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British Columbia Institute of Technology
Scope Definition Report for NE1
prepared by Sandra Rohler

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INTRODUCTION

The British Columbia Institute for Technology (BCIT) houses 6 schools, the School of Construction and the Environment (SoCE) being one of them. SoCE is leading the Factor Four Initiative in the 7 buildings it occupies in the northeast section of the Burnaby campus: the "Factor Four Area". The Factor Four initiative's purpose is to explore whether a factor four or fourfold improvement in energy- and materials-related resource productivity can be achieved without compromising service levels. Out of the 10 defined projects within the Factor Four initiative 6 have been completed. The 7th project, a wood waste-to-energy plant, has been submitted for funding and NE1 the largest building of the school has been designated to be either refurbished to the Passive House Standard (EnerPHit Standard) or to be new construction to Passive House Standard.

FACTOR FOUR

The Factor Four project aims for a fourfold (75%) reduction in levels of energy and materials consumption in order to achieve ecological sustainability.

"Factor Four - Resource productivity is intended to grow fourfold. The amount of wealth extracted from one unit of natural resources can quadruple."

INTENT

The Factor Four Team has consulted with Sandra Rohler as a Passive House expert in regards to determining further proceedings and exploring of which of the above mentioned approaches to take.

The scope of work was divided into 2 phases. Phase 1 serves to get familiar with existing reports and interview stakeholders to understand the different interests of the stakeholders and politics around the current situation and foreseen future of NE1. The result of phase 1 and thus the intent of this report is to provide the Factor Four Team with a recommendation and scope definition for further proceedings for NE1.

PASSIVE HOUSE STANDARD

"A Passivhaus is a building, for which thermal comfort can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions – without the need for additional recirculation of air."

The Passive House Standard is the current world's highest energy efficient construction standard. A performance based standard that reduces heating energy consumption of buildings by 80-90% compared to current code requirements.

Certification Requirements:

- 15 kWh/sqm/yr Specific Heating Demand
- 120 kWh/sqm/yr Specific Primary Energy Demand
- ≤ 0.6ach @50pascals (n50)

STRATEGY

Investigations during the research phase of this report are based on available reports provided by BCIT and interviews with different stakeholders. Contacts were provided by Alexandre Hebert at BCIT who also attended most interviews.

Documents provided:

- a. BCIT 5-year Capital Plan, 2013
- b. Factor Four Plan Draft, 12. December 2012

c. Seismic Assessment Program Report by Bush, Bohlman & Partners, October 2011
d. NE1 - J W Inglis Building Facility Condition Assessment Summary Report by VFA Canada Corp., July 2011

Stakeholders interviewed:

- Factor Four Team
- Academic Team, Faculty from Architectural Science
- Campus Planning Team
- BC Hydro

BUILDING DESCRIPTION

NE 1-J W Inglis Building, is located at 3700 Willingdon Avenue Burnaby, BC V5G 3H2 on the main campus of the British Columbia Institute of Technology. The facility is four (4) stories in height, totals approximately 20,077 SM in area and was originally constructed in approximately 1977. The facility contains classroom space, workshop space, faculty and staff office space, dining and food preparation space, plus HVAC and other building support spaces for the Building Trades Department.



NE1 - Context Map



NE1 - North West

INVESTIGATION SUMMARY | 4 Documents | 4 Interviews

DOCUMENTS

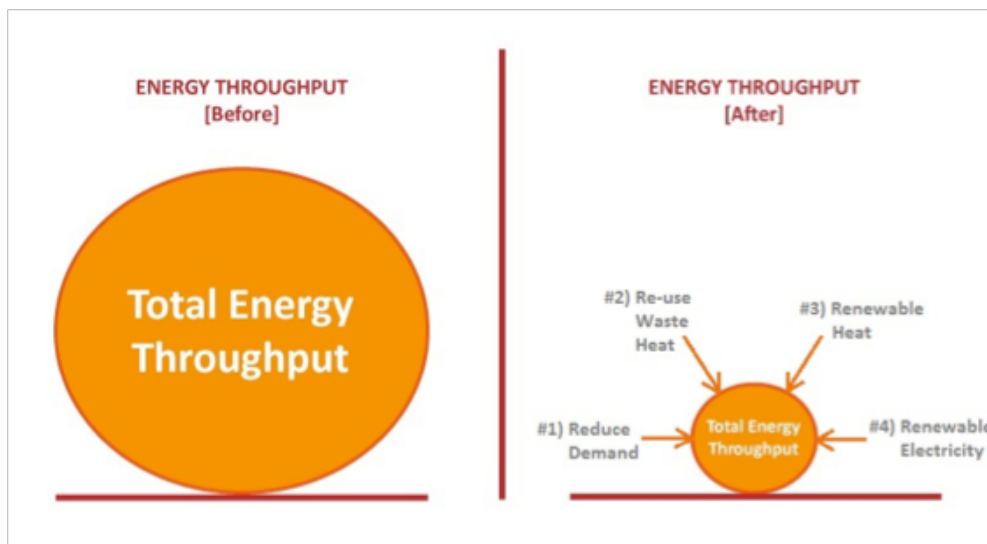
• a. BCIT 5-year Capital Plan, 2013 | Summary

- BCIT's vision: BCIT to be integral to the economic, social and environmental prosperity of British Columbia
- BCIT's mission: To serve the success of learners and employers:
 - By providing high quality technical training, and professional education and training, that supports our graduates as practitioners and as citizens
 - By advancing the state of practice
- Main focus of the Five-Year Capital plan is to renew facilities at the Burnaby Campus
- NE 1 (Skilled Trades building) existing:
 - Supported programs:
 - Architectural Science
 - Architectural and Building Engineering Technology
 - Architectural and Structural CADD and Graphics Technician
 - Building Construction Technology
 - Building Design and Architectural CAD
 - Building Engineering/Building Science (Master of Applied Science)
 - Building Science (Master of Engineering)
 - Civil Engineering • Construction Management
 - Interior Design
 - HVAC Refrigeration
 - Millwright
 - Electronics Technician
 - Large building comprising approximately 215,000 sf
 - VFA Facility Condition Index of 0.36 FCI
 - Ten-year deferred maintenance risk exposure totaling over \$56 million
 - Functionally inadequate this building is inconsistent with modern technology and teaching methods and inflexible and expensive to modify
 - The building is post-tension construction and is classified as H1 (high seismic risk)
 - Mechanical and electrical systems are obsolete and a completed hazmat study confirms the presence of extensive asbestos
- NE1 new construction proposal for two buildings each 125,000 sf (11,600 sqm)
- Renovation of building considered impractical
- NE1 project identified as rank 10 of 10 with anticipated:

- construction start of planning /program development in 2016
- start of construction 2018 (end of 5 year capital plan)
- occupancy 2020 (dates in report differ)
- end of construction incl. demolition 2021.
- Determined total project cost \$158.5 Million incl. demolition and taxes
- NE1 will be part of the Living Laboratory concept through the exposure of building structure and systems to facilitate trades education

• b. Factor Four Draft Energy Plan | Summary

- BCIT's School of Construction and the Environment is leading the Factor Four Initiative in the buildings it occupies in the northeast section of Burnaby campus: the "Factor Four Area". The purpose is to explore whether a factor four (fourfold) improvement in energy- and materials-related resource productivity can be achieved without compromising service levels (building occupant health and comfort, and educational program delivery).



To achieve a factor four energy reduction (approximately 30,000 GJ/year) the following key projects must be implemented:

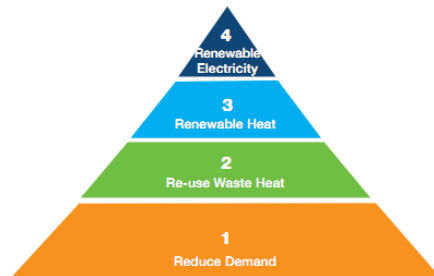
1. Sub-metering of all Factor Four buildings
2. Dust Collection System Retrofit in NE2 and NE4
3. Heating System Retrofit in NE6
4. Heat and Light Awareness Campaigns in Trade Shops
5. Street and Outdoor Light Retrofit
6. Welding Ventilation Retrofit
7. Wood Waste-to-Energy project
8. Outdoor Pipe Welding project

9. Trades Shops and Canopy Lighting Redesign

10. NE1 Passive House Building project

- NE1 has been identified as a Passive House project in the Factor Four plan
- Factor Four uses the principles of sustainable community energy planning: the 4 R's:

**4 R's of
Sustainable Community Energy Planning**



- The Passive House Standard provides a 'reducing demand' opportunity
- Energy audits for all buildings except NE1 have been completed
- The wood waste-to-energy project is intended to deliver hot water to NE1

• c. Seismic Assessment Program Report by Bush, Bohlman & Partners, October 2011 | Summary

- Seismic assessment study done in three phases for 41 buildings on campus:
 - assessments
 - risk analysis (life-safety and damage mitigation)
 - seismic retrofit cost estimate
- NE1 rated H1 for life-safety (High 1. Most vulnerable structure; at highest risk of wide-spread damage or structural failure; not repairable after event)
- Buildings with H1 designation are at Very High Risk and should be the first buildings retrofitted
- Cost analysis refers to seismic upgrade only
- Cost does not include function or system improvements, building renewal, phasing, temporary accommodations, upgrade of adjacent buildings, upgrade for other building code deficiencies, exiting, fire rated vestibules, handicapped access, building envelope or reconfiguration of space.
- Cost includes selective demolition, hazardous materials abatement, construction of seismic retrofit structural elements, make good of disturbed finishes, removal and replacement of millwork and fittings, chalkboards, whiteboards, washroom fittings, fixtures and impacted mechanical & electrical systems only

- Costs do not include non-structural seismic hazards except for those directly impacted by the structural retrofit
- Evaluated seismic upgrade costs for NE1:
 - a. Life safety upgrade estimate:
\$ 213.50/m2 or \$ 4,483,400 total incl. 32.3% soft costs and HST
 - b. Damage mitigation upgrade estimate:
\$ 349.89/m2 or \$ 7,347,700 total incl. 32.3% soft costs and HST
- The report recommends that at the time a project out of the 41 within the report is to be considered for seismic retrofit, an update project assessment should be undertaken, which would include identifying an implementation scenario (i.e. phasing, portables etc.) and look at the other deficiencies in the building (i.e. building code, building envelope, handicapped access, energy efficiency upgrades etc.) and make a priority list of additional scope to be considered in the funding envelope.

The following notes identify areas in the report that require clarification or raise further issues to be addressed:

- Report refers to BCBC 2006. Applicability and conformance with BCBC 2012 should be confirmed. Update assessment and report to BCBC 2012.
 - Risk analysis was performed under the Seismic Retrofit Guidelines 1st Edition (SRG1). Confirm that SRG1 is still the current, most up to date and recognized tool for performance based risk analysis
 - Cost summary includes hazardous materials abatement. Has an asbestos assessment being done? See 'Seismic Assessment Report by Ausenco Sandwell'
 - Method of assessments, retrofits and cost estimating for study consistent with studies carried out in 2009 and 2010 for the Vancouver School Board and Ministry of Education. Confirm that this is still the current, most up to date and recognized method
 - The status of the presence of asbestos is marked as 'Unknown'. Asbestos removal can be extremely costly and disruptive. An asbestos assessment of NE1 should be undertaken to further inform the decision of refurbishment or new built (the 5 year capital plan suggests that an asbestos assessment has been undertaken)
- **d. NE1 - J W Inglis Building Facility Condition Assessment Summary Report by VFA Canada Corp., 5. July 2011 | Summary**
 - The simplified report is broken down into:
 - Architectural Assessment (general, structure, building exterior, roofing, building interior, vertical transportation, accessibility/fire protection)
 - Mechanical Assessment (HVAC, plumbing, fire protection, vertical transportation)
 - Electrical Assessment (high voltage distribution, main electrical distribution, branch wiring and lighting, communications and security, emergency power)

- Cost / priority table
- The narrative part describes the existing building and systems parts without indicating their condition
- The cost analysis lists building components with categories, priorities, action dates and related costs. Almost all categories are rated 'Beyond Useful Life', only staircase signage is rated 'Life Safety' and some plumbing fixtures currently don't meet the accessibility requirements by code
- 15 items have an immediate action requirement for 2011/2012. The costs for these items accumulate to \$1,480,747
- The overall stated building upgrade cost is \$8,792,346. Assuming the above 15 items have been addressed that leaves an upgrade cost of \$ 7,311,599
- The Facility Condition Index (FCI) for NE1 is 0.28

The following notes identify areas in the report that require clarification or raise further issues to be addressed:

- No assessment of the building envelope, R-values, no wall, roof and floor assemblies listed to examine building science related matters
- No thermal bridge analysis
- No CO2 monitoring within NE1. Most rooms have no or no operable windows. How is fresh air supply regulated and monitored?
- Chapter 'Accessibility /Fire Protection utilizes the 1995 Canadian National Building Code, Section 3.8.1.1 and the 1995 Canadian National Fire Code. Confirm compli-
ancy with current code requirements.
- Confirm code compliancy of mechanical, fire protection and electrical systems
- Confirm code compliancy of the building layout.
- Have any of the suggested updates been executed?
- Mechanical and electrical assessment to be undertaken with the PH standard in mind. Examine if mechanical equipment would qualify for EnerPHit requirements.
- Examine if mechanical and electrical systems would qualify for EnerPHit primary en-
ergy consumption requirements

INTERVIEWS

• Craig Sidjak | Director of Campus Development | 12. December 2013 | Phone Meeting

- The Factor Four project is an initiative initiated by the School of Construction and Environment (SoCE). So is the idea of a Life Lab (using SoCE's buildings (upgrades and new construction) for educational purposes within its programs).
- Campus Development manages all Campus buildings and is not required to comply to the Factor Four goals but will try to work together if possible. Eventually Campus development is the decision making body dealing with the Ministry of Advanced Education for funding requests and submissions
- Campus Development foresees NE1's replacement on a 10-15 year time horizon
- An application of \$158,500,000 replacement cost has been submitted to the Ministry of Advanced Education
- Asbestos is assumed to be present; an asbestos assessment will be done by the time project work will be implemented
- Current building leaks require immediate action
- A feasibility study for the building exterior renewal is currently being undertaken for the building envelope. BCIT Campus Development has engaged Colborne Architecture Pacific Ltd. to develop a conceptual design which will allow Facilities and Campus Development to clearly define the scope of the work and create an accurate budget estimate to request funding from the Ministry of Advanced Education
 - The *primary* objective for the proposed project is to address deferred maintenance through remediation of the existing building envelope by:
 - Improving function (fixing leaks and improving energy efficiency)
 - Extending serviceable life of the building (repairs preserve structural integrity and reduces maintenance costs)
 - The *secondary* objective is to leverage the deferred maintenance investment through achieving added value for all users by:
 - Enhancing NE1's image and character (introducing colour, visual interest and signage)
 - Improving the pedestrian realm (clarifying pedestrian routes and improving streetscape through appropriate landscaping, lighting, sidewalks and bicycle parking facilities which also improve visibility and rain protection)
- The feasibility study is set to be completed in February 2014
- The findings of this study will be used for funding submissions to the Ministry of Advanced Education
- The roof and HVAC system will be reviewed next

• **Jennie Moore, Alexandre Herbert, Vanesa Alzate Restrepo, Sarah Campbell | Factor Four Team | 13. December 2013**

- NE1 is the largest out of the 10 buildings that define the Factor Four area
- Energy assessments have been done for NE2 - NE8 . Not for NE1
- As part of the Life Lab within the Factor Four initiative NE1 was determined to become a building according to the Passive House the Passive House standard. Either to EnerPHit requirements by refurbishment or the PH requirements by new construction.
- Even though NE1 has been defined as a replacement building in BCIT's 5-year capital plan (2014 to 2018) and a funding application has already been submitted to the Ministry of Advanced Education the Factor Four team would consider examining the possibilities to PH refurbishment or new construction as a parallel path for several reasons:
 - The Passive House standard is currently the world's leading energy efficient construction standard and SoCE wants to lead by example
 - All Factor Four buildings are part of the Architectural Science and Trade Programs therefore ideal to be used as Life Labs in programs and education
 - The process of assessing, designing and modeling NE1 as a Passive House certified building (refurbishment and new construction) will be used educationally in the Architectural Science and Trades Programs and to educate BCIT staff on the PH standard and its integrated design process
 - The intended and ideal scenario would be that the result of a Passive House related assessment, design, modeling and reports will lead to the conclusion that one of the two (refurbishment or new construction to Passive House standard) will be the desired construction type
 - As a feasibility study on a short term exterior upgrade of NE1 is currently undertaken and a funding application will be submitted in February 2014 the timing to investigate in a PH refurbishment vs new construction is right
 - The primary objective of this study is enhancement of student learning experience. A co-benefit is usability of the findings by Campus Development

