ATTACHMENT – 3

SUSTAINABILITY FRAMEWORK

Sustainability Framework

PROJECT:

Crystal Pool Wellness Centre Replacement
City of Victoria, BC

DATE:

January 2019

PREPARED FOR:

City of Victoria

PREPARED BY:

HCMA Architecture + Design
205–26 Bastion Square
Victoria, BC V8W 1H9

DRAFT

HCMA

CONTENT

Executive Summary

The replacement of the existing Crystal Pool Wellness Centre (CPWC) is a priority project for the City of Victoria that aligns with the City's strategy to sustain and enhance community-based recreation services and programs. The new CPWC will address current community needs, while responding to the future environmental and social needs in a responsible way. The new facility is targeting a gross floor area of approximately 7,700 m^2, accommodating a natatorium section with several pools, and a wellness Centre offering fitness, music, art, and multipurpose rooms.

This Sustainability Framework aims to report the ongoing dialogue around the project, and to establish sustainability principles and goals to serve as reference for the project team and client as the design develops. In developing these goals, HCMA reviewed a variety of policies which are relevant to the City, community and project, most notably the City's Climate Leadership Plan (CLP). Most relevant from the CLP are the Municipal Operations targets, which call for City-owned facilities to be 100% renewable by 2040, capital and operating plans to be informed by climate data, carbon pricing and the City's GHG reduction targets by 2020, as well as defining, communicating, and tracking GHG data.

In order to inform the design in a meaningful way with climate data as called for, the environmental conditions of the site that are relevant to the project are reviewed in the framework as well. Factors and categories of measurement are then reviewed in more detail, and recommendations are proposed based on the building program and the City's ambitions. Drawing on the framework findings and the current design case, the following high-level targets are proposed for the new CPWC. Further details and strategies on these targets are elaborated in Section 4.1 of this document.

Project Principles & Targets

ENERGY AND EMISSIONS

CPWC will achieve considerable reductions in building energy use, GHG emissions and operating costs across both embodied and operational life-cycle phases.

Targets:

CaGBC Zero Carbon Building standard – Design Certification.
BC Step Code 2 for Rec and Art facilities.
Annual Site Energy Use Intensity: 25% reduction from base code - 600-650 kWh/m²/yr .
Annual Thermal Energy Demand Intensity: 75kWh/m2.yr for entire building / 30kWh/m2.yr for building without pool ventilation.
On-site 5% renewable energy generation based on the entire project EUI.
Whole-building airtightness of maximum 1.0 Air Changes per Hour (ACH) at 50 Pascals pressure.
Complete a Commissioning process for assemblies, mechanical, electrical, plumbing, and renewable energy systems.

WATER CONSERVATION

CPWC will achieve significant reductions in site potable water consumption over a code compliant building, using source efficiency and reclamation strategies.

Target:

Manage on site runoff from developed site for the 95th percentile of rainfall events as per LEED calculations.
Avoid the use of permanent irrigation for the landscape using native and adapted vegetation.
Achieve a minimum **40% reduction in indoor water use consumption** from a pre-established 'baseline' condition, calculated with the LEED v4 BD+C credit WEc2 calculation guidelines.

SITE DEVELOPMENT

CPWC will retain the original stands of trees and will prioritize native planting on site to restore any habitat disturbed by development and provide enjoyable outdoor spaces.

Targets:

Preserve and retain existing tree canopy cover over the entire site.
Ensure site hydrology respected such that post-development flow is not greater than pre-development flow, which will align with stormwater goals, while also providing habitat.

TRANSPORTATION AND ACCESSIBILITY

CPWC will reduce the community's transportation GHG emissions by encouraging walking, using public transit, or bicycles, and minimize the need for automobile use.

Targets:

Implement a sustainable procurement policy which requires proponents to use low emitting vehicles or purchase offsets.
Dedicate a significant number of bicycle storage, and a minimum of 4 EV stations in the provided parking.

BUILDING MATERIALS

CPWC will prioritize locally sourced, healthy, and low-carbon materials while also ensuring building resilience and adaptation.

Target:
Satisfy the requirements of the LEED Building product disclosure and optimization credits for Environmental Product Declarations, Sourcing of Raw Materials, and Materials Ingredients.
Conduct a Life Cycle Analysis to estimate the embodied carbon of the construction materials.

WASTE MANAGEMENT

CPWC will strive to close the waste loop, implementing best practices during construction and providing conspicuous waste receptacles to ensure community participation in Zero Waste goals.

Target:
85% of the construction waste materials shall be diverted from landfill (by volume or weight).
100% of waste receptacles on site to be multi-stream collection points. Take appropriate measures for the safe collection, storage, and disposal of batteries and electronic waste.

INDOOR ENVIRONMENTAL QUALITY

CPWC will prioritize the long-term comfort and health of the facility occupants by ensuring a healthy indoor environment.

Targets:
Meet the ASHRAE 62.1 2010 standard for ventilation rates and indoor environmental quality
75% of interior finish materials (by volume) shall undergo a healthy material vetting process which evaluates hazardous ingredients and potential risks to occupants.
Respect materials VOC Content limits established by the SCAQMD Standards for every material installed within the waterproofing barrier (following the LEED v4 requirements).
Achieve a Spatial Daylight Autonomy of 300 lux for 50% of occupied hours across 75% of regularly occupied spaces ($sDA_{300/50}$).
Achieve a direct line of sight to the outdoors for 75% of all regularly occupied floor area.

CLIMATE REILIENCY AND RESPONSIBILITY

CPWC will be adaptable to meet the City's current needs and demonstrate distinctive responsibility and resiliency as the climate is changing.

Target:
Model the building to future climate data (2050) and compare current energy consumption benchmarks to the future climate scenario results.
All fresh air systems to be retrofitted with specialty air filtration to mitigate risk of smoke presence, preventing smoke from entering the building.

SOCIAL WELLBEING

CPWC will expand the notion of accessibility to attract and support a wide range of users by reducing barriers and focusing on the diverse needs of the community. CPWC will actively and passively encourage health and wellbeing through both the building itself and the programs it offers.

Targets:
Ensure an appropriate number of universal washrooms are available in the facility.
Be a welcoming and inclusive place, connected to the site and its surrounding community.
Conduct a post-occupancy evaluation of the building after six months to one year to ensure the building is performing as designed.

1.0 Introduction

1.1 Purpose & Overview

HCMA Architecture + Design have been engaged by the City of Victoria to provide architectural consulting services for the development of the Crystal Pool Wellness Centre replacement, to be located at 2275 Quadra Street, Victoria, BC. Its lot area is bordered on the south by Pembroke Street, on the north by Queens Avenue, on the west by Quadra Street, and on the east by Vancouver Street.

The replacement of the existing Crystal Pool Fitness Centre (CPWC) is a priority project for the City of Victoria that aligns with the City's strategy to sustain and enhance community-based recreation services and programs. The new CPWC will address current community needs, while responsibly respond to the future environmental and social needs. The facility is currently targeting a gross floor area of approximately 7,700 m^2, accommodating a natatorium area with a 50m lap pool, a 600m^2 leisure pool, a 90m^2 hot pool, a sauna, and a steam room; and a dry area with an enhanced fitness centre, a number of multipurpose rooms, and a large welcoming lobby area.

This document is intended to report on a continuing dialogue between HCMA and the client towards the development of a Sustainability Framework for this project. Sustainability principles and goals should reflect the embodiment of this project and its owner/operator – the City of Victoria. The future Crystal Pool Wellness Centre will demonstrate innovation and excellence in sustainable design, focusing on reducing its environmental footprint and GHG emissions as much as possible while providing vibrant and attractive spaces.

This project is designed to align with the requirements of the CaGBC Zero Carbon Building Program Design certification. It will also provide an opportunity to explore what a Step 2 Recreation and Sports facilities means under the forthcoming BC Energy Step Code framework for such typologies. This sustainability framework will be used to inform on strategies to achieve the above targets and other specific environmental goals developed and defined by the project team. This document aligns with the City of Victoria's Official Community Plan, the City's Climate Leadership Plan, and the City's Sustainability Framework. The principles, objectives, and strategies listed in this framework have been discussed and agreed on with the entire project team, including clients, consultants and architects.

1.2 Project Description & Characteristics

Municipal Address:	2275 Quadra Street, Victoria, BC
Gross Site Area (m²):	13,500 m²
Gross Floor Area (m²):	7,700 m²
Building Space Use/s:	Aquatic and Wellness Centre
Pre-Development Condition:	Existing Crystal Pool Fitness Centre
Building Operating Hours	5:30am – 11pm daily
Total Construction Cost:	$52,500,000.00
Estimated End of Construction	2022

Table 1: Project Description

1.3 Development and Policy Context

In preparing the first sustainability workshop, the project team reviewed the following City of Victoria vision and policy frameworks:

- *City of Victoria Climate Leadership Plan, 2018*
- *City of Victoria Sustainability Framework, 2017*
- *City if Victoria Official Community Plan, 2012*
- *City of Victoria Sustainability Action Plan, 2012*
- *City of Victoria RFP for Architectural and Engineering Services, Crystal Pool & Wellness Centre Replacement Project*

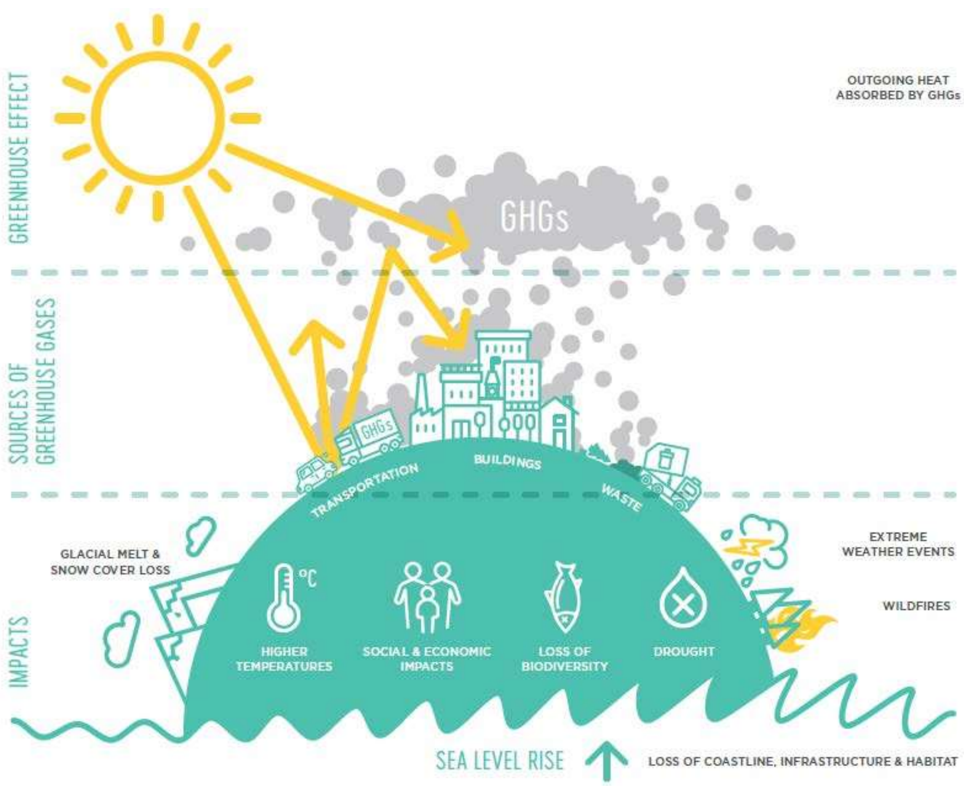
The policies and goals highlighted in these documents informed the City's aspirations and action plans. These frameworks clearly set the tone for the City's commitment to be leading the green building industry and low-emitting buildings. The following section summarizes the main action plans the City listed in the above listed documents.

