

APPENDIX A

Proposed Environmental Work Plan

Appendix A PROPOSED ENVIRONMENTAL WORK PLAN

The description of the existing environment is a key component to the successful implementation of a proposed development. This involves identification of aspects of the physical, biological, and socio-economic environments that are potentially affected by the Project, directly or indirectly. It includes research of existing information sources, as well as field surveys to collect information on a wide spectrum of environmental site characteristics and factors and desktop models in several areas. The following is the proposed desktop, field and modelling studies to be completed in support of the Project.

A.1 DESKTOP RESEARCH

Prior to fieldwork, a preliminary desktop exercise will assess the potential for bird and bat occurrences, vegetation / wildlife species at risk, wetlands, watercourses, archaeological resources and overall habitat features at the Project site using available data sources (satellite imagery, topographic maps, digital maps, aerial photos, LiDAR, and public databases). Available information on potential bat hibernation habitat (hibernacula) and important bird habitat in the region will be resourced. Atlantic Canada Conservation Data Centre records and habitat mapping will be obtained for the Project sites. Project information and/or existing studies will be reviewed and supplemented with literature searches for information that could guide field studies.

A review of study area habitats will be undertaken to determine whether defined critical habitats are present in the Project area, and whether there is potential for the presence of species that are considered:

- SAR, which are those listed under SARA; and
- SOCC, which are listed by the Committee on the Status of Endangered Wildlife in Canada, and those identified as S1, S2, and S3 by Atlantic Canada Conservation Data Centre.

A.2 FIELD STUDIES AND MODELLING

A.2.1 Atmospheric and Acoustic Environment

Atmospheric Environment

Climate and air quality related baseline conditions will be reported based on existing data, information and monitoring reports to the extent available. Sensitive receptor locations (e.g., residences) will be determined based on air photos and municipal land use and planning documents. Field verification may be required for specific aspects of model inputs. The information will be presented to provide a general characterization of the physical environment.

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Noise Assessment

A noise assessment can be undertaken to compare pre-construction and post-construction noise emissions from a wind farm to estimate the impact of those noise emissions on nearby residences and other sensitive receptors. The noise impact assessment will include:

- A baseline ambient noise monitoring survey to estimate background sound levels near the Project locations
- Computer modelling to predict sound levels at nearby sensitive receptors, including residences, educational facility, daycare / nursery, place of worship, hospital, seniors residence and vacant lots where appropriate zoning or permits to build such dwellings have been approved
- Comparison of the background and predicted future noise levels to confirm that the design of the wind farm complies with the thresholds set out by Health Canada and other Canadian standards.

A.2.2 Surface and Ground Water Resources

Surface Water

An evaluation of surface water quality and quantity will include both desktop and field-based methods. Delineation of pre- and post-development catchment areas will be completed using provided LiDAR data for the site and used to assess and mitigate changes to surface water drainage paths in the post-development scenario. Modeling of ecological maintenance flow to site watercourses is not included at this time as the intent is to maintain existing drainage pathways and avoid reducing flow to existing waterbodies. A limited surface water quality monitoring plan is proposed at select watercourse locations, to be completed in conjunction with work undertaken as described in the Aquatic Environment field component.

Groundwater

Groundwater quantity and quality will be assessed through a desktop review of relevant and publicly available water resources, geological, and hydrogeological data maps and reports for the area. Other sources of information may include topographic maps, aerial photographs and imagery, as well as water well drill records and inventory data, water chemistry test results, and aquifer test results that may be available for the area.

A field component will be carried out to establish baseline groundwater quality in proximity to the proposed development area. The field program will consist of collection of groundwater samples from a representative number of residential water wells based on the results of the desktop assessment.

A.2.3 Aquatic Environment

The freshwater environment will be evaluated to provide information for *Fisheries Act* Authorizations and NLDECC approvals (e.g., fording, culvert installation, miscellaneous works) that may be required as part of the Project.

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Watercourses, waterbodies and larger watershed areas that occur within the proposed Project footprint will be identified and described. A review will be conducted of available watershed information that could inform watershed delineation and the potential for fish presence. This information includes existing and available mapping information such as:

- 1:250,000 and 1:50,000 National Topographic Series maps
- Available digital maps and aerial photos of the area from the Government of NL

A physical description of the fish habitat at potential water crossings will be assessed in the field based on characterizations and determinations from standard Fisheries and Oceans Canada Guidelines. A subset of water crossings based on watershed size will be verified with field validation.

Potential fish species occurrences within the Study Area will be identified through a literature search of existing information from available scientific reports, government documents and previous studies. Fish species presence will be assessed with field validation using standardized methods. These surveys will likely take place in conjunction with wetland and plant surveys.

A.2.4 Avifauna

The avifauna monitoring survey design will include pre-construction bird monitoring and post-construction bird monitoring in the Spring, Summer and Fall. This plan will be reviewed and approved by NLECC.

In order to assess the potential presence of avifauna species within the study area, a number of data sources will be reviewed, including the Maritimes Breeding Bird Atlas, North American Migration Counts, Important Bird Areas) of Canada, and the Atlantic Canada Nocturnal Owl Survey. The desktop review will be used to determine the recommended avifauna surveys based on available guidance using Project details (e.g., number of turbines), proximity to bird areas (e.g., colonies, stop overs, habitats), and presence of SAR. Bird surveys will follow the applicable guidance for surveying and monitoring birds for wind energy projects including:

- Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds (CWS 2007a)
- Wind Turbines and Birds: A Guidance Document for Environmental Assessment (CWS 2007b)
- Wind Energy & Birds Environmental Assessment Guidance Update (ECCC-CWS Atlantic Region 2022)

Bird surveys will be carried out in habitats used by the targeted bird species within the Project area to maximize the quality and quantity of data obtained. Surveys will be conducted at the time of day with the highest likelihood of detecting the target species (e.g., early morning for breeding passerines, late morning to afternoon for raptors, dusk for nightjar surveys), and in favourable weather conditions with low winds and no precipitation to maximize detection probability.

The pre-construction survey method will be based on consultation with CWS. It is anticipated that bird surveys will include, at a minimum:

- Fall migration surveys: Early October to late November
- Winter birds survey: January or February
- Spring migration survey: April to late May

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- Raptors, owls and other early breeding birds survey: Late May, concurrent with the last spring migration survey
- Breeding / Nesting birds surveys: June to early July

Disturbing nests during the breeding bird season is prohibited under the MBCA. Project construction activities such as vegetation clearing will affect birds and their habitat, particularly during the breeding season. Construction and Post-construction survey method will be based on pre-construction survey work and consultation with CWS.

A.2.5 Bats

Operating wind farms are known to have potential negative effects on bats, including direct and indirect habitat loss (e.g., through visual and noise impacts), as well as potential mortality due to collision. The pattern and scale of disturbance depends on the species, life cycle stage, availability of alternate habitats, as well as siting of the wind turbines with respect to important habitat areas. The monitoring will be based on consultation with Wildlife Division.

Bat surveys will be conducted using passive acoustic survey methods to record bat calls to determine the occurrence of bats on the Project area. Aerial microphone units may also be deployed at heights within or near the operating radius of wind turbine blades, if feasible. The units will be deployed across representative suitable habitats and monitored for the duration of the Summer through Fall breeding and migration (end of September) seasons to maximize data collection at the Project site(s) under consideration.

A.2.6 Terrestrial Wildlife

Wildlife habitat within the Project footprint will be described based on available mapping, aerial photo interpretation and field surveys. A list of wildlife species that could potentially occur in these habitat types, including mammals and birds will be developed. Designated habitat features in the vicinity of the Project footprint, such as Important Bird Areas and other environmentally significant sites, will be summarized. A review of critical habitats for SAR will be undertaken to determine whether defined critical habitats are present in the Project area.

Wildlife surveys (i.e., mammals) will be conducted in conjunction with other surveys and will involve active transect based searching for signs (e.g., tracks, rubs, scat, skeletal remains, etc.) as well as recording incidental observations of individuals.

A.2.7 Rare Plants

The vegetation survey will include an initial desktop review to identify the habitat types and locations of SOCC / rare plants that have been previously reported within the Project area (e.g., wooly arnica, Lindley's aster and Mackenzie's sweetvetch).

Two vegetation surveys will be completed, one in late May, to identify "spring ephemeral" species, that are only identifiable early in the spring. The spring survey will focus mainly on high potential areas for SAR to occur such as wetlands and watercourse crossings. This survey will be concurrent with wetland and aquatic surveys. A second vegetation survey in August will cover general terrain in the Project, when most vegetation is mature and identifiable to species level. The August survey will be coordinated with

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wetland surveys. Locations of SOCC / rare plants will be recorded. For the recording of clusters of rare plants, the boundaries of the cluster will be recorded rather than recording individual waypoints. The boundaries of “critical habitat” as defined by SARA will be delineated. Vegetation surveys will also be based on consultation with regulatory agencies (e.g., ECCC, Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture (NLDFFA)).

A.2.8 Wetlands

Potential wetlands will be identified within the Project area and classified using the Canadian Wetland Classification System and Wetlands Evaluation Survey Protocol for Atlantic Canada. Prior to conducting the initial delineation, the extent of the buffer to be applied around each wetland based upon regulatory requirements (provincial and municipal) and industry best practices will be confirmed.

The wetlands will be initially delineated using high resolution satellite imagery and will be based upon a standardized, hierarchical approach which uses topographical relief, visible water bodies and the variation of vegetation assemblages. The outcome of this delineation will be the production of a georeferenced map which outlines the wetland boundaries.

After the initial desktop wetland delineation, a subsequent field survey will occur at the same time as the rare plant surveys for the Project Area. The field-level survey will validate wetland boundaries, the wetland type, and a summary of key plant species observed. The wetland boundary will be confirmed based upon the following criteria:

- The majority of the dominant vegetation are wetland associated species (e.g., hydrophytic trees, shrubs and forbs)
- Hydrologic conditions exist that result in periods of flooding, ponding, or saturation during the growing season
- Hydric soils are present (i.e., soils formed under anaerobic conditions)

While criteria one and two can be visually assessed, criteria three will require the excavation of shallow test pits to identify soil types. Test pits will be dug and examined for hydric soil indicators such as colour, moisture regime, reducing soil conditions and sulfidic material (sulfur odour). As part of the ground truthing exercise the dominant vegetation species will be recorded and photographed.

A.2.9 Historic Resources

To characterize cultural and archaeological resources potentially affected by the proposed Project, a review of relevant site documentation (records review), consultation with the Provincial Archaeology Office, and an archaeological reconnaissance of the study area will be conducted. Known and high potential sites will be investigated. The results will be documented along with recommendations for further assessment or mitigation of areas of known archaeological resources, should this be required.

A.2.10 Viewshed Analysis

Visual effects assessment will be conducted for the proposed Project. This will include public consultation on valued landscapes and visual simulations. The visual simulations will be developed to represent the wind turbines in place across the Project to illustrate their visibility from various publicly accessible vantage points. No new data needs to be collected for this activity; however, wind turbine sites will need to be confirmed.

A.2.11 Electromagnetic Interference Study

An electromagnetic interference study for a wind farm includes a receptor survey and an assessment of local radiocommunication and radar signals, as described below.

RECEPTOR SURVEY

A receptor survey is required to complete the radiocommunication and radar system study. Receptors are defined as occupied residences and businesses within the Project areas be they permanent or temporary. A receptor survey involves building a database of known receptors in the Project area(s), their specific locations, as well as their locations relative to proposed turbine locations. This information can also be used to support consultation in the local communities.

A receptor study starts with a computer study, identifying the possible receptors in the Project area(s) from accurate overhead mapping, including residences, schools, and medical facilities. Following the computer study, the locations of receptors will be ground-truthed to confirm their locations and identify additional receptors that were not visible in aerial photos. Incorrectly identifying receptors can lead to errors in the radiocommunication and radar systems studies, which can lead to negative impacts on the overall Project going forward.

RADIOCOMMUNICATION AND RADAR SYSTEM STUDY

The Radiocommunication and Radar System study will follow the guidelines laid out by the Radio Advisory Board of Canada in partnership with Canadian Wind Energy Association in their guideline document Technical Information and Coordination Process Between Wind Turbines and Radiocommunication and Radar Systems.

The study will assess potential impacts of wind turbines on multiple radiocommunication and radar systems within both the Project and surrounding areas. The study involves sharing turbine location information with mandatory contacts to acquire consent from potential impacted parties. Additionally, the study involves a technical analysis of various radio broadcast frequencies which could be impacted by turbines. This portion of the study uses the Government of Canada's Radio Frequency Database to determine the locations and parameters of radiocommunication infrastructure within a given geographical area. The radiocommunication infrastructure will be analyzed to determine potential impact of the wind turbines on existing infrastructure.

A.2.12 Shadow Flicker Study

Shadow flicker is the intermittent shadow caused by the rotating blades of wind turbines which can result in annoyance and disruption to residences and other sensitive receptors near wind farms.

A shadow flicker impact study will be completed to determine the potential impacts on residences and other sensitive receptors that might be affected within 2.0 km from the centre point of each turbine where the potential for shadow flicker is possible. The modelling software will be used to assume a worst-case scenario where the sun is shining during daytime hours, the wind turbine generators are always rotating and are always perpendicular to sunlight, and each receptor has a window that faces the nearest wind turbine generators. A report will be produced describing the methods and predicted shadow flicker impacts on receptors. Figures will be created to display the wind turbine generators, receptors, and model results in the format of isolines of minutes per day and hours per year of shadow flicker.

A.2.13 Quantitative Risk Assessment

A Project-specific QRA will be conducted to examine the potential consequences Project failures and accidental even scenarios, such as an accidental loss of control of flammable vapours, hydrogen gas, or ammonia from the facility during the operation and maintenance phase of the Project. Completion of the QRA will involve the following tasks:

- Source characterization of several loss of containment, including the following:
 - Estimated time-varying hydrogen release rates in the event of storage, piping, or electrolyzer, ruptures or leaks
 - Flammable or toxic gas releases due to upset conditions
- Consequence modelling to determine the extents of hazard zones for various combinations of release types, hazards, and meteorological conditions
- Risk modelling, which combines the results of the consequence modelling with the probability of a release occurring, to provide an estimate of the likelihood of harm on individual or societal bases

APPENDIX B

Letters of Support for the Project and Presentation to Community Leadership



May 10, 2022

John Risley, Chairman CFFI Ventures
Sean Leet, Chief Executive Officer, Horizon Maritime Services

Via email:
JRisley@CFFI.com
Sean.Leet@HorizonMaritime.com

Dear John & Sean:

RE: QALIPU FIRST NATION SUPPORT FOR PROJECT NUJIO'QONIK

We appreciate that CFFI Ventures and Horizon Maritime Services (Project Proponents) invited Qalipu First Nation (Qalipu) to the first project team meetings at Stephenville in March and we have further appreciated the ongoing dialogue since those initial informative meetings. We are looking forward to our follow up meeting and the update on Project Nujio'qonik later this week.

We understand the Project Proponents are committed to adherence on regulatory matters, including required environmental assessment criteria. As Project Proponents who are established and respected Newfoundland & Labrador and Atlantic Canadian companies, we are pleased to see your continued support in environmental stewardship in all aspects of this project. We wish to note that we have a positive, professional, and comfortable dialogue with you as Project Proponents. It is important to have this open and candid discussion with Project Proponents and we look forward to continuing our dialogue in the same manner going forward.

Qalipu is a progressive, vibrant and engaged First Nation with a strong commitment to be closely involved in developing meaningful, sustainable, responsible economic opportunities for our members, our communities, and our Province. We are looking forward to further advancing our relationship and participating in Project Nujio'qonik in a substantive role that provides value to the project. As one example, the concept you have tabled which would see Qalipu establishing the first wind / hydrogen energy training college in North America is exciting for us. We look forward to developing this valuable institution, creating renewed economic momentum and a spectrum of long-term jobs, including trades and professions, that are accessible to the community.

Furthermore, we envision unmatched Indigenous employment and commercial opportunities on Project Nujio'qonik; this project having the potential to create tremendous growth & economic progress for our community and our province. This will position us as leaders in the rapidly evolving energy transition and delivering a massive reduction in global greenhouse gas emissions.

We recognize that an important aspect of Project Nujio'qonik is the ability to develop the project with pace. The global energy transition is developing faster than perhaps any other change in world history. As a participant in Project Nujio'qonik, we are ready to meet the challenges that come with leading change and look forward to the positive outcomes that will undoubtedly result from our collective efforts.

We support Project Nujio'qonik and encourage the Government of Newfoundland and Labrador to likewise support this project as we commit to greener futures and a brighter tomorrow.

Yours Truly,



Chief Brendan Mitchell
Qalipu First Nation



TOWN OF CAPE ST. GEORGE
876 Oceanview Drive
Cape St. George, NL
A0N 1T1

Tel: 709-644-2290/Fax: 709-644-2291
E-mail: towncapestgeorge@eastlink.ca

May 18, 2022

Mr. Sean Leet, Chief Executive Officer
Horizon Maritime

Mr. John Risley, Chairman
CFFI Ventures Inc.

Dear Mr. Leet & Mr. Risley:

The Town of Cape St. George, is a scenic town on the Port au Port peninsula with 801 people. In our beautiful municipality we have three languages, English, French and Mi'Kmaq.

The Town offers the usual municipal services to its citizens including street lighting, fire fighting, ambulance services, recreational facilities, and water and waste disposal.

The town also received a national award for its efforts at recycling in 2015. Cape St. George has two schools offering both official languages. We also have two retail outlets, a restaurant and a medical clinic.

The Town of Cape St. George is pleased to draft this letter of support for CFFI Ventures and Horizon Maritime Services in the development and implementation of its current wind energy and green hydrogen investment as well as any future investments and ventures in the Bay St. George region.

It is the wish of the Town of Cape St. George that the initiative proceeds in a timely manner to maximize the benefit of global demand and maximize the market potential for the projects output.

Sincerely,



Stella Corneet
Stella Corneet, Mayor

Cc: Town council, Cape St. George



Town of Lourdes

1 Smith's Lane, P.O. Box 29
Lourdes, NL A0N 1R0
Telephone: (709) 642-5812 Fax: (709) 642-5558
e-mail: townoflourdes@eastlink.ca

May 19, 2022

Mr. Sean Leet, Chief Executive Officer
Horizon Maritime Services

Mr. John Risley, Chairman
CFFI Ventures Inc.

Reference: Information Session, Day's Inn, Stephenville, May 13, 2021

Gentlemen:

Having attended the session at reference and having heard from many of the proponents of your intended investment in our area to produce "green hydrogen" for the global market, I was impressed with your commitment towards this venture as was evidenced by the significant research and positive indicators to date that such a development would be beneficial to both your organization and the residents of the Towns and Local Service Districts of the Region.

Much of this region has been economically depressed for many years, especially the Port au Port Peninsula, which has now only one significant employer (Atlantic Minerals) while it has seen other ventures such as a fish plant, plastics plant, scallop farm and others, closing before even becoming economically viable. The construction of wind farms and extraction facilities for "green hydrogen" for the global market will, of course, be an economic boost to the area in both the short and long term.

The Town of Lourdes wholeheartedly supports CFFI Ventures and Horizon Maritime Services in its proposed development and future ventures in our region, and look forward to working closely with you as you attain these goals. Of course, being on the cutting edge of a 100% major environmentally "green" project will certainly put our region on the map as well.

Again, good luck with bringing your proposed project to fruition and we pledge our support in helping you in any way we can.

Sincerely,

Henry Gaudon, CD3
Mayor
Cell: 709-649-5452



TOWN OF PORT AU PORT WEST AGUATHUNA, FELIX COVE

17 May 2022

Sean Leet
Horizon Maritime
87 Water Street
St. John's, NL, A1C 1A5

Attention:

Sean Leet; CEO of Horizon Maritime
John Risley; Chairman CFFI Ventures

The Town of Port au Port West, Aguathuna, Felix Cove discussed your request for a letter of support. The council members agree that this initiative, to purchase the Stephenville Port, build a green hydrogen plant, and build three wind farms will help foster economic, social, and cultural growth in the entire region including the Town of Port au Port West, Aguathuna, Felix Cove in a sustainable, environmental friendly practice. The proposed investments will potentially provide a significant economic lift to the region which has experienced sustained demographic challenges and economic decline over the years.

Council would like to commend Horizon Maritime and CFFI Ventures for establishing the necessary partnerships to engage in the current wind energy and green hydrogen investments as well as any future investments and ventures in the Bay St. George Region. In addition to its support of the Project's Proponents, the Town of Port au Port West, Aguathuna, Felix Cove expresses its wish that the requisite approvals and processes which the proposed wind energy and green hydrogen investment of CFFI Ventures and Horizon Maritime Services must undergo, be expedited as much as is possible, while ensuring environmental protection and safety requirements. It is the wish of the Town of Port au Port West, Aguathuna, Felix Cove that the initiative proceeds in a timely manner to maximize the benefit of global demand and maximize the market potential for the projects output.

Council extends its support and looks forward to working with you to further promote and market this wonderful region as the future of wind farm and green hydrogen technologies.

Yours very truly,

Chalsie Kook-Marche
Mayor



The Town of Stephenville

P.O. Box 420, 125 Carolina Avenue
Stephenville, NL A2N 2Z5

May 13, 2022

Mr. Sean Leet, Chief Executive Officer
Horizon Maritime

Mr. John Risley, Chairman
CFFI Ventures Inc

Dear Mr. Leet & Mr. Risley:

The Town of Stephenville, as the largest Municipality in the Bay St. George region, providing commercial and critical services to a catchment area of 18,000 people and encompassing both a maritime Port and Airport, expresses its pleasure to be considered for a significant investment from CFFI Ventures and Horizon Maritime Services (Project Proponents). These proposed investments will potentially provide a significant economic lift to the region which has experienced sustained demographic challenges and economic decline over the years since the closure of the Abitibi Consolidated Paper Mill in 2005.

These past challenges aside, the Town of Stephenville in 2022 is poised for growth and is committed to working with the Project Proponents and stakeholders to ensure the rapid implementation of its investments. The Town of Stephenville is committed to work closely with CFFI Ventures and Horizon Maritime Services, to secure the requisite municipal permits and approvals in a timely and thorough manner. The Town of Stephenville commits to work closely with the Project Proponents to minimize, where possible, any implementation bottlenecks and delays and to assist the Project Proponents in other areas such as access to labor, inputs and resources, local suppliers, and liaising with other levels of government, within the Towns ability and remit.

The Town of Stephenville is pleased to draft this letter of support of CFFI Ventures and Horizon Maritime Services in the development and implementation of its current acquisition and future ventures in the Stephenville and the wider Bay St. George region. In addition to its support of the Project's Proponents, the Town of Stephenville expresses its wish that the requisite approvals and processes which the initiative of CFFI Ventures and Horizon Maritime Services be processed in a timely manner to maximize the benefit of global demand for green energy and maximizing the market potential for the projects output.

Sincerely,

Tom Rose, Mayor
Town of Stephenville

cc: Town of Stephenville Council



THE TOWN OF STEPHENVILLE CROSSING

P.O. BOX 68, STEPHENVILLE CROSSING, NEWFOUNDLAND A0N 2C0

TEL: (709) 646-2600 : FAX: (709) 646-2065

5/18/2022

Mr. Sean Leet
Horizon Maritime
87 Water Street
St. John's
A1C 1A5

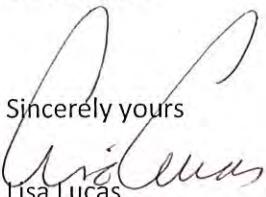
ATTNENTION

Mr. Sean Leet, CEO Horizon Maritime
Mr. John Risley, Chairman CFF! Ventures

The Town Council of Stephenville Crossing is pleased that you have considered our region for significant investment from CFFI Ventures and Horizon Maritime Services. These proposed investments will potentially provide a significant economic lift to the region which has experienced sustained demographic challenged and economic decline over the past few years.

The Town Council of Stephenville Crossing is committed to working closely with the Project Proponents to expedite where possible to assist in obtaining the appropriate approvals and permits from Government.

The town Council of Stephenville Crossing extends its support and looks forward to working with you to further promote and marker this wonderful region as the future of wind farm and green hydrogen technologies.


Sincerely yours
Lisa Lucas
Mayor



May 17, 2022

Sean Leet
Horizon Maritime
87 Water Street
St. John's, NL A1C 1A5

Attention:
Sean Leet; CEO of Horizon Maritime
John Risley; Chairman CFFI Ventures

The Town of Kippens discussed your request for a letter of support. The Chair of Council agrees that this initiative, to purchase the Stephenville Port, build and operate a Green Hydrogen facility supported by the development of three (3) windfarms will help foster the economic, social, and cultural growth of the entire Bay St. George Region, including but not limited to the Town of Kippens.

The proposed investments will potentially provide a significant socio-economic lift to the Region which has suffered a decline over the last decade.

The Town of Kippens would like to acknowledge and commend Horizon Maritime and CFFI Ventures for establishing the necessary partnership and pre-planning work to engage in the regions wind energy resources to be an industry leader in the production of Green Hydrogen at the proposed facility in Stephenville.

In addition to the Town of Kippens support of the Project Proponents, the Town endorses the approvals and processes required to be environmentally compliant via the environmental registration application required by the Provincial authorities in an expedited manner to achieve the goals set forth by both Federal and Provincial Authorities on the conversion from a Hydrocarbon dependant society to a Greener more environmentally sustainable greener energy source.

The Town of Kippens extends its support to all partners and look forward to healthy open & transparent relationship with Horizon Maritime and CFFI Ventures while supporting and promoting the idea of becoming a region recognized as the starting place of an evolution of technology in Green Hydrogen Production.

Yours truly,


for Mike Comerford
Mayor

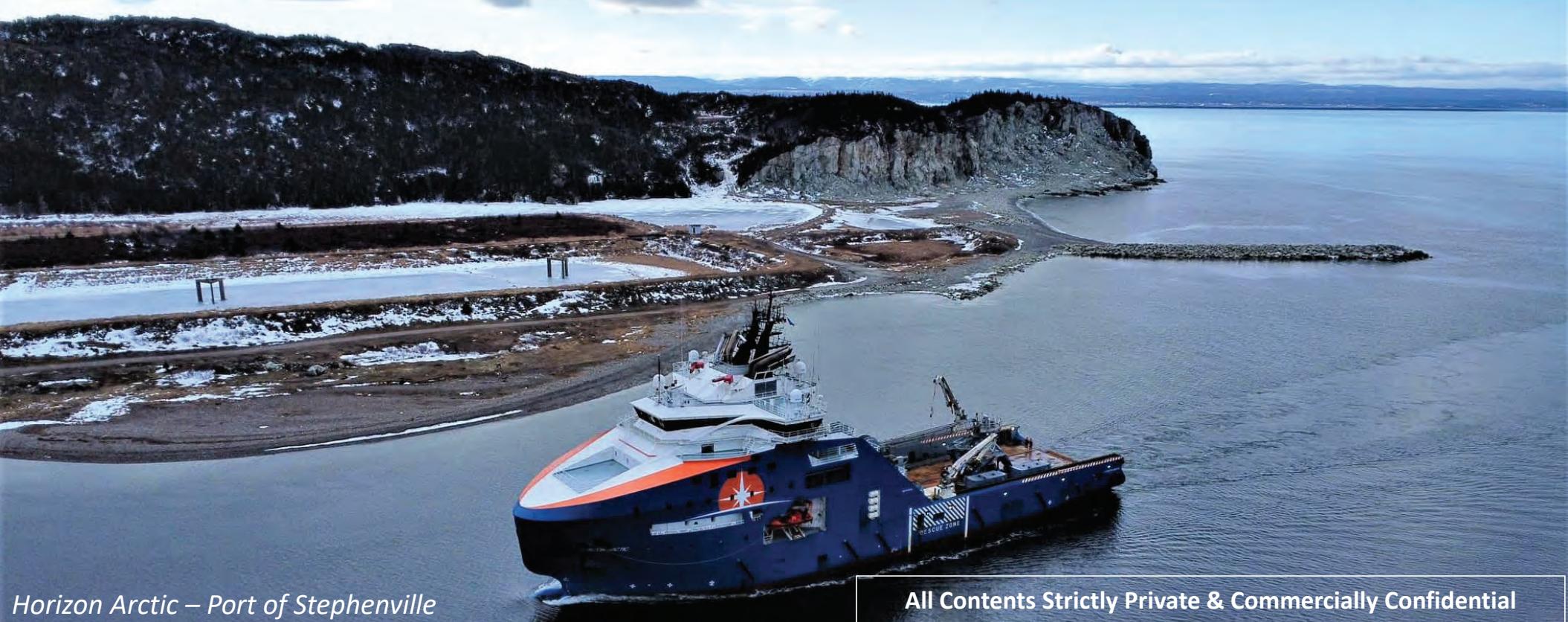


Project Nujio'qonik

The Mi'kmaq name for Bay St. George is **Nujio'qonik**

Pronounced “new-geo-ho-neek” – it means where the sand blows

May 13, 2022



Horizon Arctic – Port of Stephenville

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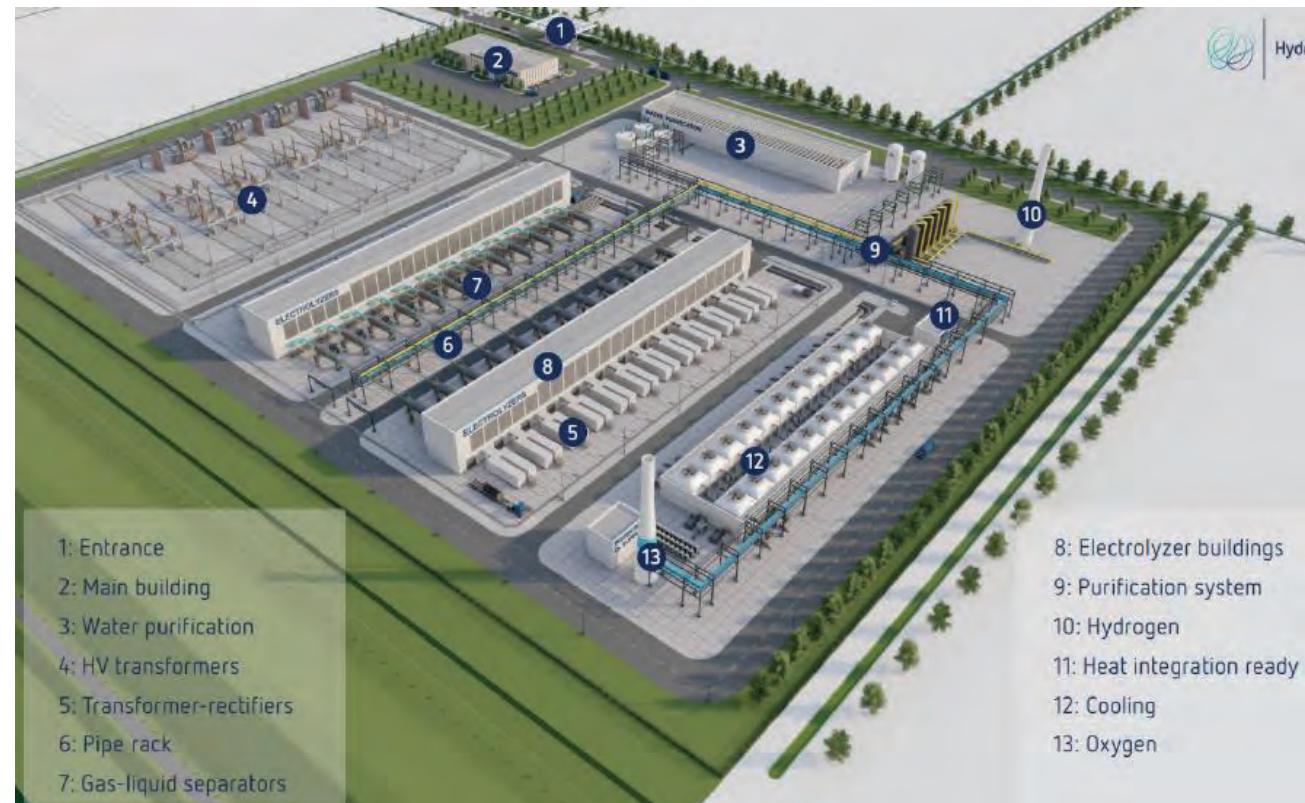
Where we have come from



Using our resources to create the fuel of the future

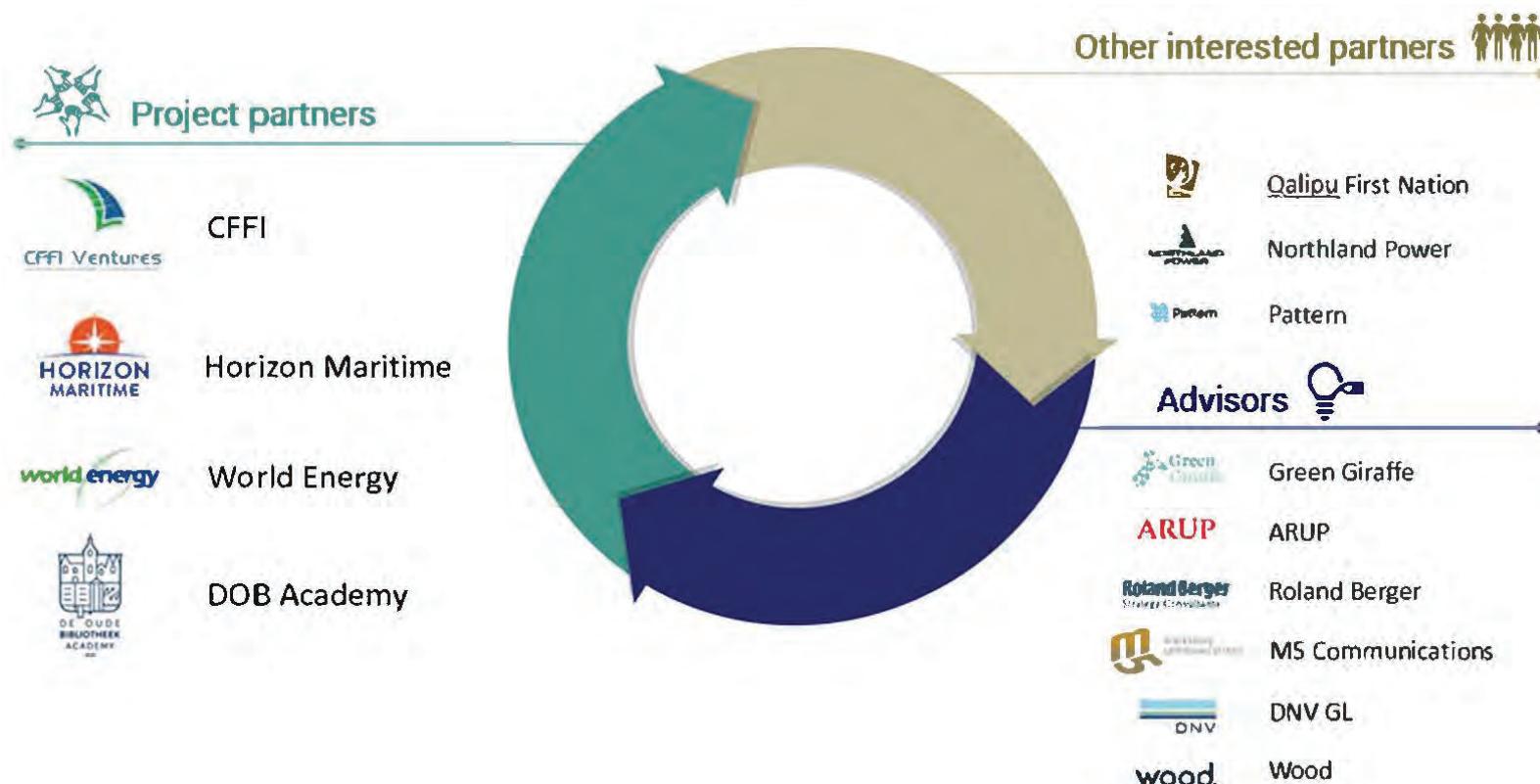
What is Green Hydrogen?

- Renewable zero-emission fuel produced through the electrolysis of water
- Cleaner than Grey or Blue hydrogen
 - Grey Hydrogen is produced from fossil fuels and emits a high level of carbon
 - Blue hydrogen is produced in a similar way, generally from natural gas, and causes carbon to be released, but the carbon is stored using carbon capture technology
- Produced from only water and renewable electric power
- Project Nujio'Qonik will utilize wind power to produce the required electricity



One-gigawatt hydrogen plant

Industry leading project team

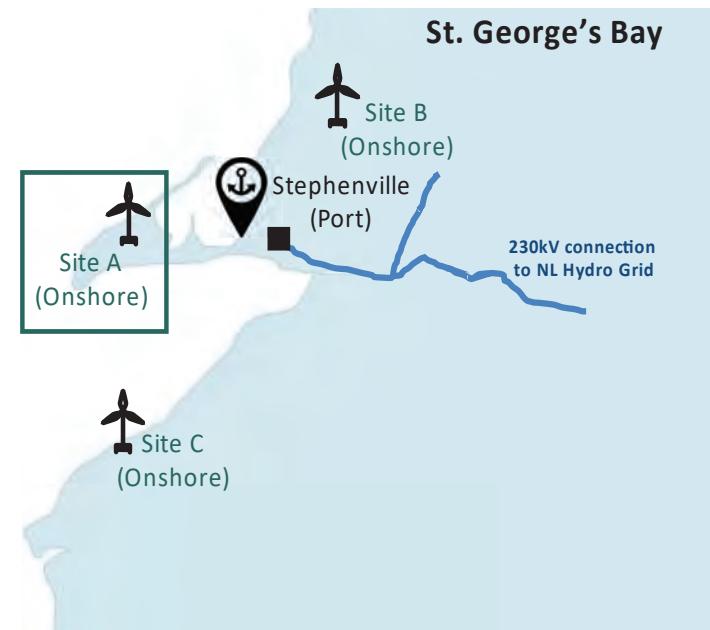


Project summary

Project Nujio'qonik

Canada's first commercial green hydrogen/ammonia producer created from 3+ GW of renewable electricity through wind projects

- Our plan is to develop a total of 3+ GW sites concurrently with staggered target delivery schedule, with increased hydrogen production over time
 - **Phase 1 development plan:**
 - Up to 1 GW through Site A (onshore)
 - Hydrogen processing facility at the Port of Stephenville
 - Grid interconnections and the hydrogen-fuelled turbine generator at the Port
 - **Phase 2 development plan :**
 - 2 GW additional through Sites B & C (onshore)
 - Concurrent expansion of the hydrogen plant
 - **Phase 3 plan:**
 - Evaluate further wind resource potential in the region and potentially expand project
- **3 GW wind farm will deliver ~ 250,000 tons/year of hydrogen using 1.5 GW electrolyzers**



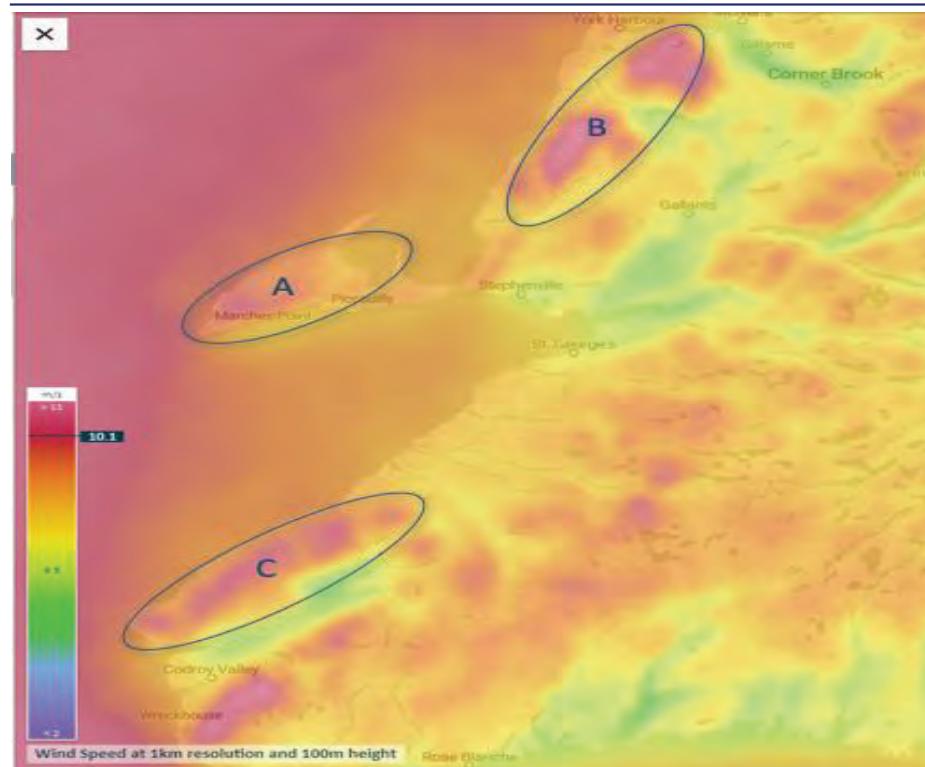
Project summary

Project Nujio'qonik is located in one of the world's best wind resource regions

This translates into a levelized cost of hydrogen (LCOH) which is competitive with proposed projects in other jurisdictions

	Location	Wind speed at WTG height (m/s)
Site A	Onshore	9.7
Site B	Onshore	11.4
Site C	Onshore	10.8

3 sites



* Source: Vortex website

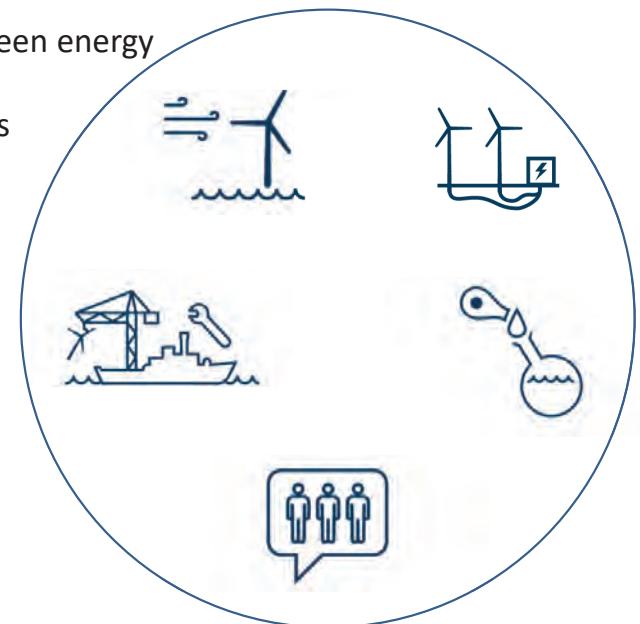
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World class wind, world class port



The targeted site area offers unique characteristics

- Sturdy wind resource onshore
- Deep-water port uniquely suited to hydrogen production & offloading
- Interconnection to the existing grid for mutual beneficial seasonable exchange of green energy
- Potential opportunity to back-stop NL Hydro commitment to EMERA for export sales
- Available harbour facilities for construction, operations and shipping
- Access to fresh water for hydrogen production
- Favourable response from preliminary community engagement
- First Nations' participation in the project as stakeholders



World-class execution team



We are local

Strong ties with the immediate project area and throughout the Province of NL

- **Opportunity to leverage deep local roots of five Canadian partners**
- **Leveraging our home-grown oil & gas and hydro development expertise**



Ability to secure the right technology

In today's seller's market strong engagement with suppliers is required

- **The right team with the right connections to procure the right assets,**



Relevant strong track record

Strong wind track records from Northland Power, a Canadian wind developer with global onshore and offshore wind experience included and bio jet fuel plant development by CFFI with synergies with Project Nujio'qonik's supply chain

- **Experience of a team strong in developing renewables**



We are global and entrepreneurial

Substantial development capital has already been deployed and willingness to put more at risk

- **Globally best in class team of advisors with most up-to-date industry views, all ready to proceed**

Local and highly capable



We are far advanced compared to other developers and ready to proceed – the only government support we require is in expediting regulatory approvals and permits

- Very early start of local stakeholder engagement
- **Thorough analyses** on project feasibility, technical information of the sites, and relevant risks in each phase has already been **conducted** and methodically considered



Work with offtake participants to materialize the forecasted success

Wind Energy helped aviation businesses meet carbon reduction through their SAF product

- Ready to deploy the SAF model in green hydrogen and green ammonia markets to establish robust offtake strategy



We bridge the transition to renewables

Pioneering and pivotal in energy, the project will bridge NL from conventional energy to renewables energy

- Capability to transform the unlimited wind resources into renewables



Communities are core to us

Canadian and First Nation interest at heart

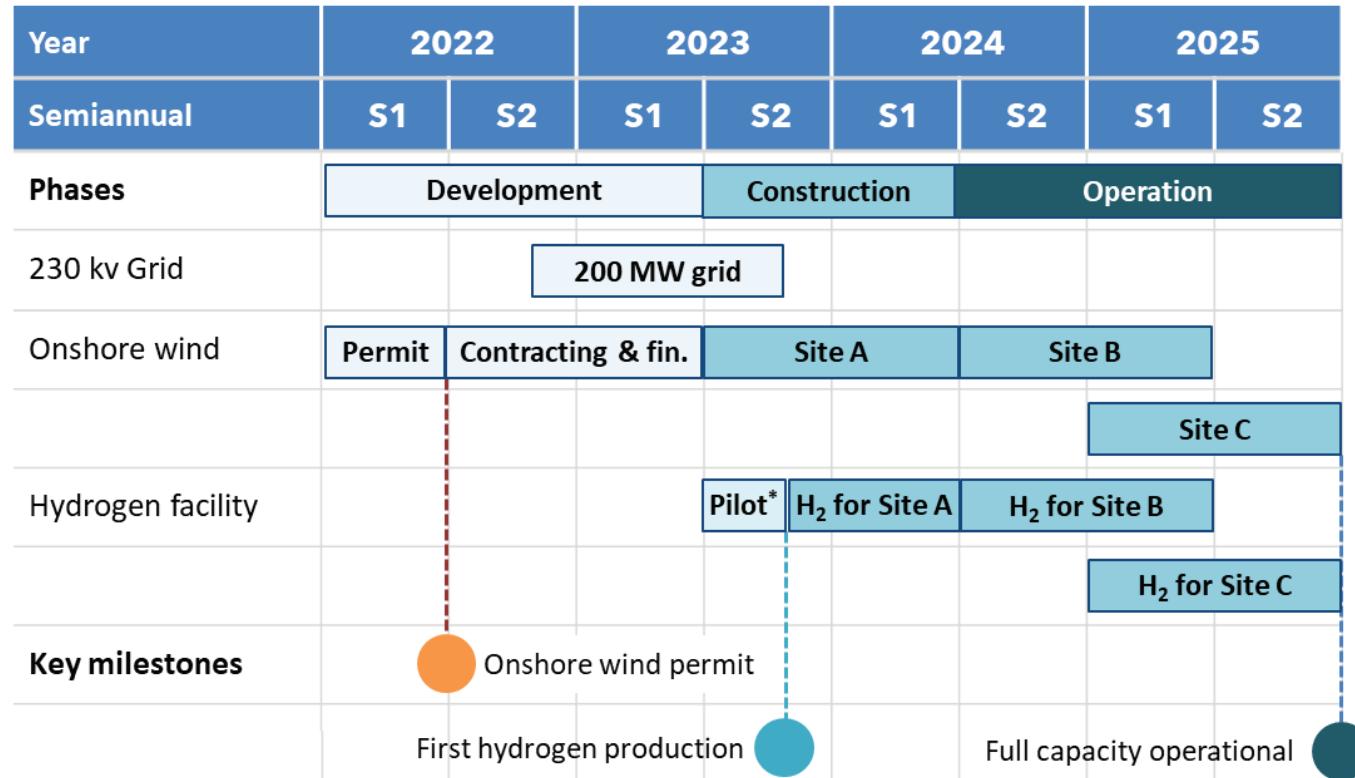
- Positive initial feedback after active and ongoing key stakeholder engagement



Solid financing

Financially strong and diverse consortium

Preliminary schedule



Regional economic benefits



Economic incentives

- **Tax revenues (regional & provincial)**
 - Taxes through project revenue (e.g., income tax, regional tax, property tax)
 - Increased tax revenue from additional revenue earned by local companies
- **Local incentives**
 - Benefits agreement (IBA) with First Nations
 - Qalipu First Nation Training Academy
 - Local community support for various improvement initiatives
 - Significant increase economic activity
 - Attracting highly-skilled immigrants
 - Positively impacting every area of the provincial economy with a massive impact on the local region
- **Estimated job creation:**

	Direct construction	Operations	Indirect
H2 Facility	600	50	200
Site A (1 GW Onshore)	400	50	1,100
Site B (1 GW Onshore)	400	50	1,100
Site C (1 GW Onshore)	400	50	1,100
Total	1,800	200	3,500

* These numbers are indicative as further analysis is needed on areas including the construction execution strategy, the contracting strategy for operations, and the results of the supply chain studies. We have planned the studies as the next phase of work

Workforce transition

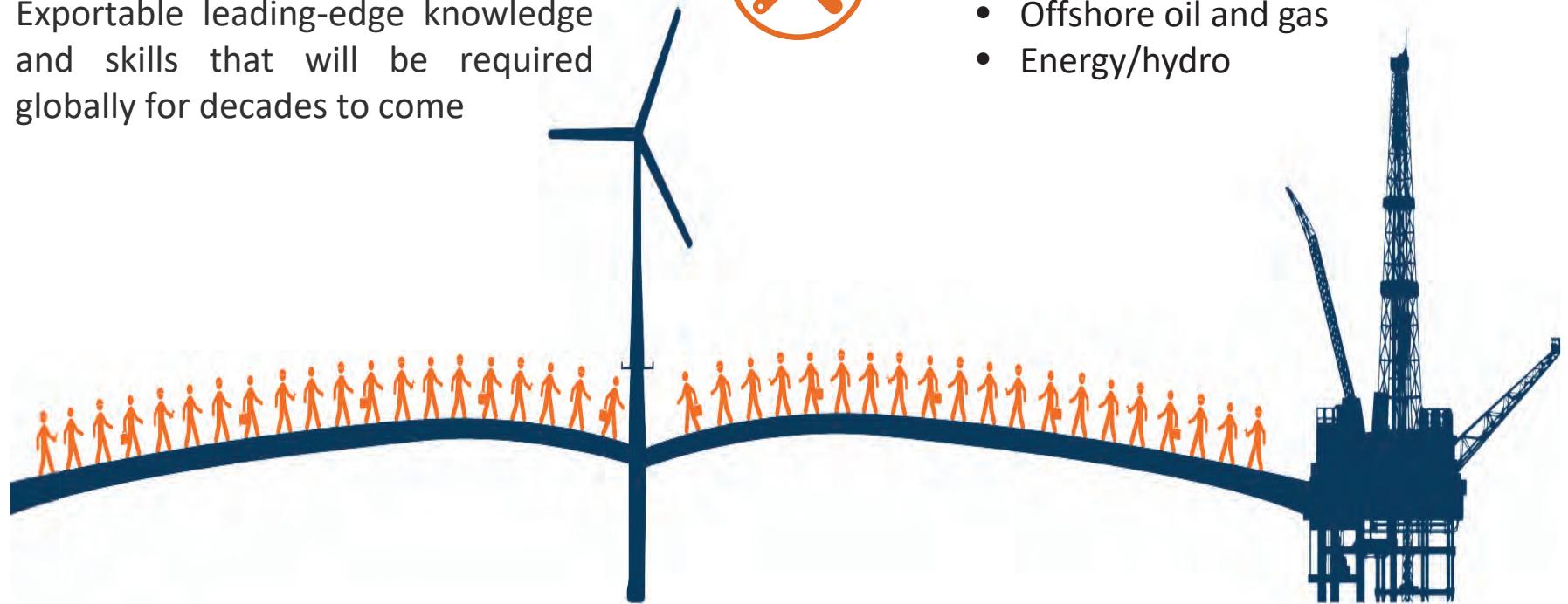
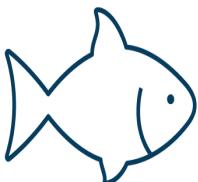
Competency building

- Re-train offshore & maritime experts
- Create new jobs
- Exportable leading-edge knowledge and skills that will be required globally for decades to come



Existing relevant skills in NL

- Marine
- Fisheries
- Offshore oil and gas
- Energy/hydro



Wind industry training institution

- First of its kind in North America and will attract an abundance of students from US and abroad – tradesperson to executive
- Knowledge transfer from project partner DOB Academy in Delft, The Netherlands
- Our vision is to work with our First Nation partners and existing post secondary institutions in the province to make this facility a reality

Basic to Expert level courses	Teach the Teacher	Community + hearts & minds
<ul style="list-style-type: none"> • Offshore wind basics • H2 supply chain • Expert training to re-train existing mariners & offshore workers 	<ul style="list-style-type: none"> • Transfer of teaching material • Training local teachers to work with the material • Custom material for local setting 	<ul style="list-style-type: none"> • Public outreach • Primary school programs • Community knowledge building 

CONFIDENTIAL

Our stakeholder engagement commitment



We are doing our homework to understand our stakeholders, with priority focus on Indigenous partners and local community



We have already engaged



We will continue to build trust



We will communicate but we will also listen



We will create a two-way communication mechanism – feedback and ongoing dialogue is essential to success



We will be open to change or a pivot that will be important to our stakeholders

Progress to date



Build a strong team



Feasibility studies



Stakeholder engagement



Continuous dialogues



Technical surveys

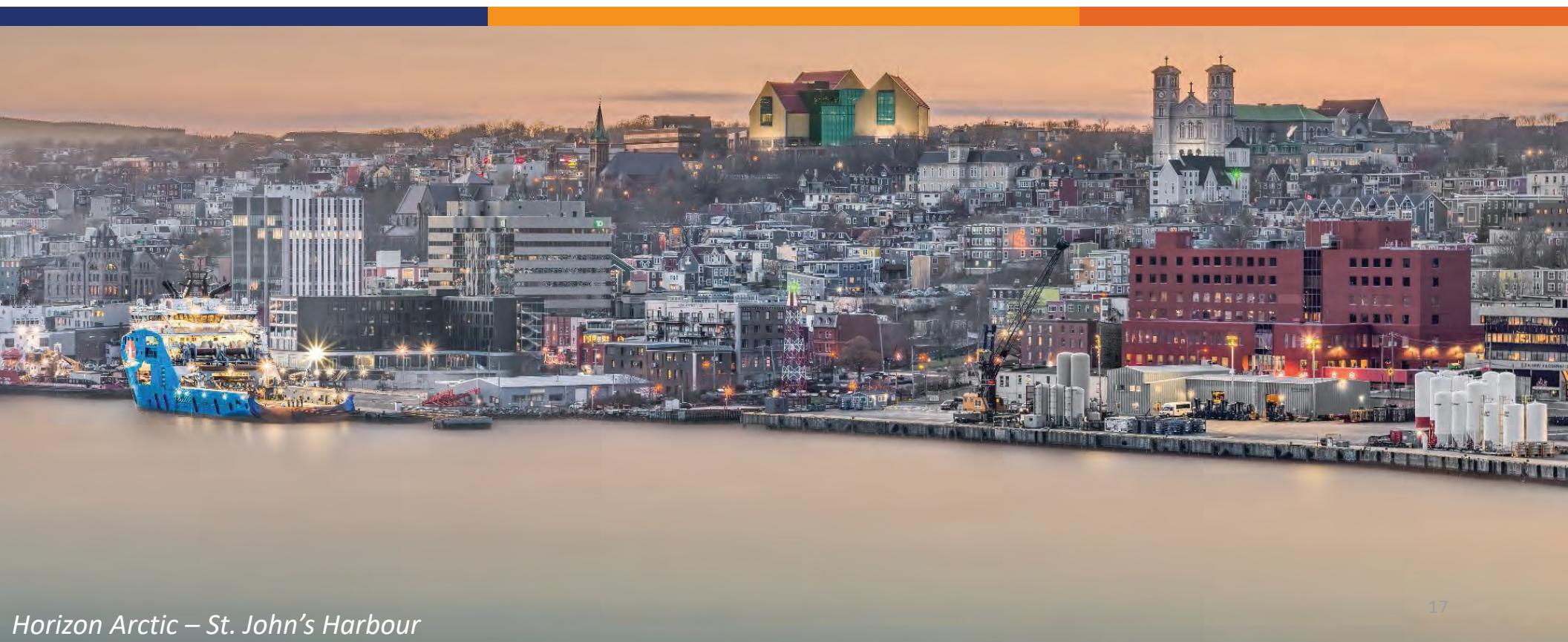


<ul style="list-style-type: none">• Five Canadian partners with track record and local expertise• A strong team of world-leading advisors• Ability to finance and execute on this CAD \$17 billion+ undertaking	<ul style="list-style-type: none">• Technical red flag analysis• Commercial feasibility red flag analysis• LCOH assessment	<ul style="list-style-type: none">• Meetings and discussions with Qalipu First Nation and Miawpukek First Nation	<ul style="list-style-type: none">• Ongoing conversations with local utility• Pending discussion with the seasonal interchange of green power	<ul style="list-style-type: none">• Desktop wind assessment by DNV• Wind resource campaign and environmental survey commissioned to Wood group	<p>We now need your support to continue this journey of energy transition that will position Newfoundland & Labrador and Canada as a global leader in the production of Green Hydrogen</p>
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Next Steps

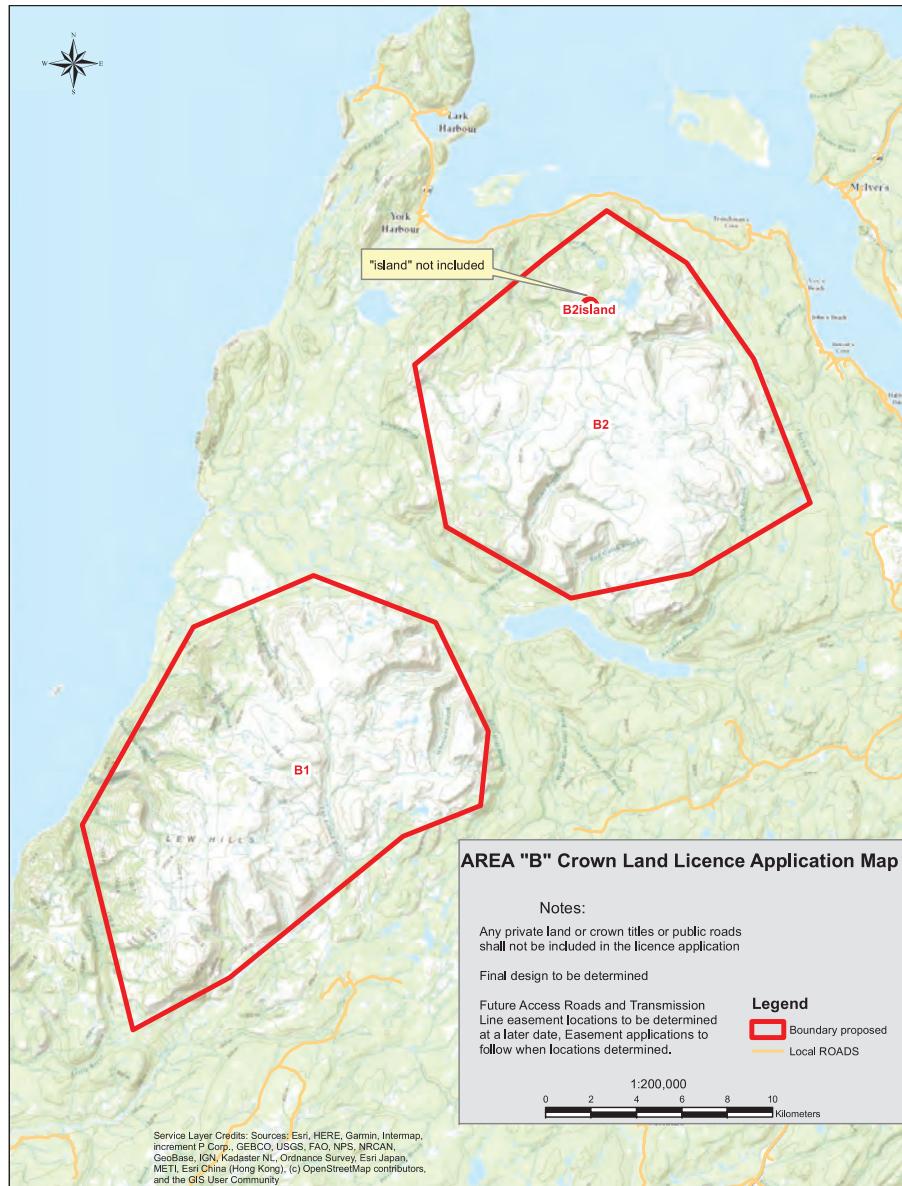


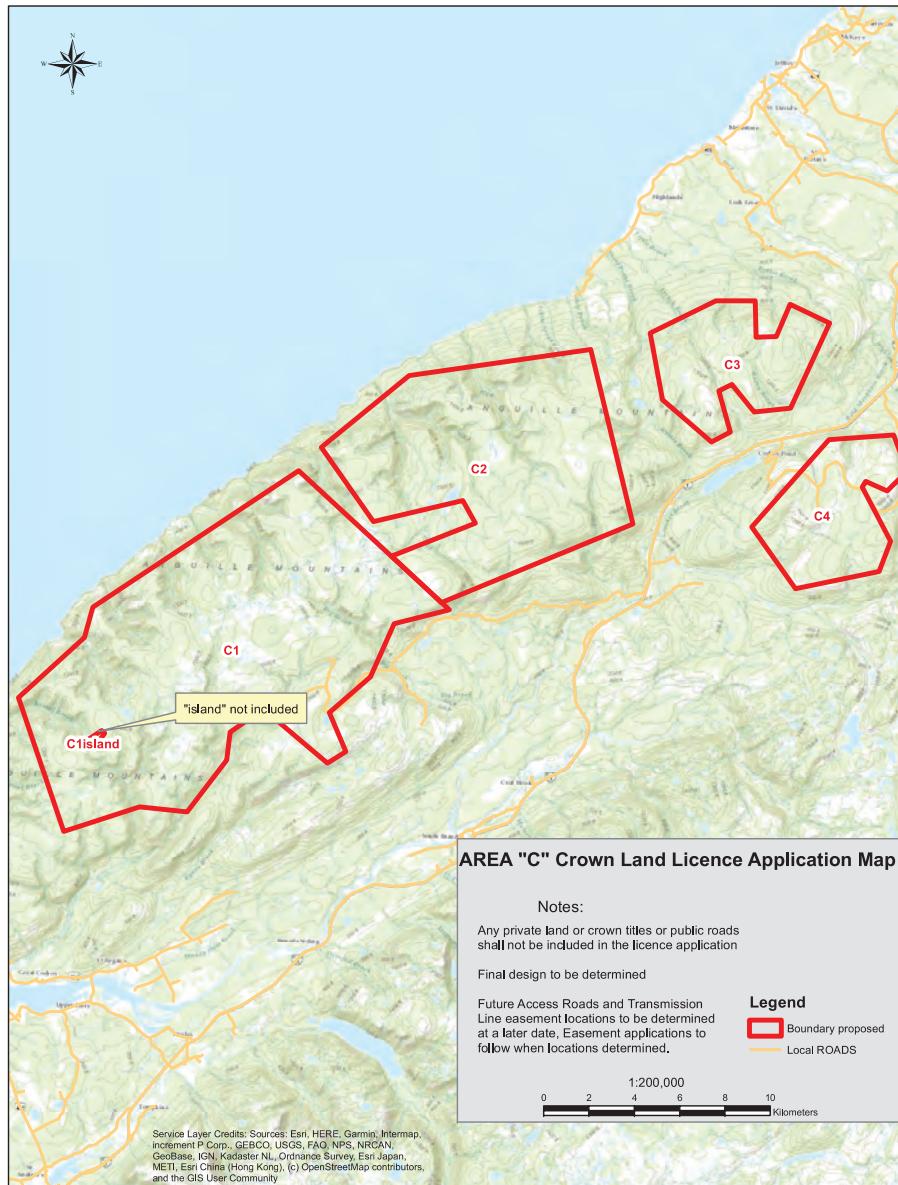
- Submit Project Registration to NL Department of Environment & Climate Change
- Further stakeholder engagement meetings:
 - Government of Newfoundland and Labrador
 - First Nations Groups
 - Industry stakeholders
- Establishment of on the ground community office in the region
- Hiring of local community relations staff
- Progress Permitting activities



Horizon Arctic – St. John's Harbour









All Contents Strictly Private & Commercially Confidential

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1. High Voltage (HV) Transformer (230 to kV)
2. Medium Voltage (MV) Transformer and rectifier
3. Electrolyzer Building, Separators, Pipe Racks
4. Cooling System and Oxygen Handling
5. Hydrogen Purification and Surge Storage
6. Compression and Processing
7. Water Purification
8. Offices, Controls, and Security
9. Truck Loading Rack for Local Distribution



APPENDIX C

Illustrative Simulations of Project Infrastructure from Various Viewpoints

Supplied as a Separate Document

APPENDIX D

Equity, Diversity, and Inclusion Policy and Preliminary Plan

EQUITY, DIVERSITY, AND INCLUSION POLICY

World Energy GH2 is committed to promoting equity, diversity, and inclusion (EDI) within a workplace that is free of discrimination.

Our Management Team values EDI within our workforce and believe this is achievable through effective and ongoing commitment starting at the corporate ownership level. It means maintaining a policy of inclusion in support of disadvantaged persons in society, particularly women, Indigenous peoples, members of visible minorities, and persons with disabilities.

Opportunities for employment and advancement shall be related to and based on ability. EDI in the workforce is a long-term goal that must occur over time by identifying and overcoming barriers to ensure a fully represented workforce.

World Energy GH2 is committed to ensuring its staff and managers are aware of and orientated in EDI in accordance with the requirements of the law and good practice.

Employees of World Energy GH2 shall support the company's initiative with regards to EDI with the intention that:

- *Employees, job applicants and clients are treated fairly in an environment which is free from any form of discrimination;*
- *All employment-related policies, practices and procedures are applied impartially and objectively;*
- *There is equality of opportunity to all and employees are provided with the opportunity to develop and realize their full potential;*
- *The company will continuously work towards achieving a diverse workforce at all levels;*
- *Employees can work in an atmosphere of dignity and respect.*

Employees have a responsibility to guard against any form of discrimination in any of their decisions and behavior. All claims of discrimination shall be taken very seriously, and appropriate action will be taken against those concerned.

World Energy GH2 aims to be an employer of choice to ensure its workforce can make a valuable contribution to the work of the company while ensuring we support our workforce's health and well-being. The goal is to have a positive impact within the local, national, and international communities.



Signature

June 8, 2022
Date

Equity and Diversity Plan

Goals	Objectives	Target Measure	Department Responsible	Target Date	Status
Goal 1					
Develop Policy and Framework					
1	Develop an Equity and Diversity Policy	Signed Equity and Diversity Policy	World Energy GH2 Executive Team	31-May-22	Closed
2	Develop a First Nations Policy	Signed First Nations Policy	World Energy GH2 Executive Team	03-Jun-22	Closed
3	Develop an overall objective and target for minimum diversity for staff and executive team	Documented baseline target established (1-5 Years)	World Energy GH2 Executive Team	31-May-22	Closed
4	Identify processes that affect work/life balance and determine areas where accommodation can be applied to individuals.	Documented list of high-level responsibilities which identifies where accommodation can be applied.	World Energy GH2 Executive Team	31-Mar-22	Closed
Goal 2					
Develop Best Practices for Recruitment					
1	Develop a Recruitment Program	Approved program that includes equity and diversity recruitment strategies, and requirements for internal promotion opportunities.	World Energy GH2 Executive Team	30-Apr-22	Closed
2	Require Supply Chain to have an equity and diversity plan	Developed evaluation process for vendors and subcontractors which includes equity and diversity requirements.	Strategic Procurement	30-May-22	Closed
3	Require all job postings and recruitment offerings be submitted for peer review	Documented provision within the Recruitment Program for peer review of job postings.	World Energy GH2 Executive Team	30-Apr-22	Closed
4	Require training for all individuals involved in the recruitment and nomination processes	Developed training for recruiters which includes determining experience and skills over education.	World Energy GH2 Executive Team	30-Apr-22	Closed
5	Demonstrate leadership by committing to at least one external diversity workshop	Documented commitment to one diversity group.	World Energy GH2 Executive Team	30-Apr-22	Closed

Equity and Diversity Plan

Goals	Objectives	Target Measure	Department Responsible	Target Date	Status
Goal 3					
Create Methodology and Data Collection					
	1 Set up a structure to collect equity information for new hires	Data collection sheet created	World Energy GH2 Executive Team	30-Apr-22	Closed
	2 Set KPI's for diversity recruitment	Documented KPI's for recruitment	World Energy GH2 Executive Team	30-Apr-22	Closed
Goal 4					
Develop Program Literature					
	1 Set deadlines for program literature that promotes diversity and equity	Documented target date for completing the diversity and equity program literature.	Stakeholder Engagement and Permitting	31-Mar-22	Closed
Goal 5					
Develop Training					
	1 Require training for all management and staff on unconscious bias	Documented onboarding program to include minimum training for all personnel including unconscious bias.	World Energy GH2 Executive Team	31-Mar-22	Closed
Goal 6					
Establish Partnerships					
	1 Establish and maintain equitable, accessible, and inclusive partnerships with First Nations for the project	Documented strategy for inclusive partnership with First Nations	Stakeholder Engagement and Permitting	31-Mar-22	Closed

APPENDIX E

Assessment of the Potential to Obtain an Industrial Water Supply, North of the Port of Stephenville, NL



TECHNICAL MEMORANDUM

TO: John MacIsaac, Horizon Maritime
Sean Leet, CEO, Horizon Maritime
Janet Kovich, Executive Assistant to the CEO, Horizon Maritime

FROM: Fracflow Consultants Inc.

DATE: June 1, 2022

SUBJECT: Assessment of the Potential to Obtain an Industrial Water Supply, North of the Port of Stephenville, NL

FFC-NL-3168-001



1.0 INTRODUCTION

Maritime Horizon has retained Fracflow Consultants Inc. to provide a desktop assessment of the potential to obtain an industrial water supply of between 350 to 700 USgpm within or north of the property of the Port of Stephenville, primarily from Mine Pond (**Figure 1**) and any interconnected surface water bodies (**Figure 2**).

2.0 HISTORICAL REVIEW

2.1 Climatic Conditions

The surface drainage in the Mine Pond area (**Figure 1**) is located on the east side of the overburden aquifer where water from Mine Pond flows as a perched stream southeast down to the main highway and then through the old Abitibi plant site and discharges to the Port of Stephenville. A smaller stream is located to the west of the old Abitibi plant site and to the immediate west of the NFLD Hydro electrical generation station.

Figure 3 shows the monthly variations in total precipitation at the Stephenville Airport for the period of 1942 to May 2022. The mean monthly precipitation varies from 69.51 mm (April) to 122.37 mm (January). Stephenville had a mean yearly precipitation of 1,240.67 mm between 1942 and 2021. The rainfall component of the mean annual precipitation at the Stephenville Airport from 1942 to 2022 is presented in **Figure 4**. The snowfall component (**Figure 5**) of the mean annual precipitation is 374.60 mm (equivalent rainfall) typically occurring between November and April with the highest monthly snowfall occurring in January (101.68 cm). **Figure 6** displays the historical annual precipitation values at the Stephenville Airport from 1942

to 2022. There are periods of low and high precipitation that tend to oscillate every five to ten years with a 30 to 40 year period of low precipitation (1942 to about 1970), increasing average precipitation between 1970 and 1985, followed by a period of higher but declining precipitation between 1985 and 2010. Overall, the recent trend appears to be one of decreasing annual precipitation.

Figure 7 shows the temperature statistics at the Stephenville Airport for each month for the period of 1942 to May 2022. The annual mean temperature for the area was about 4.96°C . The mean monthly temperatures were highest during July (16.19°C) and August (16.51°C) and decreased to the lowest values during February (-6.34°C). The temperature statistics indicate that the mean monthly temperature between December and March is below 0°C . All of the climatic data have been obtained from Environment Canada websites. These temperature statistics indicate that frozen ground conditions will exist for approximately four months of each year.

3.0 MINE POND INDUSTRIAL WATER SUPPLY

3.1 Mine Pond Drainage Area

Mine Pond has a surface area is $673,900 \text{ m}^2$, and Upper Mine Pond has an area of $129,000 \text{ m}^2$, which drains into Mine Pond. The drainage area that contributes flow directly into Mine Pond, either as runoff, interflow or as groundwater discharge, including the Mine Pond and Upper Mine Pond, is $3,556,000 \text{ m}^2$. **Figure 2** shows that Mine Pond has been and is assumed to be currently connected by a pipeline to Muddy Pond/Noel's Pond which are located at the bottom of the Warm Creek Drainage Basin.

3.2 Warm Creek Drainage Basin

The Warm Creek drainage basin lies between and generally extends parallel to the Blanche Brook drainage basin on its west side and the Harry's River drainage basin on its east side and is approximately $65,000,000 \text{ m}^2$ in area including Noel's Pond into which Warm Creek discharges and Muddy Pond, which is connected to Noel's Pond.

The Blanche Brook drainage basin is approximately $63,000,000 \text{ m}^2$ in area and is the basin from which the Town of Stephenville obtains its full groundwater supply. The installed Town of Stephenville water supply wells have a capacity of approximately 9 to $10 \text{ m}^3/\text{min}$, when fully developed. There are no large capacity water supply wells that are known to be installed in the Warm Creek drainage basin, although the new Mowi Canada East well field is located on the southern edge of the Warm Creek drainage basin. The Town of Stephenville's water supply wells are located in the middle part of the Blanche Brook drainage basin and withdrawal of water from the Warm Creek drainage basin will have no impact on the water availability in the Blanche Brook drainage basin and hence have no impact on the current Town of Stephenville water supply.

Noel's Pond and Muddy Pond form a large surface storage area in addition to the discharge from Warm Creek into Noel's Pond. A large diameter pipeline was constructed between Muddy Pond and Mine Pond (**Figure 2**) and this pipeline is assumed to have been used to provide additional industrial water to the original Labrador Linerboard Mill and subsequently to the Abitibi mill operations. It is also assumed that this pipeline and pumping system are still operational or can be made operational at a reasonable cost and in a timely manner but will most likely require the approval of the Town of Stephenville. It is understood that the Town of Stephenville is the owner of the pumping station and the pipeline.

3.3 Mine Pond Flow and Storage

The Water Resources Atlas of Newfoundland that was produced by in 1992 by the Water Resources Division, Department of Environment and Lands, Government of Newfoundland and Labrador, notes that Abitibi-Price withdrew from Mine Pond approximately $0.18 \text{ m}^3/\text{sec}$ for a period of 8 to 10 hours per day for debarking purposes and $0.3 \text{ c m}^3/\text{sec}$ for processing activities (normally water of good quality) with total annual water usage of $8,500,00 \text{ m}^3$ of water (**Table 1**). This reported annual withdrawal or usage rate is approximately $16.2 \text{ m}^3/\text{min}$ or approximately 4,200 USgpm.

Table 1 Reported and potential required annual water consumption values from Mine Pond (GovNL, 1992).

Company	Process	Flow (m^3/s)	Usage (h)	Usage Rate (Varies)
Abitibi-Price Inc.				
	Log Debarking	0.18	8 - 10	h per day
	Paper Processing	0.30	N/A	h per day
		Total	8,500,000	m^3/yr
Maritime Horizon				
	Proposed Industrial Supply	0.04	24	h per day
		Total	1,392,729	m^3/yr

Note:

- The value of $0.044 \text{ m}^3/\text{s}$ is the upper limit of the proposed rate of 300 to 700 USgpm.

The area from which the proposed industrial water supply will draw its surface water is bound by a bowl-shaped hilly area that discharges via run-off or stream flow between Upper Mine Pond (also known as Oxen Pond) and Mine Pond (also known as Gull Pond), shown in **Figure 1**. The available climatic data for 2000 to 2021 recorded by the "Stephenville A" climate station (EC, 2022) was used to determine annual precipitation and mean temperature for the water budget calculations. The full set of climatic data is available in **Figure 3** to **Figure 7**.

The mean temperature for the period was 5.52°C . The mean monthly temperatures were highest during August (17.5°C), and lowest during February (-5.5°C). The temperature statistics indicate that the mean monthly temperature between December and March is below freezing (0°C).

The mean yearly precipitation during the period between 2000 and 2021 was 1,301 mm with a standard deviation of ± 158 mm. The expected mean precipitation values are projected to vary between 1,143 mm to 1,459 mm. The mean yearly evapotranspiration rate using the Thornthwaite Equation was calculated to be 524 mm/yr. The Thornthwaite equation tends to overestimate potential evapotranspiration, which will lead to calculation of lower runoff estimates (Shaw, 1999). Evapotranspiration is applicable only to terrestrial areas, and does not include the surface water area.

The surface water area undergoes evaporation that is best described by pan evaporation rates. The mean annual lake evaporation, calculated from the pan evaporation is approximately 475 mm per year (den Hartog & Ferguson, 1978).

As the Thornthwaite equation is dependent on average temperatures above freezing, it does not account for snow sublimation in winter months. Sublimation of snow can vary significantly from 5% to 50% of the snow pack. It was assumed that sublimation accounts for precipitation (snowfall) loss of 10% or 43.9 mm during the months with average daily temperatures below freezing.

The groundwater recharge through infiltration in the area was estimated at 20% of the total yearly precipitation, which is lower than the 24% reported by other reports (Acres, 1994) due to the shallow overburden, and relatively steep terrain. The steep terrain leads to groundwater seeps that flow into the lake.

Determining the sustainable long-term supply of groundwater for an area requires that the annual production rate (output) not exceed the rate of recharge (input) from precipitation within the catchment area of interest. The inputs to Mine Pond are simply put as precipitation, minus any losses from evapotranspiration, evaporation and infiltration.

Based on the analysis shown in **Table 2** using a mean annual precipitation of $1,301 \pm 158$ mm, the calculated mean runoff is $1,721,000 \pm 450,000 \text{ m}^3$, which correlates to the maximum sustainable yield from Mine Pond. This available runoff correlates to an available $845 \pm 225 \text{ USgpm}$ for continued usage (i.e., 24 hours a day), for a range of 620 to 1,070 USgpm.

Table 2 Water budget for the surface water and land areas.

Location	Area	Precipitation (m^3)	Evapotrans- piration (m^3)	Evaporation & Sublimation (m^3)	Infiltration (m^3)	Available (m^3)
Drainage Basin	2,753,100	3,582,623	1,443,300	120,861	716,525	1,301,937
Mine Pond	673,900	876,949	0	349,687	175,390	351,873
Upper Mine Pond	129,000	167,868	0	66,938	33,574	67,357
Total	3,556,000	4,627,441	1,443,300	537,486	925,488	1,721,166

The calculated mean available runoff of 1,721,000 m³ suggests that the reported value of 8,500,000 m³ (GovNL, 1992) was supplied in large part by the industrial water pipeline (**Figure 2**) that is known to connect Mine Pond to Muddy Pond. The industrial water pipeline transports water from Muddy Pond pump house to Mine Pond through a 900 mm diameter pipeline 1,950 m in length (Acres, 1994).

4.0 POTENTIAL GROUNDWATER SUPPLY

Based on the average well yield from the large capacity wells that have been developed in the overburden aquifer for Mowi Canada East that is also assumed to underlie the old Abitibi-Price mill property and the area north of Route 490, it is reasonable to assume that properly sized and installed screened wells can produce up to 350 USgpm. For a sustained yield of 700 USgpm, three large water supply production wells would have to be constructed after the initial site investigation work had been completed and potential production well locations identified. It is important to note that the surface water in this area is generally perched with the actual water table in some areas being 10 to 15 m below the ground surface.

Based on the presence of and groundwater impacts from old landfills that are located north of Route 490, a groundwater supply that is developed in this area can be expected to have elevated Total Dissolved Solids (TDS). Also, if large capacity production wells with a combined yield of 350 to 700 USgpm were constructed east of Harbour Drive and or north of Route 490, the drawdowns are not expected to have any impact on the operation or yield of the existing Mowi Canada East production wells. Industrial water production wells in this area would capture and divert more of the high TDS water originating from the old linerboard landfill that is located on the northwest edge of Mine Pond.

5.0 CONCLUSION

Based on the average precipitation data, the Mine Pond drainage basin, with a functioning water outflow control structure, can supply the 700 USgpm water supply that is required by Maritime Horizon. An industrial water supply, up to approximately 5,000 USgpm based on the reported usage by Abitibi-Price, can be obtained from both Mine Pond and Muddy Pond/Noel's Pond with a fully functioning pumping system and pipeline. Previous reports on the area outline a combined daily demand by the Town of Stephenville and the former Abitibi-Price Mill that encompasses the estimated supply of 5,000 USgpm when Noel's Pond, Muddy Pond, and Mine Pond were servicing the water demands (Acres 1994). A more detailed estimate of the long-term industrial water supply that can be obtained from the Warm Creek drainage basin would require a current water budget-water balance calculation.

6.0 REFERENCES

Acres, 1994. Water Resources Study of the Southwestern Newfoundland Region: Volume 1. Report prepared by Acres International Limited.

den Hartog, G., & Ferguson, H.L., 1978. Mean Annual Lake Evaporation, Hydrological Atlas of Canada. Atmospheric Environment Service, Department of Fisheries and the Environment.

Environment Canada (EC), 2022. Climate Data Online: Stephenville A (8403800) Weather Station Bulk Data 1949-2012, Stephenville A (8300301) Bulk Data 1912 – 2022, Environment Canada, Ottawa, Canada, www.climate.weatheroffice.ec.gc.ca.

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Shaw, E.M., (Shaw, 1999), Hydrology in Practice, Stanley Thornes (Publishers) Ltd., Cheltenham, United Kingdom, 1999.

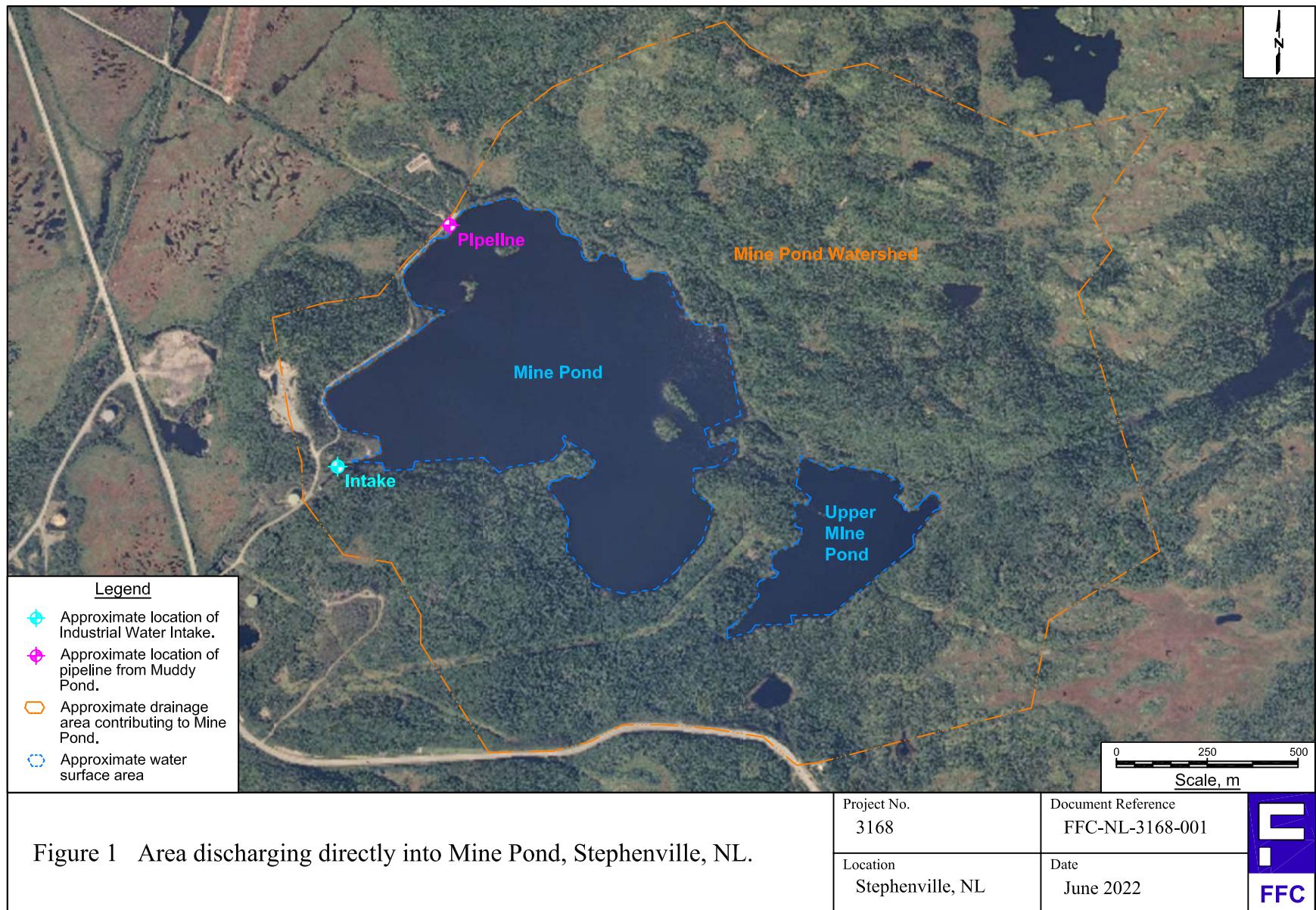




Figure 2 Location map showing source of industrial water (I.W.) supply, Stephenville, NL.

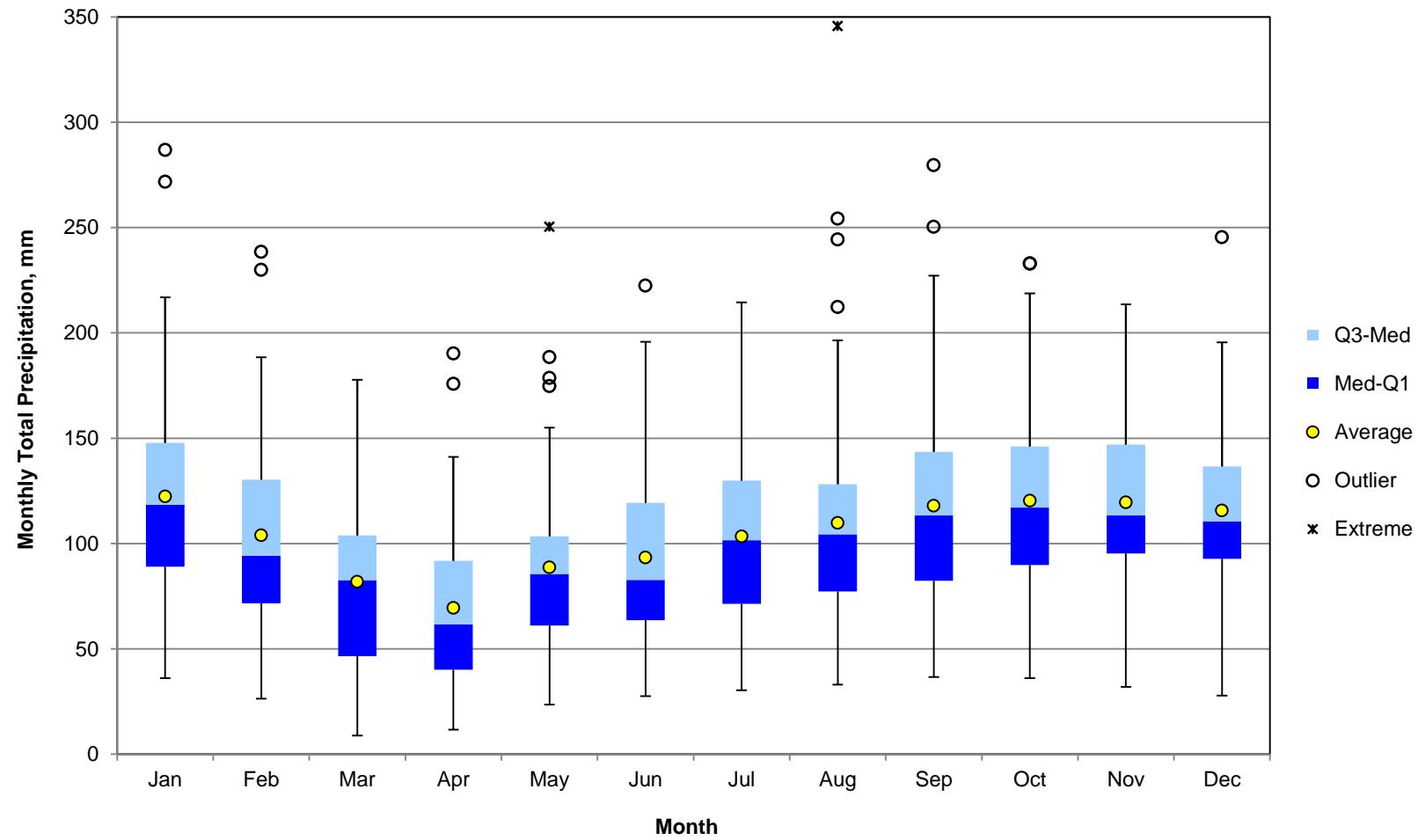


Figure 3 Monthly total precipitation of the available data from 1942 to May 2022 at the *Stephenville A* climate station (EC, 2022).

Project No.	3168	Document Reference	FFC-NL-3168-001
Location	Stephenville, NL	Date	June 2022



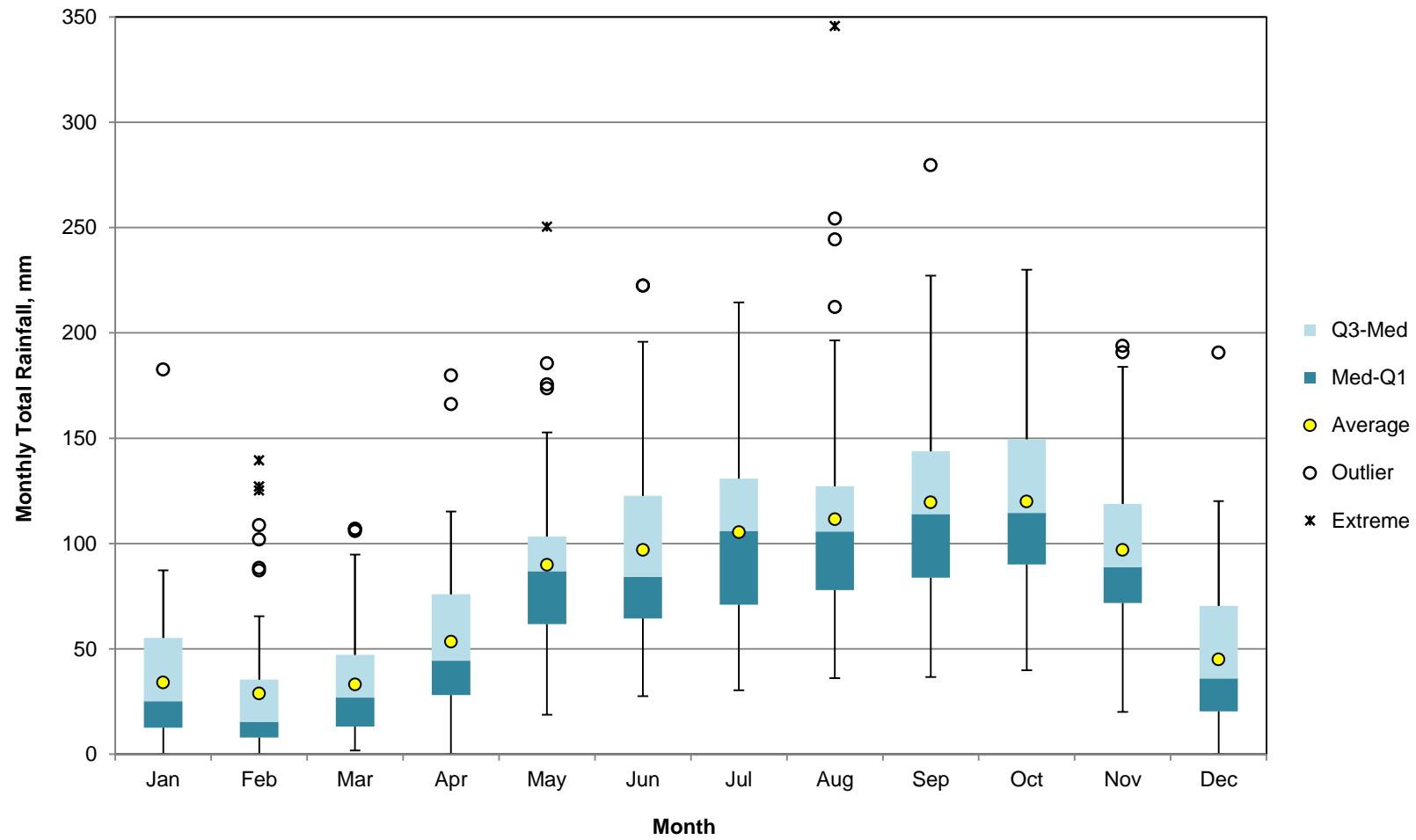


Figure 4 Monthly total rainfall of the available data from 1942 to May 2022 at the *Stephenville A* climate station (EC, 2022).

Project No.
3168
Location
Stephenville, NL

Document Reference
FFC-NL-3168-001
Date
June 2022



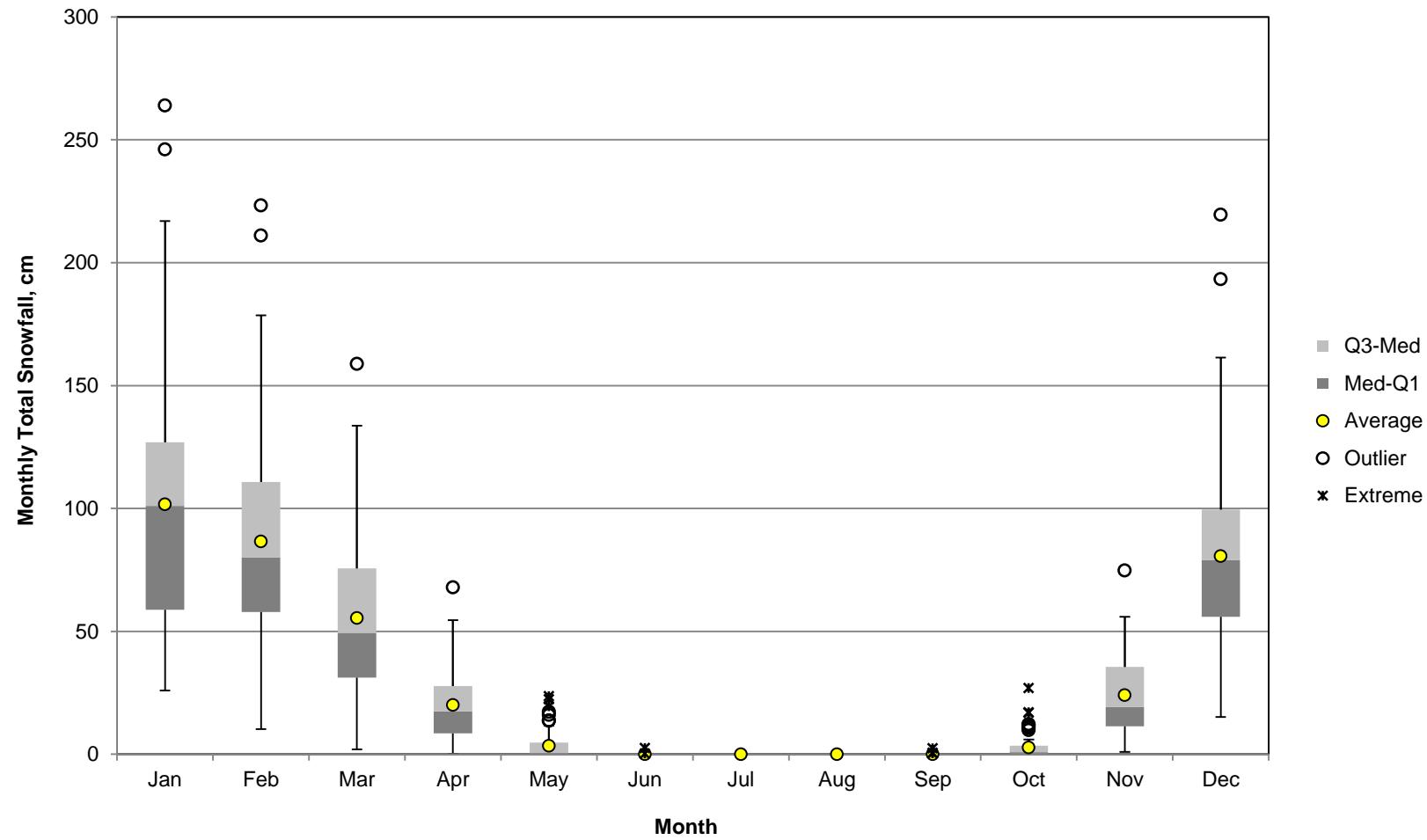


Figure 5 Monthly total snow fall from 1942 to 2022 at the *Stephenville A* climate station (EC, 2022).

Project No.	3168
Location	Stephenville, NL

Document Reference	FFC-NL-3168-001
Date	June 2022



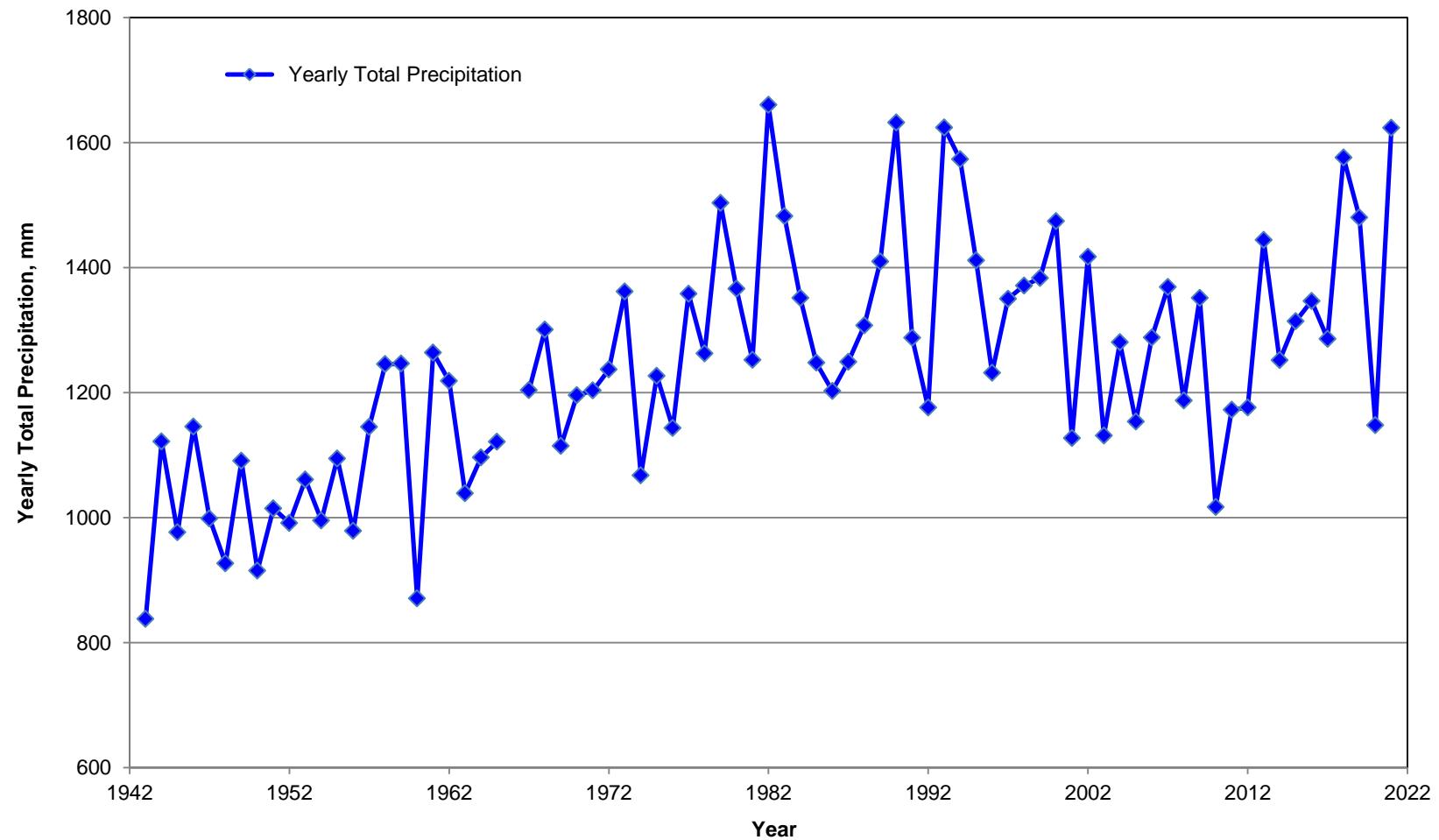


Figure 6 Yearly total precipitation from 1942 to 2022 at the *Stephenville A* climate station (EC, 2021).

Project No.	3168	Document Reference	FFC-NL-3168-001
Location	Stephenville, NL	Date	June 2022



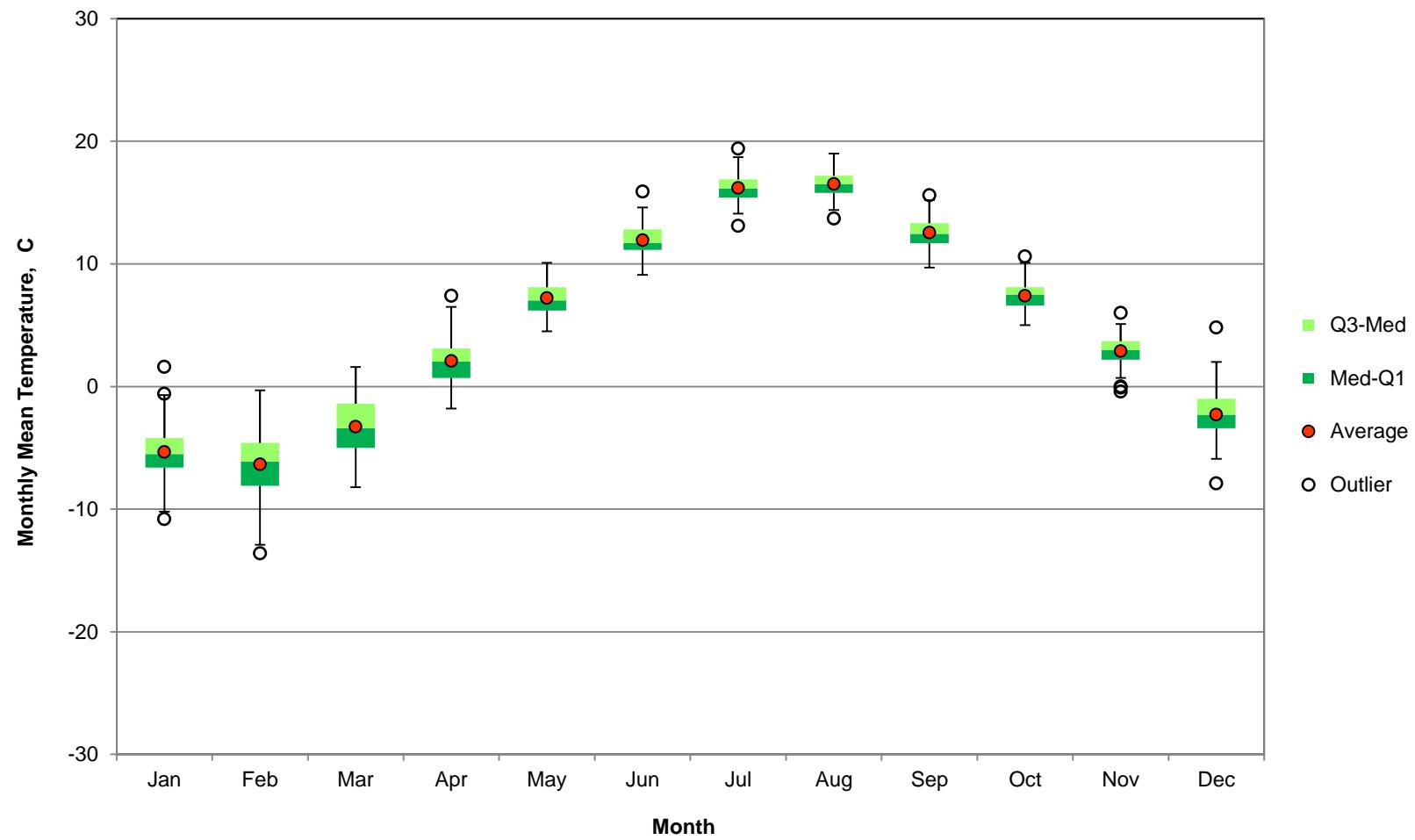


Figure 7 Monthly mean temperature from 1942 to May 2022 at the *Stephenville A* climate station (EC, 2022).

Project No.	FFC-NL-3168-001	Document Reference	FFC-NL-3168-001
Location	Stephenville, NL	Date	June 2022



APPENDIX F

Preliminary Island Isolated Customers Interconnection Mitigation Strategy

Appendix F Preliminary Island Isolated Customers Interconnection Mitigation Strategy

The purpose of this preliminary mitigation strategy is twofold. First, it provides a preliminary discussion of the technical challenges that the interconnection of a 1 GW wind farm and 500 MW H₂ Plant may face on the IIS. Second, it provides a discussion of the potential mitigation technique(s) that may be employed to ensure a technically viable interconnection that meets the reliability requirements of NL Hydro and the Newfoundland and Labrador System Operator (NLSO).

Interconnection to the IIS

The Project requires an interconnection with the NL Hydro IIS for the exchange of excess wind energy to the IIS during the winter and supply of energy from the IIS during the summer.

The IIS has an installed generating capacity of approximately 2,000 MW. The system is a winter peaking system with light loads occurring during the summer months. Consequently, connecting both a 500 MW H₂ Plant and a 1,000 MW onshore wind farm connected to the IIS is considered to be a significant undertaking given the relative grid and project sizes.

The NLSO Standard TP-S-005 “Technical Requirements for Connection to the NL Transmission System” dated 2019/09/17 is a comprehensive document providing key information for those wishing to connect to the NL Hydro transmission system. The requirements of the standard apply to:

- Wind power plants (i.e., wind farms)
- New power plants connecting directly to the NLSO transmission system
- New power plants connecting through the facilities of an industrial customer
- New power plants connecting to customer owned transmission
- Modifications to an existing power plant already connected directly or indirectly to the NLSO transmission system
- Network customers connecting to the NL transmission system, including industrial customers¹

The standard defines an industrial customer as follows:

Industrial Customer – a network service customer of NL Hydro connected to the NL transmission system at a voltage of 66 kV or greater.²

¹ NLSO Standard TP-S-005 “Technical Requirements for Connection to the NL Transmission System” dated 2019/09/17, page 1.

² NLSO Standard TP-S-005 “Technical Requirements for Connection to the NL Transmission System” dated 2019/09/17, page 6.

PROJECT NUJIO'QONIK GH2

Given the magnitude of the proposed H₂ Plant and the geographic proximity to the 230 kV transmission system, it is reasonable to state that the NLSO would view the Project as an industrial customer. Further, given the addition of a 1,000 MW wind farm, the NLSO would view the Project as an industrial customer with self-generation. Standard TP-S-005 is, therefore, applicable to the proposed Project. TP-S-005 is used as a guide to aid in the discussion of issues and mitigations.

Dominant Technical Issues

NLSO Standard TP-S-005 sets out the minimum technical requirements for connection to the NL Transmission System. The focus is on safe, reliable, secure operation of the system. There are a number of prominent technical issues that must be addressed for a project of the size being contemplated by the Project. These include:

- Loss of generation
- Loss of transformer capacity
- System strength

Technical Issue Loss of Largest Generator

TP-S-005 states:

All power producer facilities connecting a power plant with an installed capacity exceeding 155 MW on the Island of Newfoundland must be designed, built and operated such that no single element contingency in those facilities can result in loss of generation in excess of 155 MW.³

This statement does not mean that it is impossible to connect more than 155 MW of generation to the NL Transmission System. What it means is that the layout of the generation facility and its connection to the NL Transmission System must be such that no single contingency can result in the loss of more than 155 MW of power being delivered to the grid. By single contingency, the NLSO means loss of a transmission line, cable, circuit breaker, transformer, etc.

To ensure the Project complies with the NLSO single contingency requirement, the proposed 1,000 MW wind farm will not be connected to the NL Transmission System directly. Instead, the power from the wind farm is fed into the Project's 66/230 kV substation and from this 66/230 kV station to the H₂ Plant and the NL Transmission System. With this arrangement, the generated electricity is transmitted to the H₂ Plant outside of the NL Transmission System. This is also known as "behind the meter", which is a common set-up for hydrogen production from renewable electricity. The Project will explore the options to establish a connection with the NL Transmission System in such a way that no single contingency can result in the loss of more than 155 MW and thus meet the NLSO requirement. This can be achieved through constructing two separate transmission lines from the Project to the NL Transmission System.

³ NLSO Standard TP-S-005 "Technical Requirements for Connection to the NL Transmission System" dated 2019/09/17, page 23.

Technical Issue Transformers

TP-S-005 states in part:

In order to meet the NLSO planning criteria, redundant transformer capacity will be required for the transformers connected to the NL transmission system.

- *For Network Service transformers supplying local distribution systems on the Island portion of the province consideration may be given to the use of a mobile transformer station to provide the redundant transformer capacity.*
- *For Network Service transformers supplying distribution systems in Labrador there must be installed redundant spare transformer capacity.*
- *For Network Service transformers supplying industrial customers installed redundant transformer capacity is required unless specifically agreed to with the customer in the Interconnection Agreement.*
- *For transmission system transformers rated 230/46 kV, 230/66 kV, 230/138 kV, 230/315 kV and 315/138 kV there must be installed redundant transformer capacity.*
- *For 138/66 kV and 138/69 kV transmission system transformers consideration may be given to the use of a mobile transformer station to provide the redundant transformer capacity on the Island only.*
- *For power producer generator step-up transformers connecting an installed generating capacity in excess of 50 MW, a spare generator step-up transformer is required.*
- *For synchronous condenser plants generator step-up transformers connecting an installed capacity in excess of 50 megavolt ampere of reactive power, a spare generator step-up transformer is required.*
- *For HVdc converter stations a spare converter transformer is required at each station (rectifier and inverter).*
- *For three phase transformer banks comprised of single phase units, in addition to installed redundant transformer capacity, a spare single phase transformer unit is required.⁴*

As an industrial customer contemplating a large wind farm and gas turbines for firming up power, the NLSO will expect/require sufficient transformer capacity to ensure:

- No loss of load for loss of a single transformer at the H₂ Plant
- No loss of generation from the wind farm due to loss of a collector system intermediate transformer (i.e., 230/66 kV) failure
- Spare generator step-up transformer for gas turbines sized 50 MW and above

Technical Issue System Strength

Power system strength is often discussed in terms of the short circuit level at a point of interest (i.e., bus) in the power system. The short circuit level, referenced in terms of megavolt-amperes (MVA), is a function of the number of synchronous machines on line and the equivalent impedance of transmission lines and transformers between the synchronous machines and the point of interest. A large number of machines and short transmission lines results in high short circuit levels, whilst remote generation and long transmission lines can yield low short circuit levels.

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The industry has begun to acknowledge that inverter-based renewables require a minimum system strength to avoid control system issues and voltage fluctuations on the power system. To ensure successful integration of an inverter-based renewable, a minimum short circuit ratio (SCR) of 3 at the point of interconnection is being recommended based on industry experience. The short circuit ratio at the point of interconnection is defined as:

$$SCR_{POI} = \frac{SCMVA_{POI}}{MW_{POI}}$$

Where

$SCMVA_{POI}$ is the three phase short circuit MVA at the point of interconnection; and

MW_{POI} is the nominal power rating of the inverter-based wind generation at the point of interconnection.

Proposed Mitigations

In preparing the mitigations to ensure technical issues are solved (i.e., requirements met), the discussion will begin with the onshore wind farm itself, work its way through the collector/array system, then the internal transmission system between the collector/array system and the H₂ Plant, and finally the interconnection to the NL Transmission System. Bullet point form is used for ease of reference.

Proposed Wind Farm Mitigations

The electrical layout of the wind farm must be such that the generating capacity loss due to a cable, transmission line, or transformer fault, is less than 155 MW.

66 kV Collector System Mitigation

1. Preliminary analysis of the onshore wind farm resource used the GE 6.1-158 wind turbine model. This unit has a rated capacity of 6.1 MW. Initial tower spotting has resulted in 164 turbines being sited across the Port au Port Peninsula. The total installed capacity equals 1,000.4 MW. As previously noted, wind turbine size model has not yet been finalized. However, we have chosen to focus on a proven standard size for the purpose of this discussion.
2. It is proposed to utilize a 66 kV transmission voltage as the collector/array system for this project.
 - a. From a capital cost perspective it is desirable for each of these 66 kV collector lines to be single wood pole construction.
 - b. Typical single wood pole construction at 66 kV consists of post type insulators with a wooden cross arm for the outer two phases.
 - c. The Port au Port Peninsula is known to have areas of a heavy salt contamination location due to the persistent onshore winds from the Gulf (hence the wind farm). As a result, for single wood pole construction davit arms and fog type suspension insulators may be required to prevent flashovers. The salt contamination levels must be checked prior to final line design.

- d. The layout of the 66 kV collector system will meet at least two additional technical challenges:
 - i. The current carrying capacity of the 66 kV line (i.e., thermal rating)
 - ii. Voltage drop along the 66 kV line
- e. Both issues relate to the line length between the furthest wind turbine and the 66/230 kV collector station, the number of turbines connected to each 66 kV line, and the conductor selected for each line. From a capital cost perