

BUILDING FOR CARE: ENVIRONMENTAL IMPACTS AND INNOVATIONS IN THE DESIGN AND CONSTRUCTION OF **LONG-TERM CARE**

Prepared by: Shary Ramírez-Montero, Sustainability Scholar, 2025

Prepared for: Ileana Costrut and Nina Akhtar Regional Sustainability Consultants

Energy and Environmental Sustainability team

Fraser Health, Providence Health Care, Vancouver Coastal Health

August 2025





St. Vincent's Heather Long-term Care picture (Lark Group, 2025)

- _0.1 DISCLAIMER
- _0.2 ACKNOWLEDGEMENTS
- _0.3 EXECUTIVE SUMMARY

1.INTRODUCTION

- _1.1 BACKGROUND: DEMOGRAPHIC PROJECTION FOR BRITISH COLUMBIA
- _1.2 DEFINITION AND IMPORTANCE OF LONG-TERM CARE
- _1.3 THE BRITISH COLUMBIA HEALTH-CARE SYSTEM
- _1.4 ENERGY AND ENVIRONMENTAL SUSTAINABILITY TEAM
- _1.5 LCRES-GUIDELINES FOR HEALTH-CARE NEW CONSTRUCTION

2.OBJECTIVES

- _2.1 PROJECT OBJECTIVES
- _2.2 PROJECT SCOPE

3.METHODOLOGY

- _3.1 DATA COLLECTION STRATEGY AND INTERVIEWS

4.FINDINGS.

- _4.1 LITERATURE REVIEW
- _4.2 EXAMPLES
 - _4.2.1 ST. VINCENT HEATHER LTC
 - _4.2.3 DOGWOOD LTC
- _4.3 INTERVIEW ANALYSIS

5.RESEARCH CHALLENGES AND LIMITATIONS

6.CONCLUSION

- _6.1 SUGGESTED DIRECTIONS FOR FUTURE RESEARCH
- _6.2 FINAL RECOMMENDATIONS
- _6.3 PERSONAL REFLECTION

7.REFERENCES

DISCLAIMER

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organisations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability and climate action across the region. This project was conducted under the mentorship of the Energy and Environmental Sustainability (EES) team. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of EES, Fraser Health, Providence Health Care, Vancouver Coastal Health, or the University of British Columbia.

ACKNOWLEDGEMENTS

I gratefully acknowledge that the research of this project took place on the ancestral lands of the **xʷməθkʷəy̓əm** (Musqueam), **Sḵwxwú7mesh** (Squamish), **səlílwətaʔ/Selilwitulh** (Tsleil-Waututh). I humbly extend my gratitude to the indigenous inhabitants and defenders of this land since time immemorial.

I, the author of this report, would like to express my heartfelt gratitude to my mentors, Nina Akhtar and Ileana Costrut. Your mentorship and patient guidance were invaluable in shaping the research project's logical structure and purpose. You not only welcomed me into your team but also built an incredible bridge between yourselves and the rest of the EES team, ensuring that my experience and integration were positive. Your passion and dedication to your work are truly admirable and contagious. You have opened my eyes to a new world of possibilities in a field I once viewed as distant, making it now feel like a real opportunity. Thank you for taking it to the next level in your commitment to the research and my personal growth. I will always appreciate the chance to work with you and get to know you better.

I would also like to extend my gratitude to every team member I encountered. Each of you consistently demonstrated a positive attitude and showed me the essential work your team does daily. I will cherish those dining conversations and laughs in a special place in my heart. Thank you for your honest participation in the research and for allowing me to learn more about the industry. Your team spirit and passion motivate me to get involved in this discipline.

EXECUTIVE SUMMARY

This research, conducted as part of the UBC Sustainability Scholars Program in collaboration with the Energy and Environmental Sustainability team, focuses on the environmental impacts and sustainable innovations in long-term care facilities in British Columbia during their design and construction phases. With demographic projections indicating a significant increase in the senior population, investing in LTC infrastructure is not only essential but also presents an opportunity to mitigate environmental impacts related to energy use, emissions, and waste.

The study employed a literature review and interviews with 11 experts to approach this topic. The findings of this research denote that awareness of planetary health is increasing, and the Low Carbon Resilience and Environmental Sustainability Guidelines for Health-care New Construction Guidelines (LCRES) are promoting more sustainable practices. Best practices identified include designing home-like environments, integrating sustainability consultants early in the process, and planning for resilience against events such as the 2021 heat dome. Several remaining barriers were identified, including tight budgets, late involvement of consultants, a lack of tracking systems, regulatory gaps, and organizational resistance.

Recommendations for improvement postulated into three different time frames, include expanding research and case studies in the short term, piloting tracking systems and post-occupancy evaluations in the medium term, and establishing a dedicated EES team for LTC facilities while advocating for regulatory reforms in the long term. By embedding sustainability into LTC facilities now, we can create healthier, climate-resilient environments for future generations.



St. Vincent's Heather Long-term Care picture (Lark Group, 2025)

1.0 INTRODUCTION

The compartmentalized nature of our world often separates knowledge into specialized fields, limiting our understanding of how human actions, society, the environment, and health are deeply interconnected. Planetary health serves as a resistance force against this compartmentalization.

According to Planetary Health Alliance (2025), Planetary Health examines how human-caused disruptions to the Earth system affect human health. Recognizing that given the complex interactions between human activity, environmental changes, and the many dimensions of human health, we will need a multidisciplinary approach of society to drive solutions.

One example of the lack of understanding of these interconnections can be seen in construction, where the primary focus is often on efficiency, cost, and management. This narrow approach overlooks the true purpose of architecture: creating infrastructure that serves people and meets essential human needs; while simultaneously ignoring its implications for the environment.

In health care, built infrastructure is designed to provide spaces for delivering services and caring for patients and residents. However, due to their scale and intensive activities, these facilities have a considerable environmental footprint characterized by high energy use, significant greenhouse gas emissions, and substantial waste generation. To address these

impacts, the Ministry of Health has established regulatory requirements that mandate improved performance and more sustainable infrastructure planning.

Increasingly, the health-care system recognizes that it cannot operate in isolation. Over the past two years, multiple health organizations in British Columbia have started to integrate principles of planetary health into their practices and strategies.

Health-care facilities encompass a range of services, including hospitals and long-term care (referred to in the report as LTC). Although they can be managed by the same health organization, each type of facility has distinct activities, demands, and characteristics. This research focuses on LTC facilities in British Columbia, recognizing an essential opportunity for improvement. It aims to explore the environmental impact and innovation in their construction and design. The goal is to identify gaps and opportunities while highlighting best practices and successful projects among 3 Health Organizations: Fraser Health, Providence Health care, and Vancouver Coastal Health (referred to in the report as 3 HOs).

1.1 PROJECT BACKGROUND :
DEMOGRAPHIC PROJECTION FOR
BRITISH COLUMBIA

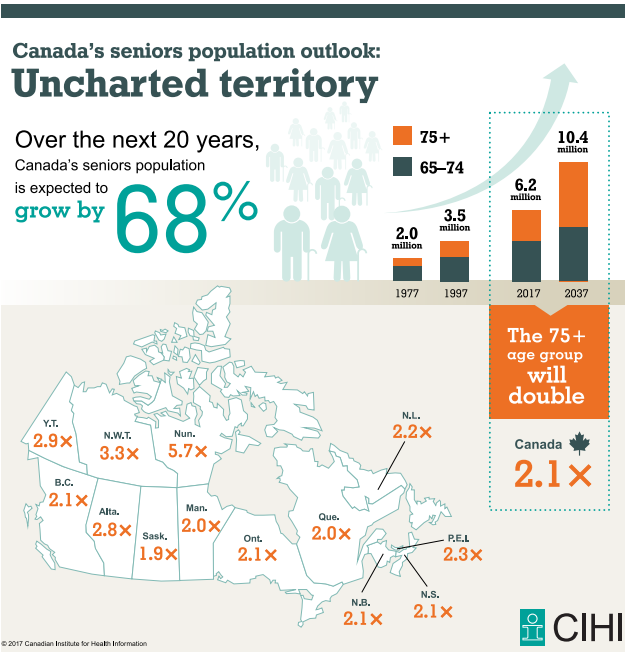
Studies indicate that the province of British Columbia (B.C.), along with the rest of Canada, will experience significant demographic changes over the next decade.

The “Baby Boom” phenomenon refers to the increased birth rates that occurred between 1946 and 1964 during the post-World War II era around the world. In Canada, this period resulted in one of the highest population increases in history. Currently, this population group is aged 60 to 79 years old, meaning many individuals are either at or approaching senior status.

An example of this growth projection is a report conducted by Birmingham & Wood Architects and Planners (2009), which supports the construction of a new LTC facility in Chinatown, a neighborhood in Vancouver. This report compares the senior population of Vancouver from 2011, which numbered 81,930 and represented 14% of the city’s population, with projections for 2036 when seniors are expected to make up 21% of the population, representing an actual growth of over 100,000 seniors (p. 6).

Additional examples include information posted by the Ministry of Health (2019), which notes that the senior population is projected to rise

from 19% in 2019 to 25% in 2034. Furthermore, the Canadian Institute for Health Information forecasts a 68% growth in the senior population across the entire country in 20 years.



Projected growth of Canada's seniors population 2017-2037 (Canadian Institute for Health Information, 2017)

This demographic shift is expected to drive significant investment, new construction, and retrofitting of existing LTC facilities throughout the province. This serves as a compelling reason for why this research is necessary and why EES should focus more on this category of construction commonly utilized by HOs.

1.2 DEFINITION AND IMPORTANCE
OF LONG-TERM CARE

Long-Term Care (LTC) is the term assigned to residential facilities under the coverage of HOs that provide continuous support to individuals with complex medical or personal care needs. These facilities are designed for individuals who, due to health conditions, functional limitations, or other factors, can no longer live independently and require continuous support.

The goal of long-term care is to provide assistance as well as a safe, supportive environment for seniors and individuals with serious health issues who require daily assistance. Some LTC facilities offer both 24-hour professional care and short-term support, including daytime services for individuals or families in need of temporary help.

With a demographic trend showing a significant increase in the senior population in Vancouver, LTC services represent essential support for families and seniors living alone.

According to the Office of the Seniors Advocate in British Columbia (2024), 19% of seniors aged 65 and older are living with complex chronic conditions, and 5% have been diagnosed with dementia. This indicates that a significant portion of the senior population is likely to require specialized care.

The different health organizations in B.C. have

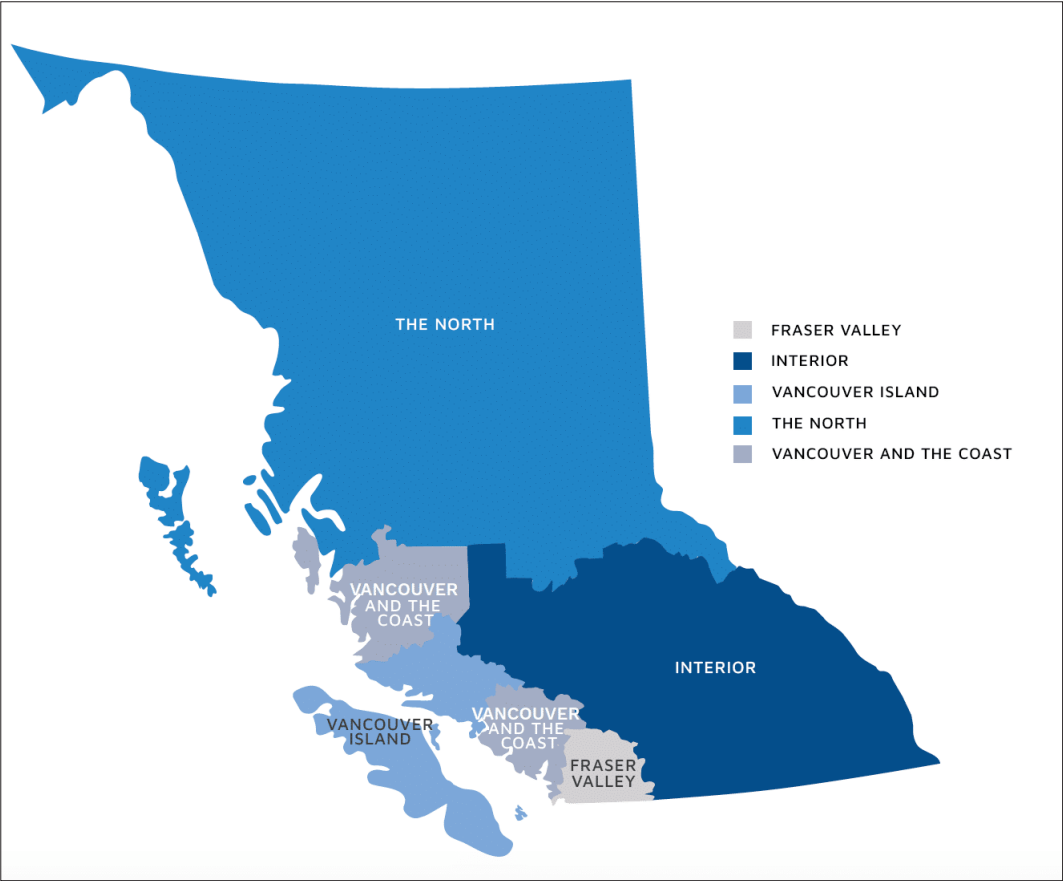
two ways of operating LTC facilities: full operational control, meaning direct oversight and management of the building and staff, or by allowing a third party to manage the facilities under the organizations' oversight.

1.3 THE B.C. HEALTH-CARE SYSTEM

While the Ministry of Health has oversight of the health-care system, the province of B.C. is comprised of 7 health organizations: Fraser Health, Interior Health, Island Health, Northern Health, and the Provincial Health Services Authority (PHSA), along with Vancouver Coastal Health.

Within British Columbia, there are five regional health authorities, alongside organizations that offer specialized services:

Regional Health Authorities:	Specialized Services:
<ul style="list-style-type: none">• Northern Health (NHA)• Island Health (VIHA)• Interior Health (IHA)• Fraser Health (FH)• Vancouver Coastal Health (VCH)	<ul style="list-style-type: none">• First Nations Health Authority (FNHA)• Providence Health care (PHC)• Provincial Health Services Authority (PHSA)



B.C. Regional Health Authorities map (PCN Jobs B.C., 2025.)

This research project focuses exclusively on Fraser Health, Providence Health care, and Vancouver Coastal Health, as these organizations operate long-term care facilities and are in the purview of the EES. Despite collaborating with EES, the Provincial Health Services Authority does not operate LTCs in the province, the reason why it was not considered part of the research.

1.4 ENERGY & ENVIRONMENTAL SUSTAINABILITY TEAM

The Energy & Environmental Sustainability team (hereafter referred to as EES), is a collaborative team focused on ensuring a regional approach to climate-resilient and environmentally sustainable care across four of the seven health organizations in British Columbia: Fraser Health, Providence Health care, Vancouver Coastal Health, and Provincial Health Services Authority

The work of EES is organized into six focus areas: climate change, food, materials, energy and carbon, water and transportation. These areas are interconnected and work synergistically, supporting various initiatives across the projects where EES is involved.

Founded in 2010, EES is also the creator of the GreenCare network in B.C., which aims to transform the health-care system toward environmentally sustainable and resilient care.

The purpose of EES is to inspire and empower everyone involved in Health care. They facilitate collaborative efforts for systemic transformation, by providing strategic direction, advising on regulatory compliance, research, health system planning and resource planning and management. This mission aligns closely with the concept of planetary health.



1. Diagram developed by EES, Theory of Change, as shown on the B.C. GreenCare website (<https://bcgreencare.ca/about-us>).

1.5 LCRES-GUIDELINES FOR HEALTH-CARE NEW CONSTRUCTION

The Low Carbon Resilience and Environmental Sustainability (LCRES) Guidelines, provides a comprehensive framework to integrate sustainability, climate resilience, and low-carbon strategies into the planning, design, and construction of health-care facilities in British Columbia. Developed by the EES team in collaboration with Fraser Health, Providence Health care, PHSA, and Vancouver Coastal Health, these guidelines refer and align with provincial policies, including CleanBC and the Ministry of Health Capital Policy Manual.

These guidelines intend to support project teams during the different stages of capital projects, from early planning through design, construction, and post-occupancy by offering clear targets, requirements, and suggested mechanisms.

The guidelines provide technical recommendations for mechanical and electrical systems, building envelope design, and material selection, while also addressing the other EES focus areas as water conservation, sustainable transportation, healthy materials, and biodiversity.

Ultimately, the LCRES Guidelines aim to ensure that new and retrofitted health-care facilities contribute positively to human and environmental health, support provincial climate and sustainability targets, and are adaptable to future climate conditions. By embedding sustainability into infrastructure development, the guideline helps health-care organizations, project managers, construction managers and any interested professional, to reduce the facilities environmental footprint, and creates healing environments that benefit both current and future generations.

2.0

OBJECTIVES

2.1 PROJECT OBJECTIVES

In the demographic context of B.C.'s aging population, more resources will need to be directed toward senior care facilities and services. Long-term care (LTC) facilities represent a significant opportunity to address environmental sustainability. This research aims to examine the environmental impacts of and sustainability innovations in the design and construction of LTC facilities. The goal is to identify both existing successful sustainability practices and projects as well as to highlight gaps and opportunities for future LTC capital projects.

2.2 PROJECT SCOPE

This research focuses on the existing infrastructure of LTC facilities in B.C., Canada. It identifies environmental impacts, actions, and strategies related to the design and construction of these facilities. This qualitative research started with a literature review and then included 11 expert interviews. After the thematic analysis of the interviews, I provided recommendations for the EES team and for future research stages. This research project focuses exclusively on LTC in Fraser Health, Providence Health care, and Vancouver Coastal Health.

The Research excludes retrofitted LTC facilities and facilities outside B.C.. It does not include quantitative analyses of LTC performance. The research provides examples of highlighted projects but does not develop case studies of specific projects. The research does not include the Provincial Health Services Authority facilities.

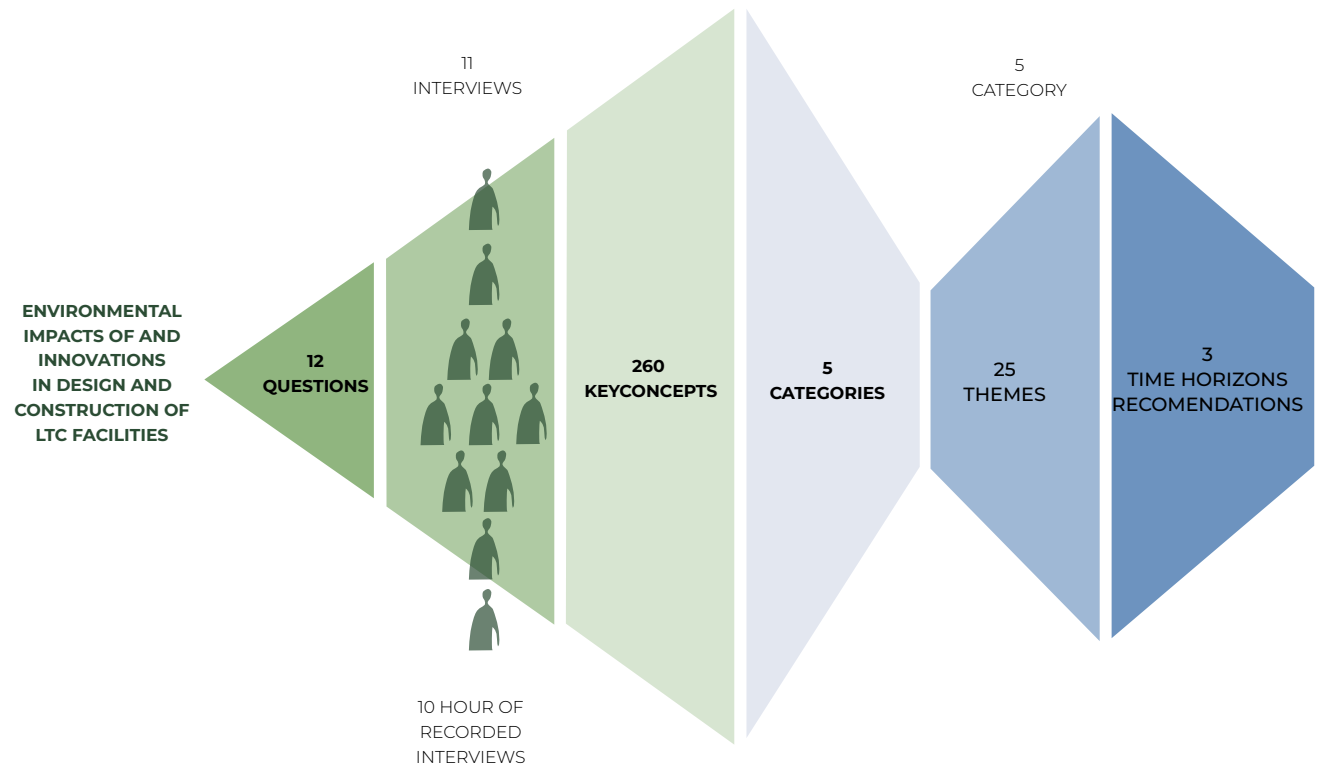
3.0 METHODOLOGY

3.1 DATA COLLECTION STRATEGY AND INTERVIEWS

The research core was qualitative, and expert interviews were selected as the primary data collection method. A final list of 11 interviewees were selected because of their experience or involvement.

The objective of the interviews was to gather insights on challenges, best practices, and opportunities for sustainable LTC design and construction. To facilitate this, a questionnaire was developed consisting of 12 questions, grouped into six distinct sections :Warm-Up/Background, Exploring Environmental Perspectives and Strategies, Climate Resilience, Facilities and Broader Sustainability, Gaps and Opportunities, Closing/Mapping.

The diagram illustrates how the qualitative information was processed through thematic analysis, which included identifying and categorizing key concepts. After analyzing the data, the recommendations were classified into three timeframes.



4.0 FINDINGS

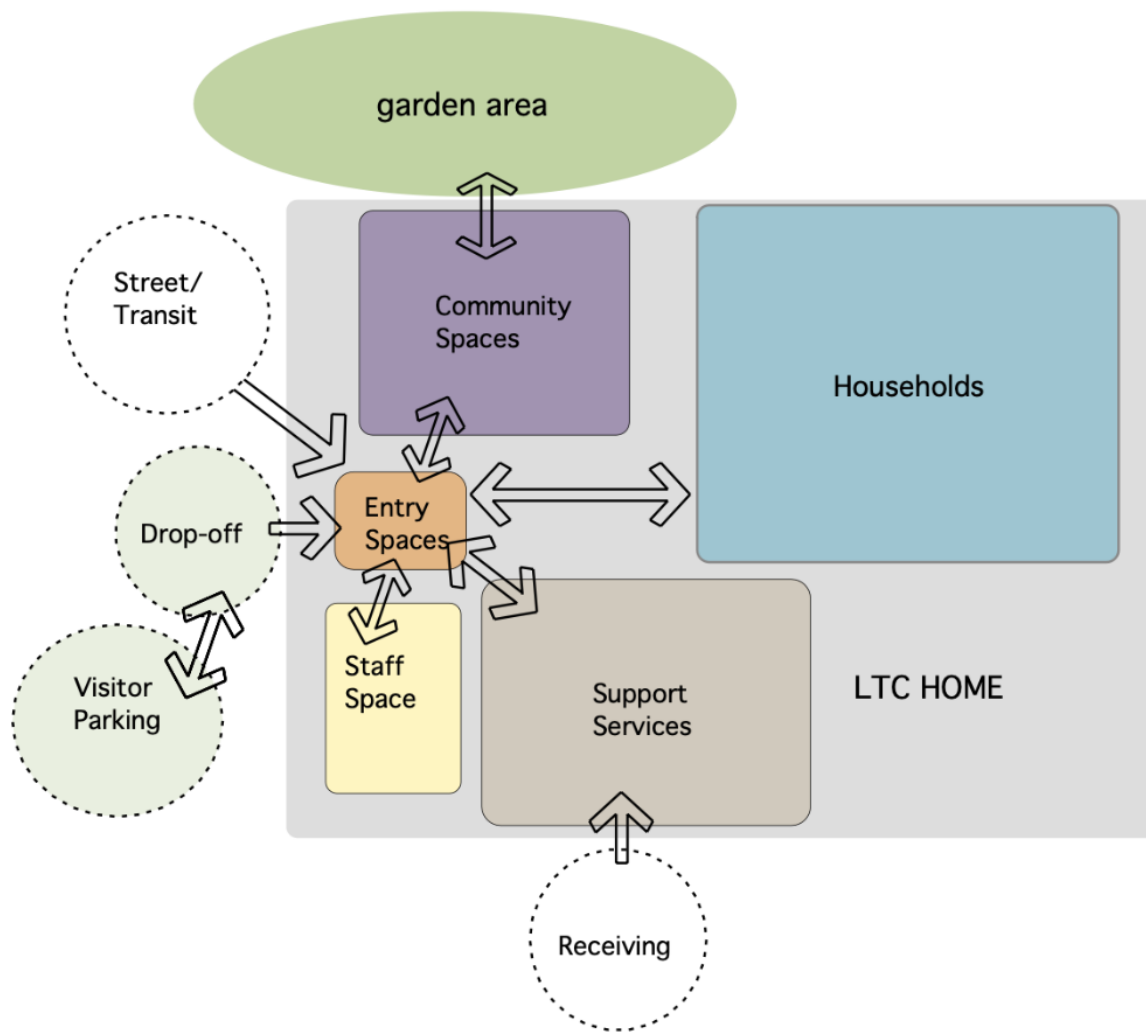
4.1 LITERATURE REVIEW

SPATIAL PROGRAM AND DESIGN CONSIDERATIONS

A review was conducted of various documents published by health organizations, publications from elderly care organizations, and publicly available web pages. However, this activity did not uncover substantial information, as detailed guidelines or standardized requirements were challenging to find. The diversity of LTC facilities across different cities and health organizations further complicated efforts to describe or standardize the spatial requirements of a typical LTC facility. Nevertheless, certain essential areas have consistently emerged in the most recent developments. It is important to note that a significant percentage of existing LTC infrastructure was built before 2010, suggesting that sustainability principles were either minimally applied or absent during their construction.

Vancouver Coastal Health has developed a Long-Term Care Design Guideline (2021), addressed primarily to the clinical team. This document provides operational insights into the infrastructure and includes a spatial zoning diagram identifying key areas that should be included in LTC facilities and the connection between them.