1.3.1 City of Victoria Climate Leadership Plan (CLP)

The City of Victoria's vision for 2050 is of a *"vibrant, healthy, and prosperous community, fueled by renewable low carbon energy systems, and integrated in ways that promote a high quality of life for all Victorians*." Victoria has taken the lead on many sustainability initiatives in the past and has made great strides in providing forward-thinking environmental guidelines. The City is committed to an 80% reduction in GHG emissions by 2050 from 2007 levels and a shift from GHG-intensive fossil fuels to 100% renewable energy. To help reach the 2050 targets, the City set an interim target - reduce all City's corporate GHG emissions by 60% by 2030 (from 2007 levels).

The City of Victoria's Climate Leadership Plan (CLP) charts a collective community-wide response to climate change. With a goal of reducing the community's GHG emissions and building a more resilient urban environment, the CLP calls for a behavioral transformation of how Victorians use and manage energy in their day-to-day life. *"Decisions and choices made by residents, business and institutions will shape the energy and GHG intensity of their buildings, transportation and waste."*

Recognizing climate change as a human-centered challenge, the CLP covers five major sectors that the community should focus on: buildings, mobility, waste, municipality operations, and adapting early. Each sector presents some high-level goals, more detailed targets, and a respective list of actions. More details about the sectors goals and targets can be found in Appendix A of this framework (page 40).



Source: City of Victoria's Victoria Climate Leadership Plan, p11

The City of Victoria Climate Leadership Plan can be found following:
https://www.victoria.ca/assets/Departments/Engineering~Public~Works/Documents/City%20of%20Victoria%20Climate%20Leadership%20Plan%20(1805).pdf

1.3.2 City of Victoria Sustainability Framework

Besides developing and implementing the CLP, the City of Victoria developed a City Sustainability Framework to support a clear path toward making Victoria one of the most sustainable urban cities in BC. The Framework's primary vision is: "*Victoria, as a community and municipal corporation, is an urban sustainability leader inspiring innovation, pride and progress towards greater ecological integrity, livability, economic vitality, and community resiliency as we confront the challenges facing society and the planet today and for generations to come."*

The major areas and strategies the framework focuses on are:

- **Ecological Integrity Domain:** Ability to sustain and renew the health of the natural environment and its ongoing capacity to produce resources necessary to urban life.
- **Livability and Social Well Being Domain:** Social and cultural dimensions of the community that sustains quality of life, celebrates self and community, and addresses human health, and overall well-being.
- **Economic Vitality Domain:** Ongoing capacity to generate and renew the skills, finances and systems of exchange and production that enable quality of life and community aspirations.
- **Resiliency Domain:** Ongoing ability to keep residents safe, to adapt to changes and to plan for an uncertain future.

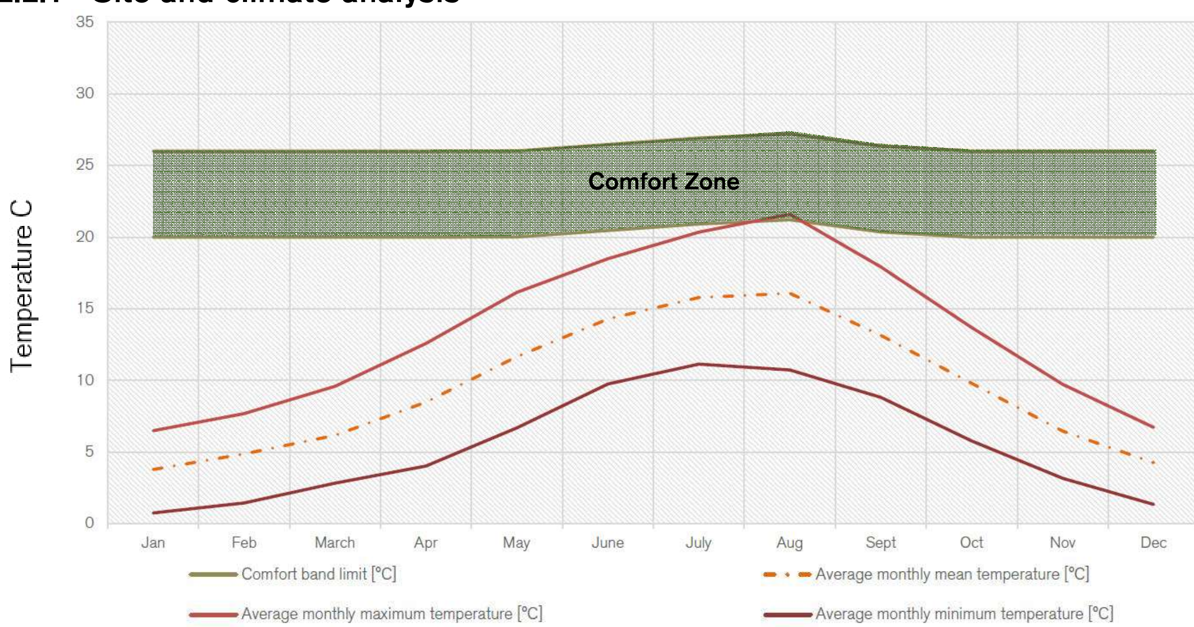
For more detail on each policy's area of scope, please refer to Appendix B of this framework or follow the link: https://www.victoria.ca/assets/Departments/Sustainability/Documents/Victoria%20Sustainability%20Framework%202017.pdf

2.0 Sustainable Design Process

2.1 Project's Sustainability Context

Prior to defining environmental targets for a project, a thorough consideration of the site climatic conditions and its surroundings is vital. Doing so identifies constraints and opportunities that would inform how the design of the facility can optimize the users' comfort and the building's performance. The following analysis was achieved prior to getting together with clients and consultants to decide on environmental targets for CPWC. These findings are tied to the next sections of this chapter being the workshops outcomes and the considerations and recommendations developed for each programmatic area of CWPC.

2.2.1 Site and climate analysis



Graph 1: City of Victoria – Exterior Temperature and Confort Zone

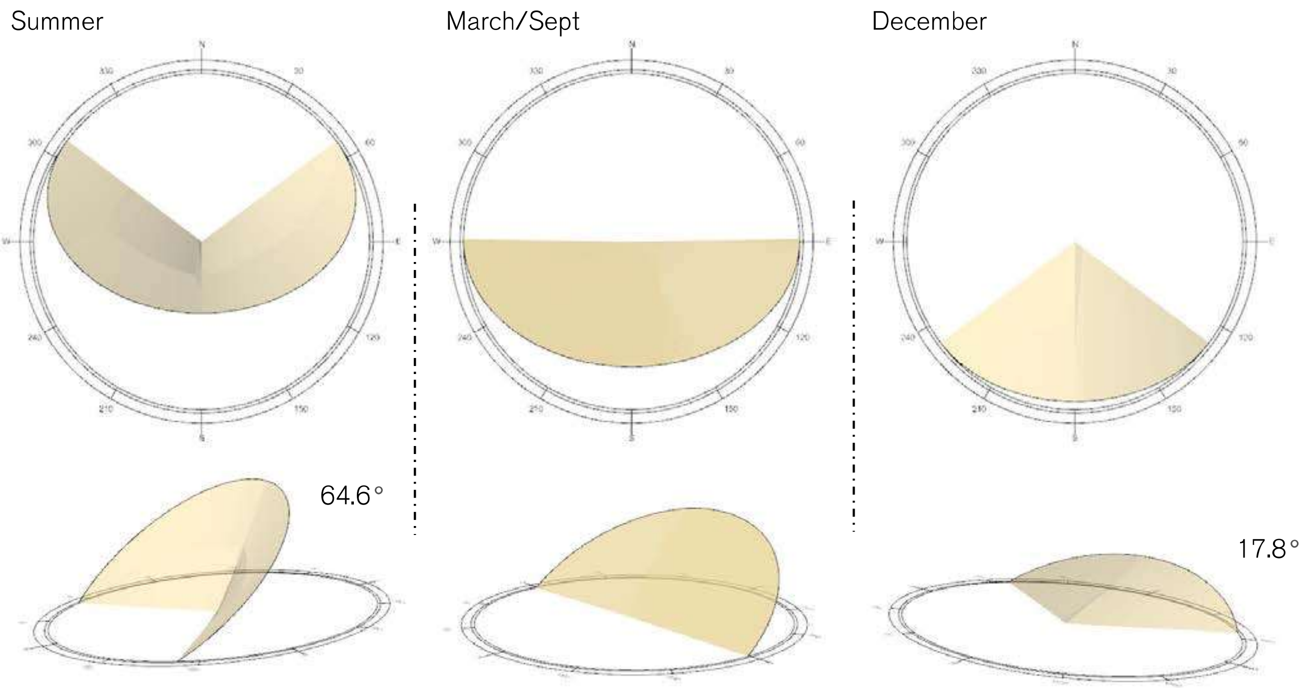
Reaching thermal comfort in Victoria:

Victoria is in a heating dominant climate as exterior temperatures are below comfort zone almost all year long. As CPWC will be operating throughout the whole year, both winter and summer season conditions are to be considered while developing the massing and envelope of the project. The intent of this analysis is to use the natural resources namely sun/daylight/wind to passively reduce the heating and cooling demand of the building.

During the winter, the CPWC building should make use of the sun and the internal heat gains to passively heat up to comfortable temperatures. An important strategy is to orientate the building east-west to benefit from a major south facing façade directly exposed to the sun. Although recreation centres with pool and fitness spaces have unique energy load characteristics, it is generaly estimated that a well oriented typical building can reduce heating demands by as much as 30 to 40%. As the pool environment also requires high levels of ventilation in order to maintain healthy indoor environmental quality, strategies to limit heat losses through ventilation include the careful construction of an airtight and highly efficient building envelope and the use of an efficient heat recovery system.

During the warm months, the building can result in significantly high cooling loads depending on its sun exposure and occupancy loads. Strategies to counter the rise of cooling demand include using efficient shading elements as fins, blinds, or overhangs, and using glass with low solar heat gain coefficient. Natural ventilation also provides great opportunities to passively eliminate the unwanted heat trapped inside the building and bring fresh air in (see the prevailing wind section below).

