumptions made in the absence of specific details at this design stage. The inputs and assumptions for the energy modeling are summarized in Appendix A.

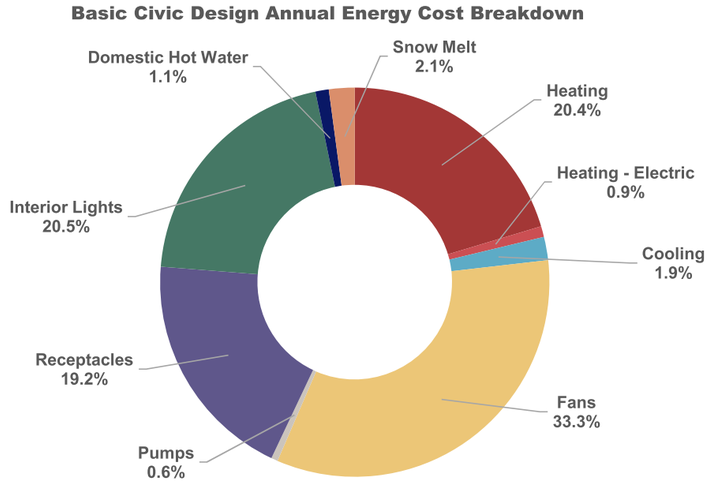
All GHG emissions in the building are generated by natural gas sources (heating plant and domestic hot water), as the City of Edmonton has procured 100% renewable electricity for city operations starting in 2024, resulting in a net zero electricity emissions[1].

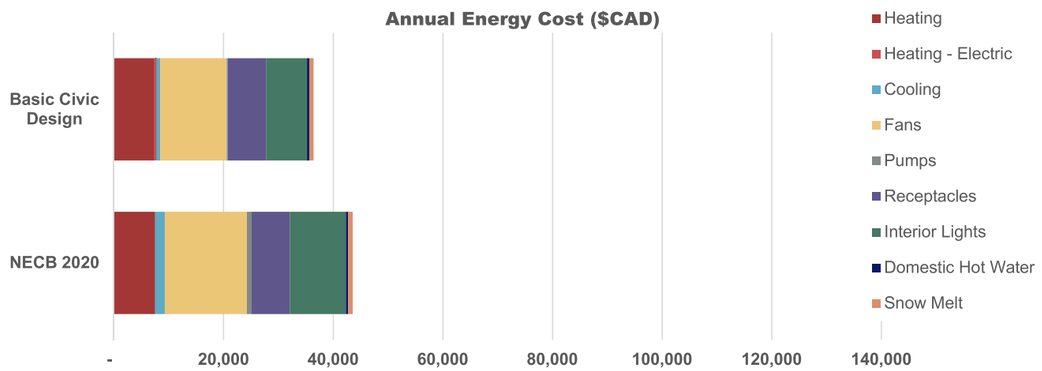


[1] The City of Edmonton's green energy purchase agreement does not extend to cover the full 25 years considered in the life cycle analysis, but only 20 years. For the purpose of this analysis, zero emissions were considered for the full 25 years.

Energy Cost Analysis

The chart below presents the distribution of energy costs by end use. Despite heating constituting a substantial share of energy consumption, it accounts for only 15.6% of the total energy cost. This discrepancy arises from the lower cost of natural gas, used for heating, compared to electricity in Alberta.





Life Cycle Costing

This section presents the results of a comprehensive life cycle cost analysis conducted over a 25-year period, utilizing the net present value methodology. The analysis encompasses various cost factors, including energy expenses, maintenance costs, and equipment/system replacement costs as provided by the design team. Additionally, utility costs, and utility escalation rates are derived from the City of Edmonton's climate-resilient technical specifications, as summarized in Appendix A.

This analysis reflects the Government of Canada's order to eliminate the Consumer Carbon Price, amending Schedule 2 of the Greenhouse Gas Pollution Pricing Act (GGPPA) to set the fuel charge rates to zero after March 31, 2025. This approach was selected to align with the current regulation, which is not captured by the City of Edmonton's climate-resilient technical specifications. Another analysis scenario, provided in the Appendix C, incorporates the impact of the carbon tax.

Table 3 provides an overview of the project's life cycle costs, including capital, maintenance, and utility costs. It also reports the total life cycle cost, offering a clear summary of the project's financial implications. Detailed life cycle costing is provided in Appendix B.

Table 3: Life Cycle Cost Analysis Summary - Net Present Value

Model	Capital Investment	Replacement Costs [1]	Maintenance Costs	Electricity Costs [2]	Natural Gas Costs	Total Costs
Current Design	13,347,500	3,000,817	243,313	536,758	162,697	17,291,085

[1] Design/estimating, and construction contingencies included

[2] Energy costs reflect the impact of renewable energy

Responsibilities

Appendix A summarizes the detailed model inputs. It is the responsibility of the design team to review the detailed inputs and confirm that the input summary is accurate and alert Footprint to any discrepancies.

The architect, mechanical engineer and electrical engineer must ensure that the building design meets the applicable mandatory requirements. Mandatory requirement checklists will be provided for signature as part of the Code Compliance Submission package.

Limitations

Building energy simulation is a way of comparing building design efficiency measures (comparative analysis) and does not predict future energy bills or absolute energy consumption with accuracy. Energy modelling is intended to analyze “regulated” energy loads and generally doesn’t accurately evaluate many other loads within buildings including process exhaust, elevator etc. Energy modelling makes assumptions for building occupancy and occupant behavior, operational and maintenance practices, schedules, air leakage and plug load which can substantially impact energy consumption.

Any use that a third party makes of this document, or reliance on or decisions to be based on it, are the responsibility of such third party. Footprint accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based upon this document.

APPENDIX A - Model Input Summary

Project Title:	Fire Station - Basic Civic Design
Project Number:	25172-002-000
Date:	2025-05-13
Location:	Edmonton, Alberta
Climate Zone:	NECB 7a - HDD18 5120
Schedules:	NECB 2020 'G'
Purpose of Model:	Design Assist
Compliance Path:	NECB 2017/ 2020
Software:	eQuest 3.65
Weather File:	Edmonton - CWEC 2020

Building Modeled GFA

Modelled Area:	1,478.6 m²
Total Floors:	1
Above Grade:	1
Below Grade:	0

Envelope	Proposed Building Design	Reference Building Design	Source
Exterior Walls	Insulated Metal Panel, 4" (R4.3/Inch) Clearfield: R-17 **Effective: R-9.3** Overall performance after accounting for linear transmittance	NECB 2017 Prescriptive Value Effective: R-27.0 NECB 2020 Prescriptive Value Effective: R-26.4	Architectural Information Linear transmittance from the Building Envelope Thermal Bridging Guide (BETBG)
Exterior Roof	Clearfield: R-30 **Effective: R-22.1** Overall performance after accounting for linear transmittance	NECB 2017 Prescriptive value Effective: R-41.2 NECB 2020 Prescriptive value Effective: R-46.9	Architectural Information Linear transmittance from the Building Envelope Thermal Bridging Guide (BETBG)
Slab-on-Grade	R-20 insulation for 48 inches vertically around the perimeter. F-0.434	NECB 2017 and 2020 Prescriptive Value Climate Zone 7A - R-7.5 for 48" Effective: F-0.65	Architectural Information
Opaque Doors	Swing Doors Double-skinned metal door c/w polyurethane core Effective: U-0.33	NECB 2017 and 2020 Prescriptive Value Climate Zone 7A Effective: U-0.33	Architectural Information
Opaque Doors	Roll-Up Doors Segmented metal door c/w polyurethane core Effective: U-0.33	NECB 2017 and 2020 Prescriptive Value Climate Zone 7A Effective: U-0.33	Architectural Information
Glazing System	Windows Double glazed with thermally broken framing Effective (NFRC): U-0.41, SHGC 0.40	NECB 2017 Prescriptive Value Effective: U-0.33, SHGC 0.40 NECB 2020 Prescriptive Value Effective: U-0.305, SHGC 0.40	Architectural Information
Glazing System	Curtain Walls Double glazed with thermally broken framing Effective (NFRC): U-0.41, SHGC 0.40	NECB 2017 Prescriptive Value Effective: U-0.33, SHGC 0.40 NECB 2020 Prescriptive Value Effective: U-0.305, SHGC 0.40	Architectural Information

Envelope	Proposed Building Design	Reference Building Design	Source
Penetration Ratios	Window to Wall: 5.7% Window & Door to Wall: 17.0%	Window & Door to Wall: 32.5%	Elevation drawings
Infiltration Rate	**NECB 2017** 0.25 Lps/m² (0.049 cfm/ft²) of above grade wall and roof area **NECB 2020** 1.5 Lps/m² (0.295 cfm/ft²) of tested envelope area@ 75 Pa *approx. 1.0 Lps/m² (0.198 cfm/ft^2) of above ground wall area @ 5 Pa*	As Proposed	Modelled rate as per NECB

Lighting	Proposed Building Design	Reference Building Design	Source
Interior (Whole Building)	**LED Lighting Fixtures** Total: 9.8 kW Average: 0.63 W/ft² 25% below NECB 2017	NECB 2017 Prescriptive Values Total: 13.4 kW Average: 0.84 W/ft² NECB 2020 Prescriptive Values Total: 13.2 kW Average: 0.85 W/ft²	Assumption

HVAC	Proposed Building Design	Reference Building Design	Source
Apparatus Bay	**Rooftop MUAs c/w Exhaust Fans** Hydronic heating Fan: 4,700 cfm (0.75 cfm/ft^2) @ 0.634 W/cfm **Exhaust fan** Fan: 4,700 cfm @ 0.42 W/cfm CO/NOx controlled Estimated to operate total 4 hours per day Space Setpoint 18°C (64.4°F) **Zonal Heat: Hydronic Heaters**	**NECB System Type #4 System per Zone** Constant Volume, Single Zone Packaged Rooftop Unit Gas-fired heating Efficiency: 80% Fan: 4,700 cfm (0.75 cfm/ft2) Fan power same as proposed **Exhaust fan** Fan: 4,700 cfm @ 0.42 W/cfm Heat Recovery: None Zonal Reheat: Hydronic baseboards, sized to offset the envelope losses	Mechanical design brief The space heating setpoint is 18°C (64.4°F), in accordance with the City of Edmonton's requirements. The thermostat will be installed 15 feet above the floor level. The conditioned space, where thermal comfort is maintained by the unit heaters, will extend up to this height.
Fire Hall Offices, Classroom, Dormitory, Corridors,…etc.	**Variable Air Volume Air Handling Unit** Hydronic heating: 181 MBH DX Cooling: 98.8 MBH, EER 10.5 Supply Air Flow: 5,000 CFM Supply Fan: 0.61 W/CFM with VSD Return Fan: 0.44 W/CFM with VSD Ventilation Air: 1,087 cfm ERV supply fan: 0.4 W/cfm ERV exhaust fan: 0.4 W/cfm **Air Side Heat Recovery** Sensible Effectiveness: 65% Latent Effectiveness: 60% **Zonal Reheat: hydronic reheat coils**	**NECB System Type #3 - 1 System per Zone** Constant Volume, Single Zone Packaged Rooftop Unit Gas-fired furnace: 80% efficiency DX Cooling - Varies (EER 12.5) Total Air Flow: Varies Fan power: as proposed Heat Recovery: 50% Effectiveness Zonal Reheat: Hydronic baseboards, sized to offset the envelope losses	Mechanical design brief

HVAC	Proposed Building Design	Reference Building Design	Source
Gym	Rooftop MUA Hydronic heating No Cooling Fan: 0.75 W/cfm Air Side Heat Recovery Sensible Effectiveness: 65% Latent Effectiveness: 60%	**NECB System Type #3 - 1 System per Zone** Constant Volume, Single Zone Packaged Rooftop Unit Gas-fired furnace: 80% efficiency Fan power: as proposed Heat Recovery: 50% Effectiveness Zonal Reheat: Hydronic baseboards, sized to offset the envelope losses	Mechanical design brief
Kitchen MUA	Gas fired MUA and exhaust hood Efficiency: 80% Supply Fan: 0.75 W/cfm Exhaust: 656 cfm 0.3 W/cfm	Gas fired MUA and exhaust hood for kitchen ventilation Efficiency: 80% Supply Fan: 0.75 W/cfm Exhaust: 656 cfm 0.3 W/cfm	Mechanical design brief
Mechanical & Electrical Rooms	**Hydronic Unit Heaters** Fan Power: 0.07 W/cfm (0.05 HP) cycles to maintain space temperature	Hydronic Unit Heaters	Mechanical design brief Estimated fan power

Central Plant	Proposed Building Design	Reference Building Design	Source
Hot Water	2 x Condensing Boilers Efficiency: 96% rated Distribution Pumps Hot Water: 21.6 W/gpm variable speed System Controls Outdoor Air Temperature Reset SWT 120°F @ OAT ≥ 23°F SWT 160°F @ OAT ≤ - 4.0°F ΔT = 40°F	One Natural Gas Fired Boiler Single-stage boiler NECB 2017 : Efficiency: 83% NECB 2020 : Efficiency: 90% Distribution Pumps Hot Water: 19 W/gpm single speed System Controls Outdoor Air Temperature Reset SWT 140°F @ OAT ≥ 32°F SWT 180°F @ OAT ≤ 3.2°F ΔT = 29°F	Mechanical design brief and Assumption
Domestic Hot Water	Hot Water Heater Gas-fired Output Temperature: 140°F Efficiency: 96% Rated	Hot Water Heater Gas-fired Output Temperature: 140°F NECB 2017 : Efficiency: 80% NECB 2020 : Efficiency: 90%	Mechanical design brief

Process Loads	Proposed Building Design	Reference Building Design	Source
Domestic Hot Water Flow	Modelled Peak 0.084gpm	As Proposed	NECB 2017 and 2020
General Receptacle Loads	Total 8.9 kW Average: 0.57 W/ft²	As Proposed	NECB 2017 and 2020
Snow Melt	Connected to the water loop 700 ft^2 (35 kW capacity) Operates for three hours after snow fall event and when outside air temp is below 32°F	As Proposed	Mechanical design brief

Utilities	Proposed Building Design	Reference Building Design	Source
Electricity	Energy-Only Electricity Prices: $0.12/ kWh Distribution, demand, rate riders and other non-energy costs: $0.119/ kWh **Total Energy Charge for 2025: $0.239 per kWh**	As Proposed	Climate Resilience Technical Specfications
Natural Gas	Energy-Only Natural Gas Prices:$3.84/GJ Distribution cost: $2.16/GJ **Total Energy Charge for 2025: $6.01/GJ**	As Proposed	Climate Resilience Technical Specfications Natural gas prices do not include the Carbon Tax, reflecting the Government of Canada's order to eliminate the Consumer Carbon Price.

GHG Factors	Proposed Building Design	Reference Building Design	Source
Electricity	0.0 $kgCO_{2e}$/kWh starting from 2025	As Proposed	Climate Resilience Technical Specfications
Natural Gas	0.053 tCO_{2e}/GJ (0.1908 $kgCO_{2e}$/ekWh) Anticipated to remain constant	As Proposed	Climate Resilience Technical Specfications

Financial Inputs	Proposed Building Design	Reference Building Design	Source
Electricity	Energy-Only Electricity Prices 2025 - 2028: $0.12/ kWh 2029 - 2033: $0.14/ kWh 2034 - 2034: $0.18/ kWh 2035 - 2037: $0.20/ kWh After 2037: apply an escalation rate of 2% Demand, rate riders and other non-energy costs: escalation rate of 2%	N/A	Climate Resilience Technical Specfications
Natural Gas	Energy-Only Natural Gas Prices: 2025: $3.84/GJ 2026: $4.05/GJ 2027: $4.16/GJ 2028: $4.37/GJ 2029: $4.48/GJ 2030: $4.56/GJ 2031: $4.65/GJ 2032: $4.75/GJ 2033: $4.85/GJ 2034: $4.94/GJ 2035: $5.04/GJ 2036: $5.14/GJ 2037: $5.25/GJ After 2037: apply an escalation rate of 2% Demand and other non-energy costs: escalation rate of 2%	N/A	Climate Resilience Technical Specfications
Carbon Price	2025: $95/tonne CO2e 2026: $110/tonne CO2e 2027: $125/tonne CO2e 2028: $140/tonne CO2e 2029: $155/tonne CO2e 2030: $170/tonne CO2e There are no carbon pricing increases announced after 2030.The price remains a constant $170 per tonne CO2e.	N/A	Climate Resilience Technical Specfications
Discount Rate	5.18%	N/A	Climate Resilience Technical Specfications Based on the average 30-year borrowing rates from the Alberta Capital Finance Authority (ACFA) over the last 12 months
Maintenance Cost	Admin Area: $1.02/$ft^2$ Service Area: $0.394/$ft^2$ 3% general inflation	N/A	Estimated based on the ASHRAE Owning and Operating Cost Database

APPENDIX B - Detailed Life Cycle Costing and GHG

Table B1: Detailed Life Cycle Cost Analysis Summary - Without Accounting for Carbon Tax

Year	Capital Investment	Replacement Costs	Maintenance Costs	Electicity Costs	Natural Gas Costs	Carbon Tax Costs	Total Costs	Electricity GHG Emissions $kgCO_{2e}$/kWh	Natural Gas GHG Emissions $kgCO_{2e}$/kWh	Net GHG Emissions $kgCO_{2e}$/kWh
Year 0	13,347,500	0	0	0	0	0	13,347,500	0	0	0
Year 1	0	0	12,372	27,298	8,963	0	48,633	0	75,906	75,906
Year 2	0	0	12,743	27,564	9,184	0	49,491	0	75,906	75,906
Year 3	0	0	13,125	27,836	9,549	0	50,511	0	75,906	75,906
Year 4	0	0	13,519	30,442	9,772	0	53,734	0	75,906	75,906
Year 5	0	0	13,925	30,725	9,954	0	54,604	0	75,906	75,906
Year 6	0	0	14,342	31,014	10,151	0	55,507	0	75,906	75,906
Year 7	0	0	14,773	31,308	10,364	0	56,445	0	75,906	75,906
Year 8	0	0	15,216	31,608	10,579	0	57,403	0	75,906	75,906
Year 9	0	0	15,672	36,572	10,780	0	63,024	0	75,906	75,906
Year 10	0	292,416	16,142	39,213	10,998	0	358,769	0	75,906	75,906
Year 11	0	0	16,627	39,531	11,217	0	67,374	0	75,906	75,906
Year 12	0	168,477	17,126	39,856	11,451	0	236,909	0	75,906	75,906
Year 13	0	0	17,639	40,653	11,680	0	69,973	0	75,906	75,906
Year 14	0	0	18,169	41,466	11,914	0	71,549	0	75,906	75,906
Year 15	0	1,040,171	18,714	42,296	12,152	0	1,113,332	0	75,906	75,906
Year 16	0	0	19,275	43,141	12,395	0	74,812	0	75,906	75,906
Year 17	0	0	19,853	44,004	12,643	0	76,501	0	75,906	75,906
Year 18	0	687,653	20,449	44,884	12,896	0	765,882	0	75,906	75,906
Year 19	0	0	21,062	45,782	13,154	0	79,998	0	75,906	75,906
Year 20	0	3,682,138	21,694	46,698	13,417	0	3,763,946	0	75,906	75,906
Year 21	0	0	22,345	47,632	13,685	0	83,662	0	75,906	75,906
Year 22	0	458,796	23,015	48,584	13,959	0	544,355	0	75,906	75,906
Year 23	0	0	23,706	49,556	14,238	0	87,500	0	75,906	75,906
Year 24	0	20,161	24,417	50,547	14,523	0	109,648	0	75,906	75,906
Year 25	0	1,137,700	25,149	51,558	14,813	0	1,229,220	0	75,906	75,906
Total Costs*	13,347,500	7,487,511	451,069	989,769	294,432	0	22,570,282	0	1,897,655	1,897,655
Present Value**	**13,347,500**	**3,000,817**	**243,313**	**536,758**	**162,697**	**0**	**17,291,085**	**N/A**	**N/A**	**N/A**

*Total costs include all expenses over the life cycle, accounting for inflation and escalation costs, but not discounted.

**Present value represents the total cost discounted to the base year (2025).

APPENDIX C - Detailed Life Cycle Costing and GHG

Table C1: Detailed Life Cycle Cost Analysis Summary - After Accounting for Carbon Tax

Year	Capital Investment	Replacement Costs	Maintenance Costs	Electicity Costs	Natural Gas Costs	Carbon Tax Costs	Total Costs	Electricity GHG Emissions $kgCO_{2e}$/kWh	Natural Gas GHG Emissions $kgCO_{2e}$/kWh	Net GHG Emissions $kgCO_{2e}$/kWh
Year 0	13,347,500	0	0	0	0	0	13,347,500			
Year 1	0	0	12,372	27,298	8,963	8,350	56,982	0	75,906	75,906
Year 2	0	0	12,743	27,564	9,184	9,488	58,979	0	75,906	75,906
Year 3	0	0	13,125	27,836	9,549	10,627	61,137	0	75,906	75,906
Year 4	0	0	13,519	30,442	9,772	11,765	65,499	0	75,906	75,906
Year 5	0	0	13,925	30,725	9,954	12,904	67,508	0	75,906	75,906
Year 6	0	0	14,342	31,014	10,151	12,904	68,411	0	75,906	75,906
Year 7	0	0	14,773	31,308	10,364	12,904	69,349	0	75,906	75,906
Year 8	0	0	15,216	31,608	10,579	12,904	70,307	0	75,906	75,906
Year 9	0	0	15,672	36,572	10,780	12,904	75,928	0	75,906	75,906
Year 10	0	292,416	16,142	39,213	10,998	12,904	371,673	0	75,906	75,906
Year 11	0	0	16,627	39,531	11,217	12,904	80,279	0	75,906	75,906
Year 12	0	168,477	17,126	39,856	11,451	12,904	249,813	0	75,906	75,906
Year 13	0	0	17,639	40,653	11,680	12,904	82,877	0	75,906	75,906
Year 14	0	0	18,169	41,466	11,914	12,904	84,453	0	75,906	75,906
Year 15	0	1,040,171	18,714	42,296	12,152	12,904	1,126,236	0	75,906	75,906
Year 16	0	0	19,275	43,141	12,395	12,904	87,716	0	75,906	75,906
Year 17	0	0	19,853	44,004	12,643	12,904	89,405	0	75,906	75,906
Year 18	0	687,653	20,449	44,884	12,896	12,904	778,786	0	75,906	75,906
Year 19	0	0	21,062	45,782	13,154	12,904	92,902	0	75,906	75,906
Year 20	0	3,682,138	21,694	46,698	13,417	12,904	3,776,850	0	75,906	75,906
Year 21	0	0	22,345	47,632	13,685	12,904	96,566	0	75,906	75,906
Year 22	0	458,796	23,015	48,584	13,959	12,904	557,259	0	75,906	75,906
Year 23	0	0	23,706	49,556	14,238	12,904	100,404	0	75,906	75,906
Year 24	0	20,161	24,417	50,547	14,523	12,904	122,552	0	75,906	75,906
Year 25	0	1,137,700	25,149	51,558	14,813	12,904	1,242,124	0	75,906	75,906
Total Costs*	13,347,500	7,487,511	451,069	989,769	294,432	311,215	22,881,497	0	1,897,655	1,897,655
Present Value**	**13,347,500**	**3,000,817**	**243,313**	**536,758**	**162,697**	**177,047**	**17,468,132**	**N/A**	**N/A**	**N/A**

*Total costs include all expenses over the life cycle, accounting for inflation and escalation costs, but not discounted.

**Present value represents the total cost discounted to the base year (2025).

APPENDIX D - Thermal Bridging Calculation Basic Civic Station

Effective Overall Walls Performance

Project	Wall ID	Net Area	U-Ualue	R-Value
Basic Civic Station	W1	9,333.7 ft²	0.107 btuh/ft²·°F	9.3 ft²·°F/btuh

Clear Field

Description	Included?	Net Area	Transmittance	Heat Flow		Source
Admin and Dorms	Y	3,595.3 ft²	0.057 btuh/ft²·°F	205.1 btuh/°F	20.4%	6.1.1
Apparatus bay	Y	5,738.4 ft²	0.057 btuh/ft²·°F	327.4 btuh/°F	32.6%	6.1.1
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	

Linear Interfaces

Description	Included?	Length	Transmittance	Heat Flow		Source
At Grade Slab Trans.	Y	573.1 ft	0.495 btuh/ft·°F	283.7 btuh/°F	28.3%	2.5.1
Floor Edge Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Floor Penat. Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Roof Transition	N	755.3 ft	0.289 btuh/ft·°F	- btuh/°F	0.0%	6.4.2
Glazing Trans.	Y	886.1 ft	0.115 btuh/ft·°F	101.6 btuh/°F	10.1%	6.3.1
Door Trans.	Y	517.0 ft	0.115 btuh/ft·°F	59.3 btuh/°F	5.9%	6.3.1
Balcony Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Outside Corners	Y	238.6 ft	0.110 btuh/ft·°F	26.2 btuh/°F	2.6%	6.5.1

Point Interfaces

Description	Included?	Quantity	Transmittance	Heat Flow		Source
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	

Effective Overall Roof Performance

Project	Wall ID	Net Area	U-Ualue	R-Value
Basic Civic Station	R1	15,610.3 ft²	0.045 btuh/ft²·°F	22.1 ft²·°F/btuh

Clear Field

Description	Included?	Net Area	Transmittance	Heat Flow		Source
Roof	Y	15,610.3 ft²	0.031 btuh/ft²·°F	487.8 btuh/°F	69.1%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	

Linear Interfaces

Description	Included?	Length	Transmittance	Heat Flow		Source
At Grade Slab Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Floor Edge Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Floor Penat. Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Roof Transition	Y	755.3 ft	0.289 btuh/ft·°F	218.5 btuh/°F	30.9%	6.4.2
Glazing Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Door Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Balcony Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Outside Corners	N	ft	btuh/ft·°F	- btuh/°F	0.0%	

Point Interfaces

Description	Included?	Quantity	Transmittance	Heat Flow		Source
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	

APPENDIX E - Compliance with the Climate Resilience Policy

The table below has been provided to demonstrate the performance of the design against the minimum performance requirements to comply with the C-627 Climate Resilient Policy.

In order to comply with the full policy requirements, the proposed design must demonstrate a minimum of 20% energy performance improvement against NECB 2017 standards. The energy model for the proposed design has been revised to meet NECB 2017 modeling requirements, as detailed below:

1) The proposed design has been revised to reflect the air leakage requirements of NECB 2017, resulting in an over all lower air infiltration rate. This impact is evident in the energy results, as the reduced air leakage based on NECB 2017 leads to lower energy consumption compared to the energy consumption in Table 2, which is based on NECB 2020 modeling requirements.

2) The reference building was modeled based on NECB 2017 requirements. The current code, NECB 2020, is more stringent than NECB 2017 in various aspects, including envelope performance, air leakage requirements, equipment efficiency, and lighting power. The results in Table D1 show that the design performs better in comparison to NECB 2017 than against NECB 2020 (Tabel 2).

Table D1: Basic Civic Design vs Climate Policy Compliance (NECB 2017 & TEDI)

Model	Electricity (kWh)	Natural Gas (ekWh)	Annual Energy (ekWh)	TEUI (ekWh/m²)	TEDI (kWh/m²)	C-627 Compliant?
NECB 2017	144,273	343,962	488,235	336.6	137.2	-
Basic Civic Design - 2017	106,965	321,630	428,595	295.5	**172.6**	NO
Savings	25.9%	6.5%	12.2%	**12.2%**	-25.8%	

The energy modeling results show that the Basic Civic Station design does not comply with the policy requirements, as the building did not achieve the 20% minimum performance improvement against NECB 2017. Additionally, the building has a Thermal Energy Demand Intensity (TEDI) of 172.6 kWh/m², which exceeds the minimum required by the climate policy (TEDI of 80 kWh/m²).

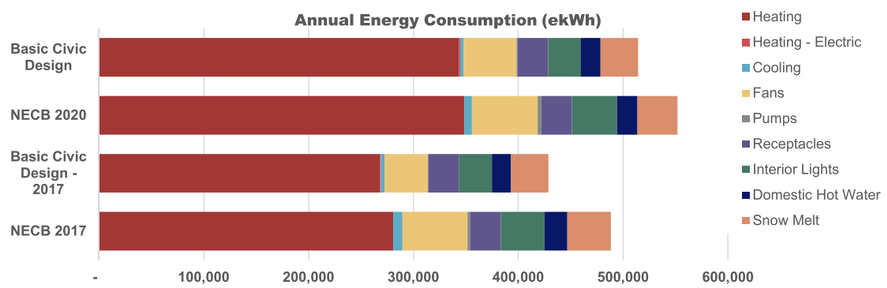
The charts below compare the energy consumption and energy costs of the four models against each other. The models are as follows:

1) Basic Civic Design: Represents the proposed Basic Civic Station design following NECB 2020 energy modeling requirements.

2) Basic Civic Design - 2017: Represents the proposed design adjusted to comply with NECB 2017 energy modeling requirements.

3) NECB 2020 (Current Code) Reference Model: Represents the reference model based on NECB 2020.

4) NECB 2017 Reference Model: Represents the reference model based on NECB 2017, which is used for policy requirements.



3.0| Full Policy Station Description and Systems' Design

Architectural

Description of Goals for the Specific Design

The goal of the Full Policy Station design is to design a fire station which is identical in function to the Basic Civic Station design, however it is to:

- Meet the requirements of the City of Edmonton's Bylaws, policies, and process requirements applicable to any city owned facility .
- Meet minimum codes with policy and regulations as increased by The City.
- Meet the minimum City of Edmonton energy requirements, attempting to achieve cost efficiencies, but prioritizing meeting policy and regulations.
- Provide mechanical and electrical within a central plant within the building. The two most impactful items are the generator and maintaining all mechanical equipment within the building.
- Design for available mechanical equipment with a minimum capacity to meet policy energy needs, prioritizing energy efficiency, not schedule.
- Provide the required on-site energy generation via solar panels.
- Use context driven design principles and concepts. This is not only within the local neighbourhood context, but also within the context of the whole of the city. Design is to be consistent with the level of design quality and design aesthetic of the whole of the city.
- Design to be vibrant, accessible, inviting building designs, which, for a fire station, typically includes the building massing and imagery and the public facing landscaping.
- Focus on climate and carbon neutrality in the design of systems, and selection of materials.
- Designed using the City's buildings' procedures and consultants' manual for the process of design and execution.

Essentially, the goal is to design a fire station which meets or exceeds all the policies and regulations as issued by The City of Edmonton and to design its aesthetic to be consistent with the direction of Edmonton Design Committee and to the context of design within the city.

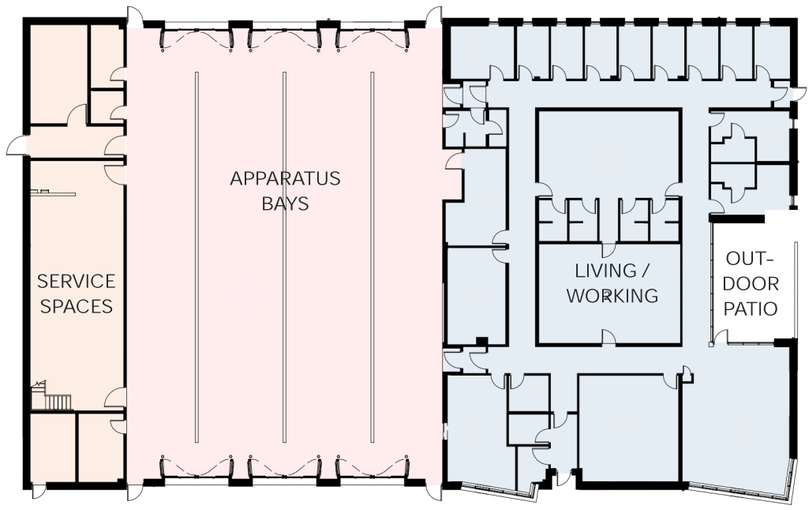
Programme

The programme used for the Full Policy Station design is a typical 3-bay station and includes for a Full Time Fire Department consistent with an EFRS station. For the purposes of this report, the programme used for both the Basic Civic and the Full Policy Station designs are as identical as possible. There are differences, namely the Full Policy Station contains mechanical and electrical entirely within the building (not on the roof as with the Basic Civic Station). The two programmes are therefore close in size, with small variations.

Firefighter washrooms are provided in the locker room area and are uni-sex. Washrooms are provided at a ratio of 1 washroom per 2 dorms except in the Captain's dorms where they are 1 per dorm. Each washroom contains a shower, a vanity, a toilet, and bench and clothes hooks. There are other washrooms provided in the facility but they are provided for the convenience of the firefighters (i.e. in the apparatus bay area).

All spaces (dorms, washrooms, locker rooms, fitness room, Captains' dorms) are all uni-sex.

Full Policy Station Building Front Elevation



Full Policy Station Floor Plan

Full Policy Project Information Highlights

Site Area:	0.81 Hectares (2.0 Acres)
Building Floor Area:	1,657 sq. m. (17,824 sq. ft.)
Number of Storeys:	1 + mezzanine
Number of Apparatus Bays:	3
Number of Dorms:	10
Number of Parking Stalls:	28 Fire Fighters / Staff 3 Visitor (includes barrier-free)

City of Edmonton - Cost Benefit Analysis Fire Stations

FULL POLICY STATION DESIGN - Area Programme

Description	Qty.	Comments	Proposed (Net) Area
LIVING / WORKING AREA			
Vestibule	1	Sightlines to Captain's Office. Exterior mailbox. Exterior flag pole. Near bf washroom. Pre-alert button recessed in wall in view of entry.	10 sq.m. 108 sq.ft.
Front Entry + Corridor	1	Area included in General Circulation.	0 sq.m. 0 sq.ft.
Station Captain's Office (3 - wk sta.)	1	Full sight glass to view occupants at exterior main door. 3 work spaces + file cabinets.	40 sq.m. 430 sq.ft.
Public Washroom (Barrier-free)	1	Adjacent to front entry. Locate within Vestibule.	6 sq.m. 65 sq.ft.
Community Storage Room	1	Storage space for station supplies, public donations. Adjacent to delivery area. Locate within Vestibule.	3 sq.m. 32 sq.ft.
Watch Box	1	Near front entry. Pull down murphy bed. Near main hallway. Room for desk.	10 sq.m. 108 sq.ft.
Day Room / Lounge (10 persons)	1	Accommodate 10 firefighters. Adjacent to kitchen. Noise and light control. Millwork canteen for 4 platoons.	50 sq.m. 538 sq.ft.
Kitchen/Eating Area (14 persons)	1	Large commercial fridges/freezers / commercial gas stove / clean up/broom closet/storage near kitchen and lounge to store cleaning supplies. Adjoining pantry. Door to outside patio w/ view of pkg.	65 sq.m. 699 sq.ft.
Captains Dorm + W/R & Shower	2	Additional Captain's Dorm + Washroom. 5 lockers @ 2' x 2' each. Captain style millwork beds c/w 4 under bed individual storage drawers.	36 sq.m. 387 sq.ft.
Study	1	2 work stations. Also include space for 2-3 murphy beds (may be flex dorm area).	21 sq.m. 226 sq.ft.
Dorm (8 rooms x 7 sq m.)	8	Captain style millwork beds c/w 4 under bed individual storge drawers. Close access to washrooms. Easy access to apparatus floor.	72 sq.m. 775 sq.ft.
Men's Washroom & Locker Room	1	Shower and change room area. Individual ceramic tile shower stalls - open to top, Seating/change benches. Option for shared Locker Room required.	95 sq.m. 1,022 sq.ft.
Women's Washroom & Locker Room	1	Shower and change room area. Individual ceramic tile shower stalls - open to top, Seating/change benches. Option for shared Locker Room required.	20 sq.m. 215 sq.ft.
Fitness	1	600 square feet minimum. 10' high ceilings. Exercise room flooring. Easy access to apparatus floor. Lots of natural light but not in view of public.	68 sq.m. 732 sq.ft.
TOTAL AREA LIVING/WORKING			**496 sq.m.** **5,337 sq.ft.**

Description	Qty.	Comments	Proposed (Net) Area
APPARATUS BAYS			
Apparatus Bays - Bays 2	1	Drive-thru bay. Double doors (air-locks) between apparatus floor and living quarters.	244 sq.m. 2,625 sq.ft.
Apparatus Bays - Bays 1 and 3	2	Wider Bay 1 and 2 for exterior ped door and movement along walkway at quarters. Drive-thru bays. Double doors (air-locks) between apparatus floor and living quarters.	396 sq.m. 4,261 sq.ft.
Washroom (off Apparatus Bay - no shower)	1	Single unit washroom with locking door off apparatus bay floor. In proposed design this space is combined with Washroom - Deluge Shower.	5 sq.m. 54 sq.ft.
Gear Storage	1	Off apparatus Bay 3. Room for 48 sets of in-service gear + 42 stowed spare sets. Quick dry area with mobile drying rack system - minimum 6 sets of turnout gear.	94 sq.m. 1,011 sq.ft.
Washdown - Deluge Shower	1	In proposed design this space is combined with Washroom (off Apparatus Bay - no shower).	6 sq.m. 65 sq.ft.
Workshop (inluding Utility/Laundry/Janitor)	1	Room for a large wooden and stainless steel workbench. Large stainless steel clean up sink with sprayer. Commercial grade pre rinse w cold & hot assembly. Towel dispensers. Battery charging.	28 sq.m. 301 sq.ft.
Decon Laundry / Washroom Space	1	Room for shower, laundry, and washroom for decontamination of dirty to clean areas	19 sq.m. 204 sq.ft.
Staff Entrance	1	Adjacent to staff parking. Storage of winter boots. Primary door to be used by firefighters, 42" wide. In-floor boot mat (non-mechanical).	0 sq.m. 0 sq.ft.
TOTAL AREA APPARATUS BAYS			**792 sq.m.** **8,522 sq.ft.**

Description	Qty.	Comments	Proposed (Net) Area
SERVICE SPACES			
General Circulation	1	Air lock vestibules to apparatus floor / general interior corridors / space andwidth for movement in dispatch call situations. The area indicated here is actual area, not a gross-up factor.	129 sq.m. 1,388 sq.ft.
Mechanical Room	1	To be designed specific to each station design (base versus Policy)	171 sq.m. 1,840 sq.ft.
Generator	1	Interior with clearance around and belly tank	30 sq.m. 323 sq.ft.
Electrical/IT/Data	1	Low-tension room for data, telephone, fire alarm, security system, Station Alerting, SCADA, dispatch paging system, stack lights, dispatch printer, etc.	28 sq.m. 301 sq.ft.
Custodial / Janitor / General Storage	1	Janitor Room at living quarters. Open shelf space for access to cleaners. Janitorial storage and mop sink.	4 sq.m. 43 sq.ft.
Outdoor Storage - Hazardous Materials	1	Storage for Hazardous materials/outdoor equipment.	7 sq.m. 70 sq.ft.
TOTAL AREA SERVICE SPACES			**369 sq.m.** **3,965 sq.ft.**
TOTAL NET BUILDING AREA			**1,657** **17,824**
		Plus Mezzanine above service area in Apparatus Bays:	221 2,378 sq. ft.

EXTERIOR SPACES			
Patio Area	1	Large enough to accommodate 10 people, out of the view of the public. Natural gas line for BBQ. Fenced in. Accessible from kitchen.	37 sq.m. 398 sq.ft.
Staff Parking	28	28 stalls, 9' wide with receptacles and wheel stops. In proposed design parking area does not include drive isles.	432 sq.m. 4,643 sq.ft.
Visitor Parking	3	Include 2 barrier-free stall. In proposed design parking area does not include drive aisles.	59 sq.m. 635 sq.ft.
Garbage & Recycling	1	Lockable containment areas. Hazardous Material Pick-up.	59 sq.m. 635 sq.ft.

Zoning Bylaw Compliance Review

The applicable zoning bylaw is The City of Edmonton | Zoning Bylaw 20001 passed by Council on October 23, 2023, effective January 1, 2024.

The site selected for both the Basic Civic Station and Full Policy Station designs is theoretical and therefore not truly impactful on the design of the building.

The site selected for both is on a large parcel of land zoned AG, Agriculture. The building function on this site (in red below) will be assumed, for the purposes of this report, to be a permitted use, in full compliance with the Bylaw.

Vehicular parking requires no minimum or maximum however 28 stalls are provided.

Building Code Summary and Occupant Load Calculation

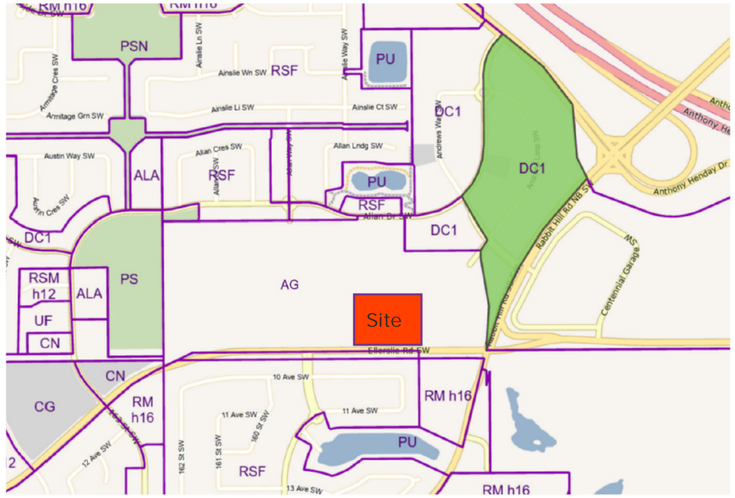
The building falls under the National Building Code of Canada 2023 - Alberta Edition (NBC 2023-AE). The applicable energy code is the National Energy Code of Canada for Buildings 2020 (NECB 2020).

This code analysis describes the construction of a new fire station (Full Policy Station) including apparatus bays, living quarters and offices. NBC 2023-AE Parts 3, 4, 5, And 6 Of Division B applies to the facility (Division A 1.3.3.2)

Building Occupancy and Major Occupancies:

- Group C – Residential Occupancy – Dormitories & Subsidiary Spaces
- Group D – Business & Personal Services Occupancy – Offices
- Group F, Division 3 – Low-Hazard Industrial Occupancy – Apparatus Bays

Building Height: 2 Storeys Above Grade (1 storey plus Mezzanine which is considered a storey).



City of Edmonton Zoning Map. Project site is located in parcel zoned AG.

Building Size and Construction Relative to Occupancy

- Group C, Sprinklered - 3.2.2.54 (Most Restrictive Of 3.2.2.54, 3.2.2.63 & 3.2.2.86, Per 3.2.2.4 & 3.2.2.6)

Construction: Combustible Or Non-combustible - Building is Non-Combustible

Floor Assemblies: Fire Separations With A Fire-Resistance Rating Of 45 Minutes

Mezzanines: 45 Minute Fire Resistance for Combustible Construction

Load bearing Walls, Columns and Arches Rating Equal To Supported Assembly

Major Occupancy and Extents

- Group C & Group D: 1 Hour Fire Separation. Table 3.1.3.1
  - Closures – 45 Minutes. Table 3.1.8.4
- Group C & Group F, Div 3: 1 Hour Fire Separation. Table 3.1.3.1
  - Closures – 90 Minutes. Table 3.1.8.4
- Group D & Group F, Div 3: No Fire-Resistance Rating Required. Table 3.1.3.1
  - Closures – 0 Minute

Component Fire Separations and Closure

- Exits: 45 Minute Fire Separation – 3.4.4.1
  - Closures – 45 Minute – Table 3.1.8.4
- Janitor Rooms: 0 Minute Fire Separation, Smoke Separation Required. – 3.3.1.21 (3)
  - Closures – 0 Minute

Building Services Penetrations

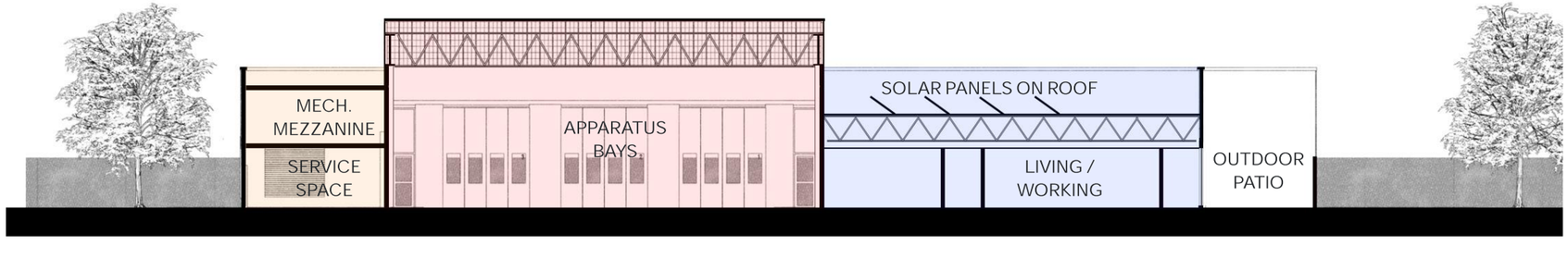
- Penetrations Through Fire Separations Will Be Fire Stopped As Per The Requirements Of 3.1.9.1 (1) Through 3.1.9.6 (1)

Occupant Load

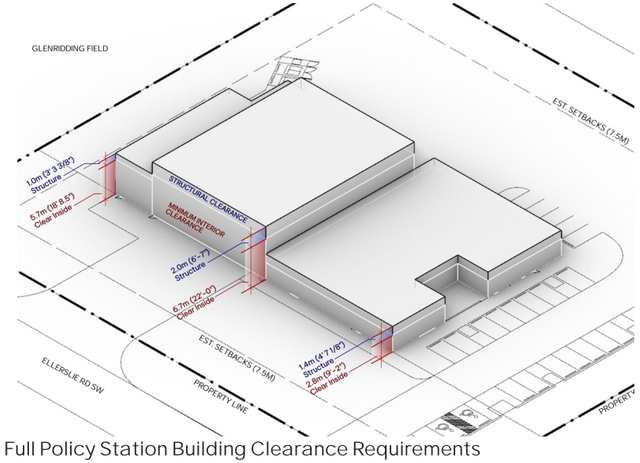
- Occupant Load: 20 Persons based on building function – code assumed to be 50% each Male / Female – actual estimated 15 (M) and 5 (F).

Exiting and Egress

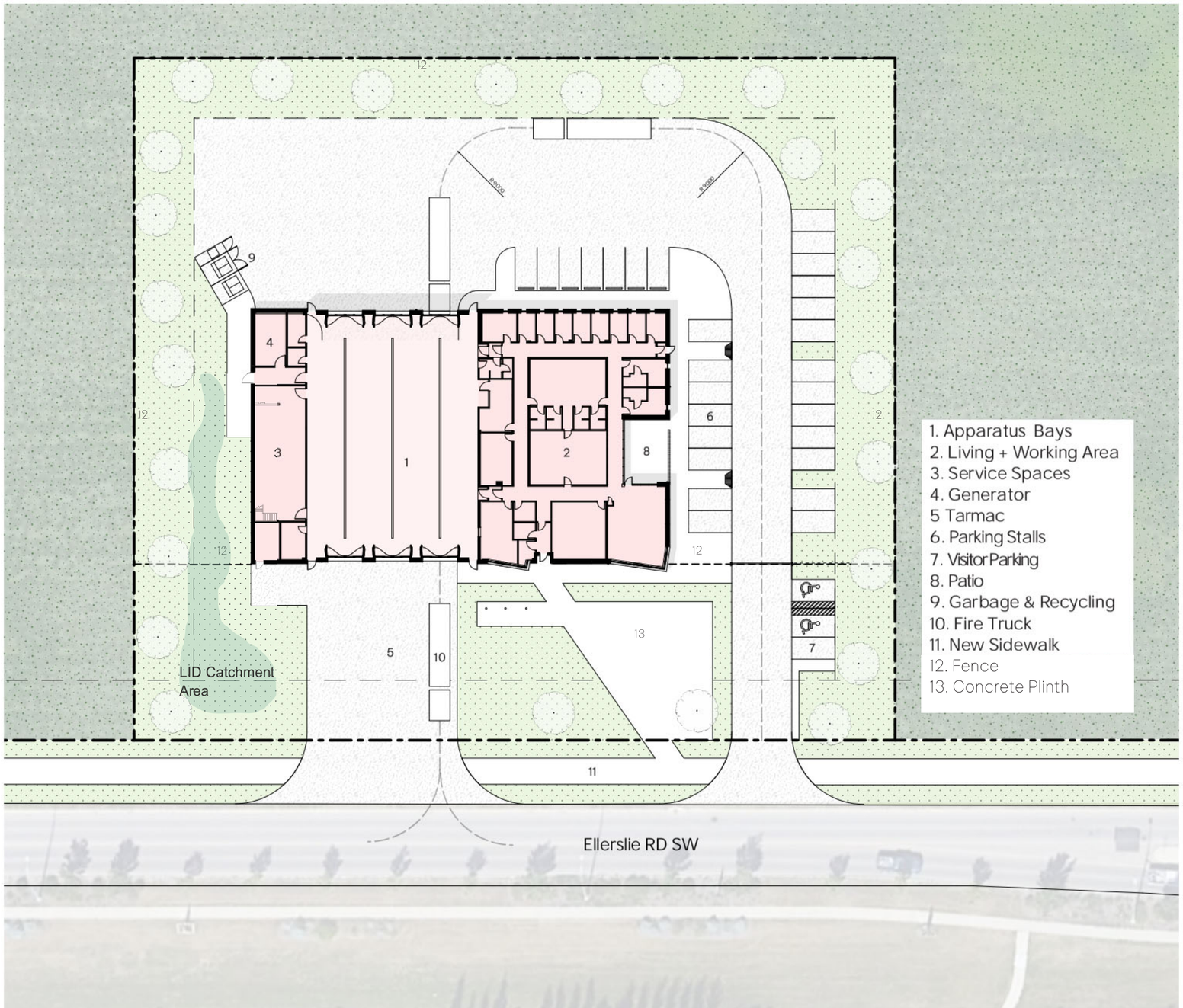
- Minimum Corridor Width – 1100mm – 3.3.1.9.(1)
- Maximum Travel Distance To Exit – 45m – 3.4.2.5
- Maximum Dead End Corridor – 3m – 3.3.1.9.(7)
- Doors Providing Access To Exit From A Room Or Suite With An Occupant Load Greater Than 60 Shall Swing In The Direction Of Travel To Exit – 3.3.1.11
- Two Means Of Egress Are Required For Floor Areas
- Maximum Travel Distance:
  - Group C Occupancy - Maximum Travel Distance: 25m
  - Group D Occupancy - Maximum Travel Distance: 25m
  - Group F(3) Occupancy - Maximum Travel Distance: 25m
- Doors Providing Access To Exit Not Less Than 800mm – 3.3.1.13



Full Policy Section Diagram



Full Policy Station Building Clearance Requirements



Barrier-Free Design Requirements

- Areas Of the Building Accessible by the Public Are To Be Designed In Accordance With Section 3.8. As is typical for a fire station, an Application For Relaxation Of Barrier-Free Requirements would be made.
- A barrier free washroom is provided in the vestibule for access to public if required by the public

Washroom Fixture Calculations

- Calculations Based On A Total Occupant Load Of 15 Male And 5 Female
  - Males = 1 Fixtures Required
  - Females = 1 Fixtures Required
  - Barrier-Free Counts Vary Based On Washroom Layouts – Refer To 3.8
- Provided:
  - Males = 5 Fixtures Provided
  - Females = 5 Fixtures Provided
  - Barrier Free (Included In Above Counts) = 1 Fixtures Provided (Included In Above Counts)
  - Unisex = 1 Fixture Required and provided

Site Design

The site is theoretical therefore assumed to be virtually flat, zoned appropriately, requires 3.0m setbacks and be permitted by planning to have two curb-cuts onto Ellerslie Road- one for the tarmac and one for the parking lot access.

The building is located sufficiently north so that a full ladder truck can perform a 360 degree turn to back-up into the bays without having to use Ellerslie. The building has three drive through bays and therefore the parking area drive aisle is designed to accommodate fire truck turning radii and sufficient width to allow any of the EFRS vehicles to drive through the parking area.

A security fence, with sliding gate, is designed to extend from the south west edge around the north of the site to the south east edge of the building. This effectively secures the site and building from the building's south face to the northern edge of the property. There are three visitor parking stalls outside the secured fenced area, two of which are for accessible / barrier-free parking.

A total of 28 EFRS dedicated parking stalls are secured behind the fencing. A 2.0m wide sidewalk extends from the north tarmac area, eastward along the south face of the building and returns north and then west around the building within the secured area. Public access is typically not encouraged.

The landscaping is designed to meet the City's context of enhanced landscaping designed contextually to integrate into the neighbourhood's pedestrian network. A plinth, connected sidewalk and flagpole base is provided for any possible art / ceremonies / public access needs. An LID stormwater containment area is provide.

Waste, recycling, and organics are located within the secure fenced area and accessible to waste vehicles through the back of the site tarmac. A back-up generator is provided within the building.

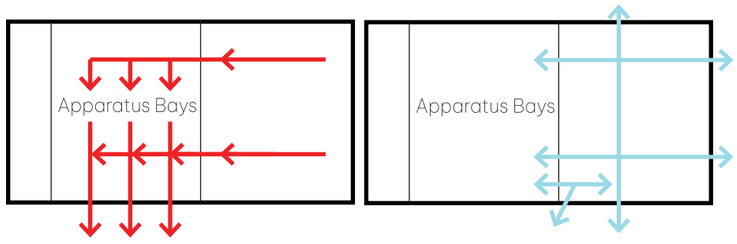
Heavy duty asphalt is designed throughout for the north and south tarmacs and from the curb-cut into the parking area and along the drive aisle. Asphalt connections to the landscaped areas have concrete rolled curbs with recycled material wheel stops.

Floor Plan Design

The principle design functional drivers are: response; and firefighter functionality. The circulation "parti" (red arrow diagram) shows the direct routing from the parking and from the dorms into the apparatus bay. This keeps the mandated 70 second turn-out time, visual cues to firefighters of the exterior is critical to firefighter orientation. The visual connections to the exterior (blue arrow diagram) show how firefighters can connect to the exterior - an important design element. The building floor plans are designed around these.

The Full Policy Station design is virtually identical to the Basic Civic Station design in function. The designs are based on a number of influences:

- The EFRS Standards' Space Programme as created by and maintained by EFRS.
- Data taken by S2 Architecture when programming Windermere Fire Station and as approved by EFRS during that project's programming phase.
- An occupancy summary spreadsheet was created and shown previously and is based on EFRS' Standards Space Programme.
- The floor plan incorporates EFRS refinements needed since the Standards were originally written. These refinements came about from earlier discussions with EFRS (separate from this report).
- The Area Summary spreadsheet was used as the Basis of Design for fire stations.
- This Full Policy Station design is slightly larger than the Basic Civic Station design because of increases in the amount of interior mechanical and electrical spaces and the location of the generator inside the building.



Full Policy Circulation

The building's circulation is designed all around response. This focus on response is seen in the simplicity of the internal movement (red lines) and the clarity of the visibility corridors (blue lines). This singular focus predicated the building planning and design.

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Building Massing

The building massing developed around two principles:

- Minimum clearances required within the functional spaces are maintained.
- Estimated ceiling height for structural, mechanical and electrical services to be run throughout the building and establish a datum for clearances.

The functional clearances required are:

- Offices: 2.7m inside clear (9'-0")
- Apparatus: 6.1m inside clear (18'-0")
- Duty Gear: 2.4m inside clear (8'-0")

The estimated clearances required above the functional clearances noted above provides space for the structure, mechanical ducts, electrical lights, ceiling structure, and other elements. The estimated clearances are:

- Offices: 1.4m (4'-4")
- Apparatus: 2.4m (8'-0")
- Duty Gear: 1.2m (4'-0")

The minimum clearances are typical to both the Basic and the Full Policy Station designs and are also typical to best practice fire stations.

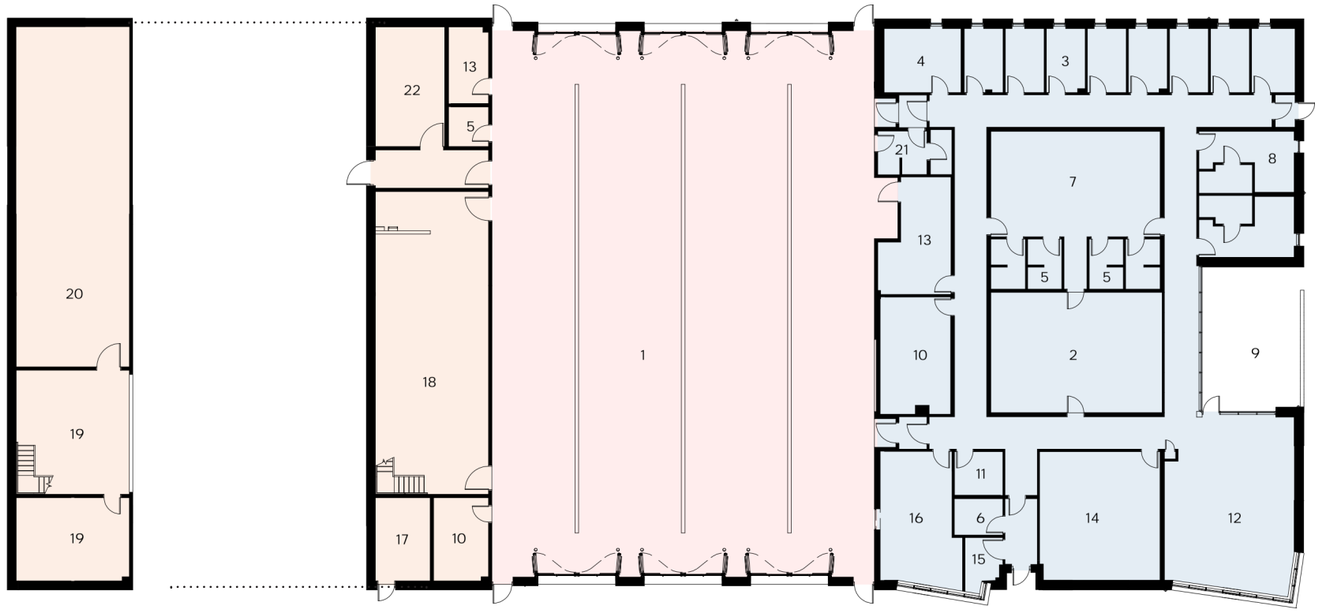
The dimensions and sizing shown below are based on averages and the structural assessment shown in the structural section of this report. The exterior profile and elevations of the roof in this Basic Civic Station design, significantly follows the profiles shown below. This is very typical for many station designs.

The profile of the design would change if the office component was two storeys but in the case of this theoretical design, sufficient space on the site exists to make it a one-storey facility. If space on the site exists, a one storey build is typically less expensive than the same building area compressed into a two-storey solution.

The building height is based on consistent top of masonry with an added "top hat" raised apparatus roof with Kalwall translucent panels at the top of the apparatus bay area.

The Full Policy Station design is larger than the Basic Civic Station design:

- Mechanical spaces have increased to accommodate interior equipment
- Electrical spaces have increased to accommodate increased needs
- Captain's office increased to accommodate mirroring of vestibule and corridor
- Apparatus Bays longer to accommodate design plan rectangle
- The generator was moved into the building increasing the footprint but also the mezzanine area above



Mezzanine Level

1. Apparatus Bays
2. Fitness Room
3. Dorm
4. Study Room
5 Washroom
6. Barrier Free Washroom
7. Locker Room
8. Captain's Dorm
9. Outdoor Patio
10. IT/Electrical Room
11. Watch Box

Main Level

12. Kitchen
13. Custodial & Maintenai
14. Day Room
15. Community Room
16. Captain's Office
17. Meter Room
18. Duty Gear
19. Storage
20. Mechanical Room
21. Decon Laundry & Washroom
22. Generator

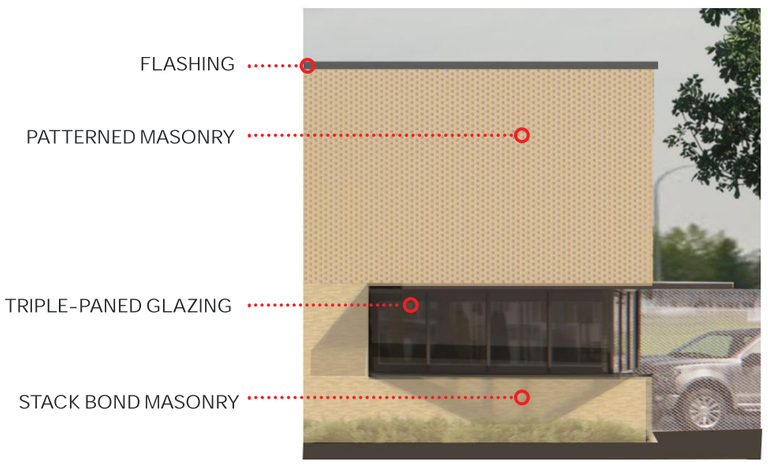
Legend

- Apparatus Bays
- Service
- Work + Living

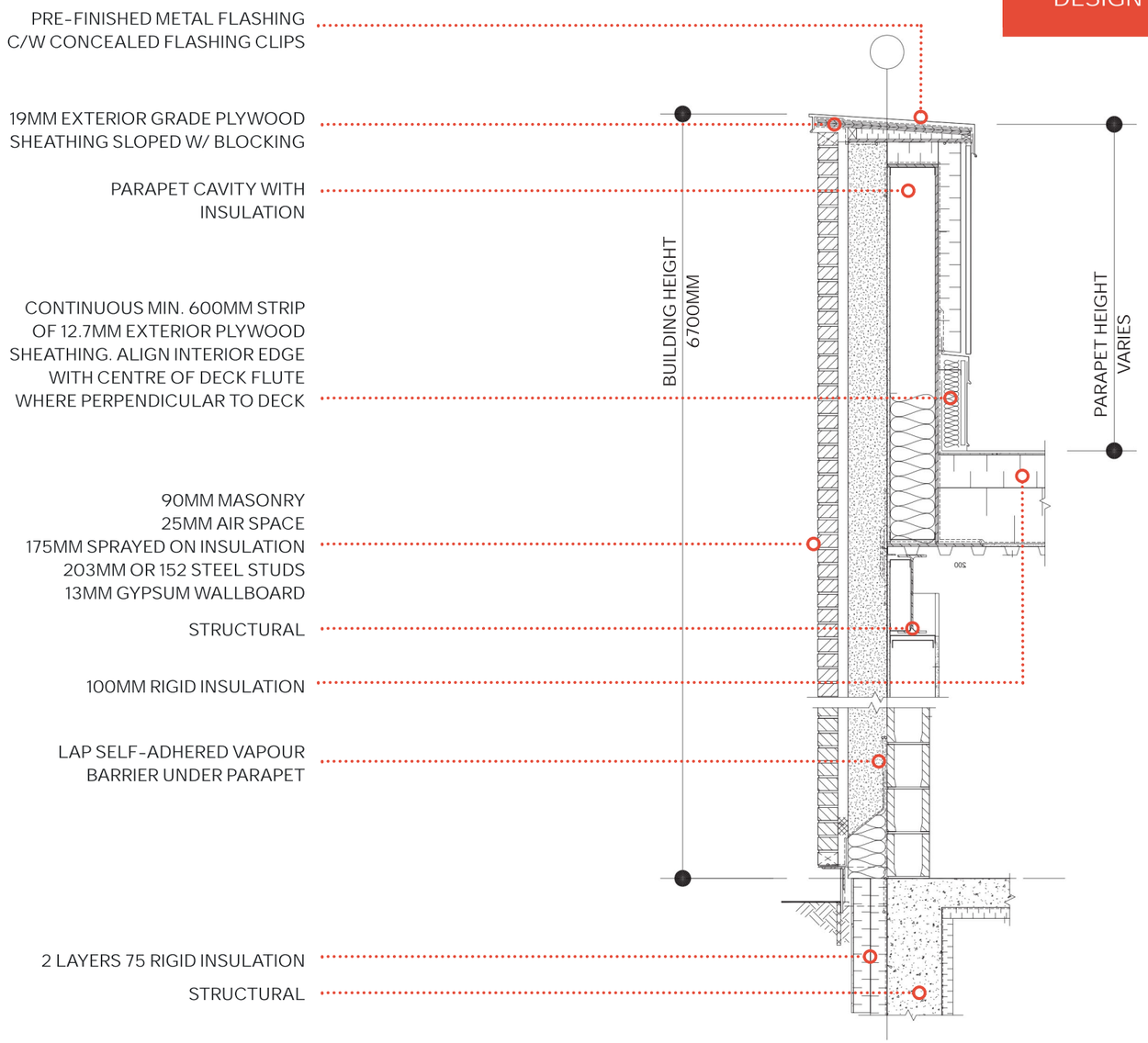
Building Materials

Building materials selected are based on aesthetic quality, performance, and contextual connection. The composition of the building envelope is:

- Exterior wall - Rain Screen Design ~R 35:
  - 13mm Exterior Gypsum Sheathing
  - 203mm Structural Steel Studs
  - 16mm Abuse-Resistant Interior Wall Gypsum Sheathing
  - 175mm Sprayed Foam Insulation and Vapour Barrier
  - 25mm Air Space
  - 90mm Masonry Veneer
- Windows:
  - Triple Paned, Argon Filled, Thermally Broken
- Exterior doors
  - Exterior alum = dark bronze anodized
  - Painted insulated metal door
  - Insulated bi-fold doors to apparatus bays
- Roof ~R-50
  - Modified Bituminous Roofing ~R32
  - 12.7mm Insulation overlay
  - 150mm Rigid insul
  - Fully adhered waterproofing A/V B
  - 12.7mm Gyp Bd
- Slab On Grade ~ R-20
  - 50mm Underslab Rigid Insulation
  - 10 mil Poly VB
- Interior Partitions
  - 16mm Abuse Resistant Drywall (both sides) on 150 Steel Studs
  - Insulation in Cavity
- Apparatus Walls
  - Full Height Concrete Block



Full Policy Exterior Building Elevation Detail



Typical Full Policy Wall Section

Note About the Section

The building sections (Basic Civic shown previously and the Full Policy shown on this page) may appear to have different and contradictory insulation thicknesses however both wall sections reflect the design intent of Basic equals minimum energy code and Full Policy equals full policy requirements (i.e. C627). The significant reason that the two sections are so different in insulation thickness is that the Basic Civic building does not have a fully thermally broken envelope whereas the Full Policy does.

A building which has a fully thermally broken envelope performs significantly better than one which does not, resulting is less insulation required. The two sections shown (Basic and Full) represent two actual building sections and the actual performance criteria for both.

Structural

Proposed City of Edmonton Full Policy Station

The structural system for the CoE Full Policy Station is not different to the Basic Civic Station design except in response to changes required by other disciplines (i.e. larger mechanical mezzanine, Solar PV's on the roof, etc).

The structural system for the Full Policy Station will be as follows:

- The structure will be a non-combustible building with a concrete foundation and conventional steel superstructure.
    - The structural system was chosen as the most common non-combustible and cost-effective system for the required spans and loading.
- The roof structure will generally consist of 38mm deep by 0.76mm thick steel roof deck on open-web steel joists (1000mm deep over apparatus bay, 300mm to 500mm deep in other areas) spaced at 1600mm on centre typically, supported by steel beams, ranging from 310 deep to 610 deep, and 125mm to 150mm square HSS columns. The OWSJ's around the RTU locations and screens above the apparatus bay will be spaced at 1200mm on centre.
- The main floor structure will consist of cast-in-place concrete slab and grade beams. It is assumed that a grade-supported slab will be suitable.
- Based on experience and common practice in this area, the foundations are assumed to be cast-in-place concrete CFA (Continuous Flight Auger) piles ranging in size from 400 diameter and 11m length to 750 diameter and 23m in length. The average size being 400 diameter and 22m in length, located under columns or at 6m under grade beams carrying load-bearing block walls.
- The lateral system will consist of concrete masonry shear walls around the apparatus bay and structural steel braces in three locations around the other areas.
- A structural steel frame is required above the roof to mount the PV system.

Applicable Codes and Standards

The following is a list of the major Codes and Standards that will be used in the structural design of this project, including many sub-codes and standards (too many to list):

1. National Building Code: Alberta Edition 2023
2. CSA S16 – Design of Steel Structures
3. CSA A23.1, A23.2 and A23.3 – Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete/ Design of Concrete Structures
4. CSA S136– Design of Cold-Formed Steel Structural Members
5. CSA S304 – Design of Masonry Structures

Use and Occupancy Loads

The following occupancy loads will be used:

- Main Floor:
    - Apparatus Bays — 12 kPa live load (also wheel loads imposed trucks)
    - Mechanical Areas — 3.6 kPa live load plus 2.4 kPa dead load
    - All other areas — 4.8 kPa live load
- Second Floor:
    - Mechanical Areas — 3.6 kPa live load plus 2.4 kPa dead load
    - All other areas — 4.8 kPa live load or 9kN concentrated load
- Roof:
    - Construction Load — 1.0 kPa live load
    - PV arrays — 0.5 kPa

Environmental Loads (Unfactored Loads)

The following environmental loads will be used:

- The building is to be "Post-Disaster" as per the Alberta Building Code, with Importance Factors as shown in the following categories:
- Snow Load — IS = 1.25 (ULS), 0.9 (SLS)
  Ss = 1.7 kPa
  Sr = 0.1 kPa
- Wind Load — IW = 1.25 (ULS), 0.75 (SLS)
  q10 = 0.36 kPa
  q50 = 0.45 kPa
- Seismic — IE = 1.5 (ULS)
  Sa(0.2) = 0.103

  Seismic Site Classification assumed to be 'D

Mechanical

FULL POLICY DESIGN

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General Limits

- This document has been prepared solely for the use of the City and its design team associated with Cost Benefit Analysis & Cost Drivers Fire Stations. The material contained in this document reflects Smith + Andersen's best judgment in light of the information available at the time of preparation. There is no warranty expressed or implied. Professional judgment was exercised in gathering and assessing information. The recommendations presented are the product of professional care and competence and cannot be construed as an absolute guarantee.
- Where expected or anticipated equipment life is provided it is based on ASHRAE Median Service Life statistics. Actual life of equipment may vary depending on variables such as operation, service and maintenance frequency.
- Where equipment sizing is provided it should be considered order-of-magnitude only as the project details that may affect systems (e.g. envelope quality, occupancy loads, equipment loading) sizing have not been established or finalized.

Introduction

- This section describes the mechanical design the Full Policy Station.
- The goal of the Full Policy Station is to comply with applicable City of Edmonton policies. Policy C627 Climate Resilience Policy is the policy that has the greatest impact on the mechanical design. This policy requires the building to be designed emissions neutral and meet the following additional requirements:
  - A most critical policy, C627A, requires that the building design consumes 20% less energy compared to the National Energy Code for Buildings (NECB) 2017 on an annual basis before accounting for renewable energy. In addition to this, the new energy code is NECB 2020 and so not only does this station design need to meet 20% better than NECB 2017, but it must also meet NECB 2020.
  - Have a Thermal Energy Demand Intensity (TEDI) less than 50 kilowatt hours per square meter for office buildings, or less than 80 kilowatt hours per square meter for all non-office building archetypes.
- High performance, all electric mechanical systems help to meet emissions neutral goal due to the high efficiency of these systems.

Full Policy Station

- The fire station is Group C, D and F2 non-combustible fire station design located in Edmonton, Alberta
- The facility will be owned by the City of Edmonton
- The building will be approximately 1,657 square metres (SM) or 17,824 square feet (SF) above grade and one story tall with a mezzanine. Approximate building height is 9.1 metres (30 feet) from average grade to the floor of the roof level main roof level. The building has an extended apparatus bay roof with translucent panels to reduce energy needs for day time lighting needs.
- A ground source heat pump system with indoor Variable Refrigerant Flow (VRF) evaporators were chosen for the following reasons:
  - High performance, all electric mechanical systems help to meet emissions neutral goal due to the high efficiency of these systems.
  - Consistent, high efficiency and capacity through the entire year. This system has an advantage over an air source heat pump which becomes less efficient and decreases in heating capacity as outdoor temperatures decrease.
  - An air source heat pump or electric resistance system requires larger electrical infrastructure as efficiency decreases during the coldest times of the year.
  - VRF evaporators take up less ceiling space compared to other types of systems which can help to increase ceiling heights.
  - The ground source heat pump system has boilers as a part of the system only as a backup in case the ground loop temperature falls too low to function properly. Other types of systems, such as a water to water loop, require additional equipment such as a dry cooler and boiler to maintain loop temperatures. This equipment takes up additional space and requires additional maintenance.
  - The ground source heat pump system will take up less space in the indoor mechanical areas of the building compared to an air source heat pump or water to water heat pump system. All mechanical equipment is located indoors in the Full Policy Station. Both the air source and water to water options require mechanical equipment that takes up more space compared to the ground source heat pump option.

Design Standards

General

- Mechanical systems are designed and installed to maximize usable space within the building while maintaining optimum service clearances for maintenance and repair.
- All equipment and materials are designed and installed in a neat and orderly fashion. In finished areas all mechanical systems are concealed to meet the implications and needs of the consultant manual.

Codes and Standards

- Mechanical systems are in accordance with applicable codes and standards including:
- Authority Having Jurisdiction is the City of Edmonton.
- National – Applicable to all Jurisdictions:
  - Air Conditioning and Refrigeration Institute (ARI)
  - American National Standards Institute (ANSI)
  - American Standard for Testing and Materials (ASTM)
  - American Society of Mechanical Engineers (ASME)
  - American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
  - Canadian/American Air Balance Council (CAABC)
  - Canadian Standards Association (CSA)
  - Natural Gas Utilization Code
  - National Fire Protection Association (NFPA)
  - Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- Alberta
  - National Building Code – Alberta Edition
  - National Fire Code – Alberta Edition
  - National Plumbing Code of Canada (NPC)
  - Canadian Electrical Code (CEC)
  - National Energy Code for Buildings (NECB)
  - City of Edmonton
  - Facility Design & Construction Consultant Manual – Volume 2 – Technical Guidelines
  - Policy C627 Climate Resilience Policy

Outdoor Design Conditions

- The sizing of mechanical systems are based on the outdoor air conditions shown in the following table:

Location	Dry Bulb Deg. C (Deg. F)	Wet Bulb Deg. C (Deg. F)	Code Reference
Cooling Edmonton	28.0 (82.4)	19.0 (66.2)	NBC – AE 2.5%
Heating Edmonton	-33.0 (-27.4)		NBC – AE 1%

Ventilation for Acceptable Indoor Air

- Ventilation to meet acceptable indoor air quality are in accordance with ASHRAE Standard 62.1, and the applicable building code.
- Specific minimum outdoor air (OA) ventilation rates are identified in the following table and are equal to the sum of a per person rate and per SM (SF) rate:

	L/s (CFM) Per Person	L/s-SM (CFM/SF)	Comment
Kitchen (cooking)	3.8 (7.5)	0.6 (0.12)	
Break rooms	2.5 (5)	0.3 (0.06)	
Corridors	0 (0)	0.3 (0.06)	
Bedroom/living room	2.5 (5)	0.3 (0.06)	
Laundry rooms	2.5 (5)	0.6 (0.12)	
Occupiable storage rooms for dry materials	2.5 (5)	0.3 (0.06)	
Office Space	2.5 (5)	0.3 (0.06)	
Health club/weight rooms	10 (20)	0.3 (0.06)	

Indoor Design Conditions

- Indoor design conditions are in accordance with the occupant comfort requirements per ASHRAE 55.
- The indoor space conditions are in accordance with the following table:

	Summer		Winter	
	Temperature Deg.C. (Deg.F.)	Relative Humidity	Temperature Deg.C. (Deg.F.)	Relative Humidity
Offices, Dorms, and similar non-service spaces	22 (71.6) +/-1 Deg.C.	30%	23 (73.4) +/-1 Deg.C.	30%
Mechanical and Electrical Rooms	26 (78.8) +/-1 Deg.C.	N/A	18 (64.4) +/-1 Deg.C.	N/A
IT Rooms	22 (71.6) +/-1 Deg.C.	N/A	20 (68) +/-1 Deg.C.	N/A
Gym	22 (71.6) +/-1 Deg.C.	30%	23 (73.4) +/-1 Deg.C.	30%
Apparatus Bay	N/A	N/A	18 (64.4) +/-1 Deg.C.	N/A

- During the programming stage, the equipment provided for each space are reviewed in order to establish required cooling. In the event that insufficient equipment information is available the design shall assume the following minimum loads:

	Lighting W/SM (W/SF)	Equipment W/SM (W/SF)	Comments
Study, dorms, kitchens, break rooms, gym,	11 (1)	22 (2)	
Corridors, vestibules, washrooms, change rooms, apparatus bay, service areas	11 (1)	0 (0)	No cooling provided to the apparatus bay
IT/Comms Rooms	11 (1)	22 (2)	

Air Filtration Design

- The following air filtration levels are:
  - Exhaust air systems: None
  - Exhaust air systems c/w Heat Recovery MERV 8
  - Supply air systems (Pre Filters): MERV 8
  - Supply air systems (Final Filters): MERV 13

Noise Design Criteria

- All mechanical systems and components are designed and installed with attention to reducing sound and vibration levels to meet noise criteria and provide a space that is comfortable, acoustically, for the occupants.
- Noise levels due to mechanical equipment, ductwork, grilles, registers, terminal devices, and diffusers are designed not to exceed the recommended ASHRAE limit or local noise by-law listed below for the areas indicated:

	NC (low)	NC (high)	Comments
All areas	30	35	
		dBA (high)	Comments
Property Line		60	Bylaw 14600 Overnight decibel level – non-residential

- The identified noise criteria resulting from the operation of mechanical systems assumes a finished room with all the final architectural finishes (e.g. ceilings and floor finishes) and furniture in place.

Flammable and Combustible Materials

- The storage and use of flammable and combustible materials is regulated by Authorities having Jurisdiction (e.g. Part 4 of the National Fire Code – Alberta Edition) and will limit and control the use of such materials. The City manages these limitations.

System Redundancy

- There are N+1 redundancy (Components – N – have at least one independent backup component +1) applied to the following systems:
  - Heating water pump system;
  - Storm sump pumps;
  - Sanitary sump pumps;
  - Diesel fuel pumps;
  - Supplementary condenser water pumps.

HVAC

General

- The heating, ventilation and air conditioning (HVAC) design and installation shall conform to applicable codes and standards and are sized by recognized computation procedures referenced in ASHRAE.
- Distribution pumps are duplex, duty/standby systems (two pumps sized at 100%of the peak design circulation rate) to provide redundancy during times of service.
- Variable flow distribution systems shall utilize variable frequency drives (VFD) on the distribution pumps and two-way control valves at the terminal devices. Minimum system flow rates are maintained either by including three-way control valves at a sufficient number of terminal devices or by installing a two-way (bypass) control valve across the supply and return mains modulated by a differential pressure controller.

Heating Systems

- The primary means of heating is provided by variable refrigerant flow (VRF) heat pumps connected to a ground source heat pump.
- The central boiler plant are used to supplement the ground source heat pump heating system when required.
- The central boiler plant consists of two electric boilers each sized for approximately 60% of the total heating water requirement. Each boiler are sized for approximately 165kW (563,000 Btu/hr) input.
- The heating plant are sized to serve:
  - Perimeter envelope losses.
  - Building air handling unit heating coils.
  - Snow melting.
- The heating water pumping system are variable primary.
- The primary system shall consist of two pumps in a run/standby configuration. Heating water pumps shall vary flow in response to building requirements through the use of variable speed drives. Minimum flow are maintained through the use of three way valves on select terminal devices or minimum flow by pass loops.
- The heating plant including boilers and distribution pumps are on fully on back-up power.
- Heating coils not subjected to below freezing conditions are serviced by the heating water system.
- Heating coils subjected to below freezing conditions are serviced by a glycol heating system complete with plate and frame heat exchanger and glycol distribution pumps. Glycol are 40% propylene glycol by volume.

- Perimeter heating for the Apparatus Bay and Duty Gear storage areas are provided through in-floor radiant heating.
- Perimeter heating for regularly occupied station areas are provided via water cooled VRF fan coils and supplemented with in-floor radiant heating.
- Entrances and service spaces are heated by electric force flow cabinets or unit heaters.
- Radiant floor heating system shall consist of high density cross-linked polyethylene tubing embedded into the flooring structure/system. System are complete with distribution manifolds, circuit isolation and balancing valves, and controls. Tubing are rated for not less than 82.2 deg. C. (180 deg. F.) working temperature and 100 psig working pressure.
- Snow melting systems shall consist of high density cross-linked polyethylene tubing embedded into the structure/system. System are complete with distribution manifolds, circuit isolation and balancing valves, and controls. Tubing are rated for not less than 82.2 deg. C. (180 deg. F.) working temperature and 100 psig working pressure. Glycol are 50% propylene glycol by volume.
- Chemical treatment systems including pipe line filters are provided for all heating water systems.

Geothermal Heating/Cooling Systems

- Space heating and cooling are generated by distributed VRF heat pumps connected to the ground source heat pump system - the VRF is off the Ground Loop. Refer to Air Handling Units section.
- Geothermal field heat sink shall consist of a vertical borehole distribution of heat exchange piping.
- Geothermal heat pumps are sized for 60% of the full building load. Two heat pumps are used at 200 kW each.
- A conductivity testing procedure are employed by the owner to refine the field size.
- Geothermal systems are regulated by Authorities having Jurisdiction (e.g. in Ontario under the Ministry of the Environment). The owner/installer are required to apply for the appropriate approval.
- The geothermal system are decoupled into a primary and secondary pumping system. The primary loop are constant volume and filled with 10% ethanol for freeze protection.
- The secondary distribution system consisting of duplex pumps shall vary flow in response to building requirements through the use of variable speed drives.
- The distribution system are fully insulated due to the cold water temperatures.
- Back-up or supplementary heat injection:
  - The geothermal field are sized for the lower load requirement (peak heat rejection versus peak heat extraction). In this case, heat rejection is the lower requirement and supplementary heat injection is required).
  - Refer to Heating System section.
- Chemical treatment system including pipe line filters are provided for the condenser water systems.
- Geothermal heat pumps system shall consist of VRF heat pump units for zone heating and cooling. Each heat pump shall contain a hermetic compressor and are capable of either heating or cooling the space on demand from a temperature sensor
- The heat pump units are connected to a common two-pipe water circulation system. Each heat pump unit shall supply cooling air to individual zones and reject the heat removed to the two-pipe loop. When the zone requires heat, the unit shall switch (by means of reversing refrigeration valve) into the heating cycle. The unit shall then extract heat from the common two-pipe water loop.
- Heat pumps connected to variable flow condenser water systems are equipped with fast acting control isolation valves and pressure independent flow balancing valves (FBV).
- Unit expansion valve are electronic to handle the low water temperature.

Refrigeration Systems

- Refrigeration systems are in accordance with CSA B52 or ASHRAE Standard 15.
- Refrigerant piping passing through different fire zones (e.g. vertical pipe shaft between floors) are in a fire rated enclosure that is vented to the outdoors.

Dehumidification

- No "active" dehumidification are provided. All cooling systems shall "passively" dehumidify by lowing supply air temperature and, consequently, dehumidifying the supply air.

Humidification

- Humidification provided in air handling units. Space relative humidity set point are 20% when the outdoor air temperature is less than 0 degrees Celsius, 30% when the outdoor air temperature is greater than 0 degrees Celsius.

Air Handling Systems

Variable Refrigerant Flow (VRF) Systems

- Variable refrigerant flow system shall consist of central condensing units and local evaporator units. Evaporator units are ceiling mounted.
- Outdoor air are ducted to the return air opening of evaporator units.
- Zoning/circuiting of the refrigeration are arranged such that total refrigerant charge are within the Code limits (e.g. CSA B52 or ASHRAE Standard 15) for the smallest zone served by the system.
- Condensate pumps are provided for evaporator units.
- VRF units are distributed throughout the space and the ground loop runs through the spaces to serve these units.

Dedicated Outdoor Air System

- A Dedicated Outdoor Air System (DOAS) are used to provide ventilation air, general exhaust, and sanitary exhaust.
- Tempered ventilation/outdoor air are supplied by a 100% outdoor air, variable air volume indoor air handling unit with heat recovery sections to reclaim/reject waste heat from exhaust air streams.
- The bathroom exhaust are centrally collected and exhausted via the air handling unit heat recovery section.
- Unit shall consist of dampers, filters, solid core heat recovery, glycol heating coil, supply fan, and exhaust fan.
- System capacities are as follows: 566 L/s (1200 cubic feet per minute)
- Locker room exhaust systems shall consist of anodized aluminum ductwork.
- Laundry exhaust are individually ducted to the perimeter and exhausted complete with booster fan and lint trap. A current sensing relay are provided to start/stop the exhaust fan.
- Acoustical concerns are addressed as described in the noise and vibration control section.

Kitchen Systems

- A kitchen exhaust system constructed in accordance with NFPA 96 and complete with hydronic make-up air unit, are provided for the kitchen space should it be equipped with an exhaust hood for collection of grease laden exhaust. Kitchen exhaust system are variable air volume.

Apparatus Bay Ventilation and Vehicle Exhaust

- The parking ventilation system are started and stopped by a carbon monoxide (CO) detection and/or nitric oxide (NO) system. Exhaust fans are interlocked with the supply fan. When any CO/NO sensor detects 50 ppm the lead exhaust fan shall start and the supply fan shall operate at low speed. When any CO/NO sensor detects 100 ppm, the lag exhaust fan shall start and the supply fan shall operate at high speed. Sensors are located 1,500mm (60 inches) above the finished floor. Sensors shall have an accuracy of 1 ppm and shall have a 0-100 ppm range.
- Nederman vehicle exhaust rails and snorkel system are provided for each lane complete with magnetic disconnect system. The apparatus bay features parking for 6 fire department vehicles in three parking lanes. Each lane will be provided with 1 exhaust rail complete with 2 exhaust reels. Vehicle exhaust rails are connected to a central high static, flat blade centrifugal utility fan. Building automation system shall modulate supply and exhaust fan speeds to maintain apparatus bay pressurization when the vehicle exhaust system is in operation. Vehicle exhaust are directly vented to the outdoors.
- Apparatus bay are negatively pressurized to adjacent spaces to ensure air contaminates and odours do not enter the station.

Miscellaneous Systems

- Separate washroom exhaust systems are provided for the washroom groups if they are not attached to heat recovery systems. The make-up are transferred from the adjacent corridors.
- Ventilation systems, comprising filtered outdoor and an exhaust air fan, are provided for the mechanical and electrical rooms. Each system shall cycle the fan to maintain a space temperature.
- Self-contained air conditioning units are provided for server/LAN rooms.
- Exhaust system of suitable construction are provided for dishwasher exhaust.
- Laundry exhaust system are provided for the laundry room. A variable volume laundry exhaust system complete with lint removal are provided.

Noise and Vibration Control

- All mechanical equipment are equipped with vibration isolation control measures to reduce the transfer of vibration generated noise into the building structure.
- All supply, return and exhaust air system are equipped with silencers to reduce the duct borne equipment noise in the occupied spaces to acceptable NC levels.

HVAC Systems Insulation

- Insulation for HVAC systems are in accordance with the National Energy Code for Buildings.

Plumbing and Drainage

General

- The Plumbing System conforms to the National Plumbing Code (NPC).
- All exterior site services including external cisterns are provided under the "Site Works" division or "Civil" contract.
- Above floor storm drains, sanitary drains and vents, 65 mm (2-1/2 inch) and larger are cast iron.
- Above floor sanitary drains and vents, 50 mm (2 inch) and smaller are hard temper DWV copper drainage tubing.
- Buried storm piping within the building are PVC.
- Buried sanitary piping within the building are PVC.
- Domestic water piping are copper type L.
- Valves are Crane or equal of type and construction to suit service and working pressures.
- For all services 50 mm (2 inch) and smaller 4,136 kPa (600 psig) WOG ball valves are used.

Storm Systems

- A complete system of roof drains and storm drainage piping are provided.
- The "Civil" consultant prepares the storm water management (SWM) approach for the site, which may determine that a retention storm cistern is required. It is assumed one is not required.

Sanitary Systems

- A complete system of plumbing fixtures and sanitary drainage and vent piping is provided.
- New above grade drains are collected and drained by gravity to site sanitary sewers. Drains below the municipal services invert elevations are collected in sump pits complete with duplex submersible pumps. Pits are pumped into the gravity drainage piping. Sump pumps are on back-up power (if available).

Satellite Plumbing Risers

- At two locations risers for future, tenant plumbing are provided consisting of capped connections to sanitary, vent and domestic cold water.

Grease Interceptors

- Grease interceptors are complete with an alarm to indicate when pump out is required. Grease interceptor are complete with piped pump-out, maximum 30 m (100 ft) to permit remote draining.

Plumbing Fixtures

- The following plumbing fixtures are anticipated for the project:

	Group	Description	Comments
W-1	Water Closet	Wall mounted, electronic flush valve	
W-2	Water Closet	Wall mounted, barrier free, electronic flush valve	
U-1	Urinal	Wall hung, electronic flush valve	
L-1	Lavatory	Counter mounted, electronic "no touch" 100 mm (4 inch) centre set.	
L-2	Lavatory	Counter mounted, barrier free, electronic "no touch" 100 mm (4 inch) centre set.	
JS-1	Janitor Sink	Precast floor mounted, faucet with hose set.	
S-1	Sink	Counter mounted, single bowl, stainless steel, 200 mm (8 inch) centre set.	
S-2	Sink	Counter mounted, double bowl, stainless steel, 200 mm (8 inch) centre set.	
SH-1	Shower	Pressure balanced mixing valve, floor or trench drain.	
SH-2	Shower	Pressure balanced mixing valve, barrier free with three fixed showerheads mounted at different heights with diverter valve, floor drain.	
DF-1	Drinking Fountain	Wall mounted, barrier free, non-refrigerated with bottle filler.	

- Plumbing fixtures are water conserving type. Minimum requirements:

	Metric	Imperial	Comments
Water Closets	4.8 Litres per flush	1.28 Gallons per flush	
Urinals	1.9 Litres per flush	0.5 Gallons per flush	
Lavatories (Public)	1.9 LPM @ 414 kPa	0.5 GPM @ 60 psig	
Kitchen Faucet	6.7 LPM @ 414 kPa	1.75 GPM @ 60 psig	
Showerheads	7.6 LPM @ 550 kPa	2.0 GPM @ 80 psig	

Domestic Cold Water

- A 150 mm (6 inch) domestic water service are brought into the building for domestic water and fire services. The domestic water and fire services are isolated from the municipal water supply by approved backflow prevention devices.

Domestic Hot Water

- Domestic hot water are generated by two 492 Litre (130 USgallon) air source heat pump storage water heaters each sized at 50% of the building load and located in the mechanical room. Each water heater are storage tank and double-walled heat exchanger capable of using raising incoming domestic water 55.6 deg.C. (100 deg.F.).
- A replaceable bladder expansion tank suitable for domestic hot water are installed on the domestic hot water system to accommodate thermal expansion. A thermal/pressure relief valve are install to accommodate thermal expansion.
- A recirculation loop and recirculation pump shall maintain flow in the domestic hot water system to maintain hot water at the fixtures at all times.

Natural Gas

- Natural gas is distributed to the kitchen ONLY. All gas piping are schedule 40. Piping 64 mm (2-1/2 inch) and larger are welded. All gas piping are painted yellow in its entirety including concealed areas.
- A low pressure PRV station at approximately 1,744 to 2,740 Pa (7 to 11 in. WC.) are provided to serve the kitchen.

Insulation

- Insulation for plumbing systems are in accordance with the National Energy Code for Buildings.
- All exposed insulation are complete with PVC jacket or canvas lagging suitable for painting.

Fire Protection and Life Safety Systems

General

- The Fire Protection System shall conform to the National Building Code - Alberta Edition.

Sprinkler

- A wet pipe, hydraulically sized sprinkler system are installed for the building. Sprinkler design are to NFPA 13.
- Sprinkler heads are:
  - Upright brass type where no ceiling exists.
  - Concealed type where ceilings occur.
  - Provided with guards in exposed areas where heads are susceptible to damage.
  - Sidewall or concealed in suites.
- All piping 65 mm (2-1/2 inch) and larger are schedule 40with Victaulic fittings.
- All piping 50 mm (2 inch) and smaller are screwed.
- The following sprinkler zones and coverage is anticipated.

Area	Type	Hazard	Remarks
Apparatus Bay	Dry	Ordinary GR2	Galvanized piping
Offices and Multi-Purpose	Wet	Light	
Gymnasium	Wet	Ordinary GR 1	Guards on heads
Generator Room	Dry	Ordinary GR 2	Galvanized piping
Mechanical Rooms, Storage Rooms	Wet	Ordinary GR 1	Guards on heads

- All supervised valves shall have end switches. Division 16 shall wire valves and switches into the main fire alarm panel.

Standpipe Systems

- At this point the building is not expected to require a fire standpipe system complete with fire hose cabinets. An independent code review shall confirm this at a later date.

Portable Fire Extinguishers

- General areas will be covered by multi-purpose, dry chemical powder type portable fire extinguishers. Fire extinguisher rating will be sized for the type of hazard present. Mechanical rooms, electrical rooms and similar spaces are provided with chemical fire extinguishers.

Additional Measures For Building Fire Safety

Diesel Generator Systems

- A complete, looped diesel fuel storage system is provided for the back-up diesel generator.
- The fuel system consists of:
  - Interior storage tank;
  - Supply and return piping;
  - A set of duplex pumps for each generator. Pumps are provided;
  - Supply and return piping to the auxiliary day tank;
  - High-Low level pump controls and alarm
  - Over-Flow alarms
  - Ventilation, combustion intake and relief air ductwork complete with dampers are provided for the indoor diesel generator.
- Main storage tank are sized for minimum 24 hour generator run-time at maximum power.
- There are an explosion proof (Class 1 Division 1) electric unit heater located in the diesel generator room.
- The mechanical division shall install the diesel muffler and discharge (using Schedule 40 black steel piping) to exterior. Termination are away from building intakes.
- The mechanical ventilation system consists of exhaust plenum (complete with silencers, exhaust dampers, and return dampers), outdoor air plenum (complete with combustion damper and ventilation damper. Return dampers are normally open. Combustion damper shall open on generator start. Room temperature sensor shall modulate ventilation, exhaust and return air dampers to maintain generator room temperature at set point, initially set at 26.7 deg.C. (80 deg.F.).

Systems on Back-Up Power

- The following systems are on Back-Up power:

System	Life Safety Item
Ground Water Sumps	Yes
Sanitary sumps	Yes
Bas (ups)	Yes
Fire pump package	Yes
Boiler controls	Yes
Boiler pumps	Yes
Venting to aid firefighting exhaust fans	Yes
Below grade stair pressurization fans	Yes
Diesel generator controls	Yes
Diesel fuel pumps	Yes
Domestic water pumps	Yes
Comfort cooling systems and pumps	No
Supplementary cooling pumps	Yes
Electric tracing	Yes
Glycol snow melt pump	Yes

Seismic Requirements

- The Architect and Structural Engineer have advised that as per Part 4 (Structural Design) of the Building Code, the mechanical system components described in the Building Code and their connections to the building structure do not require a seismic force resisting system (SFRS) however are required to meet Post-Disaster requirements.

System Controls

General

- Building Automation System (BAS)
- A microprocessor system incorporating direct digital control are installed to control and monitor the mechanical systems. The BAS are BACNET or Echelon compliant where possible.
- The BAS shall control and monitor air handlers, exhaust fan, heating and cooling equipment, and terminal units. The BAS shall interface with the geothermal system, boilers, and VRF equipment. The BAS shall monitor sump pits, temperature in critical common areas, etc.
- The building operator's terminal are located in the building operator's room.

Air and Water Balancing

General

- All air and water systems are balanced prior to building turn-over. Balancing reports are submitted for review by the consultant and owner.

Commissioning

Contractor Commissioning

- Contractor shall perform equipment testing (piping, ductwork) and obtain sign-offs, equipment start-up and check sheet (with manufacturers), arrange for training on equipment (provided to owner) and coordinate with independent commissioning agent.
- Independent Commissioning is provided by the City and is integrated into the design and construction process.

Testing of Integrated Fire Protection and Life Safety Systems

General

- The owner will hire a professional to act as the Integrated Testing Coordinator (ITC) and to prepare the multi-discipline Integrated Testing Plan (ITP) for the project.
- The ITP are in accordance with CAN/ULC-S1001 "Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems."

Mechanical and Electrical Coordination

General

- Motor starters are supplied and installed by Electrical Division. Starters are grouped into motor control centres or starter racks where feasible. Power wiring (line side and load side) are by Electrical Division.
- Variable speed drives are supplied and installed by Mechanical Division. Power wiring (load and line) are by Electrical Division.
- Control wiring are by Mechanical Division.
- All fire alarm wiring are by Electrical Division. All smoke detectors including duct-mounted smoke detectors, integral with the fire alarm system, are supplied and installed by Electrical Division.

Electrical

Design Criteria

The electrical design will be based on the following standards including:

- ANSI, IEEE, EEMAC Standard for High and Low Voltage Switchgear.
- Latest adopted Canadian Electrical Code – Part I.
- Regulations of the Alberta Electrical Protection Branch – Safety Codes Act.
- Latest Alberta Building Code.
- National Energy Code of Canada for Buildings 2011
- Latest Alberta Fire Code.
- CSA Standard B651-95 Barrier Free Design.
- Latest CSA Fire Alarm Standards and ULC Standards.
- Latest Illuminating Engineering Society of North America (IESNA) Standards.
- City of Edmonton Consultant Manual Volume 1 – Design Process and Guidelines.
- City of Edmonton Consultant Manual Volume 2 – Technical Guidelines.
- City of Edmonton Policy
- Latest version of LEED. (v4)

Sustainable Design Considerations

The fire station design will be based upon achieving LEED Silver and Emissions Neutral Building certification for the City of Edmonton Policy C627 requirements. The rationale for pursuing these certifications is to contribute to reduce demands on the Earth's resources. The electrical systems that are impacted by pursuing these certifications include energy conservation and generation, light pollution reduction, and indoor environmental quality.

Energy Conservation

Electrical energy comprises a small portion of the total energy consumed by a facility but when expressed in actual utility costs, the electrical system consumes approximately 20 to- 40% of the total building's energy budget. The following initiatives will be adopted in the design to reduce the building's energy consumption:

- Use the latest illumination technology including LED luminaires.
- Other measures that can further improve the baseline energy performance are the use of occupancy sensors, dimming controls, photocells, and improved local controls.

Lighting will comply with prescribed guidelines rather than using light levels that are on the high end of the IESNA (Illuminating Engineering Society of North America) standard. Lower ambient lighting levels will be employed in offices, dorms, circulation spaces, and corridors.

Additional practical sustainable design include:

- Providing electric vehicle chargers as required to meet the LEED credit requirements for Location and Transportation.
- Providing additional power distribution infrastructure to meet the LEED credit requirements for Advanced Energy Metering
- Specifying and locating site luminaires to meet the LEED credit requirements for Lighting Pollution Reduction.
- Additional lighting controls specified and provided to meet the LEED credit requirements for Interior Lighting – Lighting Control.

Energy Generation

A photovoltaic system is required to generate sufficient electrical energy to meet the building Certification. Electrical infrastructure will be provided to support and connect the photovoltaic system to the main electrical distribution equipment.

Electrical Systems

Main Service

A new 800A, 600V, 3P, 4W main electrical service is to be provided. It is expected that the new electrical service will be serviced by a new padmount transformer. A new enclosed second electrical room, containing only electrical equipment, will be provided. There were multiple factors considered regarding the location and size of the new electrical room, including the mechanical heating and cooling systems, automatic transfer switch and photovoltaic system infrastructure. The design intent is to provide a new electrical service with a larger electrical service with a minimum 25% spare capacity for future expansion.

The building floor plan and historical precedent of similar facilities, result in an estimated connected load of 300kW. To meet the estimated calculated connected load and allow for spare capacity, it is proposed that the main electrical panel be a 800A bus.

Backup Power Distribution

A 300kW diesel-fired backup generator is to be provided within the facility. 48 hours of diesel fuel will be provided in a sub-base fuel tank. The entire facility is to be backed up by generator power, except for life safety systems. The installation will conform to CSA Standard C282, "Emergency Electrical Power Supply for Buildings".

Power Distribution System Design

A new 800A - 600V rated main distribution board will be located in the main electrical room. A 600A rated main distribution panel will be provided downstream of the automatic transfer switch to feed various branch circuit panelboards. Additional electrical panelboards will be provided for the purposes of separating sub-systems to meet the LEED requirements for the Advanced Energy Metering credit.

Grounding and Bonding

The grounding system will be designed to provide a low impedance path for ground fault currents to flow. The main electrical room and telecommunication room will have grounding busses connected to the building's main system ground, which in turn will be connected to the ground grid. All non-current-carrying metal parts of the equipment will be bonded per the latest Canadian Electrical Code. A bonding conductor will be provided in each conduit.

General Wiring

New wiring will be installed in conduit for new electrical/mechanical. Per the City of Edmonton guidelines, only copper wiring is acceptable.

The use of cable tray systems will be limited to the main telecommunication room. Cabling for life safety systems such as fire alarm systems, etc. will be minimum two-hour fire rated. Drive-rated cables will be used from VFD's to the motors when they are separated by more than 10m of cable length from the VFD's.

Lighting

New lighting will be provided for the new facility. The Illuminating Engineering Society of North America (IESNA) standards, National Energy of Canada for Buildings 2011, and the City of Edmonton Consultant Manual Volume 2 Technical Guidelines will be the key references used.

The new exterior and interior lighting will be designed to provide integration of numerous lighting techniques to provide a vibrant and attractive atmosphere that is both inviting and engaging for the people around the space. It is the intention that the design will integrate the various aspects of the lighting system with the building's space functions, mechanical systems, and architectural elements. Integration of natural light captured by the building will take on a key role in achieving desired illumination. The basis of design will include LED luminaires throughout the exterior and interior of the facility.

Lighting Control System

All building lighting will be controlled to decrease energy use, allow flexibility, and to meet the requirements of the City of Edmonton. The lighting control system will be a combination of line voltage and low voltage systems with a combination of local and automatic controls that will interface.

Controls will include:

- Occupancy sensors will be provided in all public areas including offices, corridors, social spaces, washrooms, and similar spaces.
- Storage rooms to be complete with local on/off combination occupancy sensor switch.
- Utility rooms to be manual on/off
- Central time clock control. All general building lighting, with the exception of suites and low usage areas will be controlled using a central time clock.
- Daylight sensors will be considered for the perimeter spaces, recreation room, fitness room, upper floor corridors and social spaces. This daylight control will either shut off the nearest fixture to the windows or dim the luminaires in these areas.

Additional lighting control design is to be included to control select lighting through the Station Alerting System during a fire fighter alert 'call'.

Emergency Lighting

New LED emergency lighting in the form of remote heads will be included for the facility.

Exit Signage

All exit signage to be green running man style as per Alberta Building Code.

Fire Alarm System

The fire alarm system will be a single stage, annunciated, class A -wired and electrically supervised system. Zoning of the fire alarm system will be based on smoke zone subdivision. System devices will be of the addressable type and will consist of manual pull station, products-of-combustion detectors, thermal detectors, and sprinkler flow valves.

The main fire alarm control (FACP) is to be located in the main telecommunication room. A fire alarm annunciator panel (FAAP) will be located in the vestibule. Dorm suites will be complete with in-suite notification devices with temporary silence functionality. The network connection will be at the FACP, not the annunciator. The FAAP will be a standard transponder interface annunciator only. It will require a dedicated 120V circuit, and will consist of an 8 line display, and a spare tub for mounting a graphic. FACP will include the same functionality (display, switches, graphic, etc.).

Low Tension Systems

This section of the report discusses the various low tension and security systems that are envisioned to be installed for the new Fire Station. Security system head end equipment to be located in the proposed communications/IT room with security panels complete with 4ft x 8ft minimum clear space in front.

Access Control System

New access control system to City of Edmonton's standards will be installed at this facility. All exterior doors, including overhead doors, will be monitored through the use of door position sensors suited to each application. Specific doors will be provided with card access as required by the City of Edmonton.

Devices and head-end equipment will be located in the main telecommunication room per the City of Edmonton guidelines.

CCTV System

New CCTV system to City of Edmonton's standards will be installed at this facility. Exact quantity and location of devices will be coordinated with the City of Edmonton. Devices and head-end equipment will be located in the main telecommunication room per the City of Edmonton guidelines.

Corporate Security

Corporate Security will match the City of Edmonton's Design Standards. This is completed during detailed design and varies by building and station. The budget includes typical and generic system.

Audio Visual and IT Requirements

Audio-visual and IT connections will be provided to address the needs identified by the City of Edmonton. Further discussion will be required during detailed design. Power, data, and coax will be provided for devices required in specific areas, including the fitness room – coax locations for TVs.

Communication Infrastructure

The design intent is to provide new communication infrastructure, including horizontal structured cabling, to meet City of Edmonton standards. The overall infrastructure will be using conduit throughout the facility with zone boxes for distribution and future capacity.

Structured Cabling Pathways

Vertical communications cabling will be installed in conduits. All conduits for communication systems are EMT (electrical metallic tubing). Flex conduit is not permitted. Minimum conduit size for voice/data outlets will be 27 mm. Maximum fill ratio is 40% per the Telecommunication Industry Association standards.

Routing of horizontal structured cabling will be accomplished by utilizing conduit and communication zone boxes in strategic locations. Cable tray will be limited to the main communication room for cable management.

Data racks, floor-mounted four post and wall-mounted, will be located in the main telecommunication room. An Uninterruptible Power Supply (UPS) sized for the equipment in the room will be provided. A power duplex outlet will be placed in close proximity to all new voice and data drop outlets including future data/voice drop locations.

Network Architecture: Using standard ethernet design concepts and protocols, the new system will be based on a logical bus and centralized physical star topology using horizontal cabling and localized switching. The horizontal segments will be built using structured cabling solutions with home runs from the outlet jack back to rack mounted patch panels inside the main telecommunication room.

Copper: Certified Category 6 unshielded twisted pair structured data/voice cable will be utilized for horizontal distribution. The maximum cable run distance is 90m between terminating devices (additional 10m allowance for interconnecting patch cabling).

New communications outlets will be provided as required. New patch panels will be provided as required.

The telephone handsets and the telephone switch will be supplied, installed and programmed by the City of Edmonton

Wireless Local Area Network

New wireless infrastructure consisting of access points, network switches, servers, wireless local area network (WLAN) controllers and the necessary cabling infrastructure will be provided as required. It is expected that the head-end equipment and wireless access point devices, including locations, will be provided by the City of Edmonton.

Station Alerting System

Firefighter alert infrastructure, including headend equipment, audio and visual devices to be provided and interconnected to the Station Alerting System, with the SAS cabinet located in the main telecommunication room. It is expected that locations, devices, cabling and head-end equipment will be provided by the City of Edmonton. Conduit and rough-in to be provided by electrical contractor.

Mechanical Systems

All motors 0.25kW and smaller will be single-phase 120V and all motors at 0.37kW and larger should be 600V, 3-phase. The supply and installation of all motor protection switches, starters, and disconnect switches for mechanical equipment will be provided by the electrical contractor. Time delay relays will be provided for all motors 18.65kW (25hp) and larger. A disconnect switch will be provided for and at each motor.

VFD controlled motor loads will be fed from Distribution Centres (CDP). The mechanical loads will be segregated for metering to pursue the LEED Advanced Energy Metering credit.

The variable speed drive starters (VFDs) and electrical equipment to be grouped away from wet, dusty, or hot areas. Manual controls will be provided for all plumbing fixtures. No electrical will be provided for any infrared fixtures.

Lightning Protection

Lightning protection is provided along the raised portion above the apparatus bays. This to meet EFRS standards.

Project Summary

Project Name:	Fire Station - Full Policy Station
Project Number:	25172-002-000
Date Issued:	2025-05-13
Purpose of Model:	Design Assistance

Project Address:	Edmonton, Alberta
Compliance Path:	NECB 2017 / NECB 2020
Software Used:	eQUEST v3.65-7175 DOE-2.3
Modelled By:	Mohammad AlMasri

Purpose of Model

This section of the energy study and life cycle costing focuses exclusively on the Full Policy Station. The Full Policy Station is designed to comply with the City's comprehensive range of codes, bylaws, and policies.

The study aims to analyze the anticipated energy performance of the proposed station design (hereafter referred to as the Full Policy Station Design) to ensure compliance with the Climate Resilience Policy requirements (C-627 Climate Resilience Policy). To meet these requirements, the design must:

1) Demonstrate 20% less energy consumption compared to the National Energy Code of Canada for Buildings (NECB) 2017 reference building on an annual basis, before accounting for renewable energy.

2) Achieve a Thermal Energy Demand Intensity (TEDI) of less than 80 kilowatt-hours per square meter.

3) Allocate a minimum of 1% of the total capital project budget to the incorporation of on-site renewable energy.

4) All new city owned, occupied buildings shall be designed emissions neutral

While these requirements aim to improve sustainability and resilience, there is flexibility built into the policy. Specifically, if the lifecycle costs of implementing certain requirements are not advantageous, those requirements may be omitted. This ensures that economic feasibility is considered alongside climate resilience.

In addition to the above, the Full Policy Station must comply with the National Building Code - 2023 Alberta Edition, which is mandatory for all new construction in Alberta. Compliance will be achieved by following the guidelines of Part 8 of the NECB 2020. This requires that the annual energy consumption of the proposed design must not exceed that of a reference building based on NECB 2020 prescriptive requirements.

The building energy model will estimate the anticipated energy cost performance and greenhouse gas emissions (GHG) following the City of Edmonton Climate Resilience Technical Specifications (COE-IM-GUIDE-0030). These estimated energy costs, along with other construction capital costs, maintenance, and replacement costs, will be used to complete a life cycle costing analysis over a 25-year period using net present value methodology.

The life cycle cost analysis outcome will be used to compare the financial performance of the Full Policy Station against a Basic Civic Station, which is designed to meet the minimum code requirements

Executive Summary

An energy modeling analysis was conducted to quantify the energy performance of the Full Policy Station design. Our analysis shows that the proposed design complies with the policy requirements, achieving a **47.9%** energy performance improvement compared to **NECB 2017** (before considering renewable energy) and a **TEDI value of 79.8 kWh/m²**. In addition, the proposed design complies with the Alberta Building Code by demonstrating a **46.1%** reduction in energy consumption compared to the NECB 2020 reference building.

A life cycle costing analysis was completed, incorporating the estimated energy costs from the energy model, as well as capital costs, maintenance costs, and equipment/system replacement costs provided by the design team.

Table 1 below summarizes the key results of the energy modeling and life cycle costing analysis. Detailed performance results are provided in this reports and in the Appendix.

Table 1: Energy Modeling and Life Cycle Costing Analysis Summary Results

Model	Annual Energy Consumption (ekWh)	First Year Energy Cost ($)	First Year Net GHG Emissions (kg eCO_{2e}) [1]	25-Years Life Cycle GHG Emissions (TCO_{2e})	25-Years Total Energy Cost ($)	25-Years Total Lifecycle Costing ($) [2]
Full Policy Station Design with Solar PV	206,033	47,786	0	0	964,944	26,626,012

[1] GHG emissions accounting reflects that the city currently procures 100% renewable electricity for all city operations. Details are provided in the report

[2] Lifecycle costing does not account for carbon prices. Details are provided in the report

Building Summary

The station features two above-ground levels (ground level and mezzanine) with a gross floor area of approximately 1,517 m², divided into three main sections: Living quarters and offices, Apparatus bays with higher ceilings, and Service spaces.

To achieve the required level of performance mandated by the Climate Resilient Policy, the design incorporates several measures that outperform the energy performance required by the NECB 2017 reference model, including:

1) Insulated brick wall with 175 mm of sprayed insulation to reduce thermal bridging and linear transmittance.

2) Insulated roof with R-50 Clearfield insulation

3) Triple-glazed windows with the effective thermal performance of U-1.1 W/m^2 (NFRC U-0.20) and SHGC of 0.39

4) Triple-glazed curtain wall with an effective thermal performance of U-1.42 W/m^2 (NFRC U-0.25) and SHGC of 0.39

5) KALWALL facade with the effective thermal performance of U-0.68 W/m^2 (NFRC U-0.12) and SHGC of 0.30

6) Steel doors with thermal performance of R-2.9 and overhead doors with effective R-12

7) Full insulated slab with R-20 insulation

8) LED lights to lower lighting power density by 25% compared to NECB 2017 values

9) Hydronic makeup air unit (MUA) serving the Apparatus Bay, equipped with a heat pipe heat exchanger with a minimum effectiveness of 60%

10) Dedicated Outside Air System (DOAS) with hydronic pre-heat, equipped with a heat recovery unit that has a minimum effectiveness of 90%, to serve the Administration and Dormitory areas

11) Variable speed pumps and fans

12) Variable Refrigerant Flow (VRF) heat pump connected to the ground loop, serving the admin area dormitories

13) Ground source heat pump (GSHP) system with an electrical supplemental boiler

14) A water-to-water heat pump to connect the hydronic loop with the ground loop.

15) Air-source heat pump domestic hot water system with minimum seasonal COP of 2.5

Energy Performance Analysis

Analysis Methodology

The Full Policy Station design must meet two performance targets, each with its own reference model and set of performance criteria:

1) Compliance with the C-627 Climate Resilient Policy: The design must demonstrate a minimum of 20% energy performance improvement against a reference model based on NECB 2017 prescriptive requirements and achieve a TEDI value of less than 80 kWh/m².

2) Compliance with the Alberta Building Code: The design must not exceed the annual energy consumption of a reference building based on NECB 2020 prescriptive requirements.

To model the performance, two Full Policy Station design models and two reference models were developed based on the following modeling guidelines:

1. Air Leakage Requirements:

- NECB 2017: Air leakage set to a constant value of 0.25 L/(s·m²) of total gross above-ground wall and roof areas.
- NECB 2020: Air leakage rate not greater than 1.50 L/(s·m²) of tested envelope area at 75 Pa pressure differentials, adjusted to air leakage rate at 5 Pa pressure differentials based on the above ground envelope area.

With the current building geometry, the NECB 2020 air leakage requirements resulted in a higher infiltration load, leading to increased heating demand.

2. Stringency of NECB 2020:

NECB 2020 is more stringent than NECB 2017 in aspects such as envelope performance, air leakage requirements, equipment efficiency, and lighting power.

The four energy models included in this study are as follows:

1) Full Policy Station Design (Current Design): Represents the proposed design following NECB 2020 energy modeling requirements. This model will be used in the Life Cycle Costing.

2) Full Policy Station Design - NECB 2017 (Policy-Adjusted Design) : Represents the proposed design adjusted to comply with NECB 2017 energy modeling requirements.

3) NECB 2020 (Current Code) Reference Model: Represents the reference model based on NECB 2020.

4) NECB 2017 Reference Model: Represents the reference model based on NECB 2017, used for policy requirements.

Energy Results

Tables 2 and 3 below summarize the performance of the Full Policy Design against NECB 2020 (for Alberta Building Code compliance) and the Policy-Adjusted Design against NECB 2017 (for Climate Resilient Policy compliance). The results does not account for renewable energy.

Table 2: Alberta Energy Code Compliance (NECB 2020)

Model	Electricity (kWh)	Natural Gas (ekWh)	Annual Energy (ekWh)	TEUI (ekWh/m²)	GHG Emissions (kg eCO2)	Code Compliant?
NECB 2020	504,882	0	504,882	277.5	0	-
Full Policy Design	272,033	0	272,033	149.5	0	YES
Savings	46.1%	N/A	**46.1%**	46.1%	N/A	**-**

Table 3: Full Policy Design vs Climate Policy Compliance (NECB 2017 & TEDI)

Model	Electricity (kWh)	Natural Gas (ekWh)	Annual Energy (ekWh)	TEUI (ekWh/m²)	TEDI (kWh/m²)	C-627 Compliant?
NECB 2017	384,475	0	384,475	211.3	135.5	-
Full Policy Design - NECB 2017	200,148	0	200,148	110.0	**79.8**	YES
Savings	47.9%	N/A	47.9%	**47.9%**	41.1%	

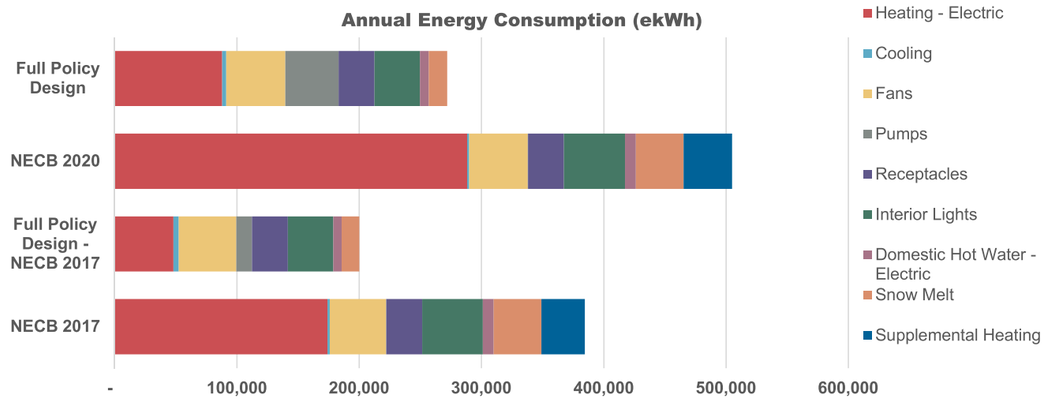
The energy modeling results in Table 2 indicate that the proposed design meets the Alberta Building Code, achieving a **46.1%** reduction in energy consumption compared to the NECB 2020 reference.

In addition, the results in Table 3 show that the building is expected to comply with the Climate Resilient Policy by achieving **47.9%** reduction in energy consumption compared to the **NECB 2017** reference building and attaining a **TEDI** value of **79.8 kWh/m².**

The results in Table 2 show that the design performs better in comparison to NECB 2017 than against NECB 2020 (Table 2), NECB 2020 is more stringent.

The energy modeling results are derived from the information provided by the design team, along with reasonable assumptions made in the absence of specific details at this design stage. The inputs and assumptions for the energy modeling are summarized in Appendix A.

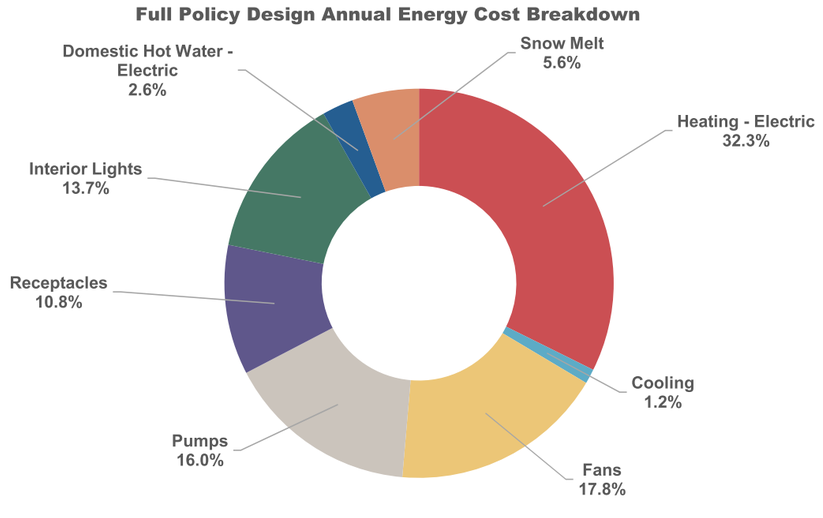
The tables show that there are no GHG emissions from the building. This is due to the City of Edmonton's procurement of 100% renewable electricity for city operations starting in 2024, resulting in a net zero electricity emissions[1].

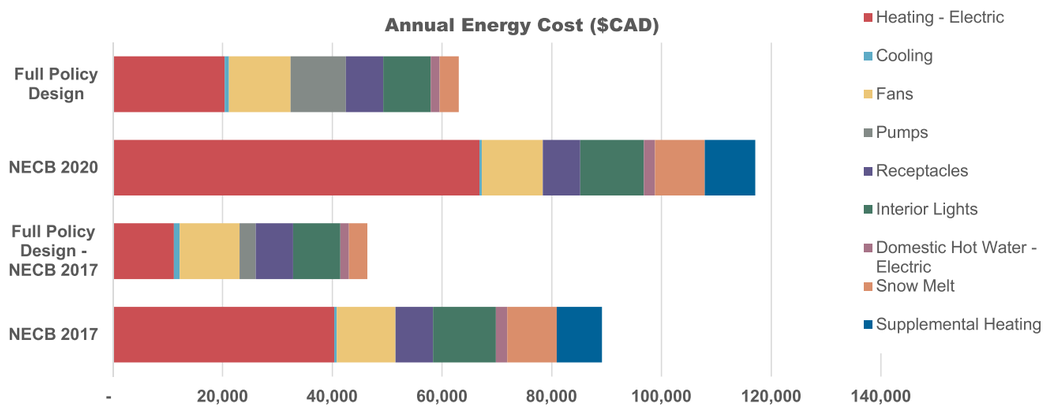


[1] The City of Edmonton's green energy purchase agreement does not extend to cover the full 25 years considered in the life cycle analysis, but only 20 years. For the purpose of this analysis, zero emissions were considered for the full 25 years.

Energy Cost Analysis

The chart below presents the distribution of energy costs by end use. Since the building utilizes only one source of energy (electricity), the energy cost breakdown matches the energy use breakdown.





*Energy costs do not reflect the impact of renewable energy

Renewable Energy System

The Climate Resilience Policy requires that at least 1% of the total capital project budget for newly designed and constructed City-Owned, Occupied Buildings be dedicated to incorporating on-site renewable or alternative energy generation systems.

Solar photovoltaic (PV) systems were chosen as the on-site renewable energy solution for several reasons:

1) Ease of design and installation

2) PV systems are highly efficient in converting sunlight into electricity

3) The Full Policy Station operates entirely on electricity, allowing it to directly consume all energy produced by its on-site PV system, thereby lowering reliance on external power sources.

4) Higher electricity rates make the PV system financially viable, reducing overall annual energy costs.

The total capital budget for the Full Policy Station is estimated at $21.04 million. Based on this, the allocated budget for the PV system is $210,393. With an estimated PV system capital cost of $3.5 per watt, the budget allows for a PV system with a rated capacity of 60 kW.

The size of the system, number of panels, and annual yield will vary depending on the system design. For the purpose of this study, a high-level analysis was conducted to predict the system performance based on the following assumptions:

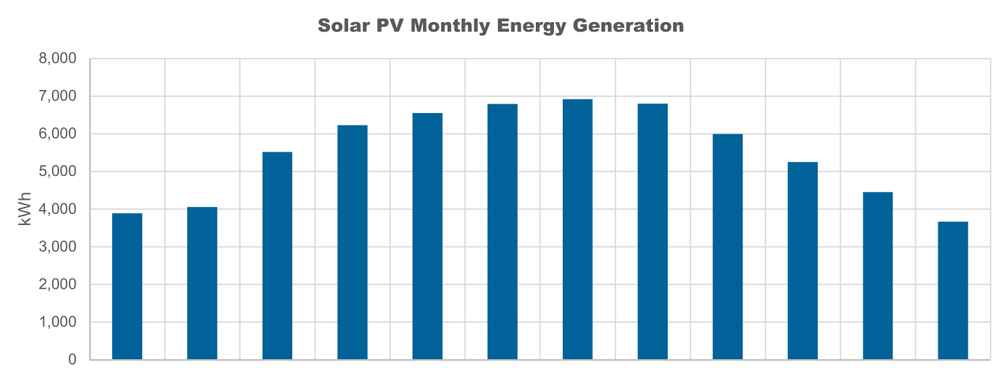
- The most convenient way to mount PV panels is utilizing ballasted fixed racks. Conventional fixed 25° tilt roof mounted PV system was considered for the proposed PV system installation. The maximum annual energy output is anticipated to be achieved at 53° tilt angle (tilt angle equal to the location's latitude), however a 25° tilt angle was selected for the analysis as it provides the best compromise among a reasonable wind load, snow load and row-to-row spacing to reduce the shading losses.
- This analysis did not account for the potential energy generation from installing tracking PV system or Concentrating PV system using spectroscopically selective reflector.
- Based on the selected module in Appendix A, a total photovoltaic (PV) panel area of 280 m² can be installed. It is estimated that 54 kW of capacity can be accommodated on the lower roof and above the service roof. The conventional installation method involves arranging each row as a single line of tilted panels (one panel high) with spacing to prevent self-shading. Additionally, the remaining panels, totaling 6 kW, will need to be installed as a ground-mounted system.
- According to Natural Resources Canada (NRCan), the PV system in Edmonton is expected to have a peak annual yield of 1,181 kWh/kW. For this analysis, we used an annual yield of 1,100 kWh/kW based on PVWatts simulation, which includes additional connection and snow losses.

Based on the above analysis, the system is estimated to generate approximately **66,000 kWh annually**. The life cycle costing has accounted for an annual degradation rate of 0.5% in energy generation.

Tables 4 below summarize the performance of the Full Policy Design Station (based on NECB 2020) with Renewable energy.

Table 4: Full Policy Design Station Performance with Renewable

Model	System Name Plate Power (kW)	PV Annual Yield (kWh)	Annual Energy before Renewable (ekWh)	Annual Energy with Renewable (ekWh)	TEUI with Renewable (ekWh/m²)	Renewable Energy Percentage (%)
Full Policy Design with PV System	60.0	66,000	272,033	206,033	113.2	24.3%



Life Cycle Costing

This section presents the results of a comprehensive life cycle cost analysis conducted over a 25-year period, utilizing the present value methodology. The analysis encompasses various cost factors, including energy expenses, maintenance costs, and equipment/system replacement costs as provided by the design team. Additionally, utility costs, and utility escalation rates are derived from the City of Edmonton's climate-resilient technical specifications, as summarized in Appendix A.

This analysis reflects the Government of Canada's order to eliminate the Consumer Carbon Price, amending Schedule 2 of the Greenhouse Gas Pollution Pricing Act (GGPPA) to set the fuel charge rates to zero after March 31, 2025. This approach was selected to align with the current regulation, which is not captured by the City of Edmonton's climate-resilient technical specifications. Another analysis scenario, provided in the Appendix C, incorporates the impact of the carbon tax.

Table 5 provides an overview of the project's life cycle costs, including capital, maintenance, and utility costs. It also reports the total life cycle cost, offering a clear summary of the project's financial implications. Detailed life cycle costing is provided in Appendix B.

Table 5: Life Cycle Cost Analysis Summary - Present Value

Model	Capital Investment	Replacement Costs [1]	Maintenance Costs	Electricity Costs [2]	Natural Gas Costs	Total Costs
Full Policy Design	21,039,300	4,420,597	201,171	964,944	0	26,626,012

[1] Design/estimating, and construction contingencies included

[2] Energy costs reflect the impact of renewable energy

Responsibilities

Appendix A summarizes the detailed model inputs. It is the responsibility of the design team to review the detailed inputs and confirm that the input summary is accurate and alert Footprint to any discrepancies.

The architect, mechanical engineer and electrical engineer must ensure that the building design meets the applicable mandatory requirements. Mandatory requirement checklists will be provided for signature as part of the Code Compliance Submission package.

Limitations

Building energy simulation is a way of comparing building design efficiency measures (comparative analysis) and does not predict future energy bills or absolute energy consumption with accuracy. Energy modelling is intended to analyze “regulated” energy loads and generally doesn’t accurately evaluate many other loads within buildings including process exhaust, elevator etc. Energy modelling makes assumptions for building occupancy and occupant behavior, operational and maintenance practices, schedules, air leakage and plug load which can substantially impact energy consumption.

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APPENDIX A - Model Input Summary

Project Title:	Fire Station - Full Policy Design
Project Number:	25172-002-000
Date:	2025-05-13
Location:	Edmonton, Alberta
Climate Zone:	NECB 7a - HDD18 5120
Schedules:	NECB 2020 'G'
Purpose of Model:	Design Assistance
Compliance Path:	NECB 2017/ 2020
Software:	eQuest 3.65
Weather File:	Edmonton - CWEC 2020

Building Modeled GFA

Modelled Area:	1,517 m²
Total Floors:	1
Above Grade:	1
Below Grade:	0

Envelope	Proposed Building Design	Reference Building Design	Source / Notes
Exterior Walls	Brick wall with 175 mm of sprayed insulation Clearfield: R-40 **Effective: R-33.9** Overall performance after accounting for linear transmittance	NECB 2017 Prescriptive Value Effective: R-27.0 NECB 2020 Prescriptive Value Effective: R-26.4	Architectural Information Linear transmittance from the Building Envelope Thermal Bridging Guide (BETBG)
Exterior Roof	Clearfield: R-50 Effective: R-41 Overall performance after accounting for linear transmittance	NECB 2017 Prescriptive value Effective: R-41.2 NECB 2020 Prescriptive value Effective: R-46.9	Architectural Information Linear transmittance from the Building Envelope Thermal Bridging Guide (BETBG)
Slab-on-Grade	R-20 fully insulated slab F-0.261	NECB 2017 and 2020 Prescriptive Value Climate Zone 7A - R-7.5 for 48" Effective: F-0.65	Architectural Information
Opaque Doors	Swing Doors Double-skinned metal door c/w polyurethane core Effective: U-0.335	NECB 2017 and 2020 Prescriptive Value Climate Zone 7A Effective: U-0.33	Architectural Information
Opaque Doors	Roll-Up Doors Segmented metal door c/w polyurethane core Effective: R-12 (U-0.083)	NECB 2017 and 2020 Prescriptive Value Climate Zone 7A Effective: U-0.33	Architectural Information
Glazing System	Windows Triple Glazed c/w thermally broken framing Effective (NFRC): U-0.20, SHGC 0.40	NECB 2017 Prescriptive Value Effective: U-0.33, SHGC 0.40 NECB 2020 Prescriptive Value Effective: U-0.305, SHGC 0.40	Architectural Information
Glazing System	Curtain Walls Triple Glazed c/w thermally broken framing Effective (NFRC): U-0.25, SHGC 0.40	NECB 2017 Prescriptive Value Effective: U-0.33, SHGC 0.40 NECB 2020 Prescriptive Value Effective: U-0.305, SHGC 0.40	Architectural Information

Envelope	Proposed Building Design	Reference Building Design	Source
Glazing System	**KALWALL** Triple Glazed c/w thermally broken framing Effective (NFRC): U-0.12, SHGC 0.30	NECB 2017 Prescriptive Value Effective: U-0.33, SHGC 0.30 NECB 2020 Prescriptive Value Effective: U-0.305, SHGC 0.30	Architectural Information Per NECB fenestration means all building envelope assemblies that transfer visible light
Penetration Ratios	Window to Wall: 28.7% Window & Door to Wall: 36.18%	Window & Door to Wall: 32.5%	Elevation drawings The KALWALL system has led to an increased windows-to-wall ratio, which representing the majority of the FWDR
Infiltration Rate	**NECB 2017** 0.25 Lps/m² (0.049 cfm/ft²) of above grade wall and roof area **NECB 2020** 1.5 Lps/m² (0.295 cfm/ft²) of tested envelope area @ 75 Pa *approx. 0.937 Lps/m² (0.184 cfm/ft^2) of above ground wall area @ 5 Pa*	As Proposed	Per the NECB 2017 and NECB 2020

Lighting	Proposed Building Design	Reference Building Design	Source / Notes
Interior (Whole Building)	**LED Lighting Fixtures** Total: 11.8 kW Average: 0.60 W/ft²	NECB 2017 Prescriptive Values Total: 14.5 kW Average: 0.74 W/ft² NECB 2020 Prescriptive Values Total: 15.6 kW Average: 0.80 W/ft²	Assumption

HVAC	Proposed Building Design	Reference Building Design	Source / Notes
Apparatus Bay	**Rooftop MUAs c/w Exhaust Fans** Hydronic heating connected to the ground loop through the water to water heat pump Supply Air Temperature: 18°C (64.4°F) Supply Fan: 4,700 cfm (0.75 cfm/ft^2) @ 0.972 W/cfm Exhaust Fan: 4,700 cfm @ 0.648 W/cfm CO/NOx controlled Estimated to operate total 4 hours per day Heat pipe heat exchanger that has a minimum effectiveness of 60% Space Setpoint 18°C (64.4°F) **Zonal Heat: hydronic unit heaters connected to the ground loop through the water to water heat pump** **6 x 62,000 btu/hr**	**NECB System Type #4 modelled as Packaged unitary rooftop heat pump** Air Source Heat Pump with Electric Auxiliary Heating Supply Fan: 4,700 cfm (0.75 cfm/ft^2) Fan power: as proposed Exhaust Fan: 4,700 cfm @ 0.648 W/cfm CO/NOx controlled Heat Recovery: None **Zonal Reheat: Electric Baseboards**	Mechanical design brief The space heating setpoint is 18°C (64.4°F), in accordance with the City of Edmonton's requirements. The thermostat will be installed 15 feet above the floor level. The conditioned space, where thermal comfort is maintained by the unit heaters, will extend up to this height.

HVAC	Proposed Building Design	Reference Building Design	Source / Notes
Fire Hall Offices, Classroom, Dormitory, Corridors…etc.	**Dedicated Outside Air System (DOAS)** Hydronic heating connected to the ground loop through the water to water heat pump Supply Fan: 1,194 cfm @ 0.91 W/cfm with VSD Return Fan: 0.607 W/cfm with VSD Ventilation Air: 1,194 cfm **Air Side Heat Recovery** Sensible Effectiveness: 90% Latent Effectiveness: 85% **Zonal Reheat: Heat Pump Units** Variable Refrigerant Flow (VRF) Heat Pump in the zones that cycle to maintain the space temperature. Connected to the ground loop through the water to water heat pump HP Supply Fan: 0.30 W/cfm Cooling EER 13.2 (per NECB 2020) Heating COP 3.1 (per NECB 2020)	**NECB System Type #3 - System per Zone** Constant Volume Packaged Unitary Rooftop Heat Pump with Electric Auxiliary Heating HP low-temperature cut-off −10°C (14°F) Air Source Heat Pump DX Cooling - Varies (EER 12.5) Heating COP-3.2 Total Air Flow: Varies Supply Fan: same as proposed Ventilation Air: same as proposed Heat Recovery: 50% Effectiveness	Mechanical design brief Reference total fan power modelled same as specified in the proposed design per Article 8.4.4.18 (5), where the total fan power is less than 10 kW
Kitchen MUA	**Hydronic MUA and exhaust hood** Hydronic heating connected to the ground loop through the water to water heat pump Supply Air Temperature: 21.1°C (70°F) Supply Fan: 0.7 W/cfm Exhaust: 656 cfm Estimated to operate total 2 hours per day	**NECB System Type #3 - System per Zone** **Constant Volume Packaged Unitary Rooftop** Supply Air Temperature: 21.1°C (70°F) HP low-temperature cut-off −10°C (14°F) Heating COP-3.2 Supply Fan: 0.7 W/cfm Exhaust: 656 cfm Estimated to operate total 2 hours per day	Mechanical design brief
Mechanical & Electrical Rooms	**Hydronic Unit Heaters** Hydronic heating connected to the ground loop through the water to water heat pump Fan Power: 0.07 W/cfm (0.05 HP) cycles to maintain space temperature	Electric Unit Heaters	Mechanical design brief

Central Plant	Proposed Building Design	Reference Building Design	Source / Notes
Hot Water	Electric Boilers Only provides supplemental heating 2 x 313 MBH Distribution Pumps 21 W/gpm with VSD speed	1 × Electric Boiler Distribution Pumps Hot Water: 21 W/gpm single speed	Mechanical design brief
Water Source Heat Pump	2 x 175 kW COP 4.7 Water to Water Heat Pump Distribution Pumps 21 W/gpm with VSD speed	N/A	Mechanical design concept
Ground Loop Heat Pump	Vertical well 49 holes at 229.7 ft Effective length and 24.6 ft spacing Fluid: propylene glycol at 30% anti-freeze concentration Grout conductivity: 0.9 Btu/h-ft.°F Variable Speed Pump Circulation 21 W/gpm with VSD speed	N/A	Mechanical design brief

Central Plant	Proposed Building Design	Reference Building Design	Source / Notes
Domestic Hot Water	Air Source Heat Pump Heater COP-2.5 Output Temperature: 140°F	Air Source Heat Pump Heater COP-2.1 Output Temperature: 140°F	Mechanical design brief

Process Loads	Proposed Building Design	Reference Building Design	Source / Notes
Domestic Hot Water Flow	Modelled Peak 0.084 gpm	As Proposed	NECB 2017 and 2020
General Receptacle Loads	Total 9.5 kW Average: 0.48 W/ft²	As Proposed	NECB 2017 and 2020
Snow Melt	Connected to the water loop 700 ft^2 (35 kW capacity) Operates for three hours after snow fall event and when outside air temp is below 32°F	As Proposed	Mechanical design brief

Renewable	Proposed Building Design	Reference Building Design	Source / Notes
Solar Photovoltaic	Total Rated Capacity: 60 kW Estimated Tilt Angle: 25° Estimated Yield: 1,100 kWh/kW Selected Moudule Output: 213.8 W/m^2 Selected Module Area: 2.83 m^2 Module Annual Degradation: 0.5% DC to AC Ratio: 1.15	N/A	Assumption According to the C627 Climate Resilience Policy, 1% of the total capital project budget is allocated to support the incorporation of on-site renewable energy. The estimated capital cost is $3.5 per Watt.

Utilities	Proposed Building Design	Reference Building Design	Source / Notes
Electricity	Energy-Only Electricity Prices: $0.12/ kWh Distribution, demand, rate riders and other non-energy costs: $0.119/ kWh **Total Energy Charge for 2025: $0.239 per kWh**	As Proposed	Climate Resilience Technical Specfications
Natural Gas	Energy-Only Natural Gas Prices:$3.84/GJ Distribution cost: $2.16/GJ **Total Energy Charge for 2025: $6.01/GJ**	As Proposed	Climate Resilience Technical Specfications Natural gas prices do not include the Carbon Tax, reflecting the Government of Canada's order to eliminate the Consumer Carbon Price.

GHG Factors	Proposed Building Design	Reference Building Design	Source / Notes
Electricity	0.0 $kgCO_{2e}$/kWh starting from 2025	As Proposed	Climate Resilience Technical Specfications
Natural Gas	0.053 tCO_{2e}/GJ (0.1908 $kgCO_{2e}$/ekWh) Anticipated to remain constant	As Proposed	Climate Resilience Technical Specfications

Financial Inputs	Proposed Building Design	Reference Building Design	Source / Notes
Electricity	Energy-Only Electricity Prices 2025 - 2028: $0.12/ kWh 2029 - 2033: $0.14/ kWh 2034 - 2034: $0.18/ kWh 2035 - 2037: $0.20/ kWh After 2037: apply an escalation rate of 2% Demand, rate riders and other non-energy costs: escalation rate of 2%	N/A	Climate Resilience Technical Specfications

Financial Inputs	Proposed Building Design	Reference Building Design	Source / Notes
Natural Gas	Energy-Only Natural Gas Prices: 2025: $3.84/GJ 2026: $4.05/GJ 2027: $4.16/GJ 2028: $4.37/GJ 2029: $4.48/GJ 2030: $4.56/GJ 2031: $4.65/GJ 2032: $4.75/GJ 2033: $4.85/GJ 2034: $4.94/GJ 2035: $5.04/GJ 2036: $5.14/GJ 2037: $5.25/GJ After 2037: apply an escalation rate of 2% Demand and other non-energy costs: escalation rate of 2%	N/A	Climate Resilience Technical Specfications
Carbon Price	2025: $95/tonne CO2e 2026: $110/tonne CO2e 2027: $125/tonne CO2e 2028: $140/tonne CO2e 2029: $155/tonne CO2e 2030: $170/tonne CO2e There are no carbon pricing increases announced after 2030.The price remains a constant $170 per tonne CO2e.	N/A	Climate Resilience Technical Specfications
Discount Rate	5.18%	N/A	Climate Resilience Technical Specfications Based on the average 30-year borrowing rates from the Alberta Capital Finance Authority (ACFA) over the last 12 months
Maintenance Cost	Admin Area: $0.74/$ft^2$ Service Area: $0.56/$ft^2$ 3% general inflation	N/A	Estimated based on the ASHRAE Owning and Operating Cost Database

APPENDIX B - Detailed Life Cycle Costing and GHG

Table B1: Detailed Life Cycle Cost Analysis Summary - Without Accounting for Carbon Tax

Year	Capital Investment	Replacement Costs	Maintenance Costs	Solar PV Costs	Electicity Costs	Natural Gas Costs	Carbon Tax Costs	Total Costs	Electricity GHG Emissions $kgCO_{2e}$/kWh	Natural Gas GHG Emissions $kgCO_{2e}$/kWh	Net GHG Emissions $kgCO_{2e}$/kWh
Year 0	21,039,300	0	0	0	0	0	0	21,039,300	0	0	0
Year 1	0	0	10,229	-15,460	63,721	0	0	58,490	0	0	0
Year 2	0	0	10,536	-15,533	64,343	0	0	59,346	0	0	0
Year 3	0	0	10,852	-15,607	64,977	0	0	60,221	0	0	0
Year 4	0	0	11,178	-16,984	71,064	0	0	65,257	0	0	0
Year 5	0	0	11,513	-17,056	71,723	0	0	66,180	0	0	0
Year 6	0	0	11,858	-17,130	72,396	0	0	67,125	0	0	0
Year 7	0	0	12,214	-17,206	73,082	0	0	68,091	0	0	0
Year 8	0	0	12,580	-17,284	73,782	0	0	69,079	0	0	0
Year 9	0	0	12,958	-19,900	85,378	0	0	78,436	0	0	0
Year 10	0	321,041	13,347	-21,231	91,547	0	0	404,703	0	0	0
Year 11	0	0	13,747	-21,296	92,289	0	0	84,740	0	0	0
Year 12	0	179,631	14,159	-21,364	93,047	0	0	265,473	0	0	0
Year 13	0	0	14,584	-21,682	94,908	0	0	87,810	0	0	0
Year 14	0	0	15,022	-22,005	96,806	0	0	89,823	0	0	0
Year 15	0	1,489,755	15,472	-22,333	98,742	0	0	1,581,636	0	0	0
Year 16	0	0	15,936	-22,666	100,717	0	0	93,988	0	0	0
Year 17	0	0	16,415	-23,004	102,732	0	0	96,143	0	0	0
Year 18	0	713,287	16,907	-23,346	104,786	0	0	811,634	0	0	0
Year 19	0	0	17,414	-23,694	106,882	0	0	100,602	0	0	0
Year 20	0	5,691,654	17,937	-24,047	109,019	0	0	5,794,563	0	0	0
Year 21	0	0	18,475	-24,406	111,200	0	0	105,269	0	0	0
Year 22	0	727,791	19,029	-24,769	113,424	0	0	835,474	0	0	0
Year 23	0	823,548	19,600	-25,138	115,692	0	0	933,702	0	0	0
Year 24	0	244,427	20,188	-25,513	118,006	0	0	357,108	0	0	0
Year 25	0	998,015	20,793	-25,893	120,366	0	0	1,113,282	0	0	0
Total Costs*	21,039,300	11,189,148	372,943	-524,546	2,310,631	0	0	34,387,476	0	0	0
Present Value**	**21,039,300**	**4,420,597**	**201,171**	**-288,107**	**1,253,051**	**0**	**0**	**26,626,012**	**N/A**	**N/A**	**N/A**

*Total costs include all expenses over the life cycle, accounting for inflation and escalation costs, but not discounted.

**Present value represents the total cost discounted to the base year (2025).

APPENDIX B - Detailed Life Cycle Costing and GHG

Table B1: Detailed Life Cycle Cost Analysis Summary - Without Accounting for Carbon Tax

Year	Capital Investment	Replacement Costs	Maintenance Costs	Solar PV Costs	Electicity Costs	Natural Gas Costs	Carbon Tax Costs	Total Costs	Electricity GHG Emissions $kgCO_{2e}$/kWh	Natural Gas GHG Emissions $kgCO_{2e}$/kWh	Net GHG Emissions $kgCO_{2e}$/kWh
Year 0	21,039,300	0	0	0	0	0	0	21,039,300	0	0	0
Year 1	0	0	10,229	-15,460	63,721	0	0	58,490	0	0	0
Year 2	0	0	10,536	-15,533	64,343	0	0	59,346	0	0	0
Year 3	0	0	10,852	-15,607	64,977	0	0	60,221	0	0	0
Year 4	0	0	11,178	-16,984	71,064	0	0	65,257	0	0	0
Year 5	0	0	11,513	-17,056	71,723	0	0	66,180	0	0	0
Year 6	0	0	11,858	-17,130	72,396	0	0	67,125	0	0	0
Year 7	0	0	12,214	-17,206	73,082	0	0	68,091	0	0	0
Year 8	0	0	12,580	-17,284	73,782	0	0	69,079	0	0	0
Year 9	0	0	12,958	-19,900	85,378	0	0	78,436	0	0	0
Year 10	0	321,041	13,347	-21,231	91,547	0	0	404,703	0	0	0
Year 11	0	0	13,747	-21,296	92,289	0	0	84,740	0	0	0
Year 12	0	179,631	14,159	-21,364	93,047	0	0	265,473	0	0	0
Year 13	0	0	14,584	-21,682	94,908	0	0	87,810	0	0	0
Year 14	0	0	15,022	-22,005	96,806	0	0	89,823	0	0	0
Year 15	0	1,489,755	15,472	-22,333	98,742	0	0	1,581,636	0	0	0
Year 16	0	0	15,936	-22,666	100,717	0	0	93,988	0	0	0
Year 17	0	0	16,415	-23,004	102,732	0	0	96,143	0	0	0
Year 18	0	713,287	16,907	-23,346	104,786	0	0	811,634	0	0	0
Year 19	0	0	17,414	-23,694	106,882	0	0	100,602	0	0	0
Year 20	0	5,691,654	17,937	-24,047	109,019	0	0	5,794,563	0	0	0
Year 21	0	0	18,475	-24,406	111,200	0	0	105,269	0	0	0
Year 22	0	727,791	19,029	-24,769	113,424	0	0	835,474	0	0	0
Year 23	0	823,548	19,600	-25,138	115,692	0	0	933,702	0	0	0
Year 24	0	244,427	20,188	-25,513	118,006	0	0	357,108	0	0	0
Year 25	0	998,015	20,793	-25,893	120,366	0	0	1,113,282	0	0	0
Total Costs*	21,039,300	11,189,148	372,943	-524,546	2,310,631	0	0	34,387,476	0	0	0
Present Value**	**21,039,300**	**4,420,597**	**201,171**	**-288,107**	**1,253,051**	**0**	**0**	**26,626,012**	**N/A**	**N/A**	**N/A**

*Total costs include all expenses over the life cycle, accounting for inflation and escalation costs, but not discounted.

**Present value represents the total cost discounted to the base year (2025).

APPENDIX D - Thermal Bridging Calculation Full Policy Station Design

Effective Overall Walls Performance

Project	Wall ID	Net Area	U-Ualue	R-Value
Full Policy Design	W1	18,584.4 ft²	0.029 btuh/ft²·°F	33.93 ft²·°F/btuh

Clear Field

Description	Included?	Net Area	Transmittance	Heat Flow		Source
All Walls	Y	18,584.4 ft²	0.025 btuh/ft²·°F	463.8 btuh/°F	84.7%	5.1.153
	N	- ft²	0.025 btuh/ft²·°F	- btuh/°F	0.0%	5.1.153
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	

Linear Interfaces

Description	Included?	Length	Transmittance	Heat Flow		Source
At Grade Slab Trans.	Y	660.9 ft	0.012 btuh/ft·°F	7.9 btuh/°F	1.4%	5.2.15
Floor Edge Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Floor Penat. Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Roof Transition	N	1,029.9 ft	0.073 btuh/ft·°F	- btuh/°F	0.0%	7.5.12
Glazing Trans.	Y	805.9 ft	0.069 btuh/ft·°F	56.0 btuh/°F	10.2%	7.3.15
Door Trans.	Y	538.9 ft	0.033 btuh/ft·°F	17.7 btuh/°F	3.2%	5.3.9
Balcony Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Outside Corners	Y	238.6 ft	0.009 btuh/ft·°F	2.2 btuh/°F	0.4%	5.6.1

Point Interfaces

Description	Included?	Quantity	Transmittance	Heat Flow		Source
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	

Effective Overall Roof Performance

Project	Wall ID	Net Area	U-Ualue	R-Value
Full Policy Design	R1	17,201.0 ft²	0.024 btuh/ft²·°F	40.99 ft²·°F/btuh

Clear Field

Description	Included?	Net Area	Transmittance	Heat Flow		Source
Roof	Y	17,201.0 ft²	0.020 btuh/ft²·°F	344.0 btuh/°F	82.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	
	N	ft²	btuh/ft²·°F	- btuh/°F	0.0%	

Linear Interfaces

Description	Included?	Length	Transmittance	Heat Flow		Source
At Grade Slab Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Floor Edge Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Floor Penat. Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Roof Transition	Y	1,029.9 ft	0.073 btuh/ft·°F	75.6 btuh/°F	18.0%	7.5.12
Glazing Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Door Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Balcony Trans.	N	ft	btuh/ft·°F	- btuh/°F	0.0%	
Outside Corners	N	ft	btuh/ft·°F	- btuh/°F	0.0%	

Point Interfaces

Description	Included?	Quantity	Transmittance	Heat Flow		Source
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	
	N	#	btuh/#·°F	- btuh/°F	0.0%	

4.0 | Comparative Analysis

Codes, Regulations and Policy Applicability Comparison

Codes, Bylaws and Regulations are, in varying degrees, applicable to every building. In the following table, we highlight the key ones as they would apply. The following lists many of the more impactful.

This table looks at each policy, code, guideline, etc. and indicates whether it is required (mandatory) or not required for each of the Basic Civic Station design and the Full Policy Station design.

Reg. / Code	Policy Name	Policy Purpose	Applicability to Basic Civic Station Design	Applicability to Full Policy Station Design
NBC-AE 2020	National Building Code - Alberta Edition	Building Code sets regulations and standards that govern the design, construction, alteration, and maintenance of buildings	Mandatory	Mandatory
NECB -2020	National Energy Code for Buildings - 2020	Regulation mandating minimum energy performance for buildings.	Mandatory	Mandatory
NECB - 2017	National Energy Code for Buildings - 2017	Regulation from 2017 mandating minimum energy performance for buildings (superseded by NECB - 2020 and referenced here only because Policy C627 references it)	N/A	Mandatory as amended by other City of Edmonton policies (20%> NECB 2017)
NFC-(AE) 2020	National Fire Code- Alberta Edition	Regulates fire prevention, protection systems, emergency planning, use of combustible materials, fire exits, and sprinkler systems.	Mandatory	Mandatory
Bylaw 20673	Edmonton Design Committee (EDC)	Review and recommendation process for Development Permit Applications	A version of EDC exists in most municipalities although it is frequently Council or a Committee of the Whole	Mandatory
Zoning 20001	Zoning and Land Use Bylaws	The City of Edmonton | Zoning Bylaw 20001 passed by Council on October 23, 2023, effective January 1, 2024.	For the purposes of this report, requirements apply	For the purposes of this report, requirements apply
Others	Many various Codes and Regulations	There are many other standard regulations and codes to follow (NFPA / Electrical / Permits / etc.)	Mandatory	Mandatory
C627A	Climate Resilience	Governance to achieve climate resilient communities and demonstrate The City's commitment to climate leadership.	N/A	Mandatory
C591	Capital Project Governance	Framework to guide management of the City's capital projects including project development and delivery.	N/A	Mandatory
C598A	Infrastructure Asset Management	Framework to realize value from both new and existing assets.	N/A	Mandatory
C602	Accessibility for People with Disabilities	Guide the City's policies and services to consider the diverse needs of individuals to ensure people with disabilities are treated with respect and equity.	N/A	Mandatory
C587A	Enterprise Risk Management	Prioritize actions to reduce risk impacts and elevate opportunities to reach corporate goals, objectives, strategy and service commitments.	N/A	Mandatory

Reg. / Code	Policy Name	Policy Purpose	Applicability to Basic Civic Station Design	Applicability to Full Policy Station Design
C588	Winter Design	New developments to achieve the outcomes, and vision of Edmonton as global model for winter city living and cold-weather design.	N/A	Mandatory
C556C	Sustainable Procurement	Ensure the City of Edmonton's procurement practices are open, fair and transparent and contribute to building and maintaining a healthy, prosperous and climate-resilient community.	N/A	Mandatory
C458E	Public Art to Enhance Edmonton's Public Realm	Public art in support of the local economy and helps build an attractive, healthy and thriving city.	N/A	Mandatory
C523A	Fire Rescue Service Delivery	Alignment with Council, legislation, standards, best practice, and international accreditation. Reflect fire rescue services, partners, and the general public.	N/A	Mandatory
C512	Environmental Policy (ENVISO)	Environmental considerations w/ guiding principles of: • Quality Of Life (healthy, sustainable environment) • Shared Responsibility (preservation of nature) • Decision-Making Model (environment into decisions) • Protection of the Natural Environment • Intergenerational Equality (minimize environmental impacts on future generations) • Public Awareness (leadership's increasing awareness of environmental issues) • Citizen Consultation and Decision Making	N/A	Mandatory
A1117D	OHS (Operational Health and Safety)	Sets workplace safety standards during construction. Implementation of OH&S Guidelines and Standards	Mandatory - provincially, not municipally	Mandatory
A1206 EAF	Financial Administration and Control Expenditure Accountability Framework	Prescriptions, descriptions, roles, and limits of those involved in approving project financials	Variations always exist - some faster and some slower than the City of Edmonton. For the purposes of this report, they will be assumed to be equal	Mandatory
A1205	Contract Administration	Processes for construction administration	N/A	Mandatory
A1448	Public Involvement	Processes for public consultation for public projects	Often an informal process is encouraged	Mandatory

Reg. / Code	Policy Name	Policy Purpose	Applicability to Basic Civic Station Design	Applicability to Full Policy Station Design
	Procurement Standards	Processes for Procurement	Variations always exist. For the purposes of this report, they will be assumed to be equal	Mandatory
	Design Standards and Construction Standards	Access / Commissioning / Consultant Manual / etc. (36 in total Standards' Manuals)	N/A except for versions of road, and procurement req'ts	Mandatory
	Project Management for Capital Projects	Processes for Project Management, roles, and limits.	Typical project management standards would apply	Mandatory
	City Contract Terms and Conditions		Typically a standard RAIC Doc 6 or similar	Mandatory
	Insurance and Bonding Requirements		Typically as provided by the Architect / Engineers	Mandatory
	Owner Performance Expectations (scope, schedule, budget)		Typically as described in the contract and typically based on "Standard Duty of Care"	Mandatory
	Low Impact development (LID)	Provides guidelines on five types of LID features including bioretention, bioswale, box planter, naturalized drainage way, and permeable pavement.	N/A	Mandatory

This table names and describes each policy, guideline, standard and other references used by the City of Edmonton.

Policy Descriptions and Impact on Design / Construction

Reg. / Code	Policy Name	Policy Purpose
C573A	**Complete Streets (Non-Applicable to this study)**	
	Policy Purpose	• Acknowledge that the design of all streets will reflect the characteristics of the area and all users (cyclists, pedestrians, truck drivers, auto drivers, young and old citizens and people who have mobility challenges) of the roadway and that an integrated, connected network approach is needed to serve all modes.
	Policy Description	• Streets that reflect the surrounding area, are safe and welcoming to all users are important for the quality of life, competitiveness and growth of our city.

	Policy Goals	• Provide travel options for all users and trip purposes in a safe, accessible, context sensitive manner in all seasons;
		• Form a network of streets that together accommodate all users and allow for efficient and high quality travel experiences;
		• Be adaptable by accommodating the needs of the present and future through effective space allocation for the many functions of the street;
		• Contribute to the environmental sustainability and resiliency of the city;
		  • Consider both direct and indirect costs, as well as the value of the roadway and the adjacent real estate; and
		  • Be vibrant and attractive people places in all seasons that contribute to an improved quality of life.

	Policy Requirements	• Utilize the principles of Complete Streets in all new and rehabilitation projects that take place on public road right-of-way.
	Impacts to Design / Construction	• Ellerslie RD SW is the southern boundary of Ambleside NSP, with a road classification of arterial. No impact on design.
C627A	**Climate Resilience (Applicable to this study)**	
	Policy Purpose	Provide clear and consistent governance and accountabilities for achieving a climate resilient community, and to demonstrate to Edmonton's citizens, businesses, and community and industry partners the City of Edmonton's commitment to climate solution leadership in all aspects of city planning, development and business decisions.
	Policy Description	The City of Edmonton, through its planning, services, decision-making processes and leadership ensures, promotes and supports a climate resilient community with clean air and water; and natural and built environments that sustain long-term health and prosperity.
	Policy Goals or Commitments	• Act to reduce emissions by 35% by 2025, 50% by 2030 and be a carbon neutral community by 2050 through Energy Transition to help limit global warming to 1.5 degrees Celsius • Act to adapt, prepare for and respond to a changing climate • Lead climate solutions in service delivery and corporate management.
	Policy Requirements	Utilize the Climate Resilient Design and Construction of City Buildings Procedure for the design and construction of new City Owned, Occupied Buildings greater than 600 square metres; and additions to City Owned, Occupied Buildings greater than 600 square metres initiated after the approval of this procedure.

	Impacts to Design / Construction	• Design and construct an Emission Neutral, climate ready building owned by City of Edmonton. • Corporate climate resilience management plan for buildings, immediately adopting sustainable and resilient building practices for the buildings it owns, leases and funds over the course of their entire lifecycle through: 1) the design and construction of Emission Neutral, climate ready buildings; 2) monitoring, benchmarking, operating, and maintaining City buildings, and 3) proactively retrofitting existing City buildings to reduce their carbon emissions and to prepare for a changing climate. An emissions neutral building is highly energy efficient and: a) uses only renewable energy for its operations on an annualized average basis (this may include either on or offsite generated renewable energy), or b) produces and supplies onsite renewable energy in an amount sufficient to offset the annual greenhouse gas emissions associated with the energy consumed for its operations. Buildings are to be designed to and obtain LEED Silver Certification. •Climate Resilience Study Required •Renewable Energy Study Required.
C591	**Capital Project Governance (Non-Applicable to this study)**	
	Policy Purpose	Provide overall framework to guide the management of the City's capital projects. This policy clarifies the City's phased approach to project development/ delivery, criteria for fast-tracking and funding for adequate planning and design.
	Policy Description	The City of Edmonton will adopt a Project Development / Delivery (PDD) approach that will ensure a phased approach is used for all capital projects. This includes but is not limited to infrastructure, fleet and equipment, information technology investments , and land. The PDD involves formal checkpoint reviews of the project as it progresses through the strategy, concept, design, build and operate value chain. This approach will be used to reduce the risk of issues arising during project delivery and ensure that through vetting and analysis have completed prior to full approval.
	Policy Goals	Achieve effective and efficient use of public funds dedicated to capital projects. Inspire trust among citizens and Council in the City's commitment and ability to deliver quality infrastructure.
	Policy Requirements	Project to utilize City of Edmonton Project Development / Delivery approach
	Impacts to Design / Construction	None
C598A	**Infrastructure Asset Management (Non-Applicable to this study)**	
	Policy Purpose	Asset Management encompasses the systems and integrated activities of the City of Edmonton, which seek to realize value from both new and existing assets.
	Policy Description	This policy provides the fundamental principles that guide corporate asset management practices. These principles form the foundation for the City's continuous improvement of asset management maturity.
	Policy Goals	To enable appropriate decisions related to assets, it is imperative that the portfolio of assets is managed within a broader service delivery framework that encompasses all of the City of Edmonton's services. By adopting a formal, consistent, and repeatable approach to asset management, the City of Edmonton will ensure that assets are properly managed throughout their lifecycle to achieve their intended useful lives in support of the services provided by the City.
	Policy Requirements	This policy applies to all assets owned and managed by the City of Edmonton.