• **Michel Labrie | Architectural Science Program | 19th December 2013**

• **Attendance via phone: Alexandre Hebert, Vanesa Alzate Restrepo**

- A design charette with Richard Register at Ecocity and the Factor Four team was held in 2009
- A 4th year design studio studied options for NE1 in 2008. This study was not focused on sustainability but might be useful. Michel will get permission to make the best works available for review
- The Architectural and Science program is in general content with the room allocation of their program

- NE1 building deficiencies stated:
 - Seismic
 - Comfort
 - Insufficient amount of windows for daylight and natural ventilation
 - Insufficient mechanical ventilation. The HVAC system is noisy and either too cold or too warm. No individual controls for different areas or rooms
 - Missing temperature control for individual rooms
 - Temperature low after work hours. Studio students regularly work late in unheated rooms
 - No CO2 monitoring
 - Poor acoustics
 - Substandard Building
 - No purpose build rooms, i.e. model making room with sufficient extract air
 - Poor way-finding, long hallways
 - Rooms are inflexible
 - The entire building is not inspiring neither exterior nor interior as a place to educate architectural and construction programs
- Suggestions by Michel Labrie:
 - The building should illustrate and demonstrate what today's architecture and technology is like
 - BCIT has the opportunity to build the way. SoCE is a place where trades, technology and architecture meet. Create interaction and communication of the different disciplines
 - i.e. combine wood shop and model shop etc.
 - Use the Life Lab to engage students in real projects
 - Make use of the roof
 - The atrium is ok but has potential for improvement
 - The best way to engage the students is to make the project a studio project
- **Ron Mastromonaco (Key account manager), Irfan Rehmanji (Technology innovation manager) , Tao Jiang | BC Hydro | 20th December 2013 | Conference Call**
 - **Attendance via phone: Alexandre Hebert**
 - Two groups at BC Hydro are interested in partnering on a NE1 Passive House study:
 - BC Hydro Power Smart Innovation & Technology
 - BC Hydro Power Smart New Construction Program, which can be extended to major renovation

- The Innovation & Technology group partners up with research institutions and customers to explore new technologies and bring them to British Columbia. Their interest in investing into the project would be in working through the Passive House Design process (new construction or refurbishment) to study the Passive House design, technology and energy modeling approach.
- The purpose of the BC Hydro New Construction program (NCP) is to create energy savings by promoting demand for, and increasing the production of, new high-performance and energy efficient buildings in BC.

One of the program's key objectives is to encourage the mainstream design and development industry to adopt an integrated design process - including building performance modeling - as standard practice and, as a result, create higher performing and more energy efficient buildings at lower cost.

The New Construction program offers financial incentives, resources and technical assistance to building owners, developers and the design industry to create high-performance, energy-efficient buildings. The financial incentive is dependent on the amount of kWh per year electricity saved. This incentive rate is tiered: the better the electricity savings achieved compared to conventional baseline building design, the higher the incentive BC Hydro will provide. Baseline buildings are designed to BCBC requirements which currently require either ASHRAE 90.1 2010 or National Energy Code for Buildings (NECB) 2011 compliancy.

Working under the BC Hydro New Construction incentive program would involve BC Hydro throughout the entire design process and require to conform with their deliverables, i.e. certain energy modeling guidelines and programs etc. which differ from the Passive House approach.

- In partnering with BCIT on this project both program representatives are interested in the study and analysis of the differences in ASHRAE, BCBC and PHPP modeling, compliance path & requirements and the cost analysis / ROI of new construction of NE1 to PH standard or refurbishment to EnerPHIT standard.
- For potential gas savings on a project BC Hydro would involve Fortis BC. Different scenarios for shared funding are possible.

CONCLUSION

- Reports suggest and stakeholders agree that NE1 is a substandard building with a low level of comfort that is past its life span, poses a high seismic risk and is inconsistent with modern technology and teaching methods.
- It is important to note that the current seismic assessment by Bush, Bohlman & Partners is intended to provide an overview global cost of magnitude of the seismic retrofit program for BCIT. Implementation scenarios (phasing, portables etc.) and other building deficiencies (building code, building envelope handicapped access, energy efficiency upgrades etc.) need to be identified for NE1 to define additional scope and further develop a refurbishment cost estimate.
- BCIT's 5-year capital plan identifies NE1 as a replacement building and a funding application to replace it by two approximately half size buildings (building 1: trades programs, building 2: architectural programs) has been submitted to the Ministry of Advanced Education. The plan states an occupancy date in 2020, common sense seems to suggest that start of construction might be 10-15 years away. A second funding application will be submitted in February 2014 for envelope issues that need immediate action. This envelope upgrade would not address seismic issues. A third study will look at the roof and HVAC system.
- The Factor Four plan defines NE1 as a Passive House Building project that would also be used as in a Life Lab concept. An EnerPHIT refurbishment study or PH new construction that would be an integral part if the architectural and trades program would serve three goals:
 1. To educate students and staff in the Passive House standard
 2. To determine whether or not a Passive House refurbishment is feasible for NE1
 3. Promote the school by building leading edge technology on Campus and integrating the project life into the educational programs
- Architectural Science and Environment suggests that leading by example is a successful educational strategy. The building should illustrate and demonstrate what today's architecture and technology is like.
- BC Hydro is interested in partnering on this project with two different programs.

RECOMMENDATION

As NE1 has been determined to be a Passive House building in the Factor Four plan, the Factor Four team has two motivations for the investigations made in this report:

1. Evaluation if a refurbishment study of NE1 to EnerPHIT Standard is worthwhile pursuing or if the study/design of new construction to Passive House standard is recommended
2. Find a viable option to make the NE1 EnerPHIT refurbishment or PH new construction part of the Life Lab concept by introducing it to the programs

Two paths could be taken from here:

1. A refurbishment study of NE1 to EnerPHIT standard could be undertaken as the time frame where funding for a new building is expected is 10-15 years. If this study shows that refurbishment is more feasible than new construction then campus development might consider refurbishment.

Points to consider regarding this option:

- An EnerPHIT refurbishment study or assessment requires further building assessments and the entire design including contraction documents as comparable statistic data on EnerPHIT refurbishments are not yet available in BC.
- The option of implementing the refurbishment in phases could be considered. That would still require the entire planning to be completed beforehand. Phased planning is not possible.
- Between EnerPHIT refurbishment and PH new construction, EnerPHIT is the more complex option which is not only more complicated for the consultants esp. in North America as they most likely have only little or no experience with the Passive House standard yet, it is also more complicated for students and staff to understand and learn as part of the Life Lab.
- BC Hydro would most likely only invest in a viable option and NE1 being identified as new construction in the 5-year capital plan does not support the refurbishment option.

Considering the higher level of complexity of an EnerPHIT refurbishment and the fact that NE1 has already been identified for new construction based on assessments by campus development there's no rational case to make for an expensive EnerPHIT refurbishment study.

2. The second path is the design of NE1 as new construction to Passive House standard. As a funding application for new construction of NE1 has already been submitted and the time of funding is expected to be in 10-15 years, hopefully earlier, there is sufficient time to work on the design while including the process into the Life Lab concept.

As this is the recommended option the following describes a guideline for the next possible steps to be taken:

- Meet with campus development and architectural sciences to understand where campus development intends to build the 2 new buildings replacing NE1. Brainstorm a potential building program
- Meet with BC Hydro to discuss their specific involvement and funding options
- Include Passive House design of NE1 into design studios
- Discuss with campus development if and how they would include student design work into the final design
- Examine how the Passive House design process can be introduced to the other programs of SoCE
- Campus Development will eventually hire an Architect and consultant team. When requesting proposals there should be a clear understanding that it'll be a building to Passive House standard and the consultants are required to have adequate qualifications and experience
- Find a ways to introduce the project work into the Life Lab concept

With trades and architectural programs in one school BCIT has the unique opportunity to bring together what belongs together and what has undergone separation in the past centuries. Both parts of the construction sides. Planning and implementation, architecture and trades, theory and practice.

With the Passive House standard being the world's leading energy standard in construction BCIT would be able to not only built the first large scale Passive House project in Canada but along the way also provide leading edge education.

I trust this report meets you needs and supports you in moving forward with this exiting project.

Please do not hesitate to contact me should you require clarification or further advice.

Sincerely,

A handwritten signature in black ink, appearing to read 'S. Rohler', with a large, stylized 'S' at the beginning.

Sandra Rohler