Households, corresponding to the private and single rooms for residents, a support service section that can include medical assistance rooms, physiotherapy spaces, as well as the hall or receiving space for independent access (perhaps corresponding to the delivery of products. The team space is for everyday work, and the private section is for the long-stay team. An entry space that corresponds to the reception and connection among the different areas, a community space that in some cases can include the dining room or a common space, depending on the distribution of the LTC, a garden area, as well as the parking space for visitors.



These zones include:

1. Households, corresponding to group or single-resident rooms;
2. Support Services, which may include medical assistance rooms, physiotherapy areas, and halls or receiving zones (potentially used for deliveries).
3. Team Spaces, which accommodate both daily work activities and private areas for long-term stay teams.
4. Entry Spaces act as reception areas and connections between functional zones.
5. Community Spaces, which, depending on the layout approach, may include dining rooms or multipurpose common areas.
6. Garden Areas: An increasing proposal for LTC, driven by the benefits identified in the connection to nature, particularly for health and wellbeing initiatives. Green spaces open up opportunities to implement proposals such as water collection, beekeeping activities, and biodiversity enhancement.
7. Visitor Parking Spaces and connections to public transport.

Diagram from Long Term Care Design Guidelines, Vancouver Coastal Health (2021).

Recent approaches to LTC design promote a fractionated layout, particularly under the concept of “design for a home-like environment”. This model encourages the division of LTC facilities into smaller “households,” each with its own dining room and communal spaces. The goal is to move away from an institutional atmosphere and create a more intimate, home-like environment where residents can interact with a smaller group of peers, fostering closer relationships and a sense of community.

This new model contrasts with the older approach of constructing large, monolithic buildings for LTC. It introduces opportunities to integrate green spaces between building volumes. It promotes new architectural proposals and demands, such as the need to enhance building envelopes due to increased exterior surface areas, and the use of decentralized mechanical systems to support the segmented design.

Despite this trend, there are still examples of medium-high buildings that adopt a similar household-based approach while maintaining a centralized layout. These facilities often feature one or two households per floor, centralizing services and limiting circulation to create a more manageable and familiar environment for residents. An example of this is Dogwood Lodge, the latest LTC project to be developed by Vancouver Coastal Health in Vancouver.

4.2.1 EXAMPLES

The following two LTC projects were highlighted by the experts interviewed as good examples of current LTC buildings, the concept of a “home-like environment”, and environmental considerations. The approach to design and construction of these two sites also highlights the active involvement and effective collaboration between project managers and construction teams. While these examples provide only a brief overview of the two B.C. projects, a recommendation for future research is to examine these projects as case studies. This in-depth exploration would enable a focus on their unique characteristics, sustainable strategies, and elements of design innovation, providing a learning opportunity for everyone interested in improving LTC environmental considerations.

4.2.1 ST. VINCENT HEATHER LTC

St. Vincent's Heather (SVH) is a LTC facility currently under construction as part of Providence Health care. This new 13-story building is situated on the historic site of the former St. Vincent's Hospital, which has served the Vancouver community for 65 years. The new LTC is designed to offer a range of services tailored to meet the needs of its residents.

The facility will feature 240 LTC beds arranged into 20 "households," each consisting of 12 residents in single-bed rooms. This configuration aims to create a more independent and less institutional atmosphere. Each household will include social and recreational spaces, such as a living room, dining room, and activity areas. Once completed, St. Vincent's Heather (SVH) will replace outdated care facilities in the city, providing essential support and supervision for seniors with complex care needs.

SVH will go beyond being just a care home; it aims to empower seniors to live life on their own terms and transform traditional caregiving and its environments.

This project has garnered attention not only for its modern approach to LTC but also for the significant role its project manager played in promoting sustainability from the project's inception, supporting environmental and energy-saving initiatives.



St. Vincent's Heather Long-term Care render (Providence Health care, 2025)

4.2.2 DOGWOOD LTC

Located in the city of Vancouver, the Dogwood Lodge is the latest LTC facility from Vancouver Coastal Health.

This six-storey, 150-bed care home was designed to create a "home-like" environment. This innovative approach to infrastructure promotes facilities modeled after a traditional home. Each of the storeys, referred to as "neighbourhoods," consists of two "homes" designed to accommodate residents with similar care needs. This results in 11-12 homes or families, each with up to 14 single bedrooms. Residents enjoy private bedrooms and washrooms, but they share living, dining, kitchen, patio, and social spaces with their home. The facility also includes two specialized homes: one for individuals with dementia, and the other for people with tracheostomies and/or ventilator needs.

The structure of this LTC facility is supported by a centralized location of services at the core of the floor plan. The basement houses an industrial kitchen and support services, which are then distributed vertically to each level's small kitchen that services its two homes.

This project has gained attention due to its concept of a home-like environment, which was a guiding principle throughout the entire development process. While this design primarily aims to enhance the mental health and well-being of residents, it has also revealed opportunities for environmental considerations, providing co-benefits alongside prioritizing well-being.

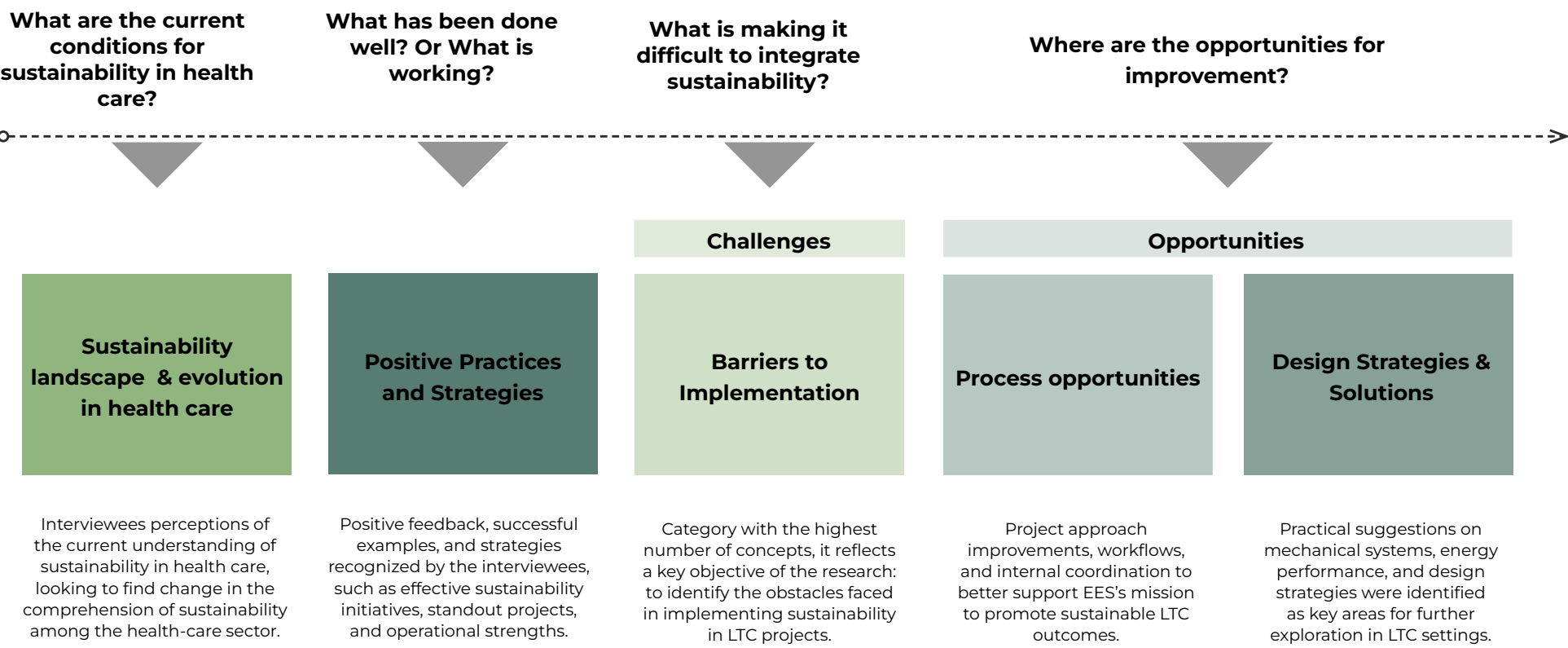


St. Vincent's Heather Long-term Care picture (Lark Group, 2025)

As part of this research, we included the project manager in our interviews, gaining a clear understanding of the process and considerations involved.

4.3 INTERVIEW ANALYSIS

In the thematic analysis of the 11 expert interviews we identified 25 themes and organized them into 5 categories illustrated in the table below.



Once the categories were established, we revisited each one and organized their contents into 4–6 sub-thematic clusters to better understand the nuances within each category and identify specific findings and recommendations that emerged from the research.

KEYWORDS THEMES

What are the current conditions for sustainability in health care

What has been done well? Or What is working?

What is making it difficult to integrate sustainability?

Where are the opportunities for improvement?

		Challenges	Opportunities	
Sustainability landscape & evolution in health care	Positive Practices and Strategies	Barriers to Implementation	Process opportunities	Design Strategies & Solutions
Growth of sustainability awareness & education	LCRES guideline as a tool for design	Budget, time pressures and process length	Early integration & business case alignment	Energy efficiency & operational performance considerations.
Planetary health embedded into organizational values	Resilience as a sustainability conversation opener	Knowledge and implementation gaps, operational disconnects	Tracking & post-occupancy evaluation	Passive design, building envelope strategies & green spaces
From LEED points to holistic sustainability	Early Integration of EES consultants	Lack of systematic tracking of ideas, transparency and structure	Holistic approach & systemic perspectives	Indoor air quality, comfort & ventilation solutions
Health and wellbeing at the heart of LTC design and decisions	Designing for a Home-Like Environment	Regulatory constraints	People Engagement, social Network, and clear objectives for consultants	Sustainable materials & modular systems for circularity
Climate change and future conditions awareness	Multidisciplinary approach and interconnection of focus areas	Organizational culture & Interest holder resistance to change		Resilience and climate adaptation in LTC design
		Human resource limitation		

SUSTAINABILITY LANDSCAPE & EVOLUTION IN HEALTH CARE

Growth of sustainability awareness & education :

When interviewees were asked about changes in the perception of sustainability within the B.C. selected HOs, they consistently mentioned the growth of awareness and education opportunities as key factors contributing to a more supportive atmosphere. This improved context makes it easier for EES to promote sustainability solutions. The reduced need to "sell" ideas or convince others demonstrates the power of education and the clear communication of co-benefits, allowing space for deeper and more meaningful conversations around sustainability in health care.

Planetary health embedded into organizational values:

Despite not being a universal situation in the 3 HOs the growth of planetary health initiatives was identified by the interviewees as a positive and important change. The attitude towards sustainability was mentioned to be significant in the progress of sustainable initiatives. As an example, we can identify the difference between the recent LTCs built and the ones

before 2010, which lack sustainable principles.

From LEED points to holistic sustainability:

One of the questions in the questionnaire tried to identify the place LEED certification is taking in the conversation. Among the interviewees, the difference between chasing points and pursuing a bigger goal of incorporating sustainability into the projects was not just relevant but one of the biggest changes in the 3 HOs landscape. Despite the certification being one of the biggest motors for sustainable principles integration into the process, it was recognized that the construction teams currently have a more holistic approach to sustainability and are walking away from point chasing, at least in some of the projects.

"We're not just chasing points, we're actually trying to make a difference with these buildings"— Interviewees reflection

Health and wellbeing at the heart of LTC design and decisions:

A fundamental change in design approach was made after HOs representatives on LTC projects made a fundamental change in the design approach: a focus in creating health and wellbeing. This focus not only modified the perception of the project but pivoted many decisions towards achieving this goal. This change in focus was mentioned by the participant as a strong driver of decision making integrating with its sustainable objectives as a co-benefit.

"The other thing that I've seen is the idea of going from a building to houses, so it'll be a conference of houses. Which means that instead of having one centralised kitchen or one centralised laundry, each house on the property would have a kitchen, and laundry. It's meant to look more like your home not an institution."— Interviewees reflection

Climate change and future conditions awareness:

Awareness of climate change and the need to understand the role of resilience in infrastructure intensified after the 2021 heat dome. However, interviewees noted that one of the most significant changes in the 3 HOs is that today's starting point is much closer to sustainability than it was in the past. This shift creates new opportunities for improved approaches and greater involvement in the design and construction process. The initial push has been made, and the current challenge is to continue the momentum.

"Sustainability as a whole, understanding and buy-in has been increasing over time. Climate resilience discussion started in 2018 as a 'nice to have'. After 2021, the heat dome, the wildfires, the flooding...were a really big turning point for the health-care sector and for the building sector.

Around that time we saw the approval of several business plans for new long-term care facilities.."— Interviewees reflection

POSITIVE PRACTICES AND STRATEGIES

LCRES guidelines as a tool for design:

The Low Carbon Resilience and Environmental Sustainability Guidelines for health care New Construction was quoted, referenced, and recognized as one of the greatest achievements and successes of the EES team. The availability of a tool to guide interest holders involved in the design and construction of health-care infrastructure is not only a widely used and effective strategy, but also the result of extensive multidisciplinary collaboration. It represents the consolidation of the knowledge of an experienced team into a single, powerful document.

“...Our vision is to move to a strategic approach to projects and the LCRES is really the tool that we’re focusing on as well as our guidelines for the environmental management plans.”— Interviewees reflection

Resilience as a sustainability conversation opener:

The changes in regulations related to climate resilience created opportunities for many other sustainability solutions and represent a significant victory toward the overall goals of EES.

“...There was a big change around the heat Dome in 2021, a turning point for considering climate resilience and then partnered with environmental sustainability at the end of the project because of the heat Dome and the impacts that it had on our facilities.

It seemed like after 2021, our team was getting called into projects more, there was receptiveness to considering sustainability, there were changes that were happening in our policy, with Chapter 11 In the health capital health policy manual, there are certain environmental sustainability considerations and having to meet or pursue lead gold. There are these big impacts on capital projects.”— Interviewees reflection

Early Integration of EES consultants:

Despite ongoing challenges in integrating sustainability and environmental strategies during the design and construction process, interviewees recognized a positive shift: sustainability consultants are now invited to provide input into projects earlier than in the past, acknowledging that incorporating a sustainability lens into a project needs to happen at an earlier stage. This change allows the team to have greater influence in decision-making. However some interviewees still emphasized the importance of promoting even earlier involvement to maximize impact, especially during the business case stage.

“Sustainability and resilience being a higher priority topics and therefore getting thought about earlier in the process.”— Interviewees reflection

Designing for a Home-Like Environment:

With completed projects serving as examples of this best practice, the strategy of establishing an early concept for the LTC project was highlighted by interviewees as a way to create a common goal that unites different disciplines throughout the design and construction process. Grounded in the understanding that an LTC facility is closer to a residence than to an institution, the objective is to guide every decision in support of creating a home-like environment.

Recognizing the common goal and focus on patient well-being enables additional co-benefits that support sustainable and environmental solutions and strategies. This includes opening the door for conversations about thermal comfort and access to green spaces, which can also incorporate natural environments as part of the spatial program.

“Dogwood care home has been brought up as a positive example of things having gone well with the design. They started with these vision statements at the very beginning of the project, and everything came out of that vision. Every system that is needed, design, and furnishings were a home-like environment. They ask themselves: Is it contributing to this vision? That seemed to be a really powerful way to positively impact design.”— Interviewees reflection

Multidisciplinary approach and interconnection of focus areas:

According to the EES interviewees, one of the team's strengths when approaching various projects, including the design and construction of LTCs, is the diversity of focus areas and consultants involved or available for consultation. This diversity, combined with integration across all other disciplines throughout the process, increases the potential for impactful results, even though it demands a high level of communication and technical coordination from team members.

"The approach to having the planetary health piece is coming into conversations now, as well as ESG for capital, in the environmental, social governance framework. One other thing is transportation, where we're electrifying both cars and other places rather, mobility options as well. Electrifying transportation is a multidisciplinary focus.."— Interviewees reflection

BARRIERS TO IMPLEMENTATION

Budget, time pressures and process length:

The design and construction of LTCs, despite being a smaller scale than hospitals, is not a simple process, especially when carried out under tight time constraints due to the need for the facility to be ready by a fixed deadline. In addition to this, budget and cost limitations are a common challenge throughout the process.

Once the budget is set in the business case stage, the objective in the following stages is to stay as close to it as possible. In this effort, and through the common practice of value engineering (cost reductions), sustainable solutions and strategies are often the first to be affected, as they are still frequently viewed as "Nice to have".

"It seems to me like in the business plan or some of those early phases, they're rushing to get to a budget. But without going to a lot of specificity yet.."— Interviewees reflection

Knowledge and implementation gaps, operational disconnects:

A common theme among the interviewees is the complexity involved in designing and constructing large health-care facilities. This intricate process is often affected by miscommunication. While LTC facilities involve a smaller scale of construction and have distinct needs, most attention has been focused on hospitals, even though LTCs present their own unique challenges.

In this context, integrating environmental solutions can be difficult due to a limited understanding of their long-term operational benefits. This challenge arises partly because Facility Management and Operations (FMO) teams are not brought into the process early enough, leading to miscommunication and gaps in knowledge. An example of this issue is that the Facilities Management Organization (FMO) is not always included in the selection of equipment. This oversight can lead to an

inaccurate assessment of the maintenance requirements for the proposed equipment, resulting in void proposals. Additionally, the lack of timely communication or the complete absence of FMO involvement can create challenges during the maintenance and operation of that equipment.

These issues frequently hinder the success of sustainability measures or result in their complete cancellation due to a lack of understanding among decision-makers.

"There's also a missing piece when looking at the connection that's going to make operational successes and design."— Interviewees reflection

Lack of systematic tracking of ideas, transparency and structure:

The complexity of designing and constructing LTCs, along with the diversity of interviewees and disciplines involved, can be understood as many people with different interests trying to steer a project while making collective decisions. In this context, sustainability consultants often act only as advisors rather than decision-makers, which limits their influence throughout the process. Additionally, the lack of transparency from other parties makes it almost impossible to track when the sustainability strategies supported by EES are canceled, as these decisions are not always communicated. The team currently does not have a process in place to monitor or follow up on these changes.

"Understanding what the project expects of engagement, to inform us, to include us in key decision making, to consult with us health authorities. Some transparency would be

great.”— Interviewees reflection

“Every time you do another layer of design, things can get lost or things can get removed or changed. Tracking sustainability strategies through that whole process is very challenging, especially when you're one person or a few people doing many. So one of those things is to get a better process for tracking things for projects..”— Interviewees reflection

Regulatory constraints:

Interviewees mentioned that, despite recognizing significant improvements in regulations, especially due to the resilience strategies incorporated in the HOs, there are still existing regulations that need to be updated, as they represent major barriers. One of the most critical issues is the continued classification of LTCs as non-post-disaster infrastructure, a decision that impacts structural resistance requirements and the availability of energy support during crises, ultimately putting the operation of these facilities at risk in the event of extreme weather events and natural disasters.

“A new acute care setting, depending on the classification of the hospital, would be designed to post disaster post disaster.

One of the biggest considerations, and the most expensive one is being designed for seismic post disaster, so that in the case of a major earthquake it would be operational.

A Long Term Care Facility in a lot of ways, It is more like a hospital than it is a regular resident building or an office building because you can not evacuate.

If you're not gonna design for seismic code, what

are all of the resilience measures that you could include anyways, including enhanced backup power to 72 hours?.”— Interviewees reflection

Organizational culture & interest holders resistance to change:

Despite significant advancements by HOs and regulatory bodies in recognizing the importance of resilience in project considerations, interviews conducted by the EES team revealed ongoing resistance within the discipline to accept new or alternative approaches, favoring more conventional solutions. This resistance makes it challenging for consultants to gain acceptance for innovative sustainability strategies, which are often labeled as costly, even when they provide clear long-term benefits. The gap between short-term thinking and long-term advantages is a major obstacle to achieving project goals.

When describing barriers “Short term thinking because of budget, our projects are structured and funded destined for failure when it comes to environment sustainability, because in fact it's about long term benefit.”— Interviewees reflection

Human resource limitation:

Being a small team, the limitations of what each EES team member can accomplish is one of the main challenges in their work. The involvement of each team member in multiple projects, often at different stages and sometimes without a proper introduction to the construction team, limits the attention they

can dedicate to each project. A heavy workload, within an environment that does not always prioritize or support sustainability, further complicates the efforts of a team that is doing its best to promote sustainability improvements in projects that go beyond simply achieving LEED certification.

“It has to do with how much we pay our consultants to do the sustainability work for us and the scope of work we give them... There's not enough money all the time, because a lot of these Business plans are political, and some of the time frames they give us are really short, and then in the end some of the value gets lost.”— Interviewees reflection

PROCESS OPPORTUNITIES

Early integration & business case alignment:

Interviewees identify the late incorporation into projects as one of the strongest reasons why it is hard to accomplish the acceptance of sustainable strategies during the design and construction process of LTCs. Moreover, the lack of EES participation during during the business case phase, when the budget is assigned, gives them the impression that adding any extra strategy is impossible or relies on the need of points for certifications. Therefore, they see opportunities in becoming involved earlier in the process, and promoting the integration of sustainable principles from the business case

to ensure the budget contemplates those strategies from the beginning.

"I'm talking to business plan right now, which is when they put a dollar value to the exercise, it's very difficult to do that if we don't have the right people highlighting where that needs to be."— Interviewees reflection

Tracking & post-occupancy evaluation:

Interviewees identified the need to develop better systems to track sustainability recommendations and strategies throughout the design and construction process. They recognize that such measures often tend to be canceled due to cost constraints and the lack of transparency during value engineering processes, which prevents the EES team or other sustainability consultants from being informed about those modifications. They also highlighted the inclusion of post-occupancy evaluation of existing infrastructure as an opportunity, a mechanism to reinforce the benefits and co-benefits of environmental strategies, alongside a better tracking system for proposals and decisions.

"Maybe doing a customised option, they have the option of a post occupancy verification where you put in indoor air quality sensors and you could demonstrate that you actually do have good indoor air quality."— Interviewees reflection

Holistic approach & systemic perspectives:

The interviewees mentioned one of the biggest opportunities for improvement lies in recognizing the importance of approaching each project holistically, understanding both the multidisciplinary nature of the professionals involved, and the repercussion of each decision for the different stages of design, as well as for the different components of a project. The proposal: avoid isolated solutions and analyze every project from a systemic perspective, where every small decision can have a positive or negative impact on each stage of the process.

"Looking at the building from a systems lens, understanding how things are going, how everything's connected to each other, whether it's some water coming, the site is located, and the surrounding environment . Site conditions, where you are building this facility, materials, and what are the energy sources, whether it's water or whatever it may be flowing through the system, and how we can effectively use as little as possible but provide the same comfort, provide the same output."— Interviewees reflection

People engagement, social network, and clear objectives for consultants:

Interviewees consistently emphasized the need to establish clear and early objectives and scopes for sustainability consultants in order to enhance their involvement and focus efforts throughout the process. The diversity of professionals involved, combined with limited time for proper introductions, can compromise communication and reduce the potential for effective outcomes. Opportunities lie in fostering stronger engagement and strengthening social networks among interviewees to achieve better outcomes. That includes educational

campaigns among construction teams.

"It would be interesting if the project teams at the very beginning were transparent on who they plan to engage with at every project phase. And then everyone on that list has the opportunity to say: You're missing these people. That oftentimes you realise someone hasn't been part of this conversation...It would be important to have the opportunity to mention who is missing- do they have an engagement plan? Do they have an interest-holder mapping at the beginning of the project?."— Interviewees reflection

DESIGN STRATEGIES & SOLUTIONS

Energy efficiency & operational performance considerations:

Interviewees recognize energy efficiency as an effective way of improving LTC infrastructure performance. However, it is vital for the design team to consider the age and physical conditions of the residents, as these may necessitate different thermal and lighting levels compared to other facilities. Interviewees also emphasized that understanding comfort and performance beyond just numerical values is not just essential but indispensable when considering specific occupant needs.

"Ventilation is performance-based, being able to more fine-tune the amount of air that you're needing to heat and cool and move around based

on achieving the performance required versus how many changes the code demands.

It may be an example of one of these barriers that makes it more difficult to pursue a strategy. It's better for the occupant, and it's also based on the idea that there's a fixed number. Whereas if we had a more fluid idea, we want to achieve this performance, and the performance is defined, but the actual ventilation rate required to achieve that performance, we will figure that out in real time based on monitoring, and then we can adjust the ventilation to suit.”— Interviewees reflection

Passive design, building envelope strategies:

Despite access to advanced mechanical and technological solutions, the interviewees emphasized passive strategies and the strength of the building envelope as essential first steps for improving the energy efficiency of the facility. These approaches not only improve comfort in the event of mechanical system failures, but also provide a stronger foundation for the effective use of mechanical solutions later on. Returning to the basics and understanding the volumetric thermal needs and characteristics of an LTC facility highlights how having more exterior walls shifts the design approach, distinguishing it from that of acute care settings.

“The idea of starting with the principles...It could flow to different strategies. Going more into the building envelope. It seems to me that it's usually dismissed pretty rapidly. The idea of really going to something more robust, it's dismissed as being too costly and yet the calculations are not being done. That could demonstrate that, for example, better windows and better insulation and solar shading could reduce like significantly reduce that peak solar gain., during that peak summer moment..”— Interviewees reflection

Indoor air quality, comfort & ventilation solutions: Interviewees highlighted the importance of considering health-care buildings as healing environments. With that in mind, every architectural or mechanical decision should be guided by the comfort and well-being it provides to LTC residents. In connection with resilience, interviewees also suggested the need to incorporate more robust measures for air quality monitoring, filtration and ventilation.

“My understanding is that it would support a healthier indoor microbiome and indoor environment that's better for people's health. And then times of the year, it's going to be more mechanical, ventilated and could displacement ventilation where air is brought in at a low level and then passes up past the breathing zone, which can help to take the contaminants away. It can lead to being able to deliver ventilation at a lower rate, which then you're less likely to have draughts. You're less likely to be having large volumes of air move through that can dry the air out and so on.”— Interviewees reflection

Sustainable materials & modular systems for circularity:

Connecting the recent acceptance and growing awareness among interest holders of the need to consider future weather conditions, particularly in response to the heat domes experienced in 2021, interviewees emphasized the importance of improving material selection and enhancing the building's capacity for future adaptation. Modular construction was mentioned as a potential area for experimentation due to its flexibility and alignment with circular design principles. Modular design facilitates easier modifications to

spaces as required and allows components to be reused or repurposed, thus minimizing the waste commonly linked to retrofitting or demolition.

“Designing for disassembly, designing our facilities so we can actually take them apart into the system. Sixty years' time for the end of life for the facility, that whatever materials can be either repurposed or recycled. We don't think about rightsizing. So modular designs, to ensure that the construct created is low.”— Interviewees reflection

Resilience and climate adaptation in LTC design:

After the heat dome experienced in B.C. in 2021, a turning point in the acceptance of sustainability and resilience considerations within health-care facilities was recognized by the interviewees. However, more is needed to ensure adaptive infrastructure for future climate shocks. Despite the change of regulations that now demand buildings use future weather data projections and design accordingly, we still have many more opportunities to ensure long-term planning buildings, climate resilient and adaptive infrastructure.

“At a higher level, resilient design is about flexible and scalable strategies. We don't necessarily know what the future holds. Let's go with no regrets, options where we choose something we know will be good, but that has flexibility to adjust in the future.”— Interviewees reflection

5.0

RESEARCH CHALLENGES AND LIMITATIONS

One of the initial limitations of the research was the lack of accessible and reliable data concerning the existing LTC infrastructure. Our original approach was to conduct a quantitative analysis to understand which LTC facilities within the 3 HOs had incorporated sustainability features and to identify those features. However, after compiling a database of the current LTC facilities, it became evident that the available information was limited. This led us to recognize the need for qualitative research to engage with the EES team and gather their insights. With this understanding, we decided to shift our approach.

Another significant limitation was the constrained time frame for developing the research. The topic proved to be extensive, uncovering multiple potential lines of inquiry, including the analysis of existing case studies and a more quantitative examination of specific projects. Unfortunately, due to time constraints, we were unable to explore as many aspects as we would have liked. As a result, we compiled a list of recommendations for future research stages, setting aside more extensive investigations for later.

6.0

CONCLUSION

Long-term care facilities play a crucial role in health care, especially regarding sustainability and demographic changes, making them a key focus for the future of British Columbia. This research highlights promising advancements in awareness, guidelines, and design practices, while also revealing ongoing challenges such as financial constraints, limited early integration of sustainability, and regulatory gaps. Although the study faced limitations in terms of time and quantitative data, the qualitative insights gathered from interviews provide valuable information and a strong foundation for further investigation.

The projected demand for long-term care in the coming years presents an opportunity to better integrate environmental considerations into the design and construction processes. As a result the research findings offer recommendations for future research stages, as well as three time-frame suggestions for enhancing information gathering and addressing identified gaps.

A key takeaway from this research is the necessity for collaboration, innovation, and systemic change. A holistic approach to infrastructure is essential for embedding sustainability in long-term care, recognizing that this is not only an environmental priority but also crucial for the health, well-being, and resilience of our seniors.

6.1 SUGGESTED DIRECTIONS FOR FUTURE RESEARCH

The findings from this initial approach to researching the impact and innovation in the design and construction of LTC facilities have highlighted the relevance and potential of deeper investigation into specific practices, projects, and additional lines of research.

Here we present some of the initial goals that had to be postponed, as well as new discoveries and suggestions for upcoming stages:

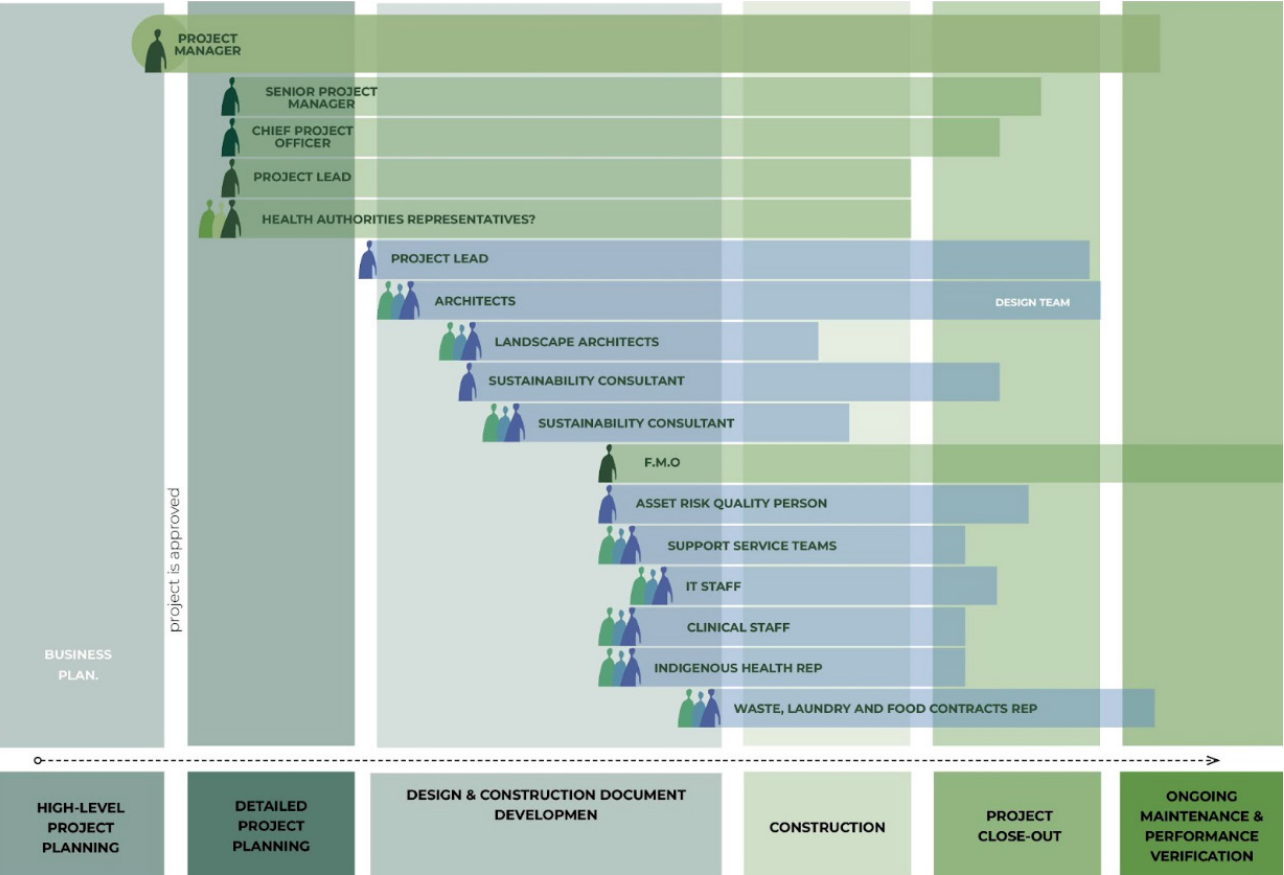
Analogous Research: Identify and complement the study with examples of innovative environmental design and construction practices that address the gaps and opportunities identified, drawing from long-term care (LTC) facilities across Canada and Europe.

Complement living diagram: One of the main concerns expressed by the EES team is the lack of clarity around project organizational structures, particularly because, as advisors, they are not decision makers in the projects they support. To address this issue, and in recognition of the diversity and variability across projects even within the same health authority, we created a draft timeline illustrating the key people involved throughout the general project process.

The intention is for this to serve as a living diagram, continuously improved through feedback from the EES team, adaptable to each project and usable as a tool to understand and track the various stakeholders involved at different stages, enabling EES consultants to identify the appropriate individuals to engage with when addressing sustainability concerns and recommendations.

This living diagram is just one of several suggestions proposed for further development in the next phase of the research.

LIVING DIAGRAM



Interest-holder Contact List:

The interviews provided not only valuable answers to the research questions but also recommendations for other interest-holders to contact in order to continue discussions and explore opportunities to improve sustainability in LTC. As part of this research, a supplementary chart has been developed, listing these referrals, their contact information, and the individuals who can facilitate introductions. One of the key recommendations for future research stages is to reach out to these contacts as part of an ongoing engagement process.

Post-Occupancy CODE in LTC Facilities:

The discovery of this gap in regulations has started ongoing discussions. A strong recommendation is to continue researching the consequences of excluding LTC facilities from post-disaster occupancy infrastructure planning. Investigating the structural conditions of existing LTC infrastructure, as well as their energy backup systems, can help build a case to present to HOs, opening critical conversations around this significant oversight.

6.2 FINAL RECOMMENDATIONS

In a dynamic environment such as health-care infrastructure planning, especially in LTC facilities, where every project is unique and requires specific considerations, the idea of transforming mechanisms or approaches can feel overwhelming. All the necessary considerations when modifying mechanisms come directly to the minds of those promoting transformations and sometimes delay the change.

My recommendations for the EES team are categorized into three different time horizons according to the complexity of the recommendations and the complications to achieving them.

Short-term (0-2 years)

The first recommendation is to continue the research on LTCs. By pursuing the remaining goals of this research, it will be possible to delve deeper into what this research has begun to visualize.

This first stage could involve the previously mentioned research opportunities, especially the case study analysis of existing LTCs. This strategy aims to provide tangible information and metrics (when analyzing the numerical performance of facilities) to support good practices, as well as identify gaps and opportunities.

The benefits of allocating time for research on ongoing practices can be significant in supporting and improving team mechanics.

Medium-term (2-5 years)

Develop one or two pilot projects to test sustainability recommendations & tracking system. Despite the uniqueness of each project, the goal of these pilot projects is to test systems without demanding a larger transformation until the system is thoroughly tested.

Moreover implement a post occupancy analysis and an ongoing monitoring of performance in one or two of the already developed facilities, this kind of test can both provide numerical metrics for performance tracking, as well as a resident survey which can provide more information about the users experience, one of the biggest goals of the EES team to understand and improve.

Long-term (5+ years)

Once the research has made more progress and various approaches and analyses have been proven on a smaller scale through pilot projects, the next step could involve a more profound change. The development of a small team focused on the design and research of LTCs within the EES team could respond internally to the projected demographic trends of the population and concentrate efforts on what could be a strong demand for infrastructure.

6.3 PERSONAL REFLECTION

Participating as a sustainability scholar in this research has been one of the best academic and personal experiences in my life. I have always been passionate about research and the structural analysis it entails; however, this was a completely new field for me. As an architect, I was unfamiliar with Health care and its facilities.

This situation required me to dedicate time to study articles and documents provided by my mentors to understand the basic concepts discussed within the team. The learning curve was challenging to navigate within the project's time constraints. Conducting this research part-time over three months felt too short to explore the topic in greater depth and on a broader scale.

My thinking as an architect tends to be spatial and numerical; I analyze things based on dimensions and physical characteristics. However, my immersion with the EES team allowed me to adopt a more holistic approach. This perspective is deeply connected to my previous research on assembly, which views the world as a fluid dynamic, an interconnected network of elements. This theory recognizes that not all entities in the assemblage are fixed

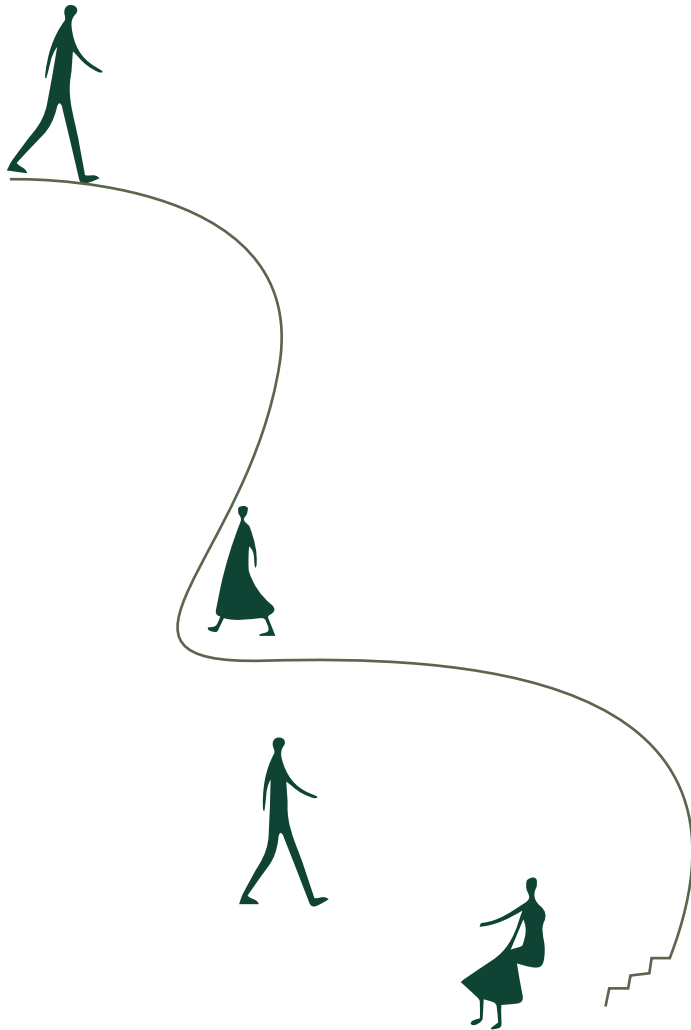
structures; both the entities (interviewees) and the network itself are in continuous movement. This supports the idea of planetary health not just as a concept, but also emphasizes the importance of the multidisciplinary team that forms the EES, inspiring me to keep learning about this needed and passionate field.

I can not mention how throughout the entire process, my mentors played a crucial role in my experience. They supported me both professionally and personally, making me feel welcomed and appreciated at all times. Their constructive comments not only helped me gain a better understanding of the research goals and topics but also improved my overall research skills. The commitment they demonstrated, combined with my engagement, enhanced the entire experience and contributed to my enjoyment. I will always be thankful for that.

This was just the beginning of a path that I look forward to continuing. I am eager to learn more about the professional landscape in the environmental and health-care fields. I recognize that being involved in this research has opened up new possibilities for me and has introduced me to incredible professionals whose work I hope to follow in the future.

7.0

REFERENCES



- B.C. GreenCare, Fraser Health, Providence Health care, Provincial Health Services Authority, & Vancouver Coastal Health. (2024, July 10). Low carbon resilience and environmental sustainability guidelines for health care new construction (v3.0). BC GreenCare. <https://bcgreencare.ca/wp-content/uploads/2024/07/LCRES-Guidelines-2024-V3-FINAL-7-10-2024.pdf>
- BC GreenCare. (2025). About us. BC GreenCare. Retrieved July 30, 2025, from <https://bcgreencare.ca/about-us>
- Birmingham & Wood Architects and Planners, & City of Vancouver. (2009). Vancouver Chinatown senior housing study: Final report. British Columbia Ministry of Tourism, Culture and the Arts. https://www2.gov.bc.ca/assets/gov/british-columbians-our-governments/our-history/historic-places/documents/heritage/chinese-legacy/clan-associations-pdfs/vancouver_chinatown_senior_housing_study_finalreport_pdf_19mb.pdf
- Canadian Institute for Health Information. (2017, July 11). Canada's seniors population outlook: Uncharted territory [Infographic]. CIHI. <https://www.cihi.ca/en/infographic-canadas-seniors-population-outlook-uncharted-territory>
- Dogwood Care Home. (2023, December 15). Virtual tour | Dogwood Care Home [Video]. YouTube. <https://www.youtube.com/watch?v=5Vla0vhuAOw>
- Lark Group. (2025). The Dogwood Lodge [Project description]. Lark Group. Retrieved July 30, 2025, from <https://www.larkgroup.com/project-dogwood-lodge/>
- McMaster University, & PEACH Health Ontario. (2024, April). Sustainable health care leaders guidebook for Canadian long-term care: An implementation guide for boards, management, and clinical team. <https://peach.healthsci.mcmaster.ca/wp-content/uploads/2024/04/Sustainable-Health-care-Leaders-Guidebook-for-Canadian-Long-Term-Care-with-ref.pdf>
- Ministry of Health. (2019, July 3). More choice, a stronger voice help seniors make long-term care decisions [News release]. Government of British Columbia. <https://news.gov.bc.ca/releases/2019HLTH0098-001385>

- Ministry of Health. (2021, February 26). Construction underway at Dogwood Lodge long-term care home. BC Gov News. <https://news.gov.bc.ca/releases/2021HLTH0042-000343>
- Office of the Seniors Advocate British Columbia. (2024, March 31). Monitoring seniors services: 2023 report (Version 1.1). <https://www.seniorsadvocatebc.ca/app/uploads/sites/4/2024/03/OSA-MSSREPORT-2023-FINAL-V1.1-LOW.pdf>
- PCN Jobs BC. (2025). B.C.'s regional health authorities [Map]. PCN Jobs BC. Retrieved August 20, 2025, from https://pcnjobsbc.ca/?da_image=258
- Planetary Health Alliance. (2025). What is planetary health? Planetary Health Alliance. Retrieved August 17, 2025, from <https://planetaryhealthalliance.org/what-is-planetary-health>
- Providence Health care. (2025). St. Vincent's Heather Long-term Care Home. Providence Health care. Retrieved August 17, 2025, from <https://www.providencehealthcare.org/en/future-sites-projects/st-vincent-s-heather-long-term-care-home>
- Vancouver Coastal Health. (2020). Long-term care design guidelines 2020 (Version 7.3). <https://www.vch.ca/sites/default/files/2021-03/long-term-care-design-guidelines-2020.pdf>
- Vancouver Coastal Health. (2025). Environmental sustainability. Vancouver Coastal Health. Retrieved July 30, 2025, from <https://www.vch.ca/en/environmental-sustainability>
- Vancouver Coastal Health. (2025). Long-term care at Dogwood Care Home. Vancouver Coastal Health. Retrieved July 30, 2025, from <https://www.vch.ca/en/location-service/long-term-care-dogwood-care-home>
- Vancouver Coastal Health. (2025). Long-term care homes. Vancouver Coastal Health. Retrieved July 30, 2025, from <https://www.vch.ca/en/service/long-term-care-homes>

