

CASE STUDY

Nanaimo Regional General Hospital (NRGH)

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TERRITORIAL ACKNOWLEDGEMENT

Before Canada and BC were formed, Indigenous peoples lived in balance and interconnectedness with the land and water in which the necessities of life are provided. Health disparities persist, which are due to the impacts of colonization and Indigenous-specific racism. Healthy lands, healthy people. Island Health acknowledges and recognizes these homelands and the stewardship of Indigenous peoples of this land; it is with humility we continue to work toward building our relationship.





Nanaimo Regional General Hospital Upgrades & Expansion

The Nanaimo Region has a growing and ageing population, housing affordability and supply challenges, and a higher proportion of Indigenous residents than most communities in BC and Canada. Social determinants of health as identified by the World Health Organization, indicate a higher level of vulnerability for these populations, and disproportionate impacts on health from climate-related events.

Over the last seven years, the Nanaimo Regional Hospital District has financed certain capital projects at the Nanaimo Regional General Hospital through the MFA. These specific projects, detailed below, address capacity constraints in health care services and facilities, as well as the thermal and electrical energy systems that heat, cool, and power the hospital campus.

Serving Nanaimo - the Community Context

Based on the 2021 Census of Canada, the Nanaimo Region is among the largest in British Columbia, and one of the fastest growing in the country. The Nanaimo Regional General Hospital (NRGH) serves the people living within the Regional District of Nanaimo. The Nanaimo Local Health Area, is part of Island Health, the Provincial authority responsible for delivering healthcare services on Vancouver Island. The Province of BC, the Nanaimo Regional Hospital District (Nanaimo RHD), and other sources such as charitable foundations, provide pooled funding to Island Health to maintain, improve, and build healthcare facilities in the region.

◀ Exterior (above) and Interior (below) of NRGH's new ICU which opened its doors in 2023

Service Area, Population & Growth:

- 2,000 km² area located along the eastern coast of central Vancouver Island; the region's coastal communities are exposed to storm surge and sea level rise, in addition to the overland flooding, wildfire risk, and heat waves common to other communities in the Province
- 75,000 households, 170,000 population (2021), 5th most populous region in the province
- Fastest growing metropolitan area on Vancouver Island, and one of the top five fastest growing metropolitan areas in Canada (4 of 5 are in BC)
- More than 2x growth over last 20 years (75,000 in 1982), with population projected to exceed 200,000 by 2040



Demographics of the Region:

- Median age of 50, with one-third of the population over 65 years of age
- 30% of households are single-person households, 10% are single-parent households
- 8% of the population has Indigenous ancestry, another 10% identify as racialized



Household Income & Housing Affordability:

- Median household income of \$76,000 (2020), with median dwelling values ~10x annual income
- Nearly 1/3 of households spend 30%+ of their income on housing
- 1/4 of households are renters





Region's Workforce & Commute to Work:

- 55% of the population participates in the labour force, the highest % of the labour force (16%) work in health care and social services, the largest employment sector in the region
- 2/3 of commuters work within the region, 86% travel by vehicle

Access to Care & Level of Service in Greater Nanaimo

Island Health published a Local Health Area profile for Greater Nanaimo and the Nanaimo Local Health Area.

The following statistics highlight the community's access to health services between 2017 and 2018. In 2018 (most recent year available):

- 20% of residents in Greater Nanaimo report being without a primary care physician; access to primary care services impacts the use of hospitals' emergency department and inpatient services
- In the 75+ age group, when compared to the average across the Island Health service area, Greater Nanaimo residents:
 - ▶ Have higher client numbers for homecare and home support
 - ▶ Received fewer home care visits, but higher total support hours
 - ▶ Have higher hospitalization rates/inpatient admissions (also higher for overall population regardless of age)
 - ▶ Have higher rates of emergency/urgent care visits

Enhancing Health Care Facilities & Access for a Growing Population

In 2018, Nanaimo Regional General Hospital (NRGH) Intensive Care Unit (ICU) visits were almost 2,500 and that number is anticipated to grow by 30% to approximately 3,250 visits by 2033. The new ICU opened in June 2023 and replaces the NRGH's 10-bed ICU which was built in 1970. The former ICU was outdated in its space and functionality for current services and the number of patient visits. It required replacement to ensure the region's growing population has access to a modern facility that provides improved care into the future.

NRGH's ICU redevelopment and expansion project included a new High Acuity Unit (HAU) to replace the current, temporary eight-bed HAU that was integral to Island Health's COVID-19 response. An ICU cares for patients with life-threatening illnesses or injuries while an HAU provides patients with more acute care and closer monitoring than a general hospital ward, but requires less resources than an ICU. In the event that there is an influx of patients requiring ICU-level care, the new HAU, scheduled to open in 2025, will be equipped to support these patients and provide the same level of monitoring and care as the ICU.

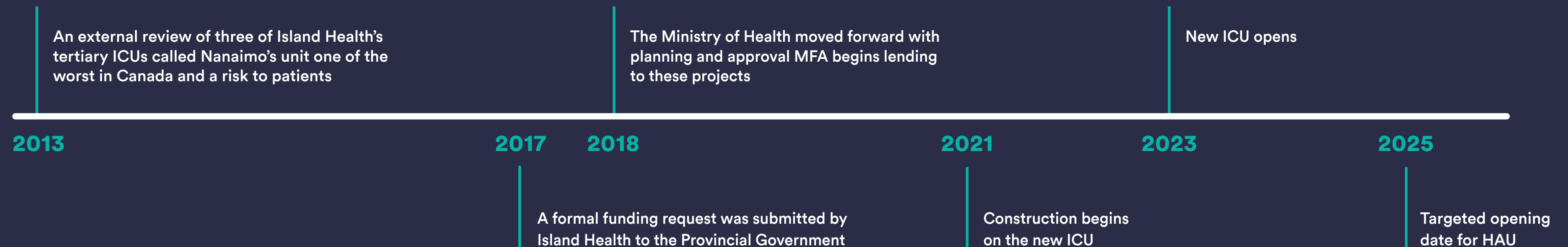
NRGH Energy Requirements

The new ICU and HAU are further supported by the hospital's new electrical energy and thermal energy centres, which provide more power to support these campus enhancements. The electrical loads of the hospital have and will continue to grow as the hospital grows in space, scope of services, service hours, and the higher

energy intensity of newer equipment using modern technologies. Stable, uninterrupted electricity is critical to the basic operation and health services of hospitals. The NRGH also utilizes electricity for all its space and equipment cooling needs.

The NRGH requires thermal energy to heat the hospital buildings, domestic hot water, provide humidification in the air, provide steam in the hospital kitchen, and provide steam sterilization in the Medical Device Reprocessing Department. The hospital's thermal energy facility as well as a portion of the distribution system at NRGH have been operating since the early 1960s. Although the thermal facility was well maintained, having undergone many upgrades over the years to continue to meet redundancy requirements, the facility was at the end of its useful life. Both the new electrical energy and thermal energy centre are designed for future growth.

NRGH's Intensive Care Unit and High Acuity Unit Capital Project



Key Benefits of the New ICU & HAU

Health and social benefits:

- The new ICU space will deliver quality critical care for generations to come
- The modern, well-equipped ICU enables the hospital's medical team to better respond to the region's critical care needs through updated technology and flexible use of space
- The ICU design was informed and adjusted by pandemic response needs: the new space is able to isolate both at a small scale (a 4-bed group) or the entire 12-bed unit, to provide air-borne disease protection for those within and outside the new building

- Together the new ICU and HAU units include 24 beds, a nurse station and support spaces. Improvements include larger single patient rooms, ceiling-mounted service booms and overhead patient lifts, a medication room, and a family consult room

Economic benefits:

- The project created approximately 200 jobs and 100 indirect jobs

Climate-related benefits:

- The building's infrastructure systems were informed by the results of the hospital's climate risk and vulnerability assessment process

- New heating, cooling, and ventilation systems were installed that can fully support the ICU and HAU operations; these systems are also integrated with the base hospital's heating and cooling systems, allowing facility operations to maximize utilization of the most energy-efficient systems at any given time of the year and also provide redundancy in that either system can support the other should equipment fail or offline maintenance be required

NRGH Electrical Energy Centre and Thermal Energy Centre Upgrades & Expansion

The Electrical Energy Centre (EEC) opened in December 2018. As construction of the EEC was nearing completion, work began on the hospital's new Thermal Energy Centre (TEC) to replace the existing boiler room and increase the thermal capacity of the NRGH campus to comply with regulatory, redundancy, and operational requirements. Completion of this multi-phased project planned for early 2024.

These energy centre projects were strategically implemented to replace existing aged equipment, but also improve the ability of the campus to grow and deliver more healthcare services. In addition to increasing capacity, redundancy, and resiliency of essential systems, the energy centre expansion projects physically relocated key infrastructure components away from centralized spaces within the main hospital building. The net benefit for this strategy will be realized with the next phase of infrastructure redevelopment, as those spaces can now be utilized for ventilation and cooling system upgrades designed to further respond to climate change adaptation needs.

Key Benefits of the Electrical Energy Centre Expanded Capacity and Future-readiness

The Electrical Energy Centre (EEC) increases both normal and emergency electrical capacity at the NRGH campus. The project accommodates current hospital electrical loads and allows for expansion as indicated by the NRGH Master Site Plan (2010). More ICU and HAU beds mean more equipment and more power usage. The new MRI and endoscopy equipment will also increase power loads as

newer technologies are more energy intensive and as operating hours related to this equipment become 24/7.

Resilience

The new EEC mitigates the most significant risks identified in the NRGH Electrical Systems Risk Assessment (2014) through improved technical components (switchgear, distribution lines, backup fuel tanks). From a climate perspective, all cooling at NRGH is powered by electric systems; a strategic benefit of the EEC project is that more resilient electrical infrastructure equates to more resilient cooling systems.

Key Benefits of the New Thermal Energy Centre

High Performance

The Thermal Energy Centre is a standalone, steel frame building designed to achieve post-disaster standards and a high level of energy performance. This new facility serves as the engineering control centre for the hospital campus. Related to a changing climate, the expansion of the TEC ensures that higher peak heating demands from extreme winter events can be met.

Redundancy and Futureproofing

The single-storey facility houses three dual-fuel steam boilers with a central configuration to allow for moderate expansion of additional boilers in the future. The upgrades ensured boiler redundancy, creating a backup boiler system to be used in the event of downtime. The additional boilers in the new facility reduce or eliminate the risk of emergency downtime and allow for proper scheduling of preventative maintenance, so that taking a boiler out of operation for service will not reduce the facility's energy supply.

◀ *Equipment of NRGH's new Thermal Energy Centre placed into operation in early 2024*



The new facility retains the use of fossil fuels due to the existing distribution system being high temperature steam, and because of the robustness and reliability of conventional technologies which is critical for essential equipment like 24/7 hospital heating. The TEC is future-ready for low-carbon fuel sources such as renewable natural gas when it becomes available, and for the eventual transition to a low temperature steam heating system.

While the TEC's design strategy used conventional boilers for the base technology, it provides for the ability to connect newer, innovative, and more efficient technology via a number of futureproofing strategies integrated into the centre's design, such as:

- a) Providing designated growth space within the building for future technology, as well as accommodating where additional growth space outside of the building could take place
- b) Sizing technical components such as pipes to accommodate lower temperatures and higher flowrates in future
- c) Specifying the boilers to accommodate fuel transitions such as renewable natural gas; Island Health works closely with its energy supply partners to implement Strategic Energy Management Plans across all its facilities, and in pursuit of the Province's legislated Greenhouse Gas (GHG) reduction goals.



Additional Resources

Technical information related to the Thermal Energy Centre (TEC) is detailed in [NRGH's business case for the project on their website](#).

◀ *Building (bottom left) and equipment (top left and right) of NRGH's new Thermal Energy Centre placed into operation in early 2024*



Capital Project Costs & Funding

NRGH Health Units & Energy Centres

Intensive Care Unit (ICU) & High Acuity Unit (HAU)

The total project budget was \$60.1M (\$41.6M for the ICU and \$18.5M for the HAU) with \$22M (37%) being contributed by the NRHD. Of the NRHD’s funding, \$11M or 77% was obtained through MFA financing from 2018 through 2023.

The total cost of the project was shared between the provincial government through Island Health and the Nanaimo Regional Hospital District. The Nanaimo District Hospital Foundation contributed further funding for equipment specific to the ICU and HAU.

Electrical Energy Centre (EEC) & Thermal Energy Centre (TEC)

The total project budget was \$29.9M (\$11.5M for the EEC and \$18.4M for the TEC). Funding for both energy centres were split 60/40 between the Province and NRHD. Of the \$12M contributed by the NRHD, \$10.4M (87%) was financed through the MFA.

The Borrower: Nanaimo Regional Hospital District

The Nanaimo RHD has \$35 million in loans outstanding as at December 31, 2023 on \$57 million in financed projects. This balance of \$35 million represents 5% of all loans outstanding to Regional Hospital Districts across BC, and 0.65% of the MFA’s total long-term loans receivable.

The majority of these 20-year loans to Nanaimo RHD are for the following infrastructure and medical equipment projects at the Nanaimo Regional General Hospital (NRGH):

- 1) the construction of a new Intensive Care Unit and High Acuity Unit, with MRI and endoscopy, to service a fast growing region with aged population, and
- 2) upgrades to the hospital’s thermal energy plant and electrical energy centre to expand its capacity and improve its resiliency

NRGH Project Financing from the MFA Through the Nanaimo RHD

The MFA authorized borrowing by the NRHD for the following projects at the regional general hospital (rounded in millions):

Electrical Energy Centre	\$3.6
Thermal Energy Centre	\$6.8
Intensive Care Unit	\$11.0
MRI	\$2.0
Endoscopy	\$1.2
TOTAL	\$24.6

As at December 31, 2023, \$19.5M remains outstanding on 20-year loans and another \$3.4M in short-term loans for these NRGH replacement and improvement projects.

NRGH Climate Risk & Vulnerability Assessment

Actual & Potential Impacts of Climate Change on the NRGH

The NRGH was the first hospital in Canada to undertake a climate risk and vulnerability assessment in 2018 for the purpose of identifying climate change drivers that may place new pressures on their hospital infrastructure in the coming decades.

The study focused on new vulnerabilities caused by climate change, as projected to 2050 from climate models produced by the Pacific Climate Impacts Consortium (PCIC) under three future climate scenarios. The Public Infrastructure Engineering Vulnerability Committee (PIEVC) protocol, developed and supported by Engineers' Canada, was used to perform this risk and vulnerability assessment of NRGH.

Key Findings from 2018 NRGH Assessment by Island Health

Future climate projections suggest that the Nanaimo region will warm by around 3°C on average and be associated with roughly a doubling of the number of days above 25°C. Precipitation is projected to decrease in the summer and increase in all other seasons, with an almost 25% increase on average for the 1 in 20-year one-day precipitation event.

The NRGH study shows that with the increased temperatures projected for 2050 in the Nanaimo region, the hospital's cooling plant and critical ventilation systems (e.g. operating room, inten-

sive care unit, etc.) will be particularly vulnerable due to increased thermal loads on buildings and atmospheric pollution from forest fires. Drier summers and warmer temperatures will also add pressure to domestic water systems that provide not only potable water, but water used in some mechanical cooling systems.

Integration of NRGH Climate Risk & Vulnerability Assessment Findings

Governance

NRGH's climate risk assessment project triggered a revision to Island Health's sustainability policy, to ensure that climate change is taken into account in all future retrofits and new construction. A comprehensive and collaborative climate risk assessment matrix is now an integral part of the NRGH's organizational decision-making and is used in capital planning to ensure its campus is more resilient, and the risk of climate-related emergencies, public health crises, and unforeseen costs are all minimized.

Strategy

Adaptation strategies included identifying climate-specific hospital retrofits such as increased cooling capacity, enhanced air filtration, and other measures to protect the facility and its patients from the potential effects of climate change along with mitigation strategies to reduce greenhouse gas emissions and corresponding fuel costs.

NRGH Projects Financed by the MFA

The findings from this risk assessment informed the project prioritization and design of the NRGH's capital projects financed by the MFA. Island Health prioritized these projects on the basis of needing to address current and future levels of service deficiencies

PIEVC Risk Assessment Protocol

PHASE
1

CONCEPT

Infrastructure Identified, Time Horizons, Decision-Maker Approval

PHASE
2

SCOPING

Project Leader, Project Work Statement

PHASE
3

TEAM BUILDING

Consultant, Internal Team, Project Schedule and Budget, Execution Plan

PHASE
4

EXECUTION

Infrastructure Inventory, Climate Data, Risk Assessment, Information Gaps

PHASE
5

REPORTING

Conclusions, Recommendations, Vulnerability and Resiliency Statement

resulting from steady growth in the region. Also realized through these projects were climate co-benefits related to the resilience of NRGH’s mechanical systems as a result of hotter, drier climate conditions and air quality impacts from wildfires.

Island Health’s GHG & Energy Reduction Commitments

As a Provincial health authority, the Province’s CleanBC plan requires that Island Health reduce its carbon emissions by 50% by 2030 from 2010 levels.

Island Health maintains a Strategic Energy Management Plan (SEMP) to guide and support their efforts and investments in pursuit of its energy and GHG reduction commitments and targets. Island Health’s latest five-year SEM (2021) is publicly available on their [website](#).

Island Health is also covered under the Province’s Carbon Neutral Government legislation and Climate Change Accountability Act. Island Health must annually:

- a) calculate and report its GHG emissions from operations and purchase credible carbon offsets to meet carbon neutral requirements;
- b) disclose their emissions and carbon neutral achievement along with their progress towards other climate commitments and GHG reduction targets.

Island Health’s most recent annual Climate Change Accountability Report is publicly available on their [website](#).

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The Nanaimo Regional Hospital District is pleased the new intensive care unit at Nanaimo Regional General Hospital is ready to take patients. This modern, well-equipped ICU will enable the hospital’s highly skilled and dedicated medical team to better respond to our region’s critical care needs. We are proud to be a funding partner of this essential investment in health care that will serve central and north Island residents for years to come.

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IAN THORPE, CHAIR, NANAIMO REGIONAL HOSPITAL DISTRICT,
JUNE 2023



Online Resources

- ▶ [Island Health - Local Health Area Profile: Greater Nanaimo](#)
- ▶ [Provincial Health Services Authority - BC Community Health Profile](#)
- ▶ [PIEVC - NRGH’s climate risk and vulnerability assessment of 2018](#)
- ▶ [Island Health - Outcome report: Environmental Sustainability](#)
- ▶ [NRGH Case Study 1](#)
- ▶ [NRGH Case Study 2](#)

The MFA thanks Island Health for their collaboration on this case study.



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