Sun Path:



Graph 2: City of Victoria – Sun path

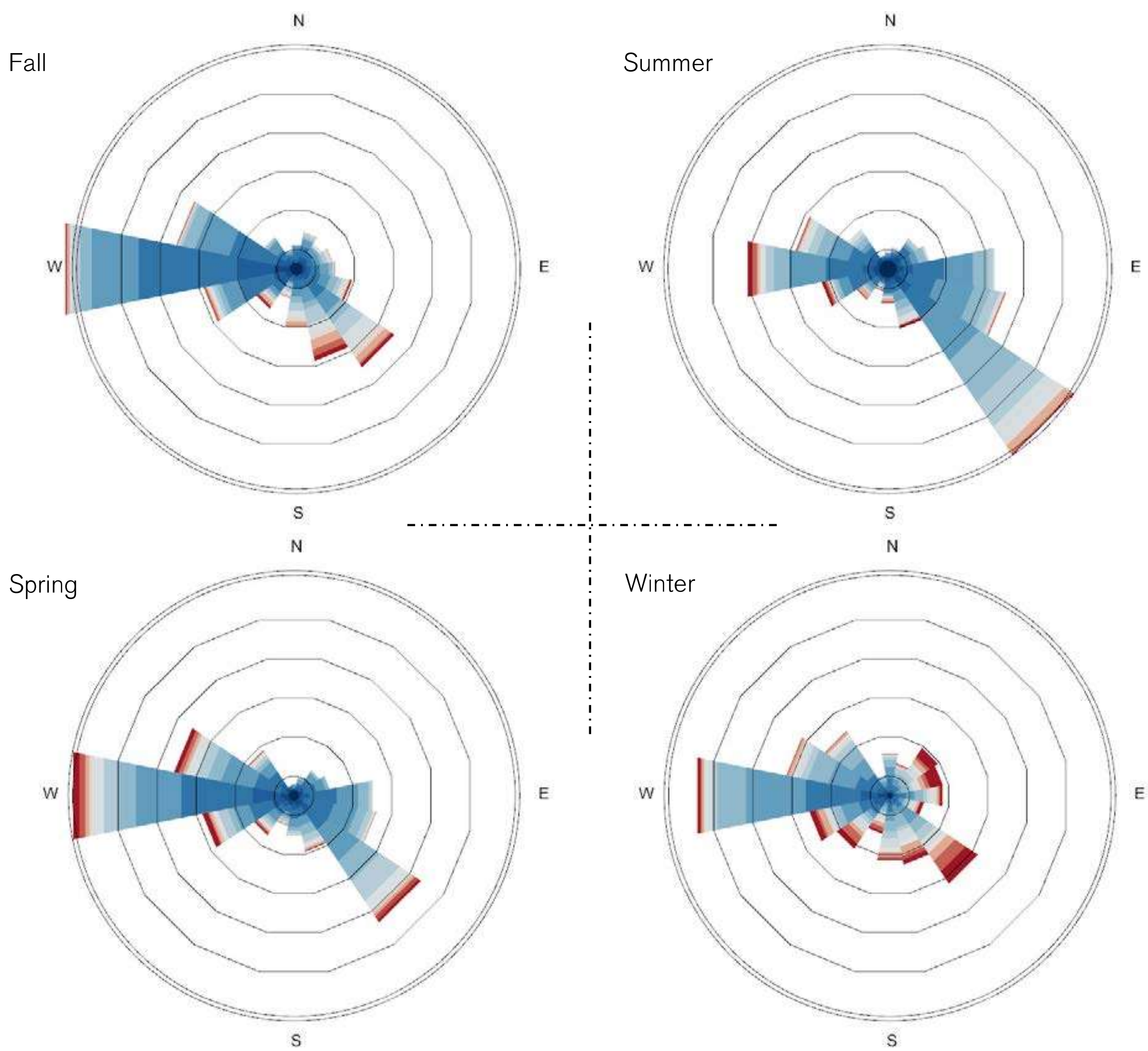
Making use of the sun hours in Victoria:

The latitude of the City of Victoria is 48.4° N, which explains the changing sun paths throughout the year. The design team should consider both the summer and winter sun trajectories when designing the building massing and planning its openings. While direct sun means high levels of daylight, natatorium environments require special attention to the sun penetrating the envelope. Ideally, no direct sun should reach the pool surfaces for glare, comfort, and security reasons.

In the wintertime days count on average 8 hours of sunlight on clear days, the sun remains pretty low (17.8°), and only buildings' south elevations are exposed to direct sun. In the CPWC case, as the sun is needed to passively heat up the building, the project team should provide large openings on the south façade of the building while carefully controlling the potential glare inside the natatorium area (mainly the sun rays reaching the water surfaces).

Summer days count approximately 16 hours of sunlight, and all facades are exposed to the sun throughout the days: the north façade gets the low early morning and late evening sun, the east façade gets the morning sun, the west facade the afternoon sun, and the south facade is exposed to the sun all day long on a clear day. The sun is also higher in the summertime than the wintertime (at a highest angle of 64.6° at noon). Based on this sun path and Victoria's temperatures in the summer months, buildings exposed to direct sun between June and September can require high internal cooling loads. In the case of CPWC, the site already offers a number of existing mature trees that can provide substantial shades on all facades. It is recommended to still consider building integrated shading devices for future resilience. Ideally, south facing openings would have horizontal fins or small overhangs, and east and west facing openings would have vertical fins.

Prevailing Winds:



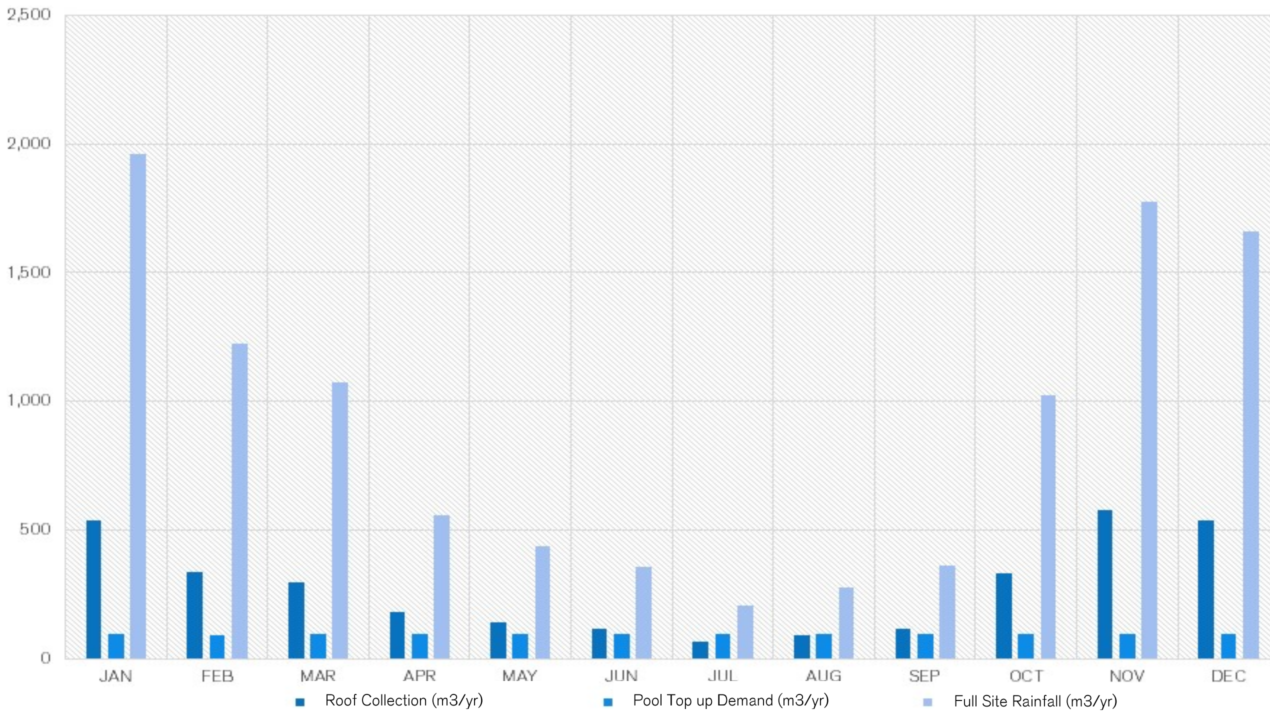
Graph 3: City of Victoria – Prevailing Wind

Making use of the wind for passive ventilation strategies in Victoria:

The wind rose is a conventional diagram for characterizing both the direction and frequency of the wind around a project site. It is important to note that the data used for generating the diagrams above was collected from Victoria's weather station; it might not accurately represent the project site microclimate conditions which are also affected by the buildings surrounding the site. However, it is apparent from the diagrams above that Victoria is a windy city with most prevailing winds coming from the west. The wind also occasionally blows from other directions throughout the year and the air is constant for 8.5% of the time - mainly in winter. Based on these conditions, CPWC's airtightness levels can have a big impact on the energy performance of the building – the more airtight the least heat losses will occur through the envelope. In the summertime, these wind conditions can be beneficial to reduce the cooling loads by using natural ventilation to passively cool down the building.

2.2.2 Site capacity / natural capital

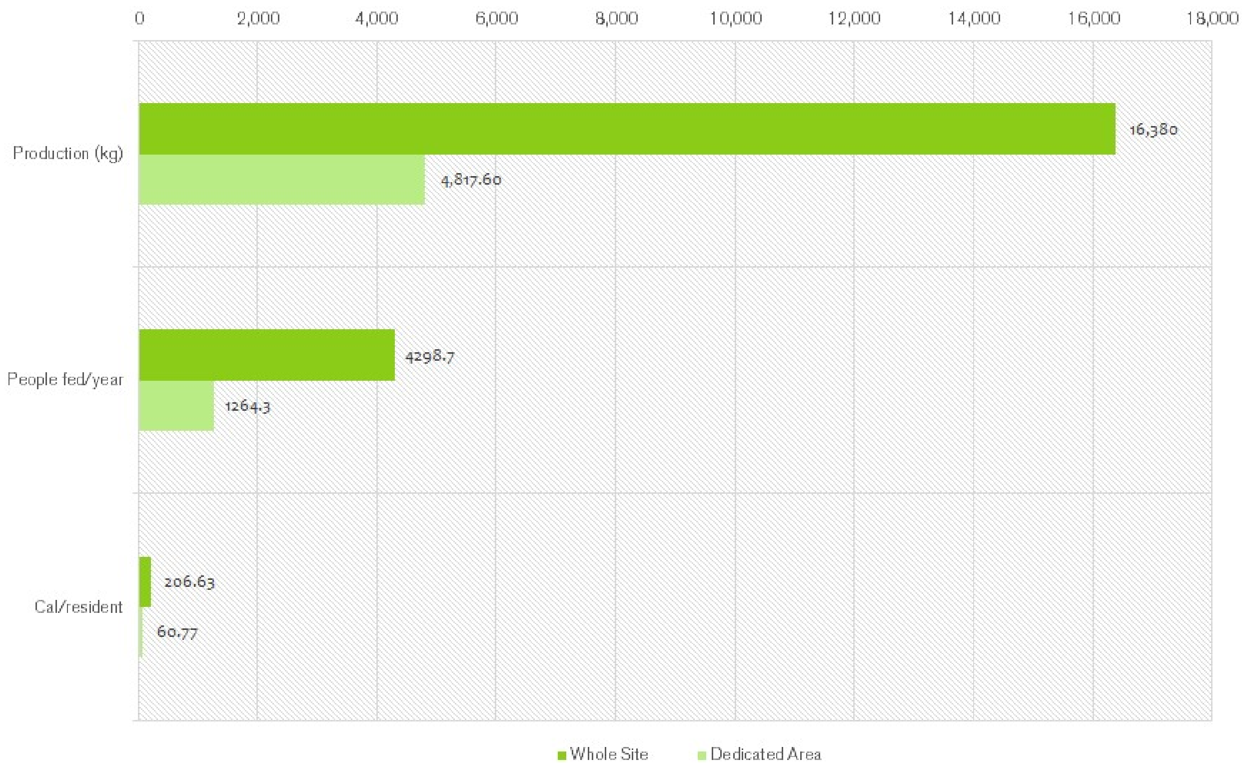
Potential Rainwater Collection



Graph 4: CPWC Site – Rainwater potential (source: Canadian Climate Normals for Victoria)