C602	**Accessibility for People with Disabilities (Applicable to this study)**	
	Policy Purpose	• Guide the development and implementation of City policies, civic engagement, programs and services, communications and technology, employee services and infrastructure that considers individual needs and diverse abilities. • Take steps towards ensuring people with disabilities are treated with respect and have equitable access and opportunity to participate and contribute to City policies, civic engagement, programs and services, communications and technology, employee services and infrastructure.
	Policy Description	The City of Edmonton's Accessibility for People with Disabilities Policy commits to accessibility and continuous improvement across all City services and programs to ensure all Edmontonians have equitable access and opportunities to participate in their city.
	Policy Goals	Ensuring all people are treated with respect, with equitable access and opportunity to participate to the fullest extent in the city.
	Policy Requirements	Utilize the City of Edmonton's Access Design Guide. The Access Design Guide exceeds the 2019 National Building Code – Alberta Version requirements and shall be used in conjunction with the Safety Codes Council – Barrier–Free Design Guide – Fifth Edition – Summer 2017, published by Safety Codes Council, to the City's planning, designing and building of infrastructure (facilities, open spaces, and transportation) either owned or occupied by the City of Edmonton.
	Impacts to Design / Construction	Building and site design, including vehicular access, exterior paths of travel, building entrances, interior paths of travel, interior spaces, washrooms and changerooms and special interior features to follow Access Design Guide. This facility, because it is a fire station, is only required to have the main entry and the front contained washroom to be accessible – this is subject to the plans examiner's discretion, however it is virtually always accepted and is typical for all regions.
C593C	**Public Engagement (Non-Applicable to this study)**	
	Policy Purpose	• Achieves a consistent, coordinated and outcomes-driven approach to public engagement; • Facilitates public input to decision-making through effective and efficient consultation, involvement, collaboration and empowerment processes; and • Adheres to the public engagement requirements within the Municipal Government Act and other applicable legislation.
	Policy Description	The City of Edmonton values public engagement processes and activities that contribute to policy, program, service and project decisions by providing City Council and Administration with the best possible information to support decision-making. The policy describes the City's overall approach and commitment to public engagement, identifying guiding principles and outcomes to support its process and activities.
	Policy Goals or Outcomes	Public Engagement allows decision-makers to strive for the best understanding of the public's views and perspectives on topics and issues, Consider public input in decision-making, and communicate to the public how their input was used and why decisions were made. Public engagement offers the opportunity for City Council to: • Deepen its role as community representatives through enhanced understanding of the interests, values and perspectives of the public. • Work with Administration to identify areas where public engagement can and will make a meaningful difference to Council decisions. • Promote and direct the public to public engagement activities. • Carefully and thoughtfully consider public input as part of the decision-making process. • Ensure public expectations for public engagement opportunities and influence are balanced with awareness of resource capacity, fiscal realities and other important context • Clearly explain the rationale for decisions and how public input was used in decision-making.
	Policy Requirements	Utilize the City of Edmonton Public Engagement Framework.
	Impacts to Design / Construction	Public engagement occurs during the site selection process for Fire Station. No public engagement is conducted during the design phases. No impact to design or construction.

C587A	**Enterprise Risk Management (Non-Applicable to this study)**	
	Policy Purpose	Ensure the consistent application of the Enterprise Risk Management process to support the alignment of informed choices and prioritize actions to address risks, reduce downside impacts and elevate opportunities to reach corporate goals, objectives, strategy and service commitments.
	Policy Description	The policy to identifies these guiding principles: • Effective Governance: Clear and consistent accountability to support the risk management culture in establishing priorities, delegation and roles for identifying and managing risks across the Corporation. • Integration: Enterprise Risk Management is vital in strategic planning, budgeting and performance management and promotes data-driven strategic business decision-making to improve programs and services. • Meaningful Engagement: A commitment to develop and maintain processes for comprehensive research and input from subject matter experts, operational leaders and service providers in business units consistently and collaboratively. Enterprise risk management occurs with the best available information from various sources, including historical data, experience, stakeholder feedback, research, observation and forecasts. • Consistency In Execution: Application of a consistent process supported by the education, training and tools required for business units to identify, analyze and respond to risks effectively. • Effective Monitoring And Reporting: Analysis and results are regularly reported to leadership and Audit Committee annually to support a culture of risk management, communication and continuous improvement.
	Policy Goals	The implementation of the Enterprise Risk Management policy allows the City of Edmonton to identify and anticipate risks to improve decision-making, strengthen resilience and create opportunities to innovate the way services are delivered to Edmontonians.
	Policy Requirements	Utilize Enterprise Risk Management Procedure
	Impacts to Design / Construction	May not have specific or direct implication to the site, however, may improve project delivery outcome.
C588	**Winter Design (Applicable to this study)**	
	Policy Purpose	Inform the planning and design of new development to achieve the outcomes, and realize the vision, of Edmonton as global model for winter city living and cold-weather design.
	Policy Description	The City of Edmonton supports urban design that fully considers its winter context. The Winter Design Guidelines provide a robust winter design lens for all development in the City. The City supports the following five winter design principles, which will be applied across neighbourhoods, streets, sites and open spaces: 1. Incorporate design strategies to block prevailing winds and downdrafts; 2. Maximize exposure to sunshine through orientation and design; 3. Use colour to enliven the winterscape; 4. Create visual interest with lighting, while being mindful of density, spread and colour; and 5. Design and provide infrastructure that supports desired winter life and improves comfort in cold weather.
	Policy Goals	1. Design our communities for winter comfort, safety, access, and aesthetic appeal. 2. Design elements for winter fun, activity, beauty and interest. Outcomes: 1. Buildings are designed so that their impact on the public realm creates better microclimates, as well as public spaces that are more vibrant and inviting. 2. Streets are vibrant and attractive people-places in all seasons. 3. Parks and open spaces are used and enjoyed year-round. 4. Public spaces support outdoor winter programming, recreation and everyday winter life.

	Policy Requirements	Apply winter design principles as provided in the Winter Design Guidelines.
	Impacts to Design / Construction	Applies to the built form, public interface, site design and streetscape. Winter Design elements include the following: • Roof design; • Building material and colour; • Entries, awning & canopies; • Building lighting and signage; • Site landscape and vegetation; • Streetscape elements such as sidewalks and bicycle routes.
C556C	**Sustainable Procurement (Non-Applicable to this study)**	
	Policy Purpose	Ensure the City of Edmonton's procurement practices are open, fair and transparent and contribute to building and maintaining a healthy, prosperous and climate-resilient community.
	Policy Description	The policy will be guided by these principles: • Ethical Standards – The City of Edmonton requires suppliers and their subcontractors to adhere to minimum standards related to ethical business practices. • Environmental Sustainability – The City of Edmonton will identify and integrate environmental sustainability requirements into purchasing procedures and supply chain management processes to advance the City's progress to achieving and maintaining climate resilience including emissions management, reduced pollution, energy efficiency and waste reduction. • Indigenous Procurement– The City will create pathways for Indigenous businesses and the Indigenous community at-large to realize social and economic impacts through the City's existing purchasing needs. • Social Value Considerations– The City of Edmonton will implement social value considerations for existing purchasing opportunities, provided any such social value considerations are consistent with the City's obligations under applicable trade agreements.
	Policy Goals	Follow the sustainable procurement guiding principals for Ethical Standards, Environmental Sustainability, Indigenous Procurement and Social Value Considerations and leverage purchases to create economic, environmental and social impacts.
	Policy Requirements	Administration will use the guiding principles for purchasing activities undertaken by the City of Edmonton.
	Impacts to Design / Construction	May limit conventional material choices. May add supply chain complexity with longer lead times. May affect contractor's bids to meet requirements such as waste diversion.
C458E	**Public Art to Enhance Edmonton's Public Realm (Applicable to this study)**	
	Policy Purpose	By investing in public art the City of Edmonton supports the local economy and helps build an attractive, healthy and thriving city where creative spaces emerge and art,design,and culture flourish.
	Policy Description	Public Art Program • City Administration partners with the Edmonton Arts Council to comprehensively and sustainably manage the City of Edmonton's public art program and collection in alignment to City Plan and Connections and Exchanges. • Public art acquired under this policy will be part of the City of Edmonton's Public Art Collection. • The program provides curatorial and artistic vision for building, caring for and animating the Public Art Collection. • Public Art will be diverse, representing the community and be distributed throughout the City. Procedure Public Art to Enhance Edmonton's Public Realm falls under Policy C458D

	Policy Goals or Principles	Guiding Principles Administration will use the following principles to invest in city-wide growth, development and care of public art. • Public Visibility and Accessibility- Public Art will be located in publicly accessible and visible locations. • Diversity and Inclusion- Public art reflects the diversity of our civic makeup with consideration for equity of marginalized communities and populations. • Public Art Appreciation- Public art raises the public awareness and appreciation of the arts. • City-Wide Impact- Invest in public art and artists with the intention to maximize city-wide impact and enhance the public realm.
	Policy Requirements	The City of Edmonton will annually fund a Public Art Reserve on a Pay-As-You-Go basis in the minimum amount of 1%of eligible capital projects, as approved by City Council through the operating budget.
	Impacts to Design / Construction	The Site does not require public art opportunity, unless as an Eligible Municipal Capital Project, the City determines this fire station on this site to be a civic project suitable for public art.
C512	**Environmental Policy (ENVISO) (Non-Applicable to this study)**	
	Policy Purpose	The policy states the City's commitment to environmental sustainability in accordance with the following guiding principles: • Quality Of Life: A healthy, sustainable environment is an essential requirement for high quality of life in Edmonton – both today and in the future. Shared Responsibility: The protection and preservation of Edmonton's natural environment is a responsibility shared by municipal departments and branches, Edmonton's business community, other orders of government, and Edmontonians. Collaboration, co-operation, and partnerships are needed to exercise this responsibility effectively. • Decision-Making Model: Environmental considerations will be factored into business decisions made by the City of Edmonton. • Protection of the Natural Environment: The City of Edmonton will take a leadership role in protecting natural heritage and biodiversity within the municipality and region. Intergenerational Equality: The City of Edmonton will strive to understand and minimize the negative environmental impacts its operations may have on future generations. • Public Awareness and Understanding: The City of Edmonton will take a leadership role in increasing public awareness of environmental issues and the actions citizens can take. • Citizen Consultation and Participatory Decision Making: Communities and stakeholders must have the opportunity to participate in the decision-making process and be empowered to develop community based environmental programs (as per Public Involvement Policy C513).
	Policy Description	The City of Edmonton, through its planning, decision-making processes, and leadership, will promote the development of an environmentally sustainable community that functions in harmony with the natural environment.
	Policy Goals	The City of Edmonton will exercise environmental stewardship of its operations, products and services, based on its commitment to: • Prevent pollution, • Continually improve its environmental performance by setting and reviewing environmental objectives and targets, and • Meet or exceed applicable environmental legal requirements and other requirements to which it subscribes.
	Policy Requirements	Utilize ENVISO Contractors Environmental Responsibilities Package For: Construction, Operations, Maintenance, Service Activities, Hired Equipment, Consultants
	Impacts to Design / Construction	May impact general contractor fees to comply with requirements of the policy.

C523A	**Fire Rescue Service Delivery (Applicable to this study)**	
	Policy Purpose	1. Ensure alignment with the direction set by City Council in *The Way Ahead* . 2. Ensure that legislative requirements are met, which include that a Quality Management Plan is in place as required by the Alberta Safety Codes Act. 3. Ensure that industry standards and benchmarks are met, which include the National Fire Protection Association, and the Commission on Fire Accreditation International. 4. Reflect the expectations of fire rescue services partners, stakeholders and the general public.
	Policy Description	The policy outlines the Edmonton Fire and Rescue Services' commitment to deliver an essential public service, helping to make Edmonton a safer place to live, work and play.
	Policy Goals	The City of Edmonton will strive to meet or exceed National Fire Protection Association standards as outlined in the Fire Rescue Master Plan and will continue to maintain the accredited agency status as granted through the Commission on Fire Accreditation International, subject to budget approval.
	Policy Requirements	1) For Edmonton Fire Rescue Services, four goals and seventeen accompanying principles have been established to help guide decision-making. 2) Recognizing that communication is an integral part of implementation, an accompanying Fire Rescue Master Plan (2012) document will be developed that more effectively communicates and coveys the breadth of additional information needed by various internal and external audiences. 3) City Policy C523A will be reviewed at least every five years and revised as necessary to reflect potential changes: in Council priorities or direction; City of Edmonton strategic plans; legislative requirements; industry standards; and community expectations.
	Impacts to Design / Construction	The strategic placement of fire stations to ensure optimal service delivery can influence building design, particularly in relation to the surrounding neighbourhood context. Additionally, the need to support rapid emergency response may shape design specifications—such as incorporating quick-opening, energy-efficient apparatus bay doors.

Reg. / Code	Administrative Directives	Administrative Directives Purpose
A1206 EAF	**Financial Administration and Control Expenditure Accountability Framework (Non-Applicable to this study)**	
	Directive Purpose	The purpose of this directive is to establish guiding principles, procedures, and processes for financial administration and control to ensure the City follows best practices when handling City money.
	Directive Description	Financial administration and control ensures that City money is well-managed, adequately controlled, and spent only as approved. Financial administration also ensures that accurate information is available for decision-making and the risk of loss, misappropriation, or theft is minimized.
	Directive Goals	The City of Edmonton is committed to the sound stewardship of financial resources. To this end, the City will ensure that there are efficient and effective tools, processes, practices, and measures for financial administration and control. This supports the effective, appropriate, transparent, and economic use of City money.
	Directive Requirements	This directive applies to any person who reports to the City Manager or City Auditor and provides services to the City of Edmonton under a contract of employment, contract for the provision of personal services, or in the capacity of agent, student, or volunteer.

A1205A	**Contract Management (Non-Applicable to this study)**	
	Directive Purpose	The purpose of this directive is to establish guiding principles, procedures, and processes to ensure the City of Edmonton follows best practices when managing contracts and suppliers' performance.
	Directive Description	Contracts provide the basis for ensuring that obligations of both the supplier and the City are fulfilled. All City contracts resulting from procurement activities must be actively managed using the processes prescribed in this directive and the associated procedures.
	Directive Goals	Guiding Principles: In carrying out their duties under the procedures accompanying this directive, or when acting in situations not explicitly addressed by an existing procedure, employees will be guided by the following principles: • ensuring that all parties to a contract fully meet their respective obligations as efficiently and effectively as possible in order to continually deliver the business, financial, and operational objectives the contract is intended to achieve; • ensuring the City's contract management practices promote and enable a fair exchange of value between the City and contracted parties for goods, services, construction, and intellectual property rights received; • complying with all relevant City policies, directives, procedures, and trade agreements; and • reducing contractual risk to the City through active contract management.
	Directive Requirements	This directive applies to any person who reports to the City Manager or City Auditor and provides services to the City of Edmonton under a contract of employment, contract for the provision of personal services, or in the capacity of agent, student, or volunteer.
	Impacts to Design / Construction	Contracts for this project to be managed using processes prescribed in this directive and associated procedures.
A1448	**Public Involvement (Non-Applicable to this study)**	
	Directive Purpose	The purpose of this directive is to provide employees with guidelines for a consistent approach when there are City sponsored public involvement processes.
	Directive Description	Employees will be expected to take a strategic approach when public involvement is considered by demonstrating the Standards of Practice identified in Public Involvement Framework.
	Directive Goals	To provide a standard of excellence to the citizens and public for all public involvement events.
	Directive Requirements	This directive applies to all City departments reporting to the City Manager and all City employees including full-time, part-time, temporary and provisional employees in addition to City hired Consultants. This also applies to the Office of City Auditor.
	Impacts to Design / Construction	Public engagement occurs during the site selection process for Fire Stations. No public engagement is conducted during the design phases
A1117D	**OHS (Operational Health and Safety) (Non-Applicable to this study)**	
	Directive Purpose	The purpose of this directive is to promote and support a safe and healthy workplace which, at a minimum, meets the requirements of Occupational Health and Safety legislation and other relevant legislation and agreements as well as the following Guiding Principles: • Our Safe Cultural Commitment supports the value we place on respecting and protecting the physical, mental and emotional well-being of each other and those we serve. • The City manages risks through the hierarchy of hazard controls (engineering controls, administrative controls and personal protective equipment). When a hazard cannot be managed by a single method, such as an engineering control, a combination of controls are used.
	Directive Description	This policy promotes and supports a safe and healthy workplace which, at a minimum, meets the requirements of Occupational Health and Safety regulations and other relevant legislation and agreements.
	Directive Goals	The City of Edmonton's staff are safe and supported to achieve their aspirations and deliver excellent services.

	Directive Requirements	Utilize City of Edmonton Occupational Health and Safety (OHS) Procedure.
	Impacts to Design / Construction	Fire station to be designed to support a safe and healthy workplace. Administrative implications ensure City of Edmonton meets OHS requirements.
Reg. / Code	Administrative Standards	Administrative Standards Purpose
	Procurement Standards (Non-Applicable to this study)	
	Standards Purpose	The purpose of this standard is to: • Ensure the City acquires goods, services, construction and intellectual property in an open, fair and transparent manner and abiding by all applicable Trade Agreements; • Outline the minimum requirements by which the City conducts procurement activities; and • Implement a consistent approach to procure to pay processes across the City.
	Standards Description	As a municipal government in the Province of Alberta, the City of Edmonton is bound by provincial and federal trade agreements which outline requirements for how the City is to procure goods, services, and construction. This Standard replaces the Procurement Administrative Policy (A1465) and all of its associated procedures.
	Standards Goals / Guiding Principles	Guiding Principles In carrying out their duties under this Standard, or when acting in situations not explicitly addressed here, employees will be guided by the following principles: • Fairness, openness and transparency, ensuring that the City's practices and processes are easily accessible and understandable; • Achievement of best value for the City, while actively supporting the City's Sustainable Procurement Policy; • Compliance with all applicable trade agreements; • Use of competitive procurement processes as the preferred method, which should be used wherever possible and appropriate; • Appropriately justifying all non-competitive procurement processes, which are available to use in specific situations; • Leveraging buying power through corporate contracts or strategic sourcing; • Thoroughly assessing risks, supplier qualifications, supplier performance, and full life cycle costs; and • Integrity and ethics in all procurement activities.
	Standards Requirements	This standard applies to any person who reports to the City Manager or City Auditor and provides services to the City of Edmonton under a contract of employment, contract for the provision of personal services, or in the capacity of agent, student or volunteer. This Procurement Standard applies to Procurement Agreements only (excludes other agreements such as funding agreements, revenue agreements, or land-related agreements).
	Impacts to Design / Construction	No direct implication, however, procurement for goods, services and construction for this project to be determined by Procurement Standards. Additionally, there are implications related to administrative requirements and resource effort.
	Design Standards and Construction Standards	
COE-IM-GUIDE-0015 V04	**Access Design Guide (Applicable to this study)**	This guideline aims to promote accessibility in open spaces and facilities owned, operated or leased by the City of Edmonton by outlining measures that exceed the requirements of 2019 National Building Code – Alberta version.
COE-IM-GUIDE-0023 V03	**Access Management Guidelines (Non-Applicable to this study)**	This document establishes guidelines for the City of Edmonton's expectations regarding the location of access to their roadway assets.
COE-IM-GUIDE-0033	**Arterial Construction with Subdivision Guidelines (Non-Applicable to this study)**	Direction on how arterial conditions are reviewed/applied at the subdivision stage of development.

COE-IM-GUIDE-0008	**Blatchford District Energy Sharing System - Design & Construction Guideline (Non-Applicable to this study)**	Design and construction requirements for the Distribution Piping System (DPS) component of a District Energy Sharing System (DESS) project.
COE-IM-FORM-0001 V07	**Building Systems Shutdown Permit (Non-Applicable to this study)**	Fillable form for Building Systems Shutdown Permit.
COE-IM-SOP-0001 V06	**Building Systems Shutdown Procedure (Non-Applicable to this study)**	Standard Operating Procedure (SOP) that outlines detailed process flow for Building Systems Shutdown.
COE-IM-GUIDE-0009 V01	**Facilities Measurement & Verification General Guidelines (Non-Applicable to this study)**	This document describes the Measurement and Verification (M&V) practices and procedures for the City of Edmonton's (COE) energy projects, and to align and integrate M&V practices with existing COE policies and procedures.
COE-IM-GUIDE-0028	**Facility Commissioning Consultant Manual Volume 2: Building Envelope Commissioning Process and Guidelines (Non-Applicable to this study)**	Reference for consultants providing Building envelope commissioning services (herein defined as the Building Envelope Commissioning Authority (BECA)) for new building projects, renovations to existing facilities or re-commissioning of existing buildings owned or operated by the City of Edmonton.
COE-IM-GUIDE-0027	**Facility Commissioning Manual Volume 1 - Building Systems Commissioning Process and Guidelines (Non-Applicable to this study)**	Reference for consultants delivering Commissioning Process services for new building projects, rehabilitations and renewals, retro commissioning existing facilities or re-commissioning of existing systems owned or operated by the City of Edmonton (CoE).
COE-IM-GUIDE-0001	**Facility Consultant Manual - Volume 1 (Applicable to this study)**	Reference for consultants providing services for new building Projects and renovations to existing facilities owned or operated by the City of Edmonton (CoE). A resource for the CoE when reviewing and evaluating the work performed by architectural and engineering firms on CoE facility Projects.
COE-IM-GUIDE-0002	**Facility Consultant Manual - Volume 2 (Applicable to this study)**	This is the technical guidelines to follow when designing new buildings or major renovations for the City of Edmonton.
COE-IM-GUIDE-0017 V02	**High Floor LRT Design Guidelines (Non-Applicable to this study)**	Guidelines for the design and construction of High Floor LRT infrastructure assets.
COE-IM-GUIDE-0036 V01	**Low-Impact Development Guidelines for Corner Lot Infill Developments (Non-Applicable to this study)**	Low-impact design facility guidelines for corner lot 3 or 4 unit infill developments.
COE-IM-GUIDE-0022 v3.0	**Open Space Consultant Manual - Volume 1 (Non-Applicable to this study)**	Reference for consultants providing services for new open space projects and redevelopments to existing spaces owned or operated by the City of Edmonton.
COE-IM-GUIDE-0016 V3	**Playspaces and Wheeled Sport Facility Design and Construction Standards (Non-Applicable to this study)**	Standards and guidelines for planning, design and construction of playgrounds in the City.
COE-IM-GUIDE-0013	**Preliminary Bridge Design Guidelines (Non-Applicable to this study)**	This document establishes guidelines for design and construction of structural preliminary design drawings.
COE-IM-GUIDE-0003 V2	**Solar Voltaic Program Volume 1: Site Selection Guideline (Non-Applicable to this study)**	Site selection guidelines for the City of Edmonton expectations for solar photovoltaic systems that are to be deployed on their facilities.

COE-IM-GUIDE-0004 V2	**Solar Voltaic Program Volume 2: Design Guideline (Applicable to this study)**	Design guidelines for solar photovoltaic systems that are to be deployed at City of Edmonton facilities. Solar Voltaic Program Volume 2: Design Guideline Amendments
COE-IM-GUIDE-0005 V2	**Solar Voltaic Program Volume 3: Construction Guideline (Non-Applicable to this study)**	Construction guidelines for solar photovoltaic systems that are to be deployed at City of Edmonton facilities.
COE-IM-GUIDE-0006 V2	**Solar Voltaic Program Volume 4: Operations & Maintenance Guideline (Non-Applicable to this study)**	Operations and Maintenance guidelines for solar photovoltaic systems that are to be deployed at City of Edmonton facilities.
COE-IM-GUIDE-0007 V2	**Solar Voltaic Program Volume 5: Operations & Maintenance Guideline (Non-Applicable to this study)**	Asset Management guidelines for solar photovoltaic systems that are to be deployed at City of Edmonton facilities.
COE-IM-GUIDE-0012 V02	**Street Identification Sign Design Manual (Non-Applicable to this study)**	Standards for designing street identification signs.
COE-IM-GUIDE-0021 V02	**Volume 1 - General (Non-Applicable to this study)**	Standards for the City of Edmonton expectations in the design and construction of their assets.
	Volume 1: Table of Minimum Offsets (Non-Applicable to this study)	Excel version. Google Sheets version available upon request.
COE-IM-GUIDE-0011 V4	**Volume 2: Complete Streets Design and Construction (Roadways) - Version 4 (Non-Applicable to this study)**	This guideline provides a single point of reference that supports the planning, design and construction of complete streets in Edmonton. *NOTE THIS IS Version 4 and Applied to all projects initiated between June 5, 2018 – January 2, 2024. Volume 2: Complete Streets Design and Construction – Alleyway Structural Pavement Design Technical Memo – This technical memo provides clarity regarding the structural design and subgrade prep requirements for the design and construction of residential and commercial alleyways under Complete Streets Design and Construction Standard Version 4
COE-IM-GUIDE-0011 V4	**Volume 2: Complete Streets Design and Construction (Roadways) - Version 5 (Non-Applicable to this study)**	This guideline provides a single point of reference that supports the planning design and construction of complete streets in Edmonton. *NOTE THIS IS Version 5 and Applied to all projects initiated after January 2, 2024.
	Volume 3: Drainage (Applicable to this study)	Guides, standards, checklists and forms (Managed by EPCOR)
COE-IM-GUIDE-0010 V2	**Volume 5: Landscaping (2022) (Non-Applicable to this study)**	Standards for well-constructed, functional, aesthetically pleasing, and sustainable public open space for landscape developments on City lands. For projects from April 2021 and later.
	Volume 5: Park Minimum Requirements-Park Site Concept Review (Non-Applicable to this study)	These requirements are applicable to all projects that are initiated into circulation as of **March 1, 2025**.

	Volume 5: Park Requirements by Classification (Non-Applicable to this study)	This document provides further guidance on some of the specifics noted in the Park Minimum Requirements.
COE-IM-GUIDE-0019	**Volume 6A: Road & Walkway Lighting Design Standards (Non-Applicable to this study)**	Standards and guidelines for the City of Edmonton's expectations in the design of transportation lighting infrastructure.
COE-IM-GUIDE-0018	**Volume 6B: Road & Walkway Lighting Construction & Material Standards (Non-Applicable to this study)**	Standards and guidelines for the City of Edmonton's expectations in the construction of transportation infrastructure.
	Volume 7: Power (Non-Applicable to this study)	Guides, standards, checklists and forms (Managed by EPCOR)
COE-IM-GUIDE-0014 V03	**Volume 8: Pavement Marking (Non-Applicable to this study)**	Standards for the City of Edmonton expectations in pavement marking design.

	Project Management for Capital Projects (Non-Applicable to this study)	
	Standards Purpose	The purpose of this standard is to ensure all City of Edmonton Capital Projects follow established project management best practice consistently and performance standards for project management are established, monitored and controlled for all capital projects. This includes but is not limited to infrastructure, fleet and equipment, information technology investments and land.
	Standards Description	The City of Edmonton is committed to follow established project management best practices on all capital projects in order to deliver Business Value in accordance with corporate goals and priorities; meet client and stakeholder needs; and demonstrate accountability for management of public assets.
	Standards Goals	The City of Edmonton's projects are well managed and assets are maintained for accountable service delivery.
	Standards Requirements	Project Management Practices for Capital Projects will be established based on project management best practices and will incorporate flexibility to accommodate individual business area requirements and different project delivery methods. This includes: • Ensuring professional staff have the knowledge and competency to perform their duties effectively, including appropriate and ongoing training and development. • Documented practices and processes. • Utilization of tools and systems to support project execution. • Continual monitoring of performance and effectiveness of practices and tools.
	Impacts to Design / Construction	This standard applies to all City departments reporting to the City Manager and involved in Capital Projects, and all City employees including full-time, part-time and temporary employees, and all contract staff working on capital projects.

Reg. / Code	Risk Tolerance	Risk Tolerance Purpose
	City Contract Terms and Conditions (Non-Applicable to this study)	
		See Codes, Regulations & Policy Applicability Comparison
	Insurance and Bonding Requirements (Non-Applicable to this study)	
		See Codes, Regulations & Policy Applicability Comparison
	Owner Performance Expectations **(scope, schedule, budget)** **(Non-Applicable to this study)**	
		See Codes, Regulations & Policy Applicability Comparison
	Low Impact Development (LID) (Applicable to this study)	
		See Codes, Regulations & Policy Applicability Comparison

General Comparative Information

Basic Civic Station Design

Full Policy Station Design

The design of the two stations is based on:

- The site selection is the same for both stations
- The site programme (number of stalls, etc.) is the same for both stations
- The site design varies between each station as the Basic assumes only hydro seeding and a few sparsely located trees are required on the site while the Full Policy design provides for a full and Edmonton Design Committee compliant landscaped space with additional trees, soft landscaping with low level soft landscaping, public plinth and generally upgraded concrete with patterning
- The programme provided for both designs is based on the EFRS standards required for fire station design with two differences between them:
    - The Basic Civic Station Design has a generator however it is located outside the building and is in its own insulated, and acoustically lined enclosure
    - The mechanical spaces for the Basic Civic Station Design are smaller as a number of the mechanical equipment items are mounted on the roof.
    - And the Full Policy Station Design has the generator inside the building and a larger mechanical room / set of spaces
- The design of the exterior building envelope is quite different. The Basic is a standard insulated metal panel wall with a one meter high masonry sill. The Full Policy aligns with additional aesthetic and contextual design considerations consistent with Edmonton Design Committee and has a full masonry wall with articulated and finely detailed brick work and is fully thermally broken. The glazing in the Basic is double paned while the Full Policy is triple paned.
    - The amount of glazing in the Basic is higher than in the Full Policy, and this increase in less energy effective windows results in a poorer performing building in regards to energy. The amount of glazing in the Full Policy is less than the Basic and is very selectively located to maximize the amount of sunlight.
    - At the roof of the Apparatus Bay is a high R-Value Kalwall series of translucent panels. These will diffuse the sunlight while permitting a tremendous amount of light into the apparatus bay space, reducing the energy for lighting during the daylight hours.
    - Both designs' roofs are flat, however the Full Policy design has a higher R-Value and it is thermally broken at all connections to the vertical surfaces, improving the building performance.

Cost Comparison Descriptions

Construction Cost Comparisons

The construction costs for the Basic Civic and the Full Policy Station are Class C estimates based on the schematic design drawings and specifications developed for both stations. The estimates are presented as probable costs and include design and change order contingencies at 12% and 10%, respectively. The estimates, in current Canadian Dollars, do not include soft costs (i.e. Consultant costs, legal fees, permit fees), owner administration costs and land acquisition costs. Furniture, fixture, equipment and fire truck costs are also not included.

The estimated construction capital costs are:

- Basic Civic Station Design $13,348,000 (rounded)
- Full Policy Station Design $21,039,000 (rounded)

Refer to the Class C estimate tables provided in 5.0 Cost Comparisons section of the report for detailed breakdown.

Service Life Data Cost Comparison

The service life costs analysis for Basic Civic and Full Policy describes the service life of elements (as identified in the Class C Estimate) in 5-year increments over a period of 25 years. The net totals include design and construction contingencies and an inflation rate is applied for the 25-year period.

The inflation rate is based on Statistics Canada:

- Released: 2025-03-18
- Consumer Price Index
- February 2025
- 2.6%
- (12-month change)
- The Consumer Price Index (CPI) rose 2.6% year over year in February, following an increase of 1.9% in January

Mechanical Comparative Analysis Between the Basic Civic Station and Full Policy Station

Capital Cost

- The Basic Civic Station uses less complex equipment compared to the equipment in the Full Policy Station.
- The building envelope of the Basic Civic Station has a lower level of performance compared to the Full Policy Station resulting in higher heating and cooling loads. This results in a larger capacity HVAC system.
- However, the complexity of the Full Policy Station systems results in a higher cost system compared to the larger capacity Basic Civic Station system.
- The Full Policy also, because it is an all electrical system, requires a larger back-up generator than the Basic Civic Station. In our examples, the Basic requires 150kW generator and the Full Policy 300kW, even though the Full policy is more energy efficient, it uses more electricity, requiring a larger generator capacity.
- Energy Performance
  - The heat pump systems used in the Full Policy Station achieve efficiencies from 200-500%, which is much higher than the gas fired systems in the Basic Civic Station which can not exceed 100%.
  - The air source heat pump water heaters used in the Full Policy building also can achieve efficiencies greater than 200%, where the gas fired hot water heaters in the Basic Civic Station can achieve 98% at most.
  - Air handling systems will be equipped with exhaust air to outside air heat recovery to minimize the energy used to heat the ventilation air. The heat recovery system can recover approximately 90% of the energy in the exhaust stream to preheat incoming outdoor air.
  - Overall the energy performance of the Full Policy Station will exceed the Basic Civic Station.
- Improved Water Efficiency
  - Low flow fixtures are used throughout the Full Policy Station to minimize water usage and demonstrate savings over the Basic Civic Station. This results in water usage savings and domestic hot water heating energy savings in the Full Policy Station.
- Occupant Comfort
  - There are spaces in the Basic Civic Station that do not have cooling in order to save capital cost such as the gym. The VRF system used in the Full Policy Station provide cooling and improve occupant comfort during warmer times of the year.

Basic Civic HVAC System

- General
  - Modular AHU with hydronic (or gas) heating and dx cooling to serve main spaces and eating area. Boilers to serve skirt heating and can be used for AHU and UH if required.
  - Dormitories and office spaces
  - Variable air volume (VAV) boxes and reheat coils for temperature control.
  - App bay
  - Gas fired make up air (MUA) unit with exhaust fans to remove vehicle exhaust
  - Gas fired unit heaters at overhead doors provide heating
  - No cooling
- Gym
  - Dedicated MUA and exhaust fan with heat recovery
  - No cooling
- Kitchen
  - Gas fired MUA and exhaust hood for kitchen ventilation
  - Simple kitchen not commercial grade
  - Heating, cooling, and ventilation supplied from AHU

Full Policy HVAC System

All new City of Edmonton buildings are required to follow Climate Resilience Policy C627. This policy requires buildings to be designed emissions neutral and meet the following additional requirements:

- Consume 20% less energy compared to the National Energy Code for Buildings (NECB) 2017 on an annual basis before accounting for renewable energy, and
- All electric HVAC systems are required to meet this policy. This includes a ground source heat pump, a dedicated outdoor air system (DOAS) with heat recovery for ventilation, and heat pumps for heating and cooling in individual spaces.
- General
  - Dedicated outdoor air unit for ventilation throughout. DOAS to have hydronic heating and cooling is not required. This will provide ventilation air and make up to serve main spaces, gym, and eating area. Electric supplemental boiler and glycol / manifold for skirt heating and app bay MUA.
  - Ground source field.
  - Water to VRF
  - Water to Water Heat Pump
- Dormitories and office spaces
  - Distributed ground source heat pump with ducted supply and return for each space. Ventilation air ducted to unit for distribution in room.
  - Individual controls per room.
    - Heat and cooling from HP
    - Less piping but compressors will be noisier
    - Distributed VRF evaporators with ducted supply and return for each space.
  - Ventilation air ducted to unit for distribution in room. Individual controls per room
  - Heat / cool form each evaporator
    - Less piping / More ceiling space due to smaller pipes
    - Quieter than HP
    - Heat / cool fan coil with ducted supply and return for each space.
  - Ventilation air ducted to unit for distribution in room. Individual controls per room
    - Perimeter hydronic heating
    - More piping connections and pipe mains in corridors
- Apparatus Bay
  - Hydronic (MUA) unit with exhaust fans to remove vehicle exhaust.
  - Hydronic unit heaters at overhead doors provide heating
  - No cooling
- Gym
  - Fan Coil / Evaporator / HP based on dormitory system for heat / cool of gym. Ducted return from space to DOAS unit
  - No cooling
- Kitchen
  - Fan Coil / Evaporator / HP based on dormitory system for heat / cool of eating area.
  - Hydronic (MUA) unit and exhaust hood for kitchen ventilation.
  - Commercial grade exhaust

5.0| Cost Comparisons

Construction Cost Comparison

Fire Hall, Basic Civic Station
Class C Estimate

Title	: Cost Benefit Analysis		Report Date :	9-May-25
	: New construction		Page :	
Location	: City of Edmonton, Alberta		C.T. Index :	
Owner/Client	: The City of Edmonton			
Architect	: S2 Architecture		Total GFA: plus 149 m^2 mezz.	1,478.6 m2

ELEMENT		Sub-total	Total	$ per m^2 of GFA	%
A	**SHELL**		**$3,899,000**	**2,636.95**	**29.2%**
A1	SUBSTRUCTURE, Tarmac prepared for heating coils included here	1,220,800		825.65	9.1%
A2	STRUCTURE	905,900		612.67	6.8%
A3	EXTERIOR ENCLOSURE	1,772,300		1,198.63	13.3%
B	**INTERIORS**		**$1,334,200**	**902.34**	**10.0%**
B1	PARTITIONS & DOORS, CEILINGS	765,000		517.38	5.7%
B2	FINISHES	212,300		143.58	1.6%
B3	FITTINGS & EQUIPMENT	356,900		241.38	2.7%
C	**SERVICES**		**$2,612,100**	**1,766.60**	**19.6%**
C1	MECHANICAL	1,574,300		1,064.72	11.8%
C2	ELECTRICAL	1,037,800		701.88	7.8%
D	**SITE & ANCILLARY WORK**		**$1,915,100**	**1,295.21**	**14.3%**
D1	SITE WORK (incl. on site services to the building, from property line)	1,915,100		1,295.21	14.3%
D2	ANCILLARY WORK, none	0		0.00	0.0%
Z	**GENERAL REQ'S/FEES AND ALLOWANCES**		**$3,466,900**	**2,344.72**	**26.0%**
Z1	GC FEE, GENERAL REQUIREMENTS 10%	976,000		660.08	7.3%
Z2a	CONTINGENCY 12% (design/estimating)	1,288,400		871.36	9.7%
Z2b	CONTINGENCY 10% (Change orders during construction)	1,202,500		813.27	9.0%
Z3	PERMITS, 1%		**$120,200**	**81.29**	**0.9%**
TOTAL, excl GST			**$13,347,500**	**9,027.12**	**100.0%**

NOTES:

The estimated construction costs are in current Dollars

This estimate is based on schematic design drawings and outline specifications issued April 2025, and communication with consultants. Geotechnical report not available at this time. Pricing for piles is dependent of this report. A pre-tender estimate from Windermere Fire Station has been used to develop this estimating template. Adjusted to match a typical Basic Fire Station in the Edmonton area.

See the details in this estimate for an outline of what is included

Potential impact **Tariffs** that may be imposed on cross border trading is not included. Suppliers are currently adding disclaimers when issuing estimates for purpose of project budgeting.

Administration of commissioning by the general contractor and sub-contractors is included in the markup on their work. Major equipment, when priced will generally have an allowance for testing and start-up/training. In the details additional expected labor costs are carried for field personnel, related to commissioning

No costs are entered for off site work/services. Assumed a cleared and level site, no demo

Soft and owner administration costs/fees not included

It is assumed that competitive bidding for a stipulates sum contract takes place, with minimum 5 qualified bids

This Construction Estimate is presented as an estimate of probable costs and is intended to be used for budget discussions. While we have made every effort to ensure accuracy of the information presented in this budget, CCL. or its directors or managers can not be held liable for its content.

Fire Hall, Full Policy Station
Class C Estimate

Title	: Cost Benefit Analysis		Report Date :	9-May-25
	: New construction		Page :	
Location	: City of Edmonton, Alberta		C.T. Index :	
Owner/Client	: The City of Edmonton			
Architect	: S2 Architecture		Total GFA: plus 221 m^2 mezz.	1,656.7 m2

ELEMENT		Sub-total	Total	$ per m^2 of GFA	%
A	**SHELL**		**$6,586,100**	**3,975.43**	**31.3%**
A1	SUBSTRUCTURE, Tarmac prepared for heating coils included here	1,602,300		967.16	7.6%
A2	STRUCTURE	1,266,500		764.47	6.0%
A3	EXTERIOR ENCLOSURE	3,717,300		2,243.80	17.7%
B	**INTERIORS**		**$1,533,600**	**925.70**	**7.3%**
B1	PARTITIONS & DOORS, CEILINGS	935,100		564.44	4.4%
B2	FINISHES	227,900		137.56	1.1%
B3	FITTINGS & EQUIPMENT	370,600		223.70	1.8%
C	**SERVICES**		**$5,137,500**	**3,101.04**	**24.4%**
C1	MECHANICAL	3,314,800		2,000.85	15.8%
C2	ELECTRICAL	1,822,700		1,100.20	8.7%
D	**SITE & ANCILLARY WORK**		**$2,127,900**	**1,284.42**	**10.1%**
D1	SITE WORK (incl. on site services to the building, from property line)	2,127,900		1,284.42	10.1%
D2	ANCILLARY WORK, none	0		0.00	0.0%
Z	**GENERAL REQ'S/FEES AND ALLOWANCES**		**$5,464,700**	**3,298.55**	**26.0%**
Z1	GC FEE, GENERAL REQUIREMENTS 10%	1,538,500		928.65	7.3%
Z2a	CONTINGENCY 12% (design/estimating)	2,030,800		1,225.81	9.7%
Z2b	CONTINGENCY 10% (Change orders during construction)	1,895,400		1,144.08	9.0%
Z3	PERMITS, 1%		**$189,500**	**114.38**	**0.9%**
TOTAL, excl GST			**$21,039,300**	**12,699.52**	**100.0%**

NOTES:

The estimated construction costs are in current Dollars

This estimate is based on schematic design drawings and outline specifications issued April 2025, and communication with consultants. Geotechnical report not available at this time. Pricing for piles is dependent of this report. A pre-tender estimate from Windermere Fire Station has been used to develop this estimating template. Adjusted to match a typical Basic Fire Station in the Edmonton area.

See the details in this estimate for an outline of what is included

Potential impact **Tariffs** that may be imposed on cross border trading is not included. Suppliers are currently adding disclaimers when issuing estimates for purpose of project budgeting.

Administration of commissioning by the general contractor and sub-contractors is included in the markup on their work. Major equipment, when priced will generally have an allowance for testing and start-up/training. In the details additional expected labor costs are carried for field personnel, related to commissioning

No costs are entered for off site work/services. Assumed a cleared and level site, no demo

Soft and owner administration costs/fees not included

It is assumed that competitive bidding for a stipulates sum contract takes place, with minimum 5 qualified bids

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
A1		**SUBSTRUCTURE**	**Total below:**	**$1,220,800**	**$1,602,300**
Quant.	Unit	Description	Unit price	Cost	Cost
		Site rough grading, see site work		See D1	See D1
		Building excavation			
739	m^3	Allow for a small portion of structural fill	75.00	55,400	
828	m^3	Allow for a small portion of structural fill	75.00		62,100
887	m^3	Excavate/backfill at foundations incl. full compaction	55.00	48,800	
994	m^3	Excavate/backfill at foundations incl. full compaction	55.00		54,700
		Pile pricing can vary a great deal depending on local soil conditions, price levels based on experience with similar projects			
74	Piles	Piles, best estimate typically 4.5 to 5 piles per 100 m2 of building footprint	4,500.00	332,700	
89	Piles	Piles, best estimate typically 4.5 to 5 piles per 100 m2 of building footprint	4,950.00		442,800
78	m^3	Grade beams and pile caps	2,400.00	188,100	
95	m^3	Grade beams and pile caps	2,400.00		227,600
1	Lot	Void foam and grade beam insulation		23,900	
1	Lot	Void foam and grade beam insulation			29,000
		SOG, not structural no piles supporting slab			
1,479	m^2	150mm gravel and radon membrane/vent	14.25	21,100	
1,657	m^2	150mm gravel and radon membrane/vent	14.25		23,600
602	m^2	250 mm used, reinforced concrete	258.38	155,600	
655	m^2	250 mm used, reinforced concrete, added rebar for in slab heating	276.47		181,100
876	m^2	150 mm used, reinforced concrete	160.03	140,200	
1,002	m^2	150 mm used, reinforced concrete, added rebar for in slab heating	171.23		171,500
0	m^3	No in slab heating for basic	783.28	0	
166	m^3	Add for insulation/extra rebar, heated slab total building. R20 rigid insulation/barrier	783.28		129,800
		Detailing, slab thickening and control joints		29,600	
		Detailing, slab thickening and control joints			35,300
		Grates/trenches		23,700	
		Grates/trenches			28,200
		Sumps/grate		27,000	
		Sumps/grate			27,000
		House keeping pads, curbs		8,000	
		House keeping pads, curbs, spill containment at generator			20,000
160	m2	Tarmac with snow melt listed here since snow melt is included. Concrete/rebar/insulation portion	1,041.66	166,700	
160	m2	Tarmac with snow melt listed here since snow melt is included. Concrete/rebar/insulation portion	1,059.75		169,600

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
A2		**STRUCTURE**	**Total below:**	**$905,900**	**$1,266,500**
Quant.	Unit	Description	Unit price	Cost	Cost
		No timber structure, all is steel framed			
		No concrete cores at stairs to mezz floor, all building stabilization is assumed to be steel bracing			
		The estimated mass of steel for structure is a best estimate, based on Celest internal statistics			
		Flat roof steel structure, clear span over apparatus bay			
		Columns and beams			
		Exterior wall framing and wind bracing			
68,016	Kg	Edge angle iron and misc. steel	9.50	646,100	
		OWSJ and bridging			
		Exhaust support system			
		Columns and beams, increased for PV on roof, additional snow load			
		Exterior wall framing and wind bracing			
87,639	Kg	Edge angle iron and misc. steel	9.50		832,600
		OWSJ and bridging, increased for PV on roof, additional snow load			
		Exhaust support system			
149	m^2	Mezz. floor add steel structure, q-deck/concrete topping, with steel stair/railings access	650.00	96,900	
221	m^2	Mezz. floor add steel structure, q-deck/concrete topping, with steel stair/railings access	650.00		143,700
2,145	Kg	Add for cantilevered columns app 2.6 m cantilever in tall parapet, light steel framing between is carried with other exterior wall framing under envelope in A3	9.50		20,400
		Roof access ladders		9,500	
		Roof access ladders			9,500
1,479	m^2	38 mm q-deck	68.00	100,500	
1,657	m^2	38 mm q-deck	68.00		112,700
		No concrete topping		0	
		No concrete topping			0
		Brick angle iron and other misc. steel		52,900	
		Brick angle iron and other misc. steel			95,500
		Assumed no structural concrete walls or masonry for this single story building		0	0
		Additional structural components to support solar panels, listed with the PV system			52,100

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
A3		**EXTERIOR ENCLOSURE**	**Total below:**	**$1,772,300**	**$3,717,300**
Quant.	Unit	Description	Unit price	Cost	Cost
		Roofing, all flat roof with tapered insulation			
1,479	m^2	SBS assembly R32 (165mm)	426.04	629,900	
1,657	m^2	SBS assembly R50	511.04		846,600
		Add allowance for additional roofing costs/detailing related to PV panels on roof			60,100
		Add for wear layer/ foot traffic to mechanical equipment		18,900	
		Add for wear layer/ foot traffic to mechanical equipment and PV panels			50,800
205	m^2	Back of parapet cladding/insulation, could be EFIS or low prices ribbed metal/insulation	340.00	69,600	
455	m^2	Back of parapet cladding/insulation, could be EFIS or low prices ribbed metal/insulation. Also includes wall below Kawal	450.00		204,600
94	m^2	At upper rood and behind Kawal, Back of parapet cladding/insulation, could be EFIS or low prices ribbed metal/insulation	450.00		42,300
		Roof drains part of mechanical		See C1	See C1
		Fall arrests, anchor points		17,700	
		Fall arrests, anchor points			26,500
		RTU screening allowance, none for Full Policy option		40,000	
1,094					
1,600		Exterior walls to top of parapet			
70	m^2	Concrete block back of exterior wall 190 mm to 4.2m	420.00	29,300	
167	m^2	Concrete block back of exterior wall 190 mm to 6.7m	420.00		70,200
914	m^2	Steel stud framing/wallboard, back of wall at exterior walls	231.42	211,600	
1,072	m^2	Steel stud framing/wallboard, back of wall at exterior walls	231.42		248,200
205	m^2	Parapet framing included above, add for additional framing members at parapet	80.00	16,400	
402	m^2	Parapet framing included above, add for additional framing members at parapet	100.00		40,200
89	m^2	Frame parapet behind Kawal, upper roof level	331.42		29,500
145	m^2	Masonry assembly to 1100mm, **veneer block, R30 or 150 mm included, clay masonry will increase cost**	569.75	82,700	
1,061	m^2	Clay brick assembly to full height, lower building parapet height, spray application 175mm/air space R35	870.98		924,000
839	m^2	Metal insulated panels like Kingspan installed over Steel stud framing/wallboard, back of wall at exterior walls, or with exposed panel at upper apparatus bay, R30	387.50	325,100	
0	m^2	Metal cladding assembly	387.50		0
		Allowance for additional architectural façade detailing, add 10% to metal cladding estimate		32,500	
		Allowance for additional architectural façade detailing such as at apparatus bay doors, and canopies over skewed windows, add 10% to masonry estimate			92,400

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
109	m^2	Glazing, no skylights, high performance, double glazing, alu frames	1,300.00	142,200	
105	m^2	Glazing, no skylights, high performance, triple glazing, alu frames	1,560.00		163,700
		Additional light steel framing, possibly structural component, for Kawal support			51,200
256	m^2	Kawal 100mm thickness	1,335.00		341,500
2	Each	Glazed entry doors/hardware	6,500.00	13,000	
2	Each	Glazed entry doors/hardware	7,500.00		15,000
7	Each	Insulated metal doors/hardware	3,200.00	22,400	
7	Each	Insulated metal doors/hardware	3,500.00		24,500
		Add for controlled access		10,500	
		Add for controlled access, all entry doors			31,500
		Motorized door, handicap access, one location		5,500	
		Motorized door, handicap access, all entry doors			49,500
6	Each	OH doors	15,000.00	90,000	
6	Each	Apparatus bay doors likely to be bifold doors, motors included	65,000.00		390,000
		Letters and logos		15,000	
		Letters and logos			15,000
B1		**PARTITIONS & DOORS, CEILINGS**	**Total below:**	**$765,000**	**$935,100**
Quant.	Unit	Description	Unit price	Cost	Cost
		Firestopping		7,500	7,500
149	m^2	Fire protection spray, mezz. floor structure	96.88	14,400	
221	m^2	Fire protection spray, mezz. floor structure	96.88		21,400
		Infill walls in exterior walls listed with envelope		See A3	See A3
389	m^2	Block walls	420.00	163,300	
651	m^2	Block walls	420.00		273,500
870	m^2	Framed walls	300.00	261,000	
942	m^2	Framed walls	300.00		282,600
		Wood blocking and backing		6,500	
		Wood blocking and backing			6,500
703	m^2	Ceilings, open structure	0.00	0	
795	m^2	Ceilings, open structure	0.00		0
709	m^2	Ceilings, T-bar	105.00	74,400	
769	m^2	Ceilings, T-bar	105.00		80,700
67	m^2	Ceilings, solid	270.00	18,100	
93	m^2	Ceilings, solid	270.00		25,100
		Bulkhead allowance		18,500	
		Bulkhead allowance			21,200

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
2	Each	Glazed vestibule doors, installed	6,500.00	13,000	
2	Each	Glazed vestibule doors, installed	6,500.00		13,000
45	Each	Steel doors/frames installed	1,900.00	85,500	
45	Each	Steel doors/frames installed	1,900.00		85,500
0	Each	Solid wood doors/steel frames, installed	2,000.00	0	
0	Each	Solid wood doors/steel frames, installed	2,000.00		0
26	m^2	Interior glazing	900.00	23,400	
26	m^2	Interior glazing	900.00		23,400
		Hardware installed, security part of electrical		73,900	
		Hardware installed, security part of electrical			83,700
		Motorized door, handicap access, one location		5,500	
		Motorized door, handicap access, two location			11,000
B2	**FINISHES**		**Total below:**	**$212,300**	**$227,900**
Quant.	Unit	Description	Unit price	Cost	Cost
1,479	m^2	Painting	42.00	62,100	
1,657	m^2	Painting	42.00		69,600
		Caulking control joints in concrete floors		7,500	
		Caulking control joints in concrete floors			7,500
703	m^2	Concrete floors, hardener and sealer	31.22	21,900	
795	m^2	Concrete floors, hardener and sealer	31.22		24,800
699	m^2	Hardened/polished finish (, honed finish)	54.63	38,200	
785	m^2	Hardened/polished finish (, honed finish)	54.63		42,900
77	m^2	Sports rubber flooring	171.79	13,200	
77	m^2	Sports rubber flooring	171.79		13,200
15	m^2	Recessed mats	968.75	14,800	
15	m^2	Recessed mats	968.75		14,800
		Rubber base		6,600	
		Rubber base			7,100
7	Pcs	Cultured marble shower stall and precast base, installed	3,552.01	24,900	
7	Pcs	Cultured marble shower stall and precast base, installed	3,552.01		24,900
		Porcelain wall tile		15,300	
		Porcelain wall tile			15,300
		Vinyl wall covering in vestibules		7,800	
		Vinyl wall covering in vestibules			7,800

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
B3	**FITTINGS & EQUIPMENT**		**Total below:**	**$356,900**	**$370,600**
Quant.	Unit	Description	Unit price	Cost	Cost
		FF&E, generally by owner		NIC	NIC
1,479	m^2	Millwork, solid surface counters included here	110.25	163,000	
1,657	m^2	Millwork, solid surface counters included here	105.00		174,000
		Tack/white boards and Misc.		22,200	
		Tack/white boards and Misc.			24,900
		Change room benches		3,500	
		Change room benches			3,500
		Washroom partitions		35,000	
		Washroom partitions			35,000
		Mirrors and accessories		19,300	
		Mirrors and accessories			19,300
		Lockers		66,500	
		Lockers			66,500
		Shower curtains/rods		6,500	
		Shower curtains/rods			6,500
		Hose racks		15,000	
		Hose racks			15,000
		Walk off grates		4,500	
		Walk off grates			4,500
		Install only owner supplied equipment and appliances, incl. kitchen appliances		5,000	
		Install only owner supplied equipment and appliances, incl. kitchen appliances			5,000
		Window covering		16,400	
		Window covering			16,400
C1	**MECHANICAL**		**Total below:**	**$1,574,300**	**$3,314,800**
Quant.	Unit	Description	Unit price	Cost	Cost
1,644	m^2	Sprinkler system, and fire department connection, kitchen see below	89.00	146,300	
1,853	m^2	Sprinkler system, and fire department connection, kitchen see below	89.00		164,900
		Fire extinguishers		6,000	
		Fire extinguishers			6,000
		<u>HVAC</u>			
		Ground loop piped to mechanical room, incl. field/piping/excavation terminated by a manifold and valve, app. 40 boreholes at 70m each as a basis for this estimate			324,100
		Boiler room equipment incl, glycol system, Heat exchanger, all pumps and piping etc.		79,100	
		2 electric boiler			98,000
		Rest of equipment in heat generation room, room equipment all pumps and piping etc.			220,100

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
		In slab heating/manifolds **throughout** (Slab insulation listed with A1)			123,600
		Snow melt at apparatus bay doors		16,000	
		Snow melt at apparatus bay doors			16,000
		Condenser/heat pump equipment/coils/piping insulated			382,100
		2 AHUs packaged units with cooling, MERV filtration, vibration control		112,000	
		3 MAUs		63,000	
		Hydronic unit heaters apparatus bay		18,700	
		VAVs		22,500	
		Fans, no ERVs		15,000	
		Air handlers and make up air units MERV filtration, humidification, vibration control			414,900
		Exhaust/ERVs also for vehicles, prop fans			54,300
		Perimeter heating, pipes and insulation		76,500	
		Server room cooling		13,000	
		Server room cooling			13,000
		Kitchen exhaust/hood and fire suppression, gas solenoid shut off valve. Fire wrap kitchen exhaust ducting		83,600	
		Kitchen exhaust/hood and fire suppression, gas solenoid shut off valve. Fire wrap kitchen exhaust ducting			83,600
		Niederman vehicle exhaust fan/system with CO/NO detection		252,700	
		Niederman vehicle exhaust fan/system with CO/NO detection			266,000
		Cabinet/force flow heaters, electric heaters		30,000	
		Cabinet/force flow heaters, VRF/FCU units, electric heaters			211,000
		Ductwork, insulation, silencers, louvers, grills,		221,800	
		Ductwork, insulation, silencers, louvers, grills,			320,200
		Plumbing			
		Natural gas lines and meter		20,000	
		Natural gas lines and meter			15,000
		Water meter room		15,400	
		Water meter room			15,400
		Hot water generation 2 HWTs/circ. pump		38,600	
		Hot water generation 2 HWTs heat pump based/circ. pump			67,200
		Plumbing rough-in, sanitary and water		80,600	
		Plumbing rough-in, sanitary and water			100,800
		Floor and trench drains, oil interceptor/sumps		27,800	
		Floor and trench drains, oil interceptor/sumps			27,800
		Plumbing fixtures, hand free faucets and flushing, grease interceptor		64,800	
		Plumbing fixtures, hand free faucets and flushing, grease interceptor, water consumption reduced			72,500
		Hose bibs and truck fill stations and pressure washer connection		9,800	
		Hose bibs and truck fill stations ands pressure washer connection			9,800
		Generator fuel fill station, generator muffler and vent			29,400

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
		Compressed air piping, compressor by owner, not mentioned in mech report I believe		14,000	
		Compressed air piping, compressor by owner, not mentioned in mech report I believe			14,000
		Storm water drain line		18,800	
		Storm water drain line			21,000
		Digital controls		110,000	
		Digital controls			213,300
		Testing, balancing, commissioning		18,300	
		Testing, balancing, commissioning			30,800
C2	**ELECTRICAL**		**Total below:**	**$1,037,800**	**$1,822,700**
Quant.	Unit	Description	Unit price	Cost	Cost
		Site electrical and secondary feeds to the building, see site work		See D1	
		Allowance for PV system on roof/inverters, installed. Support structure is moved to Structural A2			100,000
		A new 400A, 600V, 3P, 4W main electrical service, switchgear, electrical distribution equipment MCC, panelboards, grounding		101,500	
		A new 800A, 600V, 3P, 4W main electrical service, switchgear, electrical distribution equipment MCC, panelboards, grounding, Advanced Energy Metering credit.			191,000
		150kW diesel-fired backup generator/transfer switch, diesel fuel tank		172,500	
		300kW diesel-fired emergency/back-up generator/transfer switch, diesel fuel tank			258,800
		UPS system		0	
		UPS system			65,900
		Power, outlets, lighting rough-in, mechanical equipment		266,700	
		Power, outlets, lighting rough-in, mechanical equipment			410,300
		Interior lighting, lighting on exterior face of building, controls with occupancy sensing, emergency and exit lighting		258,200	
		Interior lighting, lighting on exterior face of building, emergency and exit lighting, controls with occupancy sensing, time clock, daylight sensing			414,400
		8 cord reels		17,900	
		8 cord reels			17,900
		Communication antennas		10,500	
		Communication antennas			10,500
		Painted backboard, data racks, voice patch panels, cable trays		22,900	
		Painted backboard, data racks, voice patch panels, cable trays			36,700
		Communication outlets, wireless access point		21,100	

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
		Communication outlets, wireless access point			31,500
		Fire alarm system, natural gas shut down at range Fire Alarm activated, Co/No detection		48,900	
		Fire alarm system, natural gas shut down at range Fire Alarm activated, Co/No detection			53,100
		Firefighter Alert Infrastructure – head-end equipment is by City of Edmonton. All rough-ins (incl. wiring) and devices (stack lights, reader boards, speakers) in contract.		59,100	
		Firefighter Alert Infrastructure – head-end equipment is by City of Edmonton. All rough-ins (incl. wiring) and devices (stack lights, reader boards, speakers) in contract.			59,100
		Security system, CCTV system rough-in only and no equipment included in control room, access control fully wired and included. Hardware included with A2 and B1		44,500	
		Security system, CCTV system rough-in only and no equipment included in control room, access control fully wired and included. All entry doors incl. Apparatus Bay doors fully motorized. Hardware included with A2 and B1			77,000
		Lightning protection			
		Lightning protection,			71,500
		Commissioning and testing		14,000	
		Commissioning and testing			25,000
D1	**SITE WORK**		**Total below:**	**$1,915,100**	**$2,127,900**
Quant.	Unit	Description	Unit price	Cost	Cost
		The costs listed below are for work within property lines only			
		Tarmac slabs listed with building costs since snow melt is included		See A1	See A1
		Transformer cost is assumed to be by utility company		NIC	NIC
8,030	m^2	Estimated blended site work net costs incl. electric vehicle chargers as required to meet the LEED credit requirements for Location and Transportation.	238.50	1,915,100	
8,030	m^2	Estimated blended site work net costs	265.00		2,127,900
		Below a listing of the components normally included in a site work estimate			

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

			Basic Civic	Full Policy
		Curb cuts, two location		
		Strip top soil at building and paved areas and stock pile for landscaping		
		Replace fill material under solid surface paving, as requested in geotechnical report		
		New gas lines by utility company, and remove gas lines as requested on Civil drawings, backfill with compaction		
		Connection at main line by utility company		
		Rough grading of site		
		French drain		
		Shallow man holes		
		Connect storm at property line		
		Sanitary		
		Sanitary man hole		
		Connect sanitary at property line		
		Water lines		
		Valves		
		Fire hydrant		
		Connect water at property line		
		Rough-in for pre-empt signal and traffic signal is included below, to property line. Ready for tie-in to City system and Epcor signal		
		Duct bank in sand base for EPCOR 2 - 129 mm conduits		
		EPCOR connection cost		
		Electrical transformer pad, guard rail, ground rods		
		Telecommunication duct bank concrete encased, 8 conduits		
		Secondary duct bank concrete encased, conduits and cables, transformer to electrical room		
		Conduits for future CCTV		
		Conduits for pre-empt signal and traffic, signals NIC		
		2 empty 53 mm with pull string		
		Car plugs, incl. feeders		
		Dual electric vehicle charging station		
		Site electrical, 9 pole lamp and base, incl. feeder		
		Lighting controls		
		Controlled gate access, gate motorized		
		Bollards		
		Asphalt paving, light		
		Asphalt paving, heavy		
		Curbs		
		Pre-fab wheel stops		
		Outdoor patio, paving stones		
		Concrete paving, tarmac, sandblasting added		
		Add to allow for snow melt 1500 mm from building, also to account for additional mechanical costs		
		Concrete paving, walks, light sand blasted finish and saw cut		
		Concrete paving, arts, no foundations included		

DETAILED CALCULATIONS, Class C Estimate

Date: 9-May-25

				Basic Civic	Full Policy
		Outdoor patio with clay pavers			
		Line painting			
		Place stock piled top soil			
		Imported top soil placed			
		Trees			
		Shrubs			
		Perennials, Grasses, rain garden plants			
		Mulch at trees			
		Grassland seed			
		Sod			
		Alu edger			
		Black rundle rip wrap and crushed			
		Irrigation			
		Prefabricated metal fence			
		Gate (power and access control listed above with electrical portion)			
		Waste bin enclosure			
		Concrete pads for waste/recycling, included with heavy concrete paving			
		Metal fence walls			
		3 double swing doors			
		Site sign none			
		Site signage			
		Bicycle rack			
		Trash containers, none			
		Flag pole			
D2	**ANCILLARY WORK**		**Total below:**	**$0**	**$0**
Quant.	Unit	Description	Unit price	Cost	Cost
		No work in this cost model		0	0
		Assumed a site without environmental issues		0	0

Service Life Data Cost Comparison

Basic Fire Hall

SERVICE LIFE ANALYSIS, Based on Class C Estimate Date: 30-Apr-25	20% added for demo and repairs	Service life	Years 1 to 5 2025-2030	Years 6 to 10 2031-2035	Years 11 to 15 2036-2040	Years 16 to 20 2041-2045	Years 21 to 25 2046-250
SUBSTRUCTURE							
Description	Value	Years					
Generally substructural items will have a service life beyond 25 years **At the end of service life a component will be replaces in full with new**							
Structural has been consulted							
Grates and metal covers in SOG	$41,400	20	$0	$0	$0	$41,400	$0
Bollards are carried under sire work	See D1		$0	$0	$0	$0	$0
RTU screening carried with envelope	See A3		$0	$0	$0	$0	$0
STRUCTURE							
Description	Value	Years					
Generally structural items will have a service life beyond 25 years **At the end of service life a component will be replaces in full with new**							
Structural has been consulted							
Roof access ladders	$11,400	20	$0	$0	$0	$11,400	$0
EXTERIOR ENCLOSURE							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
Roofing membrane, insulation to remain	274,700	20	$0	$0	$0	$274,700	$0
Flashing	19,200	20	$0	$0	$0	$19,200	$0
RTU screening	48,000	25	$0	$0	$0	$0	$48,000
Fall arrests	21,200	25	$0	$0	$0	$0	$21,200
Calking and sealants	36,000	10	$0	$36,000	$0	$36,000	$0
Masonry façade has a service life beyond 25 years	0		$0	$0	$0	$0	$0
Metal Panels has a service life beyond 25 years	0		$0	$0	$0	$0	$0
OH doors	108,000	20	$0	$0	$0	$108,000	$0
Hardware in envelope doors	43,500	15	$0	$0	$43,500	$0	$0
Doors and glazing should last longer than 25 years	0		$0	$0	$0	$0	$0
Letters and Logo	18,000	25	$0	$0	$0	$0	$18,000
PARTITIONS & DOORS, CEILINGS							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
NOTE: Within this category there could be associated work in other categories, typically not included in a analysis like this							
Doors and glazing should last longer than 25 years			$0	$0	$0	$0	$0
Patching drywall is maintenance			$0	$0	$0	$0	$0
T-bar ceilings, excl. solid ceilings	89,300	15	$0	$0	$89,300	$0	$0
Hardware	95,300	15	$0	$0	$95,300	$0	$0

FULL POLICY Fire Hall

SERVICE LIFE ANALYSIS, Based on Class C Estimate Date: 30-Apr-25	20% added for demo and repairs	Service life	Years 1 to 5 2025-2030	Years 6 to 10 2031-2035	Years 11 to 15 2036-2040	Years 16 to 20 2041-2045	Years 21 to 25 2046-250
SUBSTRUCTURE							
Description	Value	Years					
Generally substructural items will have a service life beyond 25 years **At the end of service life a component will be replaces in full with new**							
Structural has been consulted							
Grates and metal covers in SOG	$41,400	20	$0	$0	$0	$41,400	$0
Bollards are carried under sire work	See D1		$0	$0	$0	$0	$0
STRUCTURE							
Description	Value	Years					
Generally structural items will have a service life beyond 25 years **At the end of service life a component will be replaces in full with new**							
Structural has been consulted							
Roof access ladders	$11,400	20	$0	$0	$0	$11,400	$0
EXTERIOR ENCLOSURE							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
Roofing membrane, insulation to remain	475,400	20	$0	$0	$0	$475,400	$0
Flashing	28,500	20	$0	$0	$0	$28,500	$0
RTU screening	0	25	$0	$0	$0	$0	$0
Fall arrests	31,800	25	$0	$0	$0	$0	$31,800
Calking and sealants	43,200	10	$0	$43,200	$0	$43,200	$0
Metal panels and roof over windows should last longer than 25 years	0		$0	$0	$0	$0	$0
Masonry façade has a service life beyond 25 years	0		$0	$0	$0	$0	$0
Metal cladding has a service life beyond 25 years	0		$0	$0	$0	$0	$0
Kalwal should last longer than 25 years	0		$0	$0	$0	$0	$0
Apparatus bay doors	468,000	20	$0	$0	$0	$468,000	$0
Hardware in envelope doors	121,500	15	$0	$0	$121,500	$0	$0
Doors and glazing should last longer than 25 years	0		$0	$0	$0	$0	$0
Letters and Logo	18,000	25	$0	$0	$0	$0	$18,000
PARTITIONS & DOORS, CEILINGS							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
NOTE: Within this category there could be associated work in other categories, typically not included in a analysis like this							
Doors and glazing should last longer than 25 years			$0	$0	$0	$0	$0
Patching drywall is maintenance			$0	$0	$0	$0	$0
T-bar ceilings, excl. solid ceilings	$96,800	15	$0	$0	$96,800	$0	$0
Hardware	$100,440	15	$0	$0	$100,440	$0	$0

Basic Fire Hall

SERVICE LIFE ANALYSIS, Based on Class C Estimate Date: 30-Apr-25	20% added for demo and repairs	Service life	Years 1 to 5 2025-2030	Years 6 to 10 2031-2035	Years 11 to 15 2036-2040	Years 16 to 20 2041-2045	Years 21 to 25 2046-250
FINISHES							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
Painting	55,900	12	$0	$0	$55,900	$0	$55,900
Caulking. Floor control joints	9,200	10	$0	$9,200	$0	$9,200	$0
Concrete floor sealer, also incl polished floors	41,600	10	$0	$41,600	$0	$41,600	$0
Sports rubber floor	15,800	10	$0	$15,800	$0	$15,800	$0
Cove base	7,900	10	$0	$7,900	$0	$7,900	$0
Recessed floor mats	17,800	10	$0	$17,800	$0	$17,800	$0
Wall vinyl, vestibules	7,800	15	$0	$0	$7,800	$0	$0
Porcelain tile and cultured marble will last longer than 25 years	0		$0	$0	$0	$0	$0
FITTINGS & EQUIPMENT							
Description	Value	Years					
							$0
At the end of service life a component will be replaces in full with new							
NOTE: Within this category there could be associated work in other categories, typically not included in a analysis like this							
Millwork	199,800	18	$0	$0	$0	$199,800	$0
Tack and white boards	26,600	10	$0	$26,600	$0	$26,600	$0
Washroom partitions	42,000	15	$0	$0	$42,000	$0	$0
Lockers	79,800	18	$0	$0	$0	$79,800	$0
Washroom accessories	36,400	12	$0	$0	$36,400	$0	$36,400
Hose racks	18,000	20	$0	$0	$0	$18,000	$0
Kitchen equipment	NIC		$0	$0	$0	$0	$0
Window covering	19,700	10	$0	$19,700	$0	$19,700	$0
MECHANICAL							
Description	Value	Years					
Pipes/ducts should last longer that 25 years							
Electrical disconnects and reconnects included where applicable							
Fire extinguishers	7,200	10	$0	$7,200	$0	$7,200	$0
Pumps	41,900	22	$0	$0	$0	$0	$41,900
Heat generation equipment	96,500	25	$0	$0	$0	$0	$96,500
AHUs & MTUs	213,500	25	$0	$0	$0	$0	$213,500
Fans	20,000	20	$0	$0	$0	$20,000	$0
Niederman	168,000	20	$0	$0	$0	$168,000	$0
Coils, force flow and cabinet heaters	71,000	15	$0	$0	$71,000	$0	$0
Grills, dampers and diffusers	59,000	15	$0	$0	$59,000	$0	$0
Expansion tanks etc.	16,000	15	$0	$0	$16,000	$0	$0
Hot water generation	51,300	15	$0	$0	$51,300	$0	$0
Plumbing fixtures	77,800	22	$0	$0	$0	$0	$77,800
Misc. items such as backflow pretension floor drains, clean-outs, etc.	23,900	20	$0	$0	$0	$23,900	$0
Kitchen exhaust/hood and fire suppression, gas solenoid shut off valve	74,500	18	$0	$0	$0	$74,500	$0
Controls, wiring to remain	93,500	22	$0	$0	$0	$0	$93,500

FULL POLICY Fire Hall

SERVICE LIFE ANALYSIS, Based on Class C Estimate Date: 30-Apr-25	20% added for demo and repairs	Service life	Years 1 to 5 2025-2030	Years 6 to 10 2031-2035	Years 11 to 15 2036-2040	Years 16 to 20 2041-2045	Years 21 to 25 2046-250
FINISHES							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
Painting	$62,600	12	$0	$0	$62,600	$0	$62,600
Caulking, floor control joints	$10,300	10	$0	$10,300	$0	$10,300	$0
Concrete floor sealer, also incl polished floors	$46,900	10	$0	$46,900	$0	$46,900	$0
Sports rubber floor	$15,800	10	$0	$15,800	$0	$15,800	$0
Cove base	$8,500	10	$0	$8,500	$0	$8,500	$0
Recessed floor mats	$18,400	10	$0	$18,400	$0	$18,400	$0
Wall vinyl, vestibules	$7,800	15	$0	$0	$7,800	$0	$0
Porcelain tile and cultured marble will last longer than 25 years	0		$0	$0	$0	$0	$0
FITTINGS & EQUIPMENT							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
NOTE: Within this category there could be associated work in other categories, typically not included in a analysis like this							
Millwork	$213,000	18	$0	$0	$0	$213,000	$0
Tack and white boards	$29,900	10	$0	$29,900	$0	$29,900	$0
Washroom partitions	$42,000	15	$0	$0	$42,000	$0	$0
Lockers	$79,800	18	$0	$0	$0	$79,800	$0
Washroom accessories	$36,400	12	$0	$0	$36,400	$0	$36,400
Hose racks	$18,000	20	$0	$0	$0	$18,000	$0
Kitchen equipment	NIC		$0	$0	$0	$0	$0
Window covering	$19,700	10	$0	$19,700	$0	$19,700	$0
MECHANICAL							
Description	Value	Years					
Pipes/ducts should last longer that 25 years							
Electrical disconnects and reconnects included where applicable							
Fire extinguishers	$7,200	10	$0	$7,200	$0	$7,200	$0
Pumps	$69,900	22	$0	$0	$0	$0	$69,900
Heat generation cooling equipment	$373,000	23	$0	$0	$0	$0	$373,000
Air handling	$379,600	25	$0	$0	$0	$0	$379,600
Fans, heat recovery	$72,200	20	$0	$0	$0	$72,200	$0
Niederman	$176,900	20	$0	$0	$0	$176,900	$0
Coils, force flow and cabinet heaters	140,300	15	$0	$0	$140,300	$0	$0
Grills, dampers and diffusers	85,200	15	$0	$0	$85,200	$0	$0
Expansion tanks etc.	21,300	15	$0	$0	$21,300	$0	$0
Hot water generation	89,400	15	$0	$0	$89,400	$0	$0
Plumbing fixtures	$87,000	22	$0	$0	$0	$0	$87,000
Misc. items such as backflow pretension floor drains, clean-outs, etc.	29,300	20	$0	$0	$0	$29,300	$0
Kitchen exhaust/hood and fire suppression, gas solenoid shut off valve	74,500	18	$0	$0	$0	$74,500	$0
Controls, wiring to remain	$181,300	22	$0	$0	$0	$0	$181,300

Basic Fire Hall

SERVICE LIFE ANALYSIS, Based on Class C Estimate Date: 30-Apr-25	20% added for demo and repairs	Service life	Years 1 to 5 2025-2030	Years 6 to 10 2031-2035	Years 11 to 15 2036-2040	Years 16 to 20 2041-2045	Years 21 to 25 2046-2050
ELECTRICAL							
Description	Value	Years					
Switchgear and panels should last longer than 25 years							
Generator	207,000	20	$0	$0	$0	$207,000	$0
Light fixtures incl exit lights and fixtures on face of building	309,800	20	$0	$0	$0	$309,800	$0
Data racks	52,800	20	$0	$0	$0	$52,800	$0
Receptacles and switches, data outlets	24,000	15	$0	$0	$24,000	$0	$0
Cord reels	21,500	15	$0	$0	$21,500	$0	$0
Security end equipment	NIC		$0	$0	$0	$0	$0
Security, included 33%	17,600	15	$0	$0	$17,600	$0	$0
SITE WORK							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
No replacements to deep services within 25 years							
Bollards	$13,300	20	$0	$0	$0	$13,300	$0
Metal fence walls at garbage enclosure	$18,700	15	$0	$0	$18,700	$0	$0
3 double swing doors at garbage enclosure	$15,100	20	$0	$0	$0	$15,100	$0
Concrete curbs only	$54,100	20	$0	$0	$0	$54,100	$0
Resurface asphalt paving	$95,800	20	$0	$0	$0	$95,800	$0
Wheal stops	$7,400	15	$0	$0	$7,400	$0	$0
Pavement markings	$3,100	10	$0	$3,100	$0	$3,100	$0
Some trees and shrubs and shrubs	$53,900	20	$0	$0	$0	$53,900	$0
Site Furniture, flag pole etc.	$8,900	12	$0	$0	$8,900	$0	$8,900
Metal fence and gates/doors	$76,100	20	$0	$0	$0	$76,100	$0
Site electrical			$0	$0	$0	$0	$0
Site lighting replace heads	$30,800	20	$0	$0	$0	$30,800	$0
Lighting controls	$10,900	20	$0	$0	$0	$10,900	$0
Car plugs	$14,100	15	$0	$0	$14,100	$0	$0
Electric vehicle charging station	$12,100	20	$0	$0	$0	$12,100	$0
ANCILLARY WORK							
Description	Value	Years					
			$0	$0	$0	$0	$0
			$0	$0	$0	$0	$0
ESTIMATED NET TOTAL 2025 Dollars excl. GST			$0	$184,900	$679,700	$2,155,300	$711,600
NET TOTAL design/estimating, and construction contingencies included			$0	$232,100	$853,100	$2,705,400	$893,200
NET TOTAL inflation included, rate used: 2.60%			$0	$300,000	$1,239,900	$4,483,200	$1,653,000

FULL POLICY Fire Hall

SERVICE LIFE ANALYSIS, Based on Class C Estimate Date: 30-Apr-25	20% added for demo and repairs	Service life	Years 1 to 5 2025-2030	Years 6 to 10 2031-2035	Years 11 to 15 2036-2040	Years 16 to 20 2041-2045	Years 21 to 25 2046-2050
ELECTRICAL							
Description	Value	Years					
PV switchgear and panels should last longer than 25 years							
Generator	$310,600	20	$0	$0	$0	$310,600	$0
Light fixtures incl exit lights and fixtures on face of building	$497,300	20	$0	$0	$0	$497,300	$0
Data racks	$81,800	20	$0	$0	$0	$81,800	$0
Receptacles and switches, data outlets	$27,000	15	$0	$0	$27,000	$0	$0
Cord reels	$21,500	15	$0	$0	$21,500	$0	$0
Security end equipment	NIC		$0	$0	$0	$0	$0
Security, included 33%	$30,500	15	$0	$0	$30,500	$0	$0
SITE WORK							
Description	Value	Years					
At the end of service life a component will be replaces in full with new							
No replacements to deep services within 25 years							
Bollards	$13,300	20	$0	$0	$0	$13,300	$0
Metal fence walls at garbage enclosure	$23,300	15	$0	$0	$23,300	$0	$0
3 double swing doors at garbage enclosure	$18,900	20	$0	$0	$0	$18,900	$0
Concrete curbs only	$54,100	20	$0	$0	$0	$18,900	$0
Resurface asphalt paving	$95,800	20	$0	$0	$0	$95,800	$0
Wheal stops	$7,400	15	$0	$0	$7,400	$0	$0
Pavement markings	$3,100	10	$0	$3,100	$0	$3,100	$0
Some trees and shrubs and shrubs	$67,300	20	$0	$0	$0	$67,300	$0
Site Furniture, flag pole etc.	$8,900	12	$0	$0	$8,900	$0	$8,900
Metal fence and gates/doors	$95,100	20	$0	$0	$0	$95,100	$0
Site electrical			$0	$0	$0	$0	$0
Site lighting replace heads	$36,200	20	$0	$0	$0	$36,200	$0
Lighting controls	$12,800	20	$0	$0	$0	$12,800	$0
Car plugs	$14,100	15	$0	$0	$14,100	$0	$0
Electric vehicle charging station	$12,100	20	$0	$0	$0	$12,100	$0
ANCILLARY WORK							
Description	Value	Years					
			$0	$0	$0	$0	$0
			$0	$0	$0	$0	$0
ESTIMATED NET TOTAL 2025 Dollars excl. GST			$0	$203,000	$936,440	$3,151,500	$1,248,500
NET TOTAL design/estimating, and construction contingencies included			$0	$254,800	$1,175,400	$3,955,700	$1,567,100
NET TOTAL inflation included, rate used: 2.60%			$0	$321,000	$1,669,300	$6,404,500	$2,793,500

Energy Model Cost Comparison Findings Summary

The energy modeling analysis shows that the Full Policy Station design's energy consumption (in ekWh) is 47.1% lower than that of the Basic Civic Station design. To normalize the impact of varying floor areas between the two designs, a Total Energy Use Intensity (TEUI) comparison was used, which shows that the Full Policy Station design has reduced TEUI by 58% compared to the Basic Civic Station design.

The Full Policy Station design utilizes an onsite solar photovoltaic (PV) system, estimated to generate 24.3% of the building's total energy usage. The station is designed to be all-electric, allowing the PV system to directly use all the energy generated onsite. This will further reduce TEUI to be 68% lower than the Basic Civic Station design.

The Full Policy Station design achieves carbon neutrality through the City of Edmonton's commitment to procuring 100% renewable electricity starting in 2024. By purchasing Renewable Energy Certificates, all grid electricity emissions are offset, resulting in net zero electricity emissions. Embracing electrification and moving away from fossil fuels, the Full Policy Station design will reduce 76 tons of CO_2e emissions annually, amounting to 1,898 tons of CO_2e over 25 years, compared to the Basic Civic Station design.
Despite this significant energy and GHG emission reductions, the discrepancy between the cost of electricity and the cost of natural gas results in a discrepancy between energy savings and energy cost savings. Energy costs were calculated using utility cost and escalation rates derived from the City of Edmonton's climate-resilient technical specifications (COE-IM-GUIDE-0030). The utility rates suggested by this document align with current market prices. However, the current rates show that the cost of electricity is about 11 times higher than that of natural gas ($0.239 per kWh vs $0.0216 per kWh).

This discrepancy in utility prices means that the energy cost for the Full Policy Station design will have a lifecycle utility cost present value higher than that of the Basic Civic Design Station ($1,253,000 vs. $700,000) before accounting for renewable energy. Utilizing solar renewable energy will reduce the utility lifecycle present value difference ($964,900 vs $700,000).

As the two stations have different floor areas, using energy cost intensity allows for normalization of the area difference and makes the cost performance comparable. The Full Policy Station design has a first-year annual cost intensity of $34.7/m² compared to $25.1/m² for the Basic Civic Station design (before accounting for renewable energy). After accounting for the solar PV, the first-year annual cost intensity for the Full Policy Station design will drop to $26.3/m², making it only 4.3% higher than the Basic Civic Station design.
The life cycle costing calculation indicates that the solar PV system is expected to have a payback period of 17-18 years, considering the estimated capital cost, electricity price, and escalation rates.

A life cycle costing analysis was conducted over a 25-year period, incorporating estimated energy costs from the energy model, as well as capital costs, maintenance costs, and equipment/system replacement costs provided by the design team.

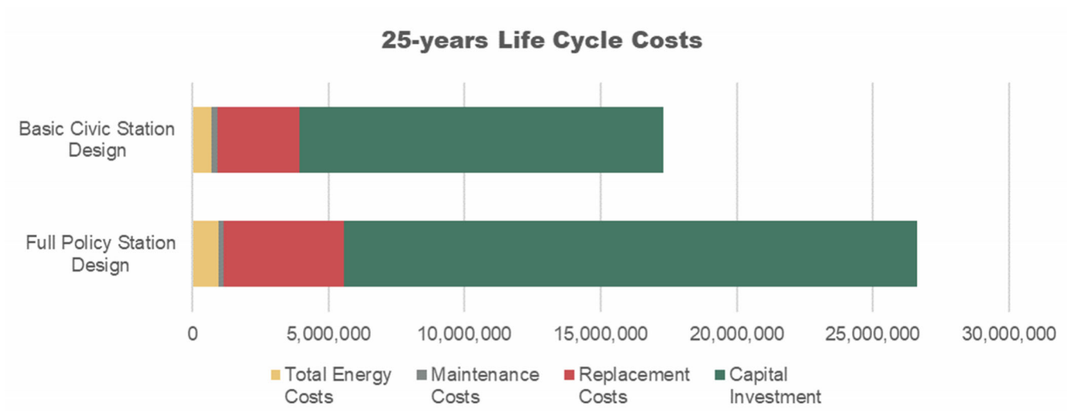
This analysis reflects the Government of Canada's order to eliminate the Consumer Carbon Price, amending Schedule 2 of the Greenhouse Gas Pollution Pricing Act (GGPPA) to set the fuel charge rates to zero after March 31, 2025. This approach was selected to align with current regulations, which are not captured by the City of Edmonton's climate-resilient technical specifications.

The table below provides an overview of the project's life cycle costs, broken down into two components: capital costs and operational costs. The analysis shows that the primary driver for the cost increase is the higher capital cost for the Full Policy Station design. Operational costs, which represent 20% of the overall building life cycle cost, are higher in the Full Policy Station design due to the higher replacement costs and higher energy costs; resulting from the higher electricity prices compared to natural gas.

Refer to Appendix 3 for detailed Energy Model Comparison and Cost Comparison

Life Cycle Costing Summary

Design	Capital Cost	Operational Costs	Total Life Cycle Cost
Basic Civic Station Design	13,347,500	3,943,585	17,291,085
Full Policy Station Design	21,039,300	5,586,712	26,626,012
Net Present Value	**-7,691,800**	**-1,643,127**	**-9,334,927**



6.0| Comparative Analysis Summary

Comparative Analysis Summary Table

Base Civic Station Design Comparison to Full Policy Station Design

This table indicates various design elements and their estimated costs to achieve the Full Policy Station design over the Basic Civic Station design. The table attributes the cost premium to its cost driver (C627, EDC, Fire Rescue, etc.)

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
ARCHITECTURAL					
Roof Assembly and Design	• Flat roof with R-Value 30. Minimum requirement to meet Alberta Building Code 2019. • Includes back of parapet cladding/insulation	• Flat roof with R-Value 50. Thermally-broken roof design, • Additional detailing around PV panels • Includes back of parapet cladding/insulation	C627- Climate Resilience A1117 - OHS C523 -Fire Rescue CoE Consultant Manual	$629,000	• Thermal performance and energy efficient design to enhance overall thermal performance and energy efficiency consistent with requirements for Climate Resilience policy and criteria outlined in Consultant Manual for Envelope Performance. • Roof performance and protection • Access to panels
Wall Assembly Design including Cladding and Parapets	• Insulated metal panel. Clearfield: R-30. Effective R-Value 13.9 • Insulated metal panel (included in wall assembly above. • Masonry to 1000mm high • Minimum parapet height. Typically 400mm high.	• 175mm sprayed insulation, Clearfield: R-30. Effective R-Value 13.9 • Translucent composite sandwich panel (Kalwall) • Thermally-broken wall system • Consistent parapet height around building to maintain design concept.	EDC - Edmonton Design Committee C627- Climate Resilience A1117 - OHS C523 -Fire Rescue CoE Consultant Manual	$1,307,000	• Thermally broken envelope design to enhance overall thermal performance and energy efficiency consistent with requirements for Climate Resilience policy and criteria outlined in Consultant Manual for Envelope Performance. • Design of cladding and parapets are consistent with the level of design quality and design aesthetic of the whole of the city. • Increased parapet height is due to OHS and roof access due to solar panel maintenance. • No soffits in this design
Overhang & Façade Detailing	• Architectural façade detailing	• Architectural façade detailing • South windows have overhang	C627 - Climate Resilience EDC - Edmonton Design Committee	$83,000	• Overhang provides shade, reducing need for interior window covering. • Detailing around apparatus bay doors and to masonry cladding.
Glazing System	• Double glazed high performance aluminum curtain wall frames	• Triple glazed high performance aluminum curtain wall frames	C627 - Climate Resilience	$30,000	• Energy efficiency
Exterior Doors	• Glazed entry and insulated metal panel doors • Control and barrier-free access on 2 doors.	• Glazed entry and insulated metal panel doors • Control and barrier-free access on all doors.	C602 - Accessibility CoE Consultant Manual C627 - Climate Resilience	$95,000	• Doors types are the same for both designs, however, there is additional control and barrier-free access for Full Policy.
Exterior Apparatus Bay Doors	• O/H doors (6 total)	• High performance, bi-fold doors (6-total)	C627- Climate Resilience A1117 - OHS C523 -Fire Rescue	$414,000	• Energy efficiency • May help to improve response time for fire fighters

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
Interior Partitions, Doors and Ceilings	• Block and framed walls • Steel and solid wood doors with steel frames • Exposed ceilings, acoustic T-bar and gypsum ceilings	• Block and framed walls • Steel and solid wood doors with steel frames • Exposed ceilings, acoustic T-bar and gypsum ceilings	CoE Consultant Manual C523 -Fire Rescue	$241,000	• Gypsum wallboard thickness increased • Surface protection • Wall height and support • Higher block walls • Added support and protection above to align with requirements for Fire Rescue and Consultant Manual, including acoustic considerations.
Interior Finishes	• Painted gypsum walls • Sealed concrete floors	• Painted gypsum walls • Sealed concrete floors	CoE Consultant Manual C523 -Fire Rescue	$26,000	• Larger surface
Interior Fitment and Equipment	• Millwork with solid surface counters • Changeroom benches, washroom partitions, mirrors, lockers. • Hose racks, walk off grates • Window coverings	• Millwork with solid surface counters • Changeroom benches, washroom partitions, mirrors, lockers. • Hose racks, walk off grates • Window coverings	C627 - Climate Resilience CoE Consultant Manual C523 - Fire Rescue	$26,000	• Upgrades to meet policy and standards, including millwork to meet Architectural Woodwork Standards of Canada .
Sitework	• No architectural finishes to hard surfaces • No perimeter fence	• Public plinth at near front entry • Upgraded concrete with patterning • Perimeter fence	EDC - Edmonton Design Committee C602 - Accessibility C458 - Public Art C523 - Fire Rescue C588 - Winter	$196,000	• Enhance design and treat plaza as civic space • Full and EDC compliant site with plinth and hard surfaces. • Plaza and walkway connection treatment for comfort, safety, beauty and interest applicable to accessibility and winter design.
Landscaping and Vegetation	• Minor addition of perimeter trees. • Hydro seeding	• Increased number of perimeter trees • Soft landscaping • Stormwater containment • Full concrete curbs throughout	EDC - Edmonton Design Committee C588 - Winter Design C627 - Climate Resilience Zoning bylaw 20001 LID - Low Impact Development CoE Design and Construction Standards	$105,000	• Expands urban forest and enhances climate resilience • Full and EDC compliant landscaped site • Trees help to block winds, particularly in winter months. • Amount and landscaping and number of trees considers zoning. Implementation of landscape per CoE standards. Implementation of native species and soft landscape to support stormwater management and biodiversity.

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
STRUCTURAL					
General Loading	• Standard snow loads, drifting only due to rooftop units or steps in roof elevation	• Additional dead load due to PV panel system and drifting around PV systems, as well as heavier loads and higher drifts if larger mechanical units are required	C627 – Climate Resilience EDC – Edmonton Design Committee CoE Consultant Manual C523 –Fire Rescue	$498,000	• Increased general loading to all components of the structure to accommodate the roof, increased snow load (PV Panels), high parapets, full wall masonry, and MUA units. • Increased to align with Consultant Manual requirements for supporting interior mechanical and electrical systems. • Structural components to support PV panels included • Plinth / plaza support
Roof System	• Steel roof deck on open-web steel joists, beams and columns	• Heavier roof structure required to carry higher loads. With PV system on roof, there may be additional requirements for servicing of panels (a number of factors can add secondary steel such as; are panels raised off of roof, angled to maximize exposure, are service walkways required, etc.)	C627- Climate Resilience A1117 – OHS C523 –Fire Rescue CoE Consultant Manual	See General Loading above for cost premium	• Same as above.
2nd Floor/Mezzanine	• Concrete topping on steel deck (130mm depth overall, reinforced with 10M at 400 each way), open-web steel joists, beams and columns	• Only changes if loading due to mechanical equipment is increased in these areas.	C627 – Climate Reslience CoE Consultant Manual C523 –Fire Rescue	See General Loading above for cost premium	• The mezzanine has increased in size and load in comparison to the Basic Civic Station to accommodate and support, per Consultant Manual, the mechanical within the building.
Floor Slab	• Conventional slab on grade, 250mm thick in apparatus bays (reinforced with 15M at 300 each way top and bottom) and 130mm thick (reinforced with 10M at 330 each way) in other areas • Tarmac with snow melt	• Geothermal grid requires implementation of structurally-supported slab throughout. Coordination of of building piles and geothermal locations is required. Also, may have to accommodate additional or heavier mechanical units on the floor in mechanical areas. • Added rebar/insulation for in-slab heating • Includes spill containment for generator • Tarmac with snow melt	C627- Climate Reslience CoE Consultant Manual C523 –Fire Rescue	$296,000	• The Geothermal requires a more complex slab to compensate for, and span over the geothermal loops • Increased to align with Consultant Manual requirements for supporting interior mechanical and electrical systems. • Thickness of slab in Working / Living to accommodate in-slab heating.

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
Foundations	• Reinforced concrete grade beams on belled concrete or CFA piles	• Reinforced concrete grade beams on CFA Piles. Belled piles can conflict with geothermal shaft locations and so may limit foundation options to CFA piles.	C627- Climate Reslience CoE Consultant Manual C523 -Fire Rescue	$231,000	• Change in piles to accommodate the geothermal loops • Increased to align with Consultant Manual requirements for supporting interior mechanical and electrical systems. • Plinth / plaza support • Added load due to PV panels • Added load for masonry cladding

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
MECHANICAL					
Main Heating System	• Modular AHU with gas heating • Gas fired boilers to serve skirt heating and can be used for AHU and UHs	• Ground source heat pump • Electric supplemental boiler and glycol/manifold for skirt heating	C627 - Climate Reslience EDC - Edmonton Design Committee CoE Consultant Manual C523 -Fire Rescue	$1,931,000	• Policy C627 is the primary cost premium driver for the mechanical systems. An electric based, highly efficient HVAC system is required to meet the emissions neutral target of C627. • Redundancy on pumps and equipment per Consultant Manual
Main Cooling System	• Modular AHU with DX cooling to serve main spaces	• Ground source heat pump	C627 - Climate Reslience C523 -Fire Rescue	See Main Heating System above for cost premium	• Same as above. • Cooling is a EFRS requirement.
Main Ventilation System	• Ventilation is provided through the MUA units and modular AHU	• Dedicated Outdoor Air System (DOAS) with hydronic heating and heat recovery (90%+ heat recovery effectiveness)	C627 - Climate Reslience	See Main Heating System above for cost premium	• Added cost for equipment when decoupling ventilation from heating and cooling. • Added cost for heat recovery.
HVAC - Dormitories and Office Spaces	• VAV boxes and reheat coils for temperature control • AHU provides heating and cooling	• Distributed VRF evaporators	C627 - Climate Reslience	See Main Heating System above for cost premium	• Added cost for VRF equipment.
HVAC - Apparatus Bay	• Gas fired MUA unit • Exhaust fans to remove vehicle exhaust • Gas fired unit heaters at overhead doors to provide heating • No cooling	• Hydronic MUA unit • Exhaust fans to remove vehicle exhaust • Hydronic unit heaters at overhead doors to provide heating • No cooling	C627 - Climate Reslience	See Main Heating System above for cost premium	• Added cost for hydronic system piping and accessories (e.g. control valves, balancing valves, etc.)

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
HVAC - Gym	• Dedicated MUA and exhaust fan with heat recovery (approximately 65% heat recovery effectiveness) • No cooling	• VRF evaporator • Cooling provided	C627 - Climate Reslience C523 -Fire Rescue	See Main Heating System above for cost premium	• Added cost for VRF equipment.
HVAC - Kitchen	• Heating, cooling, and ventilation supplied from AHU • Gas fired MUA and exhaust hood for kitchen ventilation • Commercial grade exhaust	• VRF evaporator for heating and cooling • Hydronic MUA and exhaust hood for kitchen ventilation • Commercial grade exhaust	C627 - Climate Reslience C523 -Fire Rescue	See Main Heating System above for cost premium	• Added cost for VRF equipment, hydronic system piping and accessories, and commercial grade equipment. • Specialty gas shut-off equipment for automated shut-off with manual resets for gas appliances are an EFRS requirement.
Domestic Hot Water	• Gas fired storage type water heaters	• Air source heat pump storage type water heaters	C627 - Climate Reslience	$33,000	• Added cost for heat pump equipment over more traditional gas fired equipment.
Controls	• Building Automation System • BACNET or Echelon compliant • Monitors equipment such as air handlers, exhaust fans, boilers, and terminal units	• Building Automation System • BACNET or Echelon compliant • Monitors equipment such as air handlers, exhaust fans, heating and cooling equipment, terminal units, chillers, cooling towers, boilers, sump pits, and temperatures in critical common areas	C627 - Climate Reslience	$143,000	• The Full Policy Station has more mechanical equipment compared to the Basic Civic Station and this results in more control and monitoring points. Each additional point adds capital cost. • Individual dorm temperature control also has a premium compared to grouping dorms on fewer thermostats
Floor Heating	• No radiant flooring • Snow melt system with glycol heat exchanger	• Radiant floors throughout • Refrigerant fan coils to provide heating to offset potential deficient slab heating • Snow melt system with glycol heat exchanger	C523 - Fire Rescue	$171,000	• Radiant floors provide space heating and also increase local thermal comfort compared to an all air system.
Fire Protection	• Sprinkler, FD connection	• Sprinkler, FD connection - cost in additional to Basic for area/connections/points/piping	CoE Consultant Manual	$26,000	• CoE Consultant Manual requirement • Additional building area requires sprinklers
Plumbing	• Rough-in, sanitary and water / storm water drain line	• Rough-in, sanitary and water / storm water drain line • Generator fuel fill station	CoE Consultant Manual	$82,000	• CoE Consultant Manual requirement
Testing, balancing, commissioning			CoE Consultant Manual	$17,000	• CoE Consultant Manual requirement

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
ELECTRICAL					
Main electrical utility service	• 400A-600V-3Ph-4W main electrical utility service • Historically ~35-50kW average, with peaks of ~70kW • Additional space required to be allocated for future digital metering system; odes not need to be installed.	• 800A - 600V - 3Ph - 4 W main electrical service • Main electrical utility service is considerably larger to accommodate **photovoltaics**, and **policy-informed mechanical loads**. (physical size and electrical capacity) • Digital metering system required to meet LEED advanced energy metering credit. • Avoid electric heat if possible, as electric heat will increase electrical utility service size considerably.	C627 - Climate Resilience	$124,000	• See descriptions in "Full Policy" column • Supports Net-Zero/Emissions-Neutral, LEED, NBC (AE)
Materials (conductors and transformers)	• Aluminum is provided for feeders above 100A • All other wiring is Copper wire • Cost-savings: clients virtually always opt for the lesser expensive aluminum	• All copper	CoE Consultant Manual	$28,000	• See descriptions in "Full Policy" column • Extra conduit provided for redundancy
Photovoltaics (Solar)	• None	• Full Policy requires partial solar power generation. • Some form of renewables required for LEED Renewable Energy Credit • Shutdown safety equipment as per COE-IM-TMO-0001 • Providing PV's to City of Edmonton's policies (1% of	C627 - Climate Resilience CoE Solar Photovoltatic Program Volume 2 COE-IM-GUIDE-0004 w/ Technical Memo COE-IM-TMO-0001	$138,000	• See descriptions in "Full Policy" column • Supports LEED
Backup Generator	• Full building backup - exterior generator in enclosure: • Sized 150kW. • Exterior generator enclosure, muffler, and sub-base fuel tank	• Full building backup - interior generator room as per CoE Consultant Manual. • Backup generator size increases to accommodate mechanical loads. • Sized 300kW	CoE Consultant Manual C627 - Climate Resilience C523 - Fire Rescue	$119,000	• See descriptions in "Full Policy" column • Supports Net-Zero/Emissions-Neutral, LEED, NBC (AE) • Per EFRS, generator size is increased to pick up entire building. Fuel Station ofo 72 hours is needed.
Lighting & Lighting Controls, Power, Outlets	• Providing basic LED lighting system to minimal standards and Foot Candles • Providing basic lighting controls and line voltage switching with occupancy sensors to comply with NECB • Power, outlets per programme requirement	• Low voltage addressable LED controls systems with occupancy sensors to comply with NECB with low voltage digital system • Arch lighting / exterior lighting for CPTED	C627 - Climate Resilience EDC- Edmonton Design Committee CoE Consultant Manual C588 - Winter Design	$414,000	• See descriptions in "Full Policy" column • Supports LEED • Exterior lighting & Architectural lighting • 'Top hat' (Kalwall) lit with min. low energy LED lights to reduce energy consumption. • CPTED requirements

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
Communications	• Standard Cat6 with minimal connections • Wireless Access Points with minimal connections	• Standard CAT6 with maximum connections to meet CoE consultant manual (VOIP at 200% increase over basic station) • Full wireless access point connections systems (approx. 200% more than basic station)	CoE Consultant Manual	$33,000	• Additional costs attributed to the increased connectivity required within and without the station The VOIP system is referenced in the COE Consultant Manual. IT section notes two data drops are required per workstation.
Fire Alarm	• Per applicable codes	• Per applicable codes. • Additional fire alarm equipment for photovoltaics.	CoE Solar Photovoltatic Program Volume 2 COE-IM-GUIDE-0004 w/ Technical Memo COE-IM-TMO-0001 driven by C627	$6,000	• See descriptions in "Full Policy" column
Card Access	• Rough-in for entry door	• Full Cabling and Head end equipment provided to CoE Consultant Manual, locations provided by CoE CorpSec and EFRS	CoE Consultant Manual	$45,000	• A full Card Reader system provided
CCTV	• No cameras	• Full Cabling and Head end equipment provided to CoE Consultant Manual, locations provided by EFRS	CoE Consultant Manual	See Card Access cost premium above	• A full CCTV Back-Up and Rough-In system provided
SAS (Station Alerting System)	• Full Cabling and Head end equipment	• Full Cabling and Head end equipment provided to CoE Consultant Manual, locations provided by CoE CorpSec and EFRS	C523 - Fire Rescue	$0	• The Full Policy Station would accommodate a fully robust SAS system, but the CofE would provide the systems, therefore no direct costs to a station borne by the contractor.
UPS SYSTEM	• None provided	• Provided UPS for all data and systems networks	CoE Consultant Manual	$91,000	• Consultant Manual requires UPS system(s)
Lightning Protection	• None provided	• Provided	C523 - Fire Rescue	$99,000	• Fire Rescue requirement
Commissioning and Testing		• Per CoE - fully commissioned building provided	CoE Consultant Manual	$15,000	• Consultant Manual requirement

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
ENERGY					
Exterior Walls	• R10 Overall performance	Minimum R34 or higher overall performance (Clearfield: R	C627 and NECB 2017	See Note 1	TEDI Target Refer to Architectural for premium costs
Exterior Roof	• Clearfield: R-30	• Clearfield: R-50	C627 and NECB 2017	See Note 1	TEDI Target Refer to Architectural for premium costs
Slab-on-Grade	• Uninsulated	• R-20 fully insulated slab (F-0.261)	C627 and NECB 2017	See Note 1	TEDI Target Refer to Architectural for premium costs
Glazing System	Double Glazed Clear Effective (NFRC): U-0.35, SHGC 0.3	Triple Glaze U-0.2	C627 and NECB 2017	See Note 1	TEDI Target Refer to Architectural for premium costs
Infiltration Rate	0.25 Lps/m² per NECB 2017	0.25 Lps/m² per NECB 2017	C627 and NECB 2017	See Note 1	TEDI Target
Penetration Ratios	Window & Door to Wall: 17%	Window & Door to Wall: 37% or lower (include Apparatus KALWALL) without KALWALL, Window & Door to Wall less than 15%	C627 and NECB 2017	See Note 1	TEDI Target Refer to Architectural for premium costs
Interior lighting	20% below NECB Prescriptive Values	25% to 30% below NECB Prescriptive Values	C627 and NECB 2017	See Note 1	20% below NECB 2017 Refer to Electrical for premium costs
Apparatus Bay	Hydronic heating	Hydronic heating connected to the ground loop through the water to water heat pump	C627 and NECB 2017	See Note 1	20% below NECB 2017 Refer to Mechanical for premium costs
Offices, Classroom, Dormitory, Corridors	Variable Air Volume Air Handling Unit Hydronic heating, DX Cooling, Air Side Heat Recovery Effectiveness: 65%	Dedicated Outside Air System (DOAS) + Zonal Heat Pump Units Hydronic heating connected to the ground loop through the water to water heat pump	C627 and NECB 2017	See Note 1	TEDI Target and 20% below NECB 2017 Refer to Mechanical for premium costs
Mechanical & Electrical Rooms	Hydronic heating	Hydronic heating connected to the ground loop through the water to water heat pump	C627 and NECB 2017	See Note 1	TEDI Target and 20% below NECB 2017 Refer to Mechanical for premium costs
Hot Water Plant	Condensing Boilers Efficiency: 96% rated @ 80°F Return Temp VSD Pumps	Electric Boilers only provides supplemental heating Hydronic heating connected to the ground loop through the water to water heat pump	C627 and NECB 2017	See Note 1	TEDI Target and 20% below NECB 2017 Refer to Mechanical for premium costs
Chilled Water	DX Cooling	VRF connected to the ground loop	C627 and NECB 2017	See Note 1	20% below NECB 2017 Refer to Mechanical for premium costs
Domestic Hot Water	Gas Fired . Efficiency: 96% Rated	Air Soure Heat Pump	C627 and NECB 2017	See Note 1	20% below NECB 2017 Refer to Mechanical for premium costs
Onsite renewable	None	1% PV System of Capital Cost	C627 and NECB 2017	See Note 1	Climate Resilience Refer to Electrical for premium costs

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			
				$7,692,000	Estimated Total CoE Full Policy Cost Premium (includes Architectural (A), Structural (S), Mechanical (M) & Electrical (E))

Note 1: Energy is for reference only. Cost premiums associated with Energy are captured in architectural, structural, mechanical and electrical costs.
Note 2: Cost premiums account for GC fee, general requirements, design contingency, cost contingency and permits
Note 3: Cost premiums reflect floor area differences between Basic Civic and Full Policy scopes, impacting architectural, structural, mechanical, and electrical costs.

Item	BASIC CIVIC STATION DESIGN Systems Description Summary	CoE FULL POLICY STATION DESIGN Systems Description Summary	APPLICABLE POLICIES For CoE Full Policy Station Design	Estimated CoE Full Policy Cost Premium (costs w/o GC costs)	Reason for Cost Premium
	Description	Description			

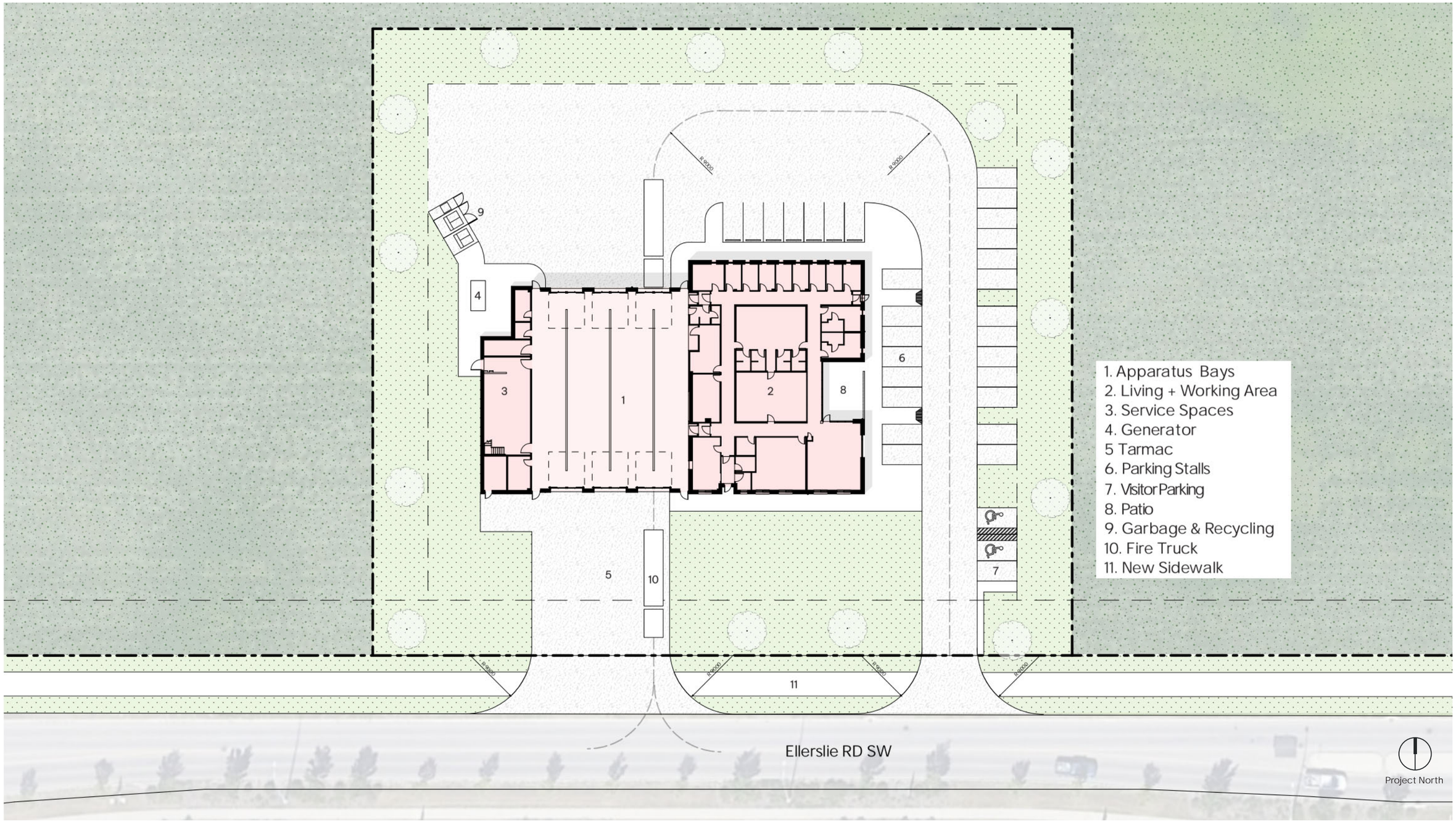
PUBLIC ART

Public Art Allocation Per Policy C458E	None	Allocation of Funds of 1% of Construction Costs	C458E	$210,000	This is not included in the cost differential as the art costs are assumed outside of the construction cost and part of the project costs.

Note 1: Energy is for reference only. Cost premiums associated with Energy are captured in architectural, structural, mechanical and electrical costs.
Note 2: Cost premiums account for GC fee, general requirements, design contingency, cost contingency and permits
Note 3: Cost premiums reflect floor area differences between Basic Civic and Full Policy scopes, impacting architectural, structural, mechanical, and electrical costs

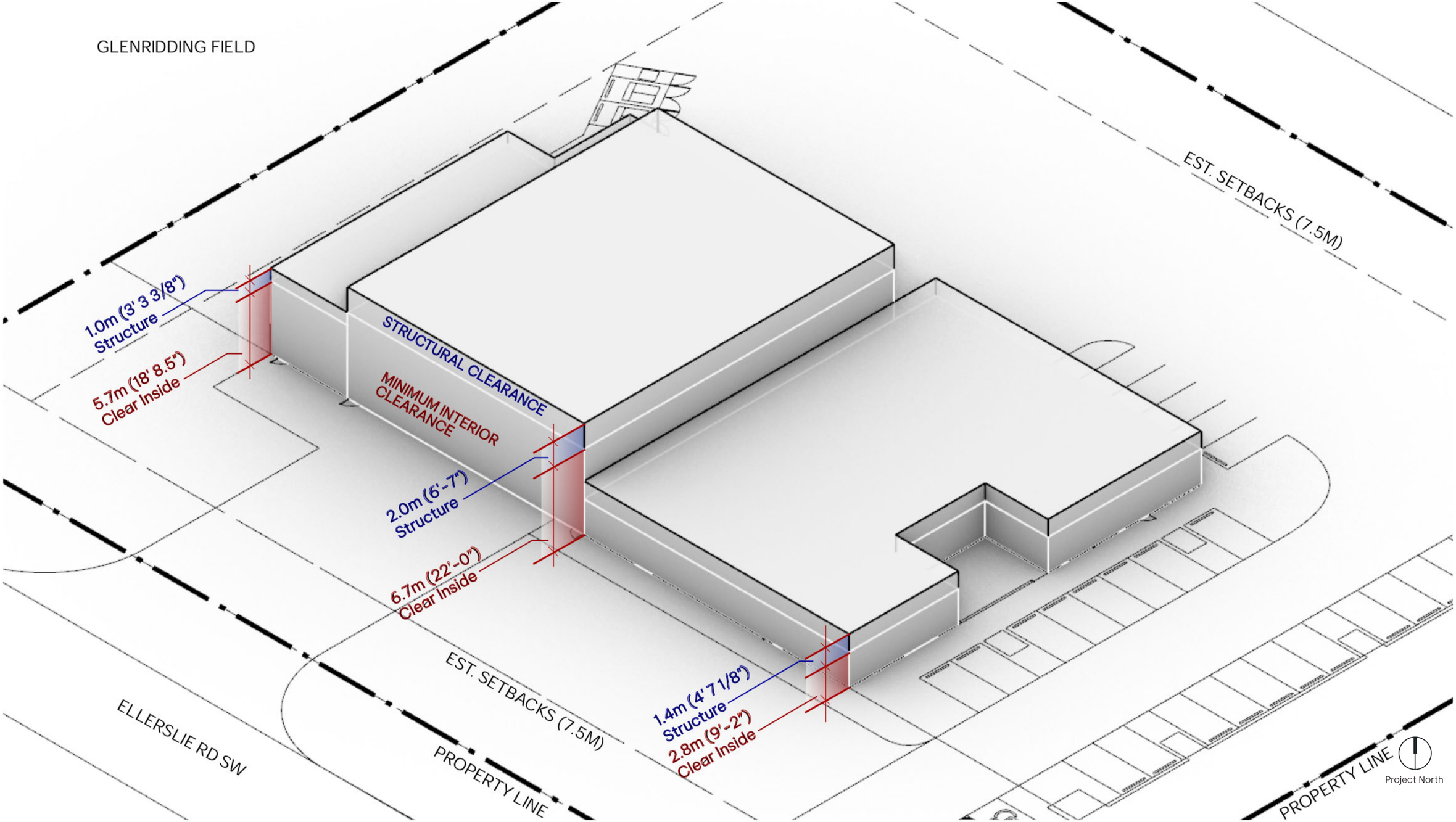
Appendix 1 | Basic Civic Design Drawings

Site Plan



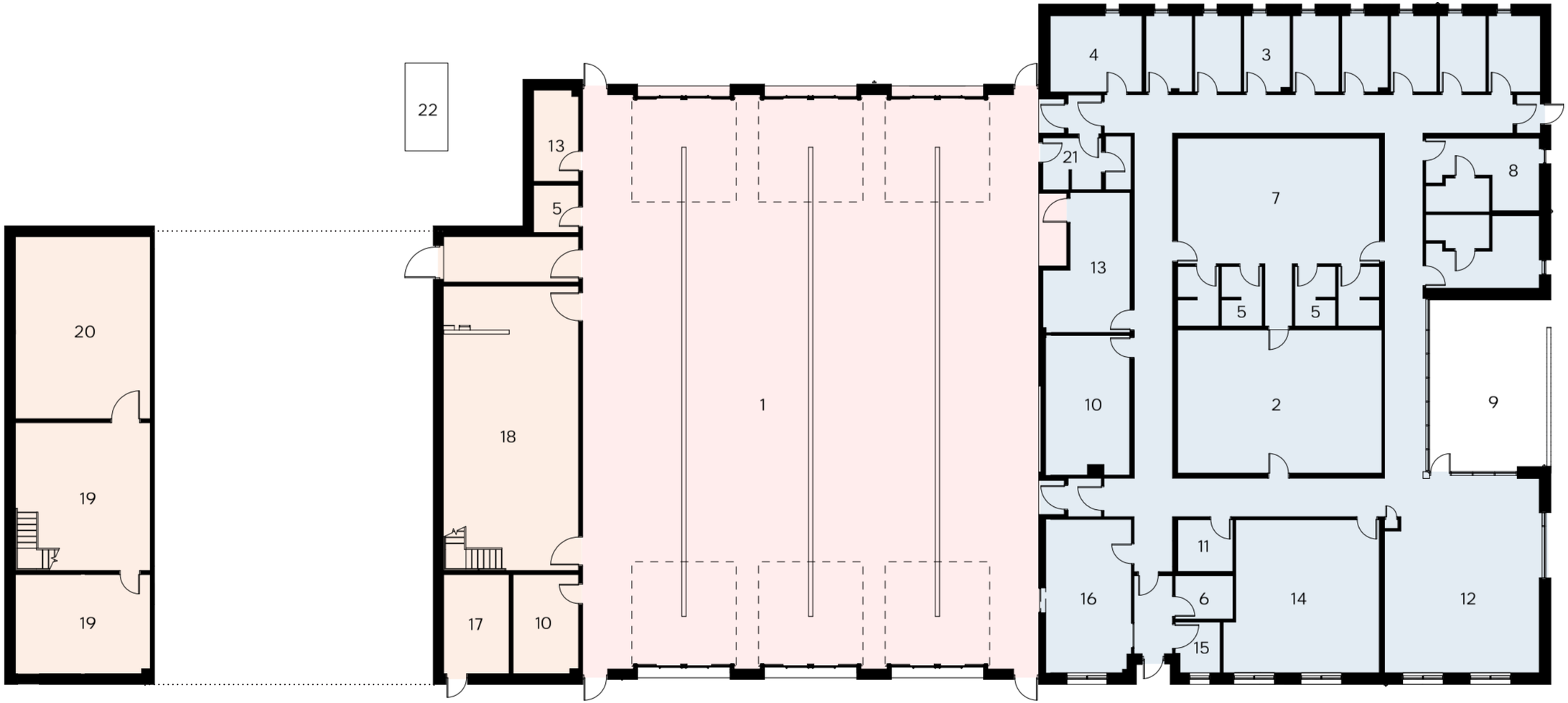
Scale 1 : 500

Massing Diagram



Floor Plans

BASIC CIVIC DESIGN



Mezzanine Level

Main Level

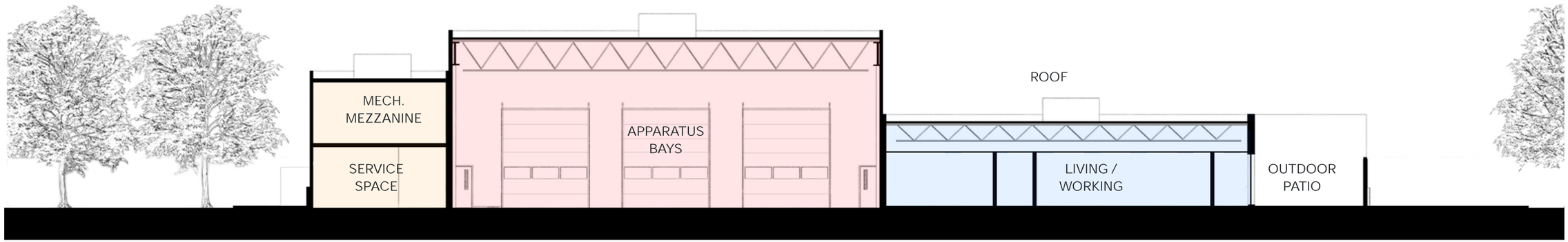
1. Apparatus Bays
2. Fitness Room
3. Dorm
4. Study Room
5 Washroom
6. Barrier Free Washroom
7. Locker Room
8. Captain's Dorm
9. Outdoor Patio
10. IT/Electrical Room
11. Watch Box
12. Kitchen
13. Custodial & Maintenance Storage
14. Day Room
15. Community Room
16. Captain's Office
17. Meter Room
18. Duty Gear
19. Storage
20. Mechanical Room
21. Decon Laundry & Washroom
22. Generator

Legend

- Apparatus Bays
- Service
- Work + Living

oject North

Building Section



Legend

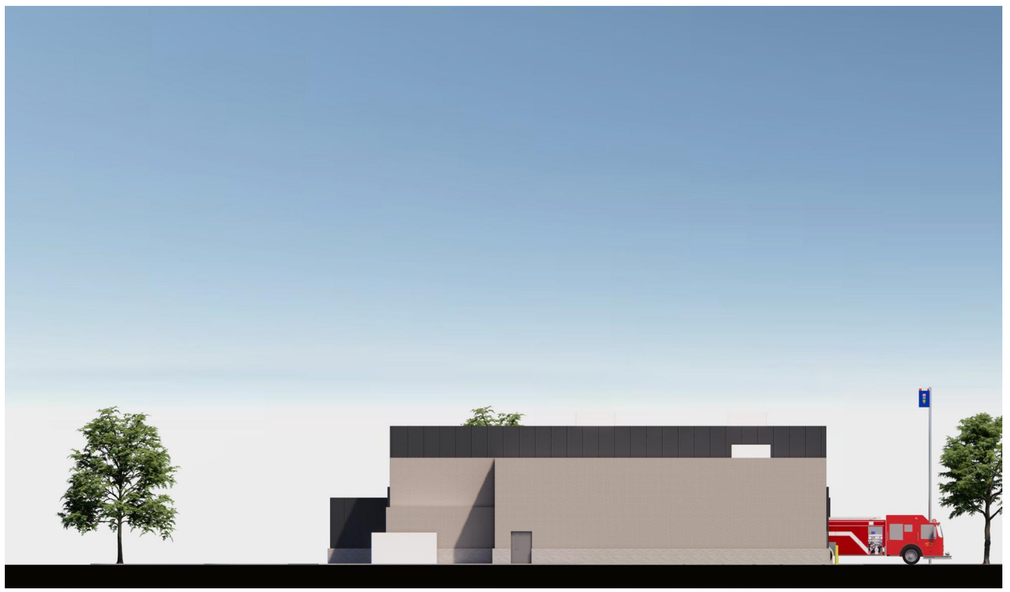
- Apparatus Bays
- Service
- Work + Living

Building Elevations

SOUTH ELEVATION

EAST ELEVATION

NORTH ELEVATION



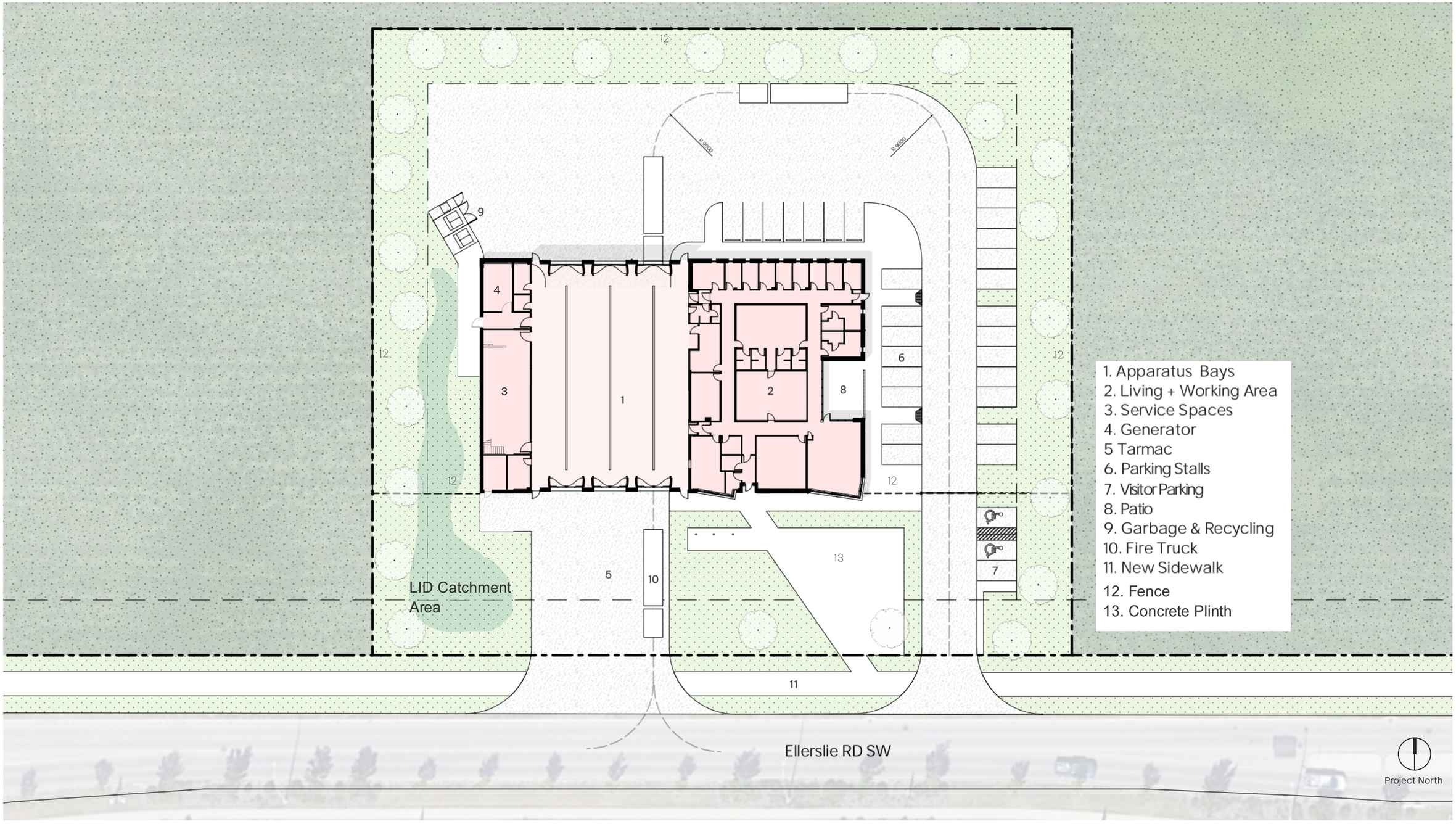
WEST ELEVATION

Concept Rendering

Appendix 2 | Full Policy Design Drawings

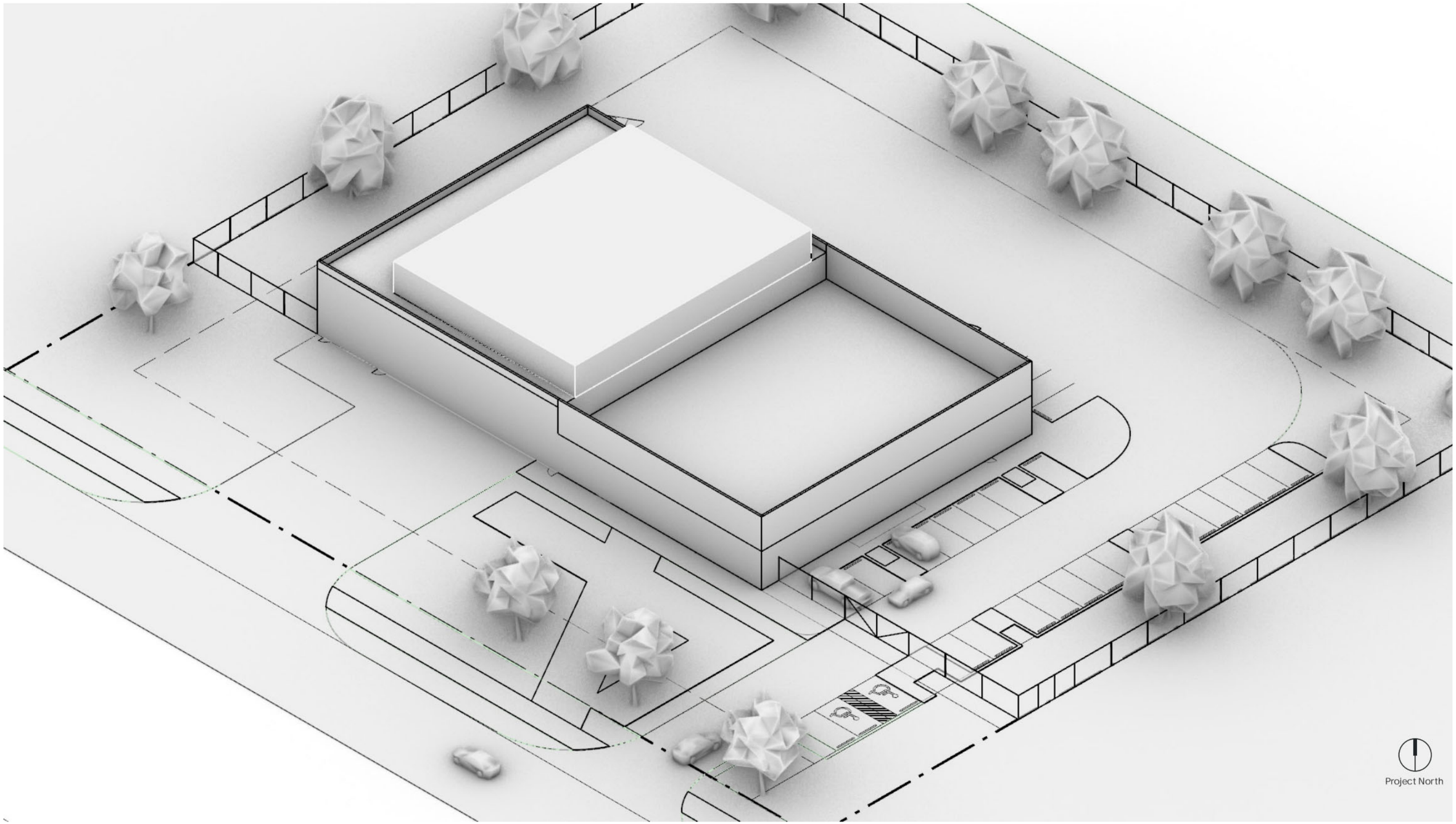
Site Plan

FULL POLICY DESIGN



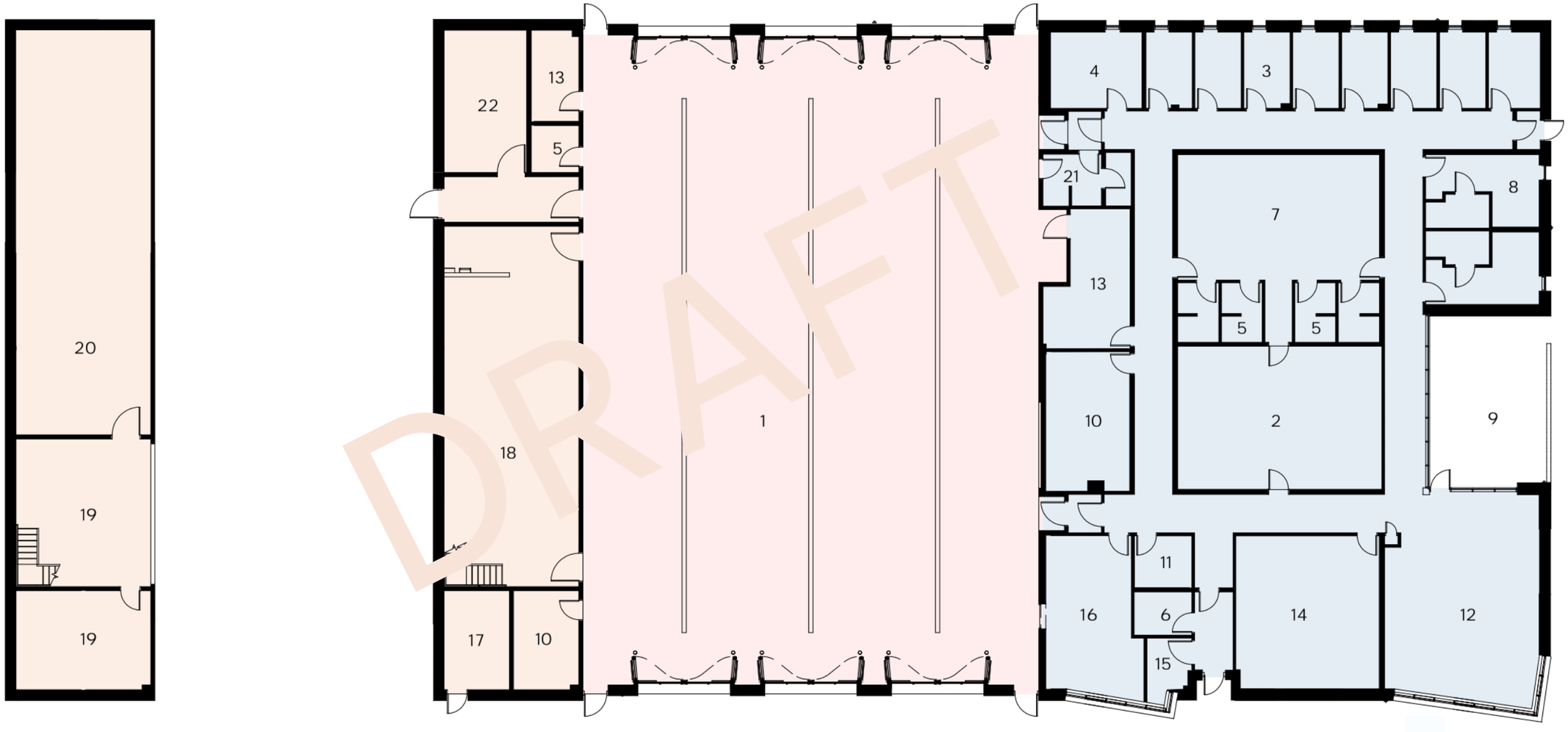
Scale 1 : 500

Site Plan



Floor Plans

FULL POLICY DESIGN



1. Apparatus Bays
2. Fitness Room
3. Dorm
4. Study Room
5 Washroom
6. Barrier Free Washroom
7. Locker Room
8. Captain's Dorm
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14. Day Room
15. Community Room
16. Captain's Office
17. Meter Room
18. Duty Gear
19. Storage
20. Mechanical Room
21. Decon Laundry & Washroom
22. Generator

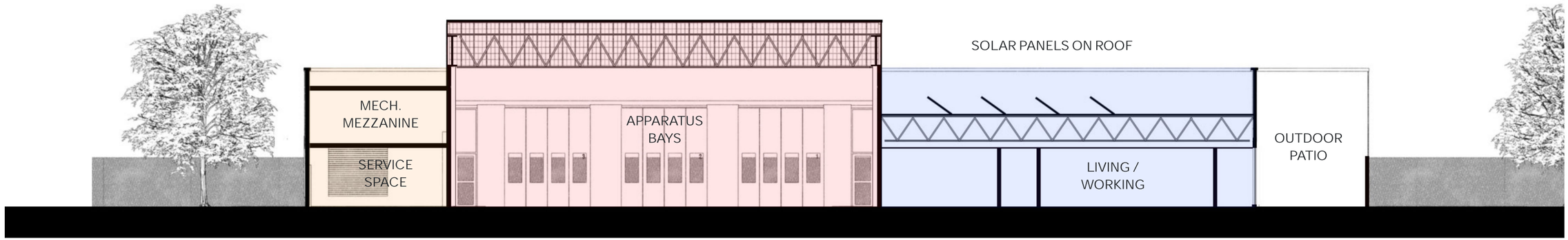
Legend

- Apparatus Bays
- Service
- Work + Living

Project North

Building Section

FULL
POLICY
DESIGN



Legend

- Apparatus Bays
- Service
- Work + Living

Building Elevations

FULL POLICY DESIGN

SOUTH ELEVATION

EAST ELEVATION

NORTH ELEVATION

WEST ELEVATION

Concept Rendering

FULL
POLICY
DESIGN

Concept Rendering

FULL
POLICY
DESIGN

Appendix 3 | Energy Model Comparison and Energy Model Cost Comparison

Energy Modelling Comparison

1- Energy Performance

A consistent energy modeling analysis method was used to evaluate the energy performance of the two proposed designs, following the guidelines in Part 8 of NECB 2017 and NECB 2020. The anticipated energy performance for each station's design will vary based on several factors, including floor area, space volume, envelope area, and equipment efficiencies.

The table below compares the energy performance of the two designed stations in terms of Total Energy Use Intensity (TEUI) in ekWh/m², against each other and the generated reference models.

Utilizing the TEUI to compare energy performance enables the normalization of the impact of varying floor areas. This approach ensures that energy efficiency assessments are consistent and comparable across buildings of different sizes. Note that the TEUI does not account for the impact of renewable energy systems in the Full Policy Station design.

Total Energy Use Intensity Summary

Design	Current Design (per NECB 2020)	NECB 2020 Reference	Design (per NECB 2017)	NECB 2017 Reference
Basic Civic Station Design	354.6	380.5	295.5	336.6
Full Policy Station Design	149.5	277.5	110.0	211.3
TEUI Reduction [1]	57.9%	27.1%	62.8%	37.2%

[1] Energy consumption savings differ from TEUI savings due to variations in the floor area of different buildings.

The energy modeling results indicate that the Full Policy Station design has reduced the Total Energy Use Intensity (TEUI) by 58% compared to the Civic Station design. These energy savings are achieved through various envelope and system improvement measures. When comparing total consumption in equivalent kilowatt-hours (ekWh), the Full Policy Station design's energy consumption is 47.1% lower than that of the Basic Station design.

The energy modeling results indicate that the performance of the reference model improves when the heating source is changed from natural gas to electricity. According to NECB energy modeling guidelines, both the proposed and reference models must use the same energy type. Consequently, the reference model in the Basic Civic station design is changed from natural gas boilers and furnaces to heat pumps and electric resistance in the Full Policy Station design. This change in the system type increases the reference system's efficiency, making it more challenging to achieve energy target compliance. When the proposed building's system includes an air-source, water-source, or ground-source heat pump, the reference system must be an air-source heat pump. Therefore, using a ground-source heat pump system is the best option to achieve substantial energy performance improvements compared to the reference model.

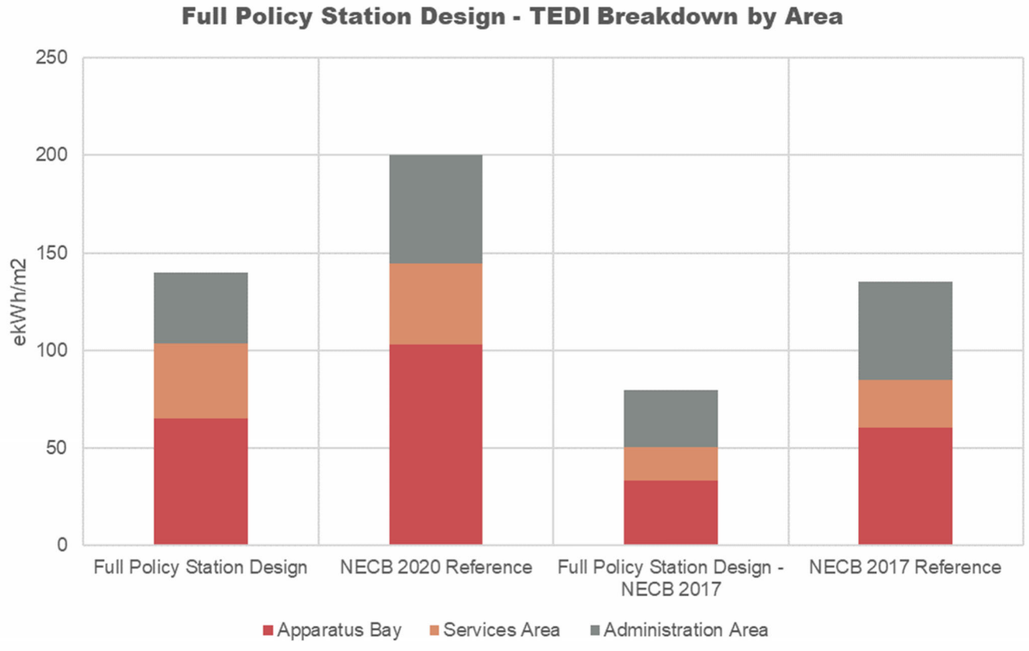
Energy performance targets can be achieved using Variable Refrigerant Flow (VRF) systems or water-source heat pumps. However, ground-source heat pumps (GSHP) offer distinct advantages in cold climates. GSHPs maintain high performance year-round, significantly reducing the need for supplemental electric heating. In contrast, air-source and water-source heat pumps experience efficiency drops during cold seasons, relying more heavily on supplemental heat.

The results also indicate that the NECB 2020 energy modeling requirements, particularly those related to air leakage, significantly impact energy performance. No energy savings are claimed from air leakage reduction. However, reducing air leakage below NECB requirements can substantially improve heating performance. This strategy can be considered for the administration and services areas of the building, although large overhead doors may limit the potential for reducing air leakage in the apparatus bay.

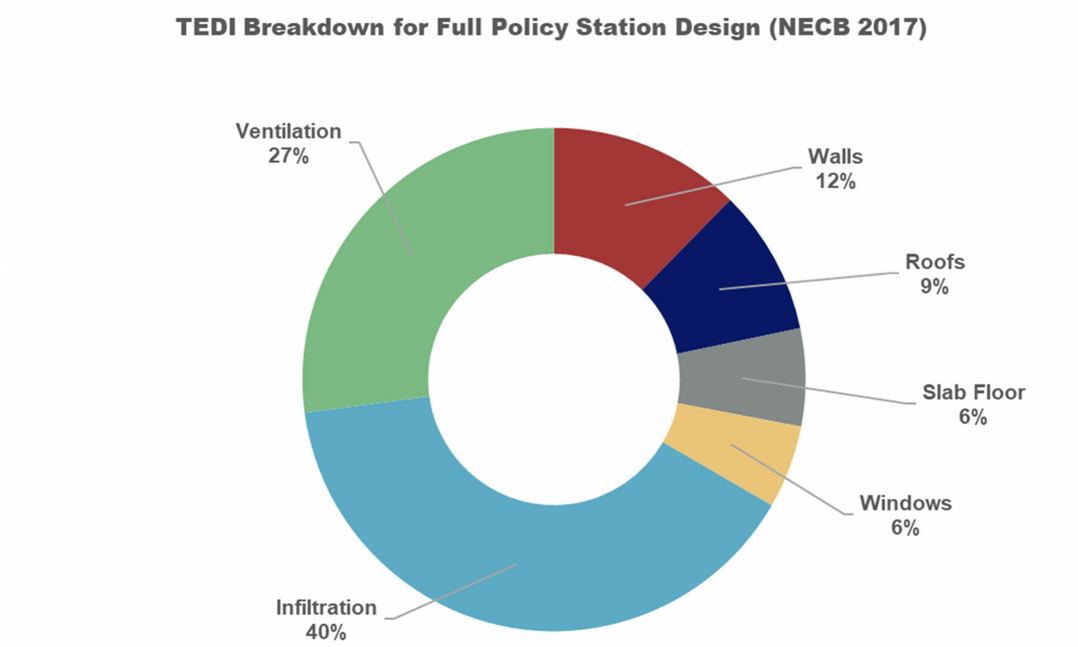
2- Thermal Energy Demand Intensity

Thermal energy demand intensity (TEDI) refers to the annual heat loss from a building's envelope and ventilation, after accounting for all passive heat gains and losses. When measured with model, this is the amount of heating energy delivered to the project from all types of space heating equipment, per unit of modelled floor area. The Full Policy Station design is required to achieve TEDI less than 80 kilowatt hours per square meter (ekWh/m²).

In this building type, TEDI is driven by the envelope performance more than the ventilation performance (e.g. TEDI in healthcare facilities is driven by ventilation requirements). Achieving policy TEDI target in the project is challenging due to the high Surface Area Ratio (SAR), which measure the total envelope area over the built-up area. The higher the number indicate that building has large exposure with significant envelope losses. Both the Basic Civic design and the Full Policy Station design have an SAR value larger than 1.8 m²/m². Approximate, the apparatus bay accounts for 40-46% of the overall TEDI due to its large area and large volume in comparison to other spaces. The figure below shows a break down to TEDI by area for the Full Policy Station design against the NECB reference models. The chart shows the significant impact of air leakage on TEDI.



The next chart shows the TEDI breakdown based on heating losses for the Full Policy Station design, in accordance with NECB 2017 (required for C-627 Climate Resilience Policy compliance). The chart demonstrates that improvements to the walls, roofs, slab, and glazing have significantly reduced thermal losses, enabling the achievement of the TEDI target. Ventilation strategies, such as heat pipes in the apparatus bay, heat recovery, and dedicated outdoor air systems, have significantly reduced ventilation TEDI.



It is important to recognize that improving the building's TEDI performance helps ensure long-term energy efficiency, as building envelopes have long lifespans and provide reliable efficiency gains. Additionally, building envelope retrofits can be costly and challenging to implement without disturbing occupants. Improved thermal performance also enhances resilience during power outages, as buildings can better maintain comfortable interior temperatures when the power supply is disrupted.

3- Renewable Energy Performance

The Full Policy Station design utilizes an onsite solar photovoltaic (PV) system, which is estimated to generate 24.3% of the building's total energy usage. The station is designed to be all-electric, allowing the PV system to directly use all the energy generated on-site. Solar PV system will reduce the TEUI to 113.2 kWh/m^2 which is 68% better than the Basic Civic Station design.

4- GHG Emissions Performance

The Full Policy Station design achieves carbon neutrality through the City of Edmonton's commitment to procuring 100% renewable electricity starting in 2024. The City of Edmonton's green energy purchase agreement does not extend to cover the full 25 years considered in the life cycle analysis. For the purpose of this analysis, zero emissions were considered for the full 25 years. With the green energy purchase agreement, all grid electricity emissions are offset, resulting in net zero electricity emissions.

Embracing electrification and moving away from fossil fuels, the Full Policy Station design will reduce 75.9 tons of CO_{2e} emissions annually, amounting to 1,898 tons of CO_{2e} over 25 years, compared to the Basic Civic Station Design.

Energy Model Cost Comparison

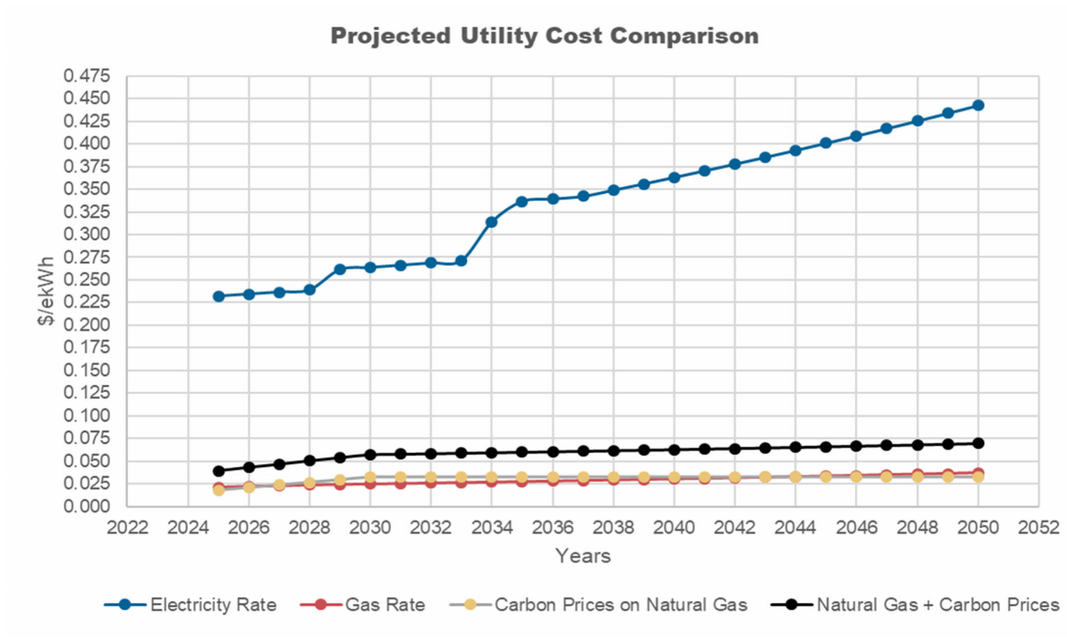
1- Utility Cost Analysis

As part of this analysis, utility costs, escalation rates, predicted carbon tax, and GHG emissions factors are derived from the City of Edmonton's climate-resilient technical specifications (COE-IM-GUIDE-0030). The utility rates suggested by this document align with current market prices.

Based on these utility prices, the overall energy cost (including energy and demand costs) of electricity is $0.239 per kWh, while the cost of natural gas is approximately $0.0216 per kWh ($6.01/GJ). This means that the energy cost of electricity is about 11 times higher than that of natural gas. The discrepancy between the cost of electricity and the cost of natural gas results in a discrepancy between energy and energy cost savings.

The carbon tax is expected to reduce the gap between electricity and natural gas costs over time, assuming the grid increasingly relies on non-fossil fuel energy sources. However, the life cycle costing analysis accounts for the impact of the Government of Canada's decision to eliminate the Consumer Carbon Price, effective April 1, 2025. Carbon pricing is not included in this analysis. For demonstration purposes only, the life cycle costing including carbon prices was provided in the energy modelling report appendix, allowing the City to recognize the potential impact if regulations change.

The chart below provides a comparison between the utility cost over the building life cycle. The chart shows the significant difference in electricity prices against the natural gas price, even after accounting for carbon tax.



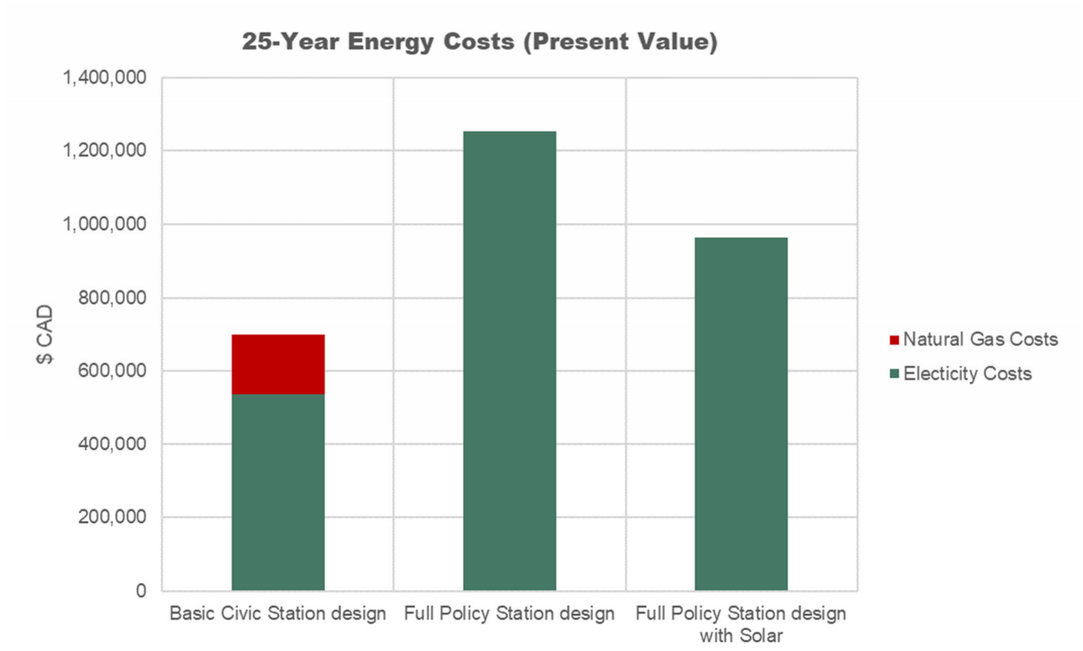
The Full Policy Station heating system is designed to rely on a high-efficiency heat pump system instead of traditional electric boiler heating. Simulation results show that the ground loop is sized to manage all heating loads during peak demand, eliminating the need for supplemental electrical heating and significantly reducing energy costs. Using a ground source heat pump with a seasonal COP between 3.5 and 4.0 will narrow the cost difference between electricity and natural gas, making electricity about 2.7 to 3.0 times more expensive than natural gas, instead of 11 times.

Relying on electric boilers to provide heating during peak hours leads to higher operational costs due to their lower efficiency compared to heat pump systems. Implementing a hybrid heating system that combines electric heat pumps with a secondary heating source, such as natural gas or propane, can reduce energy costs during emergency demand and provide resilience in case of electricity blackouts. Additionally, this hybrid system allows for transitioning between different energy sources based on costs.

Although the current study and analysis predict lower natural gas prices, especially since the study does not account for carbon prices, there will always be uncertainty in natural gas prices due to external factors such as regulations, political or weather events. A hybrid system that includes a high-efficiency electrical system and high-efficiency natural gas heating can optimize utility costs based on the energy source market price. However, an offsetting to the onsite emissions from the fusil fuel will be required.

2- Energy Cost Analysis

The life cycle cost analysis, which incorporates energy escalation rates and discount rates, shows that the 25-year energy cost for the Full Policy Station design is higher than that for the Basic Civic Station design (present value of $1,253,000 vs. $700,000). The figure below compares the life cycle energy costs between the two design stations, broken down by energy type.



the energy cost savings will be less significant when compared to a reference building heated with natural gas.

The incremental capital costs of the geothermal system and the difference in utility costs due to switching from natural gas to electric heating make it important to reduce the base building heating and cooling loads as much as possible. Cost benefits associated with ground-source heat pumps are more likely when the overall building loads have been minimized first.

Ground-source heat pumps do not provide cost benefits as an individual measure. However, when combined with strategies such as decreased glazing area, improved envelope performance, heat recovery and solar energy utilization, ground-source heat pumps play a key role in achieving lower energy use intensities and cost-effective design.

Energy Model GHG Emissions Comparison

Alberta's grid has a higher GHG emissions factor compared to natural gas. The government of Alberta is implementing a planned process to reduce grid GHG emissions by retiring coal generation plants (which was completed in mid-2024) and substituting them with lower carbon emission sources and more renewable energy generation. As a result, the electricity grid GHG emission factor has been decreasing over time as the province transitions to lower-GHG electricity production. The projected electricity grid GHG emissions factors are available in Environment and Climate Change Canada's (ECCC) National Inventory Report and emissions forecast.

On the other hand, the City of Edmonton has procured 100% renewable electricity (green energy purchase) for city operations starting from 2024. The City of Edmonton's green energy purchase agreement does not extend to cover the full 25 years considered in the life cycle analysis. For the purpose of this analysis, zero emissions were considered for the full 25 years. The green energy purchase will offset all electricity GHG emissions by the City of Edmonton, resulting in a grid emission factor of zero.

The tables below summarize the life cycle GHG emissions for the Basic Civic Station design and the Full Policy Station design, with and without the green energy purchase. The results show that during the building life cycle, without accounting for the green energy purchase, the Full Policy Station design will have total GHG emissions of 947.8 tonnes of CO_{2e}, which is 61% lower than the Basic Civic Station design (with no green energy purchase).

By combining the energy efficiency of the Full Policy Station design with a green energy purchase agreement, the City of Edmonton has avoided emitting approximately 2,432 tonnes of CO_2e over the building's 25-year life cycle—emissions that would have occurred if the building had been constructed using the Basic Civic Station design without a green energy purchase.

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Total GHG Emissions Summary with City of Edmonton Green Electricity Purchase

Year NO.	Year	City of Edmonton Grid Factor (With Green Electricity Purchase) $kgCO_{2e}/kWh$	Natural Gas $kgCO_{2e}/kWh$	Total Basic Civic Station with Green Electricity Purchase $kgCO_{2e}$	Total Full Policy Station with Green Electricity Purchase $kgCO_{2e}$
1	2026	0	0.1908	75,906	0
2	2027	0	0.1908	75,906	0
3	2028	0	0.1908	75,906	0
4	2029	0	0.1908	75,906	0
5	2030	0	0.1908	75,906	0
6	2031	0	0.1908	75,906	0
7	2032	0	0.1908	75,906	0
8	2033	0	0.1908	75,906	0
9	2034	0	0.1908	75,906	0
10	2035	0	0.1908	75,906	0
11	2036	0	0.1908	75,906	0
12	2037	0	0.1908	75,906	0
13	2038	0	0.1908	75,906	0
14	2039	0	0.1908	75,906	0
15	2040	0	0.1908	75,906	0
16	2041	0	0.1908	75,906	0
17	2042	0	0.1908	75,906	0
18	2043	0	0.1908	75,906	0
19	2044	0	0.1908	75,906	0
20	2045	0	0.1908	75,906	0
21	2046	0	0.1908	75,906	0
22	2047	0	0.1908	75,906	0
23	2048	0	0.1908	75,906	0
24	2049	0	0.1908	75,906	0
25	2050	0	0.1908	75,906	0
Total				**1,897,655**	**0**

Total GHG Emissions Summary without Green Electricity Purchase

Year NO.	Year	Alberta Electrical Grid Factor $kgCO_{2e}/kWh$	Natural Gas $kgCO_{2e}/kWh$	Total Basic Civic Station without Green Electricity Purchase $kgCO_{2e}$	Total Full Policy Station without Green Electricity Purchase $kgCO_{2e}$
1	2026	0.250	0.1908	105,015	51,508
2	2027	0.230	0.1908	102,687	47,388
3	2028	0.210	0.1908	100,358	43,267
4	2029	0.210	0.1908	100,358	43,267
5	2030	0.210	0.1908	100,358	43,267
6	2031	0.190	0.1908	98,029	39,146
7	2032	0.190	0.1908	98,029	39,146
8	2033	0.180	0.1908	96,865	37,086
9	2034	0.180	0.1908	96,865	37,086
10	2035	0.170	0.1908	95,700	35,026
11	2036	0.170	0.1908	95,700	35,026
12	2037	0.170	0.1908	95,700	35,026
13	2038	0.170	0.1908	95,700	35,026
14	2039	0.170	0.1908	95,700	35,026
15	2040	0.170	0.1908	95,700	35,026
16	2041	0.170	0.1908	95,700	35,026
17	2042	0.170	0.1908	95,700	35,026
18	2043	0.170	0.1908	95,700	35,026
19	2044	0.170	0.1908	95,700	35,026
20	2045	0.170	0.1908	95,700	35,026
21	2046	0.180	0.1908	96,865	37,086
22	2047	0.180	0.1908	96,865	37,086
23	2048	0.180	0.1908	96,865	37,086
24	2049	0.170	0.1908	95,700	35,026
25	2050	0.170	0.1908	95,700	35,026
Total				**2,433,265**	**947,753**

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