Collecting rainwater for building usage:
Water is a major resource for consideration, especially in an aquatic facility. Analyzing the current roof area and average climate data for Victoria, the potential supply was graphed and compared to the water demand for pool top-up (calculated at 3128L/day). We can see that in all months except July and August there is sufficient supply to provide renewable water for topping up the pool. This analysis assumes a 15% loss rate from roof collection. Additional water uses could be considered to use this supply water for toilet flushing and irrigation. Lastly, the rainfall across the entire site was calculated to understand the significant natural capital available on the site, but also to understand the seasonality of the water flows. It is also important to note that climate change will have a significant impact on precipitation, and the normal from 1981-2000 and 1981-2010 has already been changing dramatically (more than 10% in some months), so it will become increasingly important to consider how to deal with the flows of water across the site.

Potential Food Production



Graph 6: CPWC Site – Food production potential

Using some of the site's land for food production:
Looking at the capacity of the site to provide food for the community, an analysis was conducted to examine how much food could be produced on one acre of the site and across the whole site, as well as looking at how many people could be fed from this area for the whole year, or alternatively how many calories would this provide for every resident in Victoria. If one acre of the site was dedicated to a productive urban farm growing food (approximately the size of the field that will exist where the current pool sits) over 1200 residents could receive fresh produce throughout the year, based on about 4kg of produce per growing season and experience with other urban farms in colder climates.

2.2 Development Process

HCMA held two environmental sustainability workshops during schematic design and design development phases to set tailored environmental targets for the CWPC project and assess "*What's possible?*". Both sessions were attended by a broad cross section of city staff who are concerned with both the planning and operations of the proposed CPWC, and various project team members including architects, envelope, mechanical, electrical, and sustainability consultants. Assembling an integrated project team and including as many professionals as possible helped to bring in as much expertise and experience as possible. While detailed descriptions of each session can be found in Appendix C of this framework, below are listed the workshops outcomes for each green building feature discussed.

Energy and Emissions:

The CPWC should strive to achieve the **CaGBC Zero Carbon Building program** (ZCB) certification to eliminate the carbon impact of the existing facility and inform the development of the **BC Step Code** framework for Recreation and Community facilities. The CPWC design should consider **passive architectural and mechanical strategies** to optimize the energy performance of the building and ensure the occupants comfort. The project team should consider **capturing and reusing energy** by directing it efficiently, and should consider site opportunities for geo-exchange, energy storage and recovery. In relation to renewables generation, the CPWC project team should conduct a study of on-site renewable energy opportunities and create a **renewable energy strategy** for the project that will help achieve the ZCB certification. For systems verification and monitoring, a **commissioning process** should be scheduled for the end of construction phase to ensure all systems and assemblies are functioning as expected. CPWC should also implement systems that allow for **monitoring of energy use** during the life of the building to inform and optimize the facility's operational energy use.

Water Conservation:

First, the project team should implement an **Integrated Rainwater Management plan** to encourages infiltration and absorption. The project should also consider opportunities to collect roof rainwater for pool refill. Regarding outdoor water use, the landscape should only incorporate **native or adaptive vegetation** that does not require any long-time irrigation. For reducing the indoor water use, the CPWC facility should integrate strategies to limit its water consumption using **efficient water fixtures**, and potentially **collecting and recycling waste-water**.

Site Development:

The CPWC shall maximize retention of the significant stands of trees existing on site that provide numerous environmental benefits. The CPWC should also aim to **restore the habitat corridors** and create **accessible outstanding outdoor spaces** for the community to encourage social interactions and connections to nature.

Transportation and Accessibility:

Support pedestrians, cyclists and transit users: The CPWC Complex should actively support the reduction of transportation emissions by addressing different strategies to **increase the use of alternative transportation** (e.g. public transit, cycling path and bicycle storage). The CPWC should also provide enough **EV stations** to encourage the use of electric vehicles.

Building Materials:

The CPWC should consider the use of **advanced wood technology and pre-fabricate assemblies** for the structure and the envelope of the building to minimize the building embodied carbon and reduce the demand for, and use of, non-renewables materials. The project team should encourage the selection of **materials with full disclosure and transparency** (EDPs, HPDs etc.) and ethically sourced materials. The team should also conduct a **life cycle assessment calculation** to understand the embodied carbon related to the building materials, as required by the Zero Carbon program. This process can also support responsible industries, and local manufacturers to understand and declare the emissions related to their products.

Waste Management:

As part of the CPWC construction, the team should seek to minimize waste sent to landfill through exercising careful **segregation of construction waste into recyclable streams**. The team should target a construction waste diversion to landfill of 85%. During building's operation, the CPWC should provide **multiple collection points for collection and storage of recyclable materials** for the building (paper, glass, plastics, metals etc.).

Indoor Environmental Quality:

The project should focus on ensuring good air and water quality. Amongst the strategies endorsed is the implementation of a **construction materials selection plan** to reduce the concentration of chemical contaminants that can damage air quality, health, productivity, and the environment. **A Sustainable Purchasing Policy** should also be considered to ensure the products continually used for pool filtration, cleaning, maintenance and operation have low environmental impacts on the air quality of the building. Regarding the pool water quality and filtration, the team should ensure that **high pool water quality and clarity** will be provided by looking for the most environmentally friendly and cost-effective ways to treat the pools water.

Climate Resiliency and Responsibility:

The project team should exhibit a **high level of awareness related to adaptability and resilience to climate change** during the design stages. This attention can ensure that the facility can adapt successfully to effects of climate change and become a center of resilience.

Social wellbeing:

Social Wellbeing workshops took place throughout each phase of the project, including various focus groups, large community engagements, and online and in person surveys. This engagement process yielded five guiding principles for the project. ***Inclusive*****:** The project will strive to ensure that the facility allows seamless access to the broadest possible range of users. ***Barrier-free*****:** The CPWC will endeavor to remove barriers from participation in the space wherever possible. ***Efficient and Sustainable***: The previous seven sections address this goal, though there are certain elements of social wellbeing that can be considered around efficiency and synergies with energy strategies. ***High Quality Health and Wellness*****:** A variety of strategies from the previous sections will address the indoor health of the building and the products, but the intention of this principle extends to the physical and emotional health of the community served by the project. ***Place for Community****:* The community identified the current Crystal Pool as a place that plays an important role in their life, as well as the character of the place, and the project will honour the uniqueness of place in the new CPWC.

2.3 Program Considerations

The previous site analysis sets the tone that the project should take into consideration the on-site existing microclimate to optimize the indoor comfort and reduce its overall energy consumption and GHG emissions (see section 3.2.1 for more details).

The following section is comprised of an evaluation of each individual space within the CPWC project program. Each of the spaces provided in the new building has unique requirements and considerations to account for in order to offer enjoyable environments and comfortable spaces. Based on these considerations: *orientation, glazing, daylight,* and *ventilation* recommendations are refined to inform the design team while developing the project. Since the location of major program elements is driven by several considerations that sometimes do not allow the ideal orientation or adjacencies, strategies to mitigate issues arising from their current location are also suggested.

2.3.1 Entry, Reception and Administration

Spaces

Foyer and lobby, administration and reception

Considerations

The entrance and reception desk spaces are known for their openness and their connection to the outdoors.

Administrative enclosed offices present a moderate overheating risk due to their relatively small size and heat loads from the IT/equipment. Strategies should seek to reduce unwanted sun heat during summer months to prevent any associated high cooling loads risk. In winter, the expected small heating demand can be mechanically controlled with heat recovery ventilation.

Recommendations

Orientation: North and east orientations are recommended for these spaces. West and south exposure could result in overheating in the afternoons. It would result in mechanical cooling requirements as well as potential glare issues.

Glazing and shading: Lobby and reception areas of public buildings typically consider a maximum amount of glazing for security and visibility purposes. If the glazing ratio in those areas is higher than 60%, the use of shading devices (interior or exterior) and/or frit over glazing should be considered. The administration rooms should also provide flexible and controllable shading options to mitigate glare and control solar heat gains when needed.

Daylight: In all spaces, natural daylight entering the reception and administration offices should be optimized for employee's productivity, comfort and wellbeing. Shading strategies should seek to eliminate any instances of glare in administrative areas. Indirect light can be harvested with fins, louvers, or redirection films and frit.

Ventilation: Consider a hybrid ventilation system for the entrance and the administration offices. Natural ventilation in these spaces during the warm months would reduce their reliance on mechanical cooling; and mechanical heat recovery would cover a majority of the required heat during the winter months.

2.3.2 Natatorium

Spaces

Lap pool, leisure pool, hot pool, pool deck, sauna, steam

Considerations

Natatorium spaces are known for their challenging mechanical needs in order to provide comfortable thermal and humidity levels. They are anticipated to present both peak heating and peak cooling challenges. Previous project analysis suggests that a typically high volume will reduce any overheating risk at lower levels. This high volume can be used as an effective stack ventilation system to serve exhaust air from adjacent spaces – depending on plan layout. This stack creates a high potential to capture exhaust air heat using heat recovery ventilation in winter, and enables the project to benefit from high openings for passively cooling down the natatorium in summer.

Recommendations

Orientation: Pool environments can benefit from any orientation as long as the sun is controlled to not penetrate directly to the pool surfaces (for security reasons and provide visual comfort with no glare).

Glazing and shading: Based on numerous studies, the window to wall ratio in pool environments does not considerably affect the overall EUI of the facility due to the high mechanical ventilation demands (considering a good double-glazed system or a triple glazed system). Depending on the level of competition that will be hosted in the pool, different glazing ratios can apply. For non-competition facilities, pool environments can benefit from high levels of glazing (approx. 60%) to capture useful solar heat gains during winter months, yet shading should be provided to mitigate unwanted solar heat during summer months and control glare. If the glazing ratio is higher than 60%, the project team should consider a combination of strategically located solid sections on the envelope, frit on glass, and exterior or interior shades to control the adverse effects of the glazing. Competitive pools have specific requirements as sun and uneven lighting can impact the performance of competitors.

Daylight: Pool environments can benefit from high levels of natural light to enhance the enjoyment of the swimmers and lifeguards and their appreciation of the spaces. There is greater potential to introduce daylight through roof glazing or clerestories, but their shapes and orientations should be strategically decided on.

Ventilation: Pool environments require heavy mechanical systems to provide adequate thermal and humidity levels. Apart from focusing on using a highly efficient heat recovery, strategies should target reducing the ventilation loads. Amongst others: using a highly performant envelope combined with humidity sensors on interior surfaces and using displacement style ventilation (introduce air at low level, extracting at high level) can be effective for this space type.

2.3.3 Change Rooms

Spaces

Men change room, women change room, universal change room, dry change

Considerations

The change rooms will likely experience high levels of heat gain due to the nature of the spaces and the number of showers being taken by the building users. With high internal heat loads and high humidity levels, supplementary heat from mechanical sources is likely to be minimal, but the ventilation needs would remain very high (10 to 12 ACH). Design strategies should therefore focus on minimizing space cooling demand, using methods of passive cooling through ventilation and site placement.

Recommendations

Orientation: Change rooms can benefit from any orientation, but the decision is driven by privacy and security concerns. Typically change rooms end up being located more centrally within the building, allowing more regularly occupied spaces to inhabit the perimeter, but if natural ventilation is an important consideration, these spaces should have some adjacency to the perimeter.

Glazing and shading: Glazing would not be an issue if the change rooms are located centrally within the building. If the decision is made to locate the change rooms along a façade, attention to window-to-wall ratio, orientation and shading should be taken into account to enable views and daylight, while still controlling privacy and security.

Daylight: Change rooms can benefit from high levels of natural light to enhance the experience of the space. Introducing daylight through roof glazing or high level clerestory glazing would provide evenly distrubuted daylight while addressing privacy.

Ventilation: Using natural ventilation to supplement mechanical ventilation is a strategy that can be considered for this type of space. With very high ventilation rates (10 to 12 ACH), design strategies should focus on minimizing space cooling demand through passive cooling by ventilation and site placement as discussed above.

2.3.4 Multipurpose Rooms

Spaces

Fitness room, dance room, arts and seniors' rooms, multipurpose room and child minding room.

Considerations

With the exception of fitness rooms, multipurpose rooms are anticipated to present both peak heating and peak cooling challenges based on their sun exposure and occupancy loads. Providing space flexibility and considering displacement style ventilation (introduce air at low level, extracting at high level) can be effective solutions to increase efficiency and passively ventilate the rooms.

Fitness rooms are usually cooling dominant due to the users high activity levels and the resultant heat produced. Opportunities to reduce peak cooling demand should be investigated in order to reduce the project's cooling plant size. For example, efficient ventilation systems and natural 'free' cooling have the potential to reduce fan energy associated with mechanical ventilation. Glare elimination is also critical when considering glazing placement and size; this should be reviewed using environmental analysis.

Recommendations

Orientation: Multipurpose rooms can benefit from every orientation as long as occupants are in control of the rooms exposure, temperature, lighting levels, etc. Providing flexibility and adaptive opportunities in these spaces is key for satisfying as many situations as possible. These strategies include the provision of operable windows, movable or retractable shades and lighting and temperature controls.

The fitness room should ideally be facing east or north to avoid high solar heat gains. If facing south or west, a high consideration should be given to strategies mitigating direct sun inside the room (e.g. fins, frit, blinds, overhangs).

Glazing and shading: As per the orientation recommendations, multipurpose rooms can benefit from high glazing ratios as long as shading devices are offered to occupants so they can adjust the room microclimate to their needs. The fitness room should however be carefully designed to avoid overheating. It is advised to avoid a high ratio of glazing on east, west, and south oriented fitness rooms. If the glazing ratio in those areas is higher than 60%, the use of shading devices (interior or exterior) and/or frit over the glazing to mitigate solar gains should be considered. Careful solar control is critical to prevent unwanted heat gains and glare.

Daylight: Multipurpose rooms can benefit from high levels of natural light to enhance the wellness of the occupants and their appreciation of the spaces. For the fitness room, even though daylight is highly appreciated, south, east & west facing windows should include substantial shading to avoid direct sunlight and sun heat.

Ventilation: Multipurpose rooms and fitness rooms would benefit from a hybrid ventilation system. Supplementing mechanical ventilation with natural ventilation during summer; and employing a mechanically focused system with heat recovery during winter would constitute an efficient ventilation system for these types of spaces.

3.0 Sustainability Framework

3.1 Environmental Objectives

Based on the understanding of the wider city-led objectives outlined in Section 1, the sustainability workshops outcomes listed in Section 2, and the site and programmatic studies results shown in Section 3, project specific **'Environmental Objectives'** were established to guide the development of the project and its success.

ENERGY AND EMISSIONS

Aligned with the corporate targets outlined in the City's CLP, CPWC will achieve considerable reductions in building energy use, GHG emissions and operating costs across both embodied and operational life-cycle phases.

WATER CONSERVATION

CPWC will achieve significant reductions in site potable water consumption over a code compliant building, using source efficiency and reclamation strategies.

SITE DEVELOPMENT

CPWC will maximize retention of the original stands of trees and will prioritize native planting on site to restore any habitat disturbed by development and provide enjoyable outdoor spaces.

TRANSPORTATION AND ACCESSIBILITY

CPWC will reduce the community's transportation GHG emissions by encouraging walking, using public transit, or bicycles, and minimize the need for automobile use.

BUILDING MATERIALS

CPWC will prioritize locally sourced, healthy, and low-carbon materials while also ensuring building resilience and adaptation.

WASTE MANAGEMENT

CPWC will strive to close the waste loop, implementing best practices during construction and providing conspicuous waste receptacles to ensure community participation in Zero Waste goals.

INDOOR ENVIRONMENTAL QUALITY

CPWC will prioritize the long-term comfort and health of the facility occupants by ensuring the building's climate resilience and a healthy indoor environment.

CLIMATE REILIENCY AND RESPONSIBILITY

CPWC will be adaptable to meet the City's current needs and demonstrate distinctive responsibility and resiliency as the climate is changing.

SOCIAL WELLBEING

CPWC will expand the notion of accessibility to attract and support a wide range of users by reducing barriers and focusing on the diverse needs of the community. CPWC will actively and passively encourage health and wellbeing through both the building itself and the programs it offers.

3.2 Sustainability Strategies

In alignment with the listed principles in section 3.1, the green building features and systems agreed on with the project team were individually examined, and targets, benchmarks and strategies for each were developed for the CPWC.

3.2.1 Energy and Emissions

Principle:

CPWC will achieve considerable reductions in building energy use, GHG emissions and operating costs across both embodied and operational life-cycle phases.

Targets:

CaGBC Zero Carbon Building program – Design Certification: Achieve a zero-carbon building using the CaGBC ZCB program framework and requirements.

BC Step Code 2: provide an opportunity to explore what a Step 2 Recreation and Sports facilities means under the forthcoming BC Energy Step Code framework for such typologies.

Energy Consumption:

- Considering the typology of this facility, the EUI greatly varies depending on the ratio of dry land and natatorium program (as pool areas have a much higher EUI than dry areas). Based on the energy modeling exercise done for Crystal Pool, a **25% reduction from base code (NECB 2015)** would result in an EUI ranging between **600 to 650 kWh/m2.yr.**
- Regarding the Thermal Energy Demand Intensity (TEDI), this facility is required to achieve a TEDI of **75kWh/m2.yr for the entire building, and or 30kWh/m2.yr for the building without accounting for the pool ventilation** (for the CaGBC ZCB certification).

Airtightness: Achieve a whole-building airtightness of maximum 1.0 Air Changes per Hour (ACH) at 50 Pascals pressure, verified using onsite pressure test (under both pressurized and depressurized conditions).

Daylighting: Achieve a Spatial Daylight Autonomy of 300 lux for 50% of occupied hours across 75% of all regularly occupied floor area (sDA300/50).

Commissioning: Complete a Commissioning process for assemblies, mechanical, electrical, plumbing, and renewable energy systems.

Benchmark:

SOURCE	VALUE
ENERGY CONSUMPTION	
ASHRAE 90.1:2010 Energy Standard (% Reduction)	% reduction figure based on base case building performance
Architecture 2030: 2030 Challenge (Art, Entertainment and Recreation)	Average Site EUI (2015): 502 $kWh/m^2/yr$ 70% Target: 150.5 $kWh/m^2/yr$
Energy Star Portfolio Manager, Canadian National Median Reference Values, (Entertainment, Rec. Swimming Pool)	Site EUI (2016): 419 kWh/m2.yr

CIBSE Guide F: Energy Efficiency in Buildings Energy Benchmarks – Swimming Pool (p20-3)	Typical Practice: 237 kWh/m²/yr Good Practice: 152 kWh/m²/yr
Passive House Standard	Max. 15 kWh/m²/yr Annual Space Heating Demand Max. 60 kWh/m²/yr Primary Energy Demand
Passive House Standard - Low Energy Building	Max. 30 kWh/m²/yr Annual Space Heating Demand
CARBON EMISSIONS	
CaGBC Zero Carbon Building Program – Design certification	Demonstrate Zero Carbon Balance
City of Victoria corporate buildings target for 2030	Reduce by 30% the City's corporate GHG emissions based on the 2007 levels
AIRTIGHTNESS	
Passive House Standard	0.6 Air Changes per Hour (ACH) @50 Pascals
City of Vancouver Zero Emissions Plan	2.03 L/s/m²
International Energy Conservation Code (IECC) 2012	< 3 Air Changes per Hour @ 50 Pascals

Strategies:

Energy intensity reduction, also called energy efficiency, is one of the most pertinent goals when it comes to impacting the environmental footprint of a project. The main goal of reducing the amount of energy required to operate a building is essential for reducing greenhouse gas emissions (GHG emissions) as well as reducing the project's overall operations costs. Targets related to energy efficiency are generally achieved by designing a high-performance building with low heating and cooling loads, adopting efficient mechanical systems, light fixtures and pug loads, and educating the building occupants on how to efficiently use the facility. **Space heating/cooling demand:** The building space heating/cooling demand is an important quantifiable metric when seeking to deliver substantial reductions in overall energy demand – as space conditioning represents on average between 40-60% energy use in recreational buildings. Emphasizing reductions in space heating/cooling demand ensures that reductions are sought through improvements in the buildings core elements - **form, orientation, building envelope efficiency and glazing levels** –as opposed to increasing efficiency levels in complex mechanical and electrical systems. The methods being used in support of this passive strategy are:

- **Optimize Building Form and Orientation:** As per section 2.2 elaborates on, the building should be oriented along an east – west axis, to encourage south facing glazing. Compact building form is achieved through iterative analysis using the 'form factor' metric. Each space within the facility has different requirements and recommendations for providing high comfort and enjoyable atmosphere.
- **Envelope Efficiency:** Provide building envelope systems with excellent levels of thermal efficiency to reduce heat loss.
- **Thermal Bridging & Airtightness:** Create careful construction detailing that ensures that connections between main elements do not provide a thermally conductive route for heat loss through the envelope.
- **Daylight, Lighting, and Energy Demand:** Daylighting reduces the need for electric lighting, which in turn lowers energy use. Providing naturally daylit spaces is proven to increase occupant wellness & productivity and reduce illness. However, excessive amounts of windows can result in heat loss or overheating

depending on the season, and glare probability. Measures such as shading devices and glazing properties can considerably help mitigate those risks.

While strategies for energy efficiency are inherently reducing a building's GHG emissions, some other aspects regarding the functioning of the mechanical systems and the embodied carbon of building materials directly affect a building's overall carbon footprint:

GHG Emissions in operation: The building Greenhouse Gas emissions (GHGe) is dependent on the thermal performance of the building envelope as well as the mechanical system designed for the project. Providing a low carbon building in operations can be achieved through **fuel shifting from gas to electricity**. This shift can be reinforced with the **addition of on-site renewable energy** systems to improve building resilience, reduce its demand from the electrical grid, minimize the environmental impacts from power generation facilities, and prepare for a distributed energy future.

Construction GHG Emissions: Although operational carbon emissions represent a key focus, addressing the embodied carbon and other emissions associated with building materials also impacts the building overall GHG emissions. Emissions associated with the manufacture/assembly, transport, installation, and eventual disposal of building components currently represent a relatively low proportion of an average building's total carbon footprint, but these emissions grow in importance as operational emissions are reduced. Life cycle analysis (LCA) is used to provide an understanding of embodied energy and inform product selection towards less energy intensive alternatives. Amongst other strategies, reducing the embodied emissions of the building's materials can be achieved through **selecting locally sourced natural materials, recycling or reusing existing building materials, choosing carbon sequestering materials, using highly recyclable content materials, and maximizing the structural efficiency** of the building.

Systems commissioning is a set of activities that ensures that the project meets the design intent and owner's operational needs. Properly commissioned buildings results in fewer system deficiencies and improved planning/coordination of systems testing. Systems optimization refers to analysis of the building operations following completion, to identify deficiencies and potential optimization in the operation of the building energy consuming systems and related controls. Projects are encouraged to engage a third party for developing a commissioning plan prior to construction. The plan should consider reviewing and testing the building assemblies, the mechanical, electrical, plumbing, and renewable energy systems.

3.2.2 Water and Conservation

Principle:

CPWC will achieve significant reductions in site potable water consumption over a code compliant building, using source efficiency (fixture consumption) and reclamation strategies (filtration, reuse, retention and detention).

Targets:

Manage on site runoff from developed site for the 95th percentile of rainfall events as per LEED calculations.
Avoid the use of permanent irrigation for the landscape using native and adapted vegetation.
Achieve a minimum **40% reduction in indoor water use consumption** from a pre-established 'baseline' condition, calculated in accordance with LEED v4 BD+C credit WEc2 calculation guidelines.

Benchmark:

WATER CONSUMPTION	
LEED v4 BD+C Rating System - Rainwater Management	Manage on site the runoff from the developed site for the 95th/98th percentile of rainfall events.
LEED v4 BD+C Rating System - Outdoor Water Consumption	Avoid the use of permanent irrigation or reduce the landscape water requirement min. 50% from the calculated baseline for the site peak watering month.
LEED v4 BD+C Rating System - Indoor Water Consumption	% figure for water use reduction from 'baseline' building: 25% = 1 Point, 30% = 2 Points, 35% = 3 Points 40% = 4 Points, 45% = 5 Points, 50% = 6 Points

Strategies:

- **Stormwater management:** Manage on-site runoff to reduce the wider site's burden upon municipal storm water systems. Strategies include increasing the site's 'carrying capacity' and seeking to **mimic natural hydrological site flows** through strategic integration of **Low Impact Development** (LID) and **green infrastructure** (such as rain gardens, vegetated swales, permeable paving). Such strategies also act to reduce risk of localized flooding in high rainfall events. Additional measures in instances of high impermeable area can include rainwater detention/retention.
- **Outdoor water use reduction:** Measures to reduce and conserve potable water use and mitigate water wastage, in indoor and outdoor uses. Outdoor water use is directly related to the irrigation needs. The **use of local and native plants** allows for low maintenance exterior planting and considerably reduces the water needs of the landscape.
- Indoor water use can be reduced by identifying high water usages within the building and ensuring the **use of efficient fixtures**. Collecting and **reusing rainwater in pool refiling** also greatly reduces the need for potable water.
- **Water metering** requirements address a disparity between design efficiency and built performance – metering provides the capability for building owners to track water consumption and diagnose any unforeseen high end-uses.

3.2.3 Site Development

Principle:

CPWC will retain the original stands of trees and will prioritize native planting on site to restore any habitat disturbed by development and provide enjoyable outdoor spaces.

Targets:

Preserve and retain existing tree canopy cover over the entire site.
Ensure site hydrology respected such that post-development flow is not greater than pre-development flow, which will align with stormwater goals, while also providing habitat.

Benchmark:

LEED v4 BD+C Rating System - Open Space Credit: Provide outdoor space greater than or equal to 30% of the total site area (including building footprint). A minimum of 25% of that outdoor space must be vegetated (turf grass does not count as vegetation) or have overhead vegetated canopy.

LEED v4 BD+C Rating System - Site development – Protect or Restore habitat: Preserve and protect from all development and construction activity 40% of the greenfield area on the site (if such areas exist). Using native or adapted vegetation, restore 30% (including the building footprint) of all portions of the site identified as previously disturbed. Projects that achieve a density of 1.5 floor-area ratio may include vegetated roof surfaces in this calculation if the plants are native or adapted, provide habitat, and promote biodiversity.

Strategies:

Site development strategies address ways to conserve existing natural areas and restore damaged areas to provide habitat, promote biodiversity, and create outdoor spaces that encourage social interaction and passive recreation.

- Provide **large and enjoyable outdoor spaces** for public and community use.
- **Preserve and protect** current site vegetation from all development and construction activity.
- Use of **native or adapted** vegetation.
- **Restore** all disturbed or compacted soils.

3.2.4 Transportation and Accessibility

Principle:

CPWC will reduce the community's transportation GHG emissions by encouraging walking, using public transit, or bicycles, and minimize the need for automobile use.

Targets:

Implement a sustainable procurement policy which encourages users to use low emitting vehicles or purchase offsets.

Include a significant number of bicycle storage, and parking stalls with 4 EV stations. Final numbers to be determined based on City regulations and report from transportation consultants.

Benchmark:

LEED v4 BD+C Rating System - Access to quality transit: Locate any functional entry of the project within a ¼-mile (400-meter) walking distance of existing or planned bus, streetcar, or informal transit stops, or within a ½-mile (800-meter) walking distance of existing or planned bus rapid transit stops, light or heavy rail stations, commuter rail stations or ferry terminals.

LEED v4 BD+C Rating System - Reduced parking credit: 20% reduction from the base ratios recommended by the Parking Consultants Council, as shown in the Institute of Transportation Engineers' Transportation Planning Handbook

LEED v4 BD+C Rating System - Bicycle Facilities credit: Provide short-term bicycle storage for at least 2.5% of all peak visitors, but no fewer than four storage spaces per building; provide long-term bicycle storage for at least 5% of all regular building occupants, but no fewer than four storage spaces per building in addition to the short-term bicycle storage spaces; and provide at least one on-site shower with changing facility for the first 100 regular building occupants and one additional shower for every 150 regular building occupants thereafter.

Strategies:

This strategy seeks to encourage active transportation (walking, cycling) and address the often-overlooked emissions associated with transportation to and from project site (24% of total GHG emissions in 2015 across Canada). Methods for reduction can include public transit availability and access, parking management and incentive schemes, walkability and bicycle accessibility to site.

- Methods for reducing the transportation emissions intensity can include public transit access, parking management and incentive schemes, walkability and bicycle accessibility to site. Other sustainable transportation goals identified that should be further developed in the design process include:
  - Optimize pick up and drop off areas.
  - Provide ample and secure safe bike parking for guests and staff.
  - Explore pooled / car-sharing program or shared parking with neighbouring developments.
  - Integrate electric vehicle charging hubs to support the use of electric vehicles.
  - Share public transit schedules and travel routes with occupants (screens for next bus, directions etc.)

3.2.5 Building Materials

Principle:

CPWC will prioritize locally sourced, healthy, and low-carbon materials while also ensuring building resilience and adaptation.

Targets:

Satisfy the requirements of the LEED Building product disclosure and optimization credits for Environmental Product Declarations, Sourcing of Raw Materials, and Materials Ingredients.

Conduct a Life Cycle Analysis to understand the embodied carbon of the facility's construction materials.

Benchmark:

Life cycle Analysis: LCA study can either be LEED benchmark (conduct a LCA demonstrating at least 10% reduction in Global Warming Potential of materials) , ZCB benchmark or ISO 14040 and 14044 benchmark.

LEED v4 BD+C Rating System - EPD Credit Requirements: Collect EPDs for at least 20 products, with category level EPDs only counting as 0.25 of a product and industry-average EPDs only counting as 0.5.

LBC Materials Petal, Responsible Industry: The project must advocate for the creation and adoption of third-party certified standards for sustainable resource extraction and fair labor practices. Applicable raw materials include stone and rock, metal, minerals, and timber. For timber, all wood must be certified to Forest Stewardship Council (FSC) 100% labeling standards, from salvaged sources, or from the intentional harvest of timber on-site for the purpose of clearing the area for construction or restoring/maintaining the continued ecological function of the on-site bionetwork.

Strategies:

To reduce the damaging environmental and social impact related to industries that rely on natural resource extraction, the notion of responsible industry advocates for the application of a purchasing plan that encourages the use of locally sourced, healthy, renewable materials. To implement such a plan, project teams should specify the need to file environmental declarations for each material and conduct a life cycle assessment project completion:

- **Transparency in materials:** Transparency is fundamental to the development of responsible industry practices. Not only does this affect the overall life cycle of the building, but also significantly impacts the occupants' well-being and comfort. To reduce the damaging environmental and social impacts, the design team should **specify a process for transparency in materials**, including EPDs or Living Building Challenge materials requirements. In the spirit of transparency and collaboration, **developing a good working relationship with contractors and trades** ensures that alternates are of equal or better environmental impact to products specified.
- **Life Cycle Assessment**: LCA is used to provide an understanding of embodied energy and inform product selection towards less energy intensive alternatives. Amongst other strategies, reducing the embodied emissions of the building's materials can be achieved through **selecting locally sourced natural materials, recycling or reusing existing building materials, choosing carbon sequestering materials, using highly recyclable content materials, and maximizing the structural** efficiency of the building.

3.2.6 Waste Management

Principle:

CPWC will strive to close the waste loop, implementing best practices during construction and providing conspicuous waste receptacles to ensure community participation in Zero Waste goals.

Targets:

A minimum of 85% of the construction waste materials shall be diverted from landfill (by volume or weight) following the LEED v4 calculations requirements.

100% of waste receptacles on site to be multi-stream collection points. Take appropriate measures for the safe collection, storage, and disposal of batteries, mercury-containing lamps, and electronic waste.

Benchmark:

LEED v4 BD+C Rating System - Construction and Demolition waste management: Divert at least 50% or 75% of the total construction and demolition material.

LBC Materials Petal, Net Positive Waste: The project team must create a Material Conservation Management Plan that explains how the project optimizes materials in each of the project phases described above. The construction materials diversion requirements should be as follow:

- Metals: 99% minimum diversion by weight.
- Paper and Cardboard: 99% minimum diversion by weight.
- Soil and Biomass: 100% minimum diversion by weight.
- Rigid foam, carpet and insulation: 95% minimum diversion by weight.
- All others – combined weighted average: 90% minimum diversion by weight.

Strategies:

Every building should strive to reduce or eliminate the production of waste during its design, construction, operation, and end of life in order to conserve natural resources and to find ways to integrate waste back into either an industrial loop or natural nutrient loop. Strategies to be implemented in each phase of the project's development include:

- **Design Phase:** consideration of recycled materials, or appropriate durability/recyclability of specified products
- **Construction Phase:** including product optimization and collection of wasted materials. Develop a CWM Plan that outlines how construction waste will be diverted from landfills in support of any applied target.
- **Operation Phase:** including a collection plan for consumables and durables. Multi-residential buildings are starting to design the waste rooms to ensure people feel safe and comfortable going there and positively reinforcing the habit of reducing, reusing, and recycling.
- **End of Life Phase:** including a plan for adaptable reuse of the building materials and deconstruction

3.2.7 Indoor Environmental Quality

Principle:

CPWC will prioritize the long-term comfort and health of the facility occupants by ensuring a healthy indoor environment.

Targets:

Meet the **ASHRAE 62.1 2010** standard for ventilation rates and indoor environmental quality

75% of interior finish materials (by volume) shall undergo a h**ealthy material vetting process** which evaluates hazardous ingredients and potential risks to occupants.

Respect materials **VOC Content limits** established by the SCAQMD Standards for every material installed within the waterproofing barrier (following the LEED v4 requirements).

Achieve a **Spatial Daylight Autonomy of 300 lux for 50% of occupied hours across 75% of regularly occupied spaces** ($sDA_{300/50}$).

Achieve a **direct line of sight to the outdoors for 75% of all regularly occupied floor area**.

Benchmark:

Living Building Challenge Red List: The Living Building Challenge has developed a list of materials and chemicals that must be excluded from all products which go into a Living Building Challenge project. The chemicals identified have the greatest impact on human and ecosystem health:

LEED v4 BD+C Rating System - Low-Emitting Materials: The LEED v4 credit covers volatile organic compound (VOC) emissions in the indoor air and the VOC content of materials. Different materials must meet different requirements to be considered compliant.

Strategies:

High consideration towards air quality throughout a project's design, construction and occupancy is an important aspect to consider – with emphasis on minimizing pollutant risk through adequate ventilation and source control.

- **High levels of airtightness** provided by high performance construction methods increases the need for air quality to be free from harmful odours and contaminants to occupants.
- Provide a high emphasis on healthy materials specification, prioritizing products and materials that do not contain hazardous chemicals with risks to human health. This project will provide a high emphasis on healthy materials specification, prioritizing products and materials that do not contain hazardous chemicals with risks to human health.
- Seek to obtain ingredient declarations from manufacturers where possible and seek to **specify materials in accordance with the Living Building Challenge 'Red List'** – particularly inboard of the weatherproof layer. Added **emphasis on material VOC content** can minimize occupant risk and reactions from consistent exposure.

3.2.8 Climate Resiliency and Responsibility

Principle:

CPWC will be adaptable to meet the City's current needs and demonstrate distinctive responsibility and resiliency as the climate is changing.

Target:

Energy consumption benchmark can be applied to the project while modelling the building to future climate data (2050).

All fresh air systems to be retrofitted with specialty air filtration to mitigate risk of smoke presence, preventing smoke from entering the building.

A zero-carbon building mitigates the risk of gas availability and potential restrictions in gas use in the future.

Ultra-low flow plumbing fixtures and low water consuming pool filtration to mitigate the risk of changing water availability.

Benchmark:

<u>Building Resilience and Climate Adaptability:</u> No benchmark is specific to building resilience and climate adaptability. Frameworks like RELi or Envision are helpful resources to stimate the resiliency achieved and ensure the project tackles all aspects of building resilience.

Strategies:

- Most of the efforts to address climate change through green building are focused on reducing greenhouse gas emission as GHG emissions reductions are climate change mitigation. Shaping the built environment to be both responsive and resilient to future climate extremes includes both **climate mitigation and adaptation strategies**.
- Target a **Climate Adaptation & Resilience objective** throughout the project's anticipated service life. This initiative is intended to ensure that the proposed building can withstand anticipated risks under a projected climate change environment
- Provide the building owner with a **comprehensive climate adaptation plan** which can be used to implement building modifications over its life span and thus prevent premature obsolete use.

3.2.9 Social Wellbeing

Principle:

The CPWC will expand the notion of accessibility to attract and support a wide range of users by reducing barriers and focusing on the diverse needs of the community. The CPWC will actively and passively encourage health and wellbeing through both the building itself and the programs it offers.

Targets:

Provide a resilient facility that will serve the community as it grows and adapts over time.
Ensure a significant proportion of universal washrooms are available in the facility.
Be welcoming and inclusive place, connected to the site and surrounding community.
Conduct a post-occupancy evaluation of the building after six months to one year to ensure the building is performing as designed, both in regard to above developed environmental targets and social impact goals.

Benchmark:

HCMA has been developing a social impact framework to guide how we can enable and evaluate social impact across all of our projects. The project team will endeavor to apply this knowledge and learning to the CPWC.

The social impact framework is comprised of three performance principles which are themselves constituted of four indicators each. These indicators, and the metrics which speak to them, are used to guide design decisions towards maximizing positive social impact. The performance principles to which indicators are associated are: Include, Enable, Connect.

Strategies:

- An inclusive facility will require measures to enhance access for diverse groups from across the city. This involves both physical and operational strategies. Physical strategies involve tactile and high contrast wayfinding, auditory support and inclusive signage. Operational strategies can be examined to provide greater access through programming, a review of operational hours, and staffing considerations.
- Transportation strategies can further enhance access.
- Provide services that appeal not only to athletes and health aficionados but also to families, friends, residents of all ages and abilities, therefore ensuring greater inclusivity.
- Include community event and informal gathering place in addition to the opportunities to participate in programs and services.
- An important aspect of long-term viability of a project is to ensure that the spaces are flexible enough to adapt to changing conditions, both in terms of climate, but especially as it relates to the community. Resiliency and inclusivity are synergistic; being barrier-free, and providing a place for community for generations to come.

4.0 Strategies Integration

4.1 Project Performance Targets

Drawing the targets from the above framework together, we propose the following targets for the new Crystal Pool and Wellness Centre.

ENERGY AND EMISSIONS

- CaGBC Zero Carbon Building standard – Design Certification.
- BC Step Code 2 for Rec and Art facilities.
- EUI: 25% reduction from base code - 600-650 kWh/m²/yr .
- TEDI: 75kWh/m2.yr for entire building / 30kWh/m2.yr for building without pool ventilation.
- On-site 5% renewable energy generation based on the entire project EUI.
- Whole-building airtightness of maximum 1 Air Changes per Hour (ACH) at 50 Pascals pressure.
- Complete a Commissioning process for assemblies, mechanical, electrical, plumbing, and renewable energy systems.

WATER CONSERVATION

- Manage on site runoff from developed site for the 95th percentile of rainfall events as per LEED calculations.
- Avoid the use of permanent irrigation for the landscape using native and adapted vegetation.
- Achieve a minimum 40% reduction in indoor water use consumption from a pre-established 'baseline' condition, calculated in accordance with LEED v4 BD+C credit WEc2 calculation guidelines.

SITE DEVELOPMENT

- Retain when possible existing tree canopy cover over the entire site.
- Ensure site hydrology respected such that post-development flow is not greater than pre-development flow, which will align with stormwater goals, while also providing habitat.

TRANSPORTATION AND ACCESSIBILITY

- Implement a sustainable procurement policy which requires proponents to use low emitting vehicles or purchase offsets.
- Dedicate a significant number of bicycle storage, and parking stalls with EV stations. Still to be determined based on City regulations and report from transportation consultants.

BUILDING MATERIALS

- Pursue LEED v4 BD+C Building product disclosure and optimization credits for Environmental Product Declarations, Sourcing of Raw Materials, and Materials Ingredients

WASTE MANAGEMENT

- 85% of the construction waste materials shall be diverted from landfill (by volume or weight).
- 100% of waste receptacles on site to be multi-stream collection points. Take appropriate measures for the safe collection, storage, and disposal of batteries, mercury-containing lamps, and electronic waste.

INDOOR ENVIRONMENTAL QUALITY

- Meet the ASHRAE 62.1 2010 standard for ventilation rates and indoor environmental quality
- 75% of interior finish materials (by volume) shall undergo a healthy material vetting process which evaluates hazardous ingredients and potential risks to occupants.
- Respect materials VOC Content limits established by the SCAQMD Standards for every material installed within the waterproofing barrier (following the LEED v4 requirements).

- Achieve a Spatial Daylight Autonomy of 300 lux for 50% of occupied hours across 75% of regularly occupied spaces (sDA300/50).
- Achieve a direct line of sight to the outdoors for 75% of all regularly occupied floor area.

CLIMATE REILIENCY AND RESPONSIBILITY

- Energy consumption benchmark to be applied while modelling the building to future climate data (2050).
- All fresh air systems to be retrofitted with specialty air filtration to mitigate risk of smoke presence, preventing smoke from entering the building.
- A zero-carbon building mitigates the risk of gas availability and potential restrictions in gas use in the future.
- Ultra-low flow plumbing fixtures and low water consuming pool filtration to mitigate the risk of changing water availability.

SOCIAL WELLBEING

- Provide a resilient facility that will serve the community as it grows and adapts over time.
- Ensure an appropriate number of universal washrooms are available in the facility.
- Be welcoming and inclusive place, connected to the site and surrounding community.
- Conduct a post-occupancy evaluation of the building after six months to one year to ensure the building is performing as designed.

4.2 Certifications

4.2.1. CaGBC – Zero Carbon Building standard, principles

The CaGBC Zero Carbon Building framework has been designed to spearhead a nationwide drive to reduce Greenhouse Gas (GHG) emissions by 30% below 2005 recorded levels by the year 2030. The framework is currently comprised of four key elements:

1. Demonstrate Zero Carbon Balance
2. Install Minimum 5% Onsite Renewable Energy
3. Achieve Thermal Energy Demand Intensity (TEDI) Target, report Energy Use Intensity (EUI) & peak demand
4. Report Embodied Carbon

There are two main certification components to the Zero Carbon Standard – 'ZCB - Design' and 'ZCB - Performance'. Achieving dual certification earns the complete designation of ZCB - Design+Performance. To know more about the certification, visit: https://www.cagbc.org/cagbcdocs/zerocarbon/CaGBC_Zero_Carbon_Building_Standard_EN.pdf

4.2.2 Requirements

The CPWC is registered for the CaGBC's Zero Carbon Building Accelerator Program, which ensures an additional level of support to projects pursuing certification under the Zero Carbon Building – Design program. The program has the seven following requirements:

1. Demonstrate a Zero Carbon Balance – By pursuing an electrical focused system, the project should easily achieve this goal.
2. Provide a Zero Carbon Transition Plan – If any on-site combustion fuels are used, the applicant must submit a plan outlining how the project will transition away from these fuels. If CPWC uses an electrical only system, this plan would not be required.
3. Install a Minimum of 5% On-site Renewable Energy – Solar PV panels would be the best option, but further analysis will be required.
4. Achieve TEDI Target – The ZCB program TEDI target of 30 kWh/m^2 is quite impractical for pools to achieve, but the CaGBC has indicated that they are considering some leniency for unique typologies. The Accelerator program support should clarify this, but we will need to demonstrate effort was made to limit the TEDI through envelope design.
5. Report EUI – Share energy reports with the CaGBC.
6. Report Peak Demand – As above.
7. Report Embodied Carbon – An Life Cycle Assessment study must be conducted and submitted.

4.2.3 Coordination

To ensure that the above targets are implemented and met, HCMA will serve as the liaison between the project team and the CaGBC, providing guidance regarding compliance with Zero Carbon Building requirements and identified Project Performance Targets, and providing progress reports to the client and project team.

HCMA will carry out design stage reviews throughout Schematic Design (SD), Design Development (DD) and Construction Documents (CD) stages, at defined points to be agreed. These reviews will seek to identify any areas of the design which are not in compliance with the requirements of each target. This process has been found to reduce risk and any additional costs associated with late consideration/remedial action.

At review stage, HCMA will circulate a customized ZCB Submittals Checklist to each member of the design team to assist them in tracking the ZCB submittals for which they are responsible. The checklist includes a detailed breakdown of the submittals, calculations, and links them to timeline, responsible party, and priority. Each member will be asked to submit the documents for the requirements and targets for which they are responsible to HCMA for review and forwarding to the CaGBC for ZCB certification.

4.3 Post Occupancy

It is strongly recommended to plan and budget for a post-occupancy review of the building between six months to one year after occupancy. The nature of this process assists the owner, operators and design team to learn how the building is performing and whether it is measuring up to designed/modeled targets and assumptions.

Methodology
Typically, this process would require access to the energy metering data for the project, as well as a series of interviews, site walks and surveys with building occupants over the course of a week or two. The data is then compiled and analyzed against the design stage targets and goals for the building.

Value
This process is invaluable to help determine any areas where the building systems might be behaving abnormally, or experiencing unexpected losses, which will in turn help the owner and operator save energy. This process will also help identify how the project is performing socially in relation to the goals and vision set out at the beginning of the project, and help the team learn from user experiences of the space and site.

APPENDIX

Appendix A: Overview of The City of Victoria Climate Leadership Plan goals and targets

Key sectors	Goals	Targets
Low Carbon High-performance Buildings	All buildings are highly energy efficient	All new buildings are **net-zero energy ready** by 2030. All existing buildings meet new **high efficiency standards** by 2050.
	All buildings are powered by renewable energy.	**Heating oil is phased** out by 2030. All buildings exclusively **use renewable energy** by 2050.
Low Carbon Mobility	All Victorians have access to low carbon, high-performance and affordable transportation	25% of all trips by Victorians are by **public transportation** by 2030. 100% of BC Transit buses are **renewably** powered by 2030. Victorians choose **walking and cycling** for 55% of all trips by 2030
	Vehicles in Victoria are powered by renewable energy	Renewable energy powers 30% of passenger vehicles registered in Victoria by 2030 30% of commercial **vehicles are renewably powered** by 2030. 100% of passenger **vehicles are renewably powered** by 2050.
	Smart land use minimizes transportation emissions	100% of Victoria's neighborhoods are "complete" by design with substantial **transportation system diversit**y by 2030.
Low Carbon Waste Management	Organic materials are managed to avoid GHG emissions	Eliminate 100% of **food and yard waste** sent to landfill by 2030. Eliminate 100% of other **organic materials** sent to landfill by 2030. Capture **methane from collected organic** waste to provide renewable energy y 2025.
Municipal Operations	The City is a recognized leader in climate mitigation and adaptation	All City facilities are powered 100% by **renewable energy** by 2040. All new City facilities are **renewably powered facilities**. All City power tools and small engine-driven equipment are renewably powered by 2025. 80% of the **City fleet is electrified/renewably powered** by 2040.
	The City takes integrated and informed climate action.	Capital and operating plans are informed by **climate data, carbon pricing, and the City's GHG reduction targets** by 2020. The City has developed a **'triple bottom line'** accounting system that guides planning by assessing and balancing environmental and social risks and financial costs and opportunities by 2022.
	The City will provide timely and accurate data supporting strong climate mitigation and adaptation actions.	Partner with other local governments and the region to develop a community-accessible Energy and GHG information management System (EGIMS) to **define, communicate and track community energy and GHG reduction** across all sectors by 2022.
Adapting Early	All climate-related risks to City infrastructure are minimized through early and wise planning and action	**Climate resilience** is embedded into all City business. The City's infrastructure and services are ready to **protect and respond to the risks associated with a changing climate**.
	Victoria's natural environment flourishes in a changing climate	**Natural habitats** support healthy fish, wildlife, and plant populations and healthy ecosystem function.
	All Victorians are empowered and prepared for climate impacts and emergencies	The community is **knowledgeable and prepared** to address the impacts from a changing climate. The City incorporates best practices in **risk communication** covering all climate hazards. Climate resilience **enhances quality of life** for all Victorians, especially the most vulnerable.

Appendix B: Overview of The City of Victoria Sustainability Framework policies and scopes

Policy Area	Policy Area Scope
Ecological Integrity Domain	**Ability to sustain and renew the health of the natural environment and its ongoing capacity to produce resources necessary to urban life.** • Land Management: - Compact, human-orientated development patterns that use land efficiency - Natural Diversity and Habitat • Waste and Materials: - Reduce, recover, reuse, recycle and compost solid waste - Efficient and effective liquid waste management • Water: - Drinking water used in a thrifty way and maintained through generations - Rainwater is collected, diverted, re-used to moderate run-offs and maximize water quality • Climate Change, Energy and Air: - Buildings and their systems are energy efficient, produce few GHG and have a good air quality - Transportation reduce fossil fuel dependence and help conserve energy and produce low GHG. - City relies on clean, renewable, and efficient energy sources.
Livability and Social Well Being Domain	**Social and cultural dimensions of the community that sustains quality of life, celebrates self and community, and addresses human health, and overall well-being.** • Housing • Mobility and Accessibility - Safe, integrated, and convenient network of public transit, bike routes, inviting pedestrian realm. - Accessible services, amenities, buildings, facilities and public spaces. • Education/Learning • Health and Well Being: - Convenient access to a network of health-related amenities, facilities and programs to promote wellness and meet the needs of all levels of mental and physical care. • Sense of Community: - Social interaction and inclusion - Formal and informal opportunities to create and enjoy arts, culture, entertainment activities. - Vibrancy: sense of place, urban design, and beauty • Food Systems • Governance
Economic Vitality Domain	**Ongoing capacity to generate and renew the skills, finances and systems of exchange and production that enable quality of life and community aspirations.** • Economic Development • Finance
Resiliency Domain	**Ongoing ability to keep residents safe, to adapt to changes and to plan for an uncertain future.** • Security - Everyone feels secure in public and workplaces. - Rely on local sources of food, energy, and materials to meet needs under any conditions. • Adaptive Capacity

Appendix C: CPWC Project team sustainability workshops descriptions

2.1.1 Sustainability Workshop 1– Building Performance, March 20, 2018

The first workshop was intended to be an introduction to Building Performance goals. The team reviewed the project requirements, looked at precedents of high performing aquatic centres around the world, and reviewed currently available environmental sustainability certifications and standards. It was determined that CPWC could be included as a case study for BC Step Code development for recreation facilities - exercise being conducted by the province to help determine performance limits for unique building typologies. Discussions around the CaGBC Zero Carbon Building program and the LEED certification were fruitful, with direction for further internal review undertaken by the City at that time.

The workshop also focused on assessing mechanical strategies that would help improve building performance both from an energy and emissions standpoint. Significant strategies discussed included fuel shifting to electric or renewable natural gas, heat-recovery of waste water and air, natural ventilation, low-flow plumbing fixtures, rainwater harvesting, and indoor environmental quality & materials.

The project team agreed on pursuing researches to assess the achievability of the CaGBC Zero Carbon Building program, and to pursue best practice in all sustainability categories that the certification does not cover.

2.1.2: DD Technical Meeting #5 – Sustainability, September 11, 2018

In preparation for this second sustainability session, the project team did numerous research, visits, and workshops to estimate the achievability of targets discussed about during workshop 1 and set realistic nonetheless challenging goals for the CPWC project. Amongst other events, a conference call with the CaGBC Zero Carbon Building program manager, a mechanical systems workshop, and a tour of several aquatic facilities in the lower mainland including Hillcrest Community Centre (a successful aquatic and ice rink facility in Vancouver) and Minoru Centre for Active Living (a soon to open aquatic facility in Richmond pursuing LEED Gold).

During workshop 2, results were shared and environmental targets were agreed on. An energy modeling exercise was held to estimate the energy use of the new CPWC and its long term environmental footprint. The analysis was performed showing the energy impacts of the central mechanical system, glazing characteristics, opaque wall assemblies, roof insulation, lighting efficiency, and permanent shading strategies.

The project team came to a consensus on what the optimal targets could be for the CPWC project. In order to respect the City's GHG targets and show leadership in low-emitting buildings, it was decided to pursue the CaGBC Zero Carbon Building Standard - Accelerator program, and in addition add some other defined environmental goals related to other sustainability categories (e.g. water and stormwater management, construction materials and waste management, transportation, indoor environmental quality, and social wellbeing). A complete list of the environmental sustainability targets and final strategies agreed on during this workshop are listed in Section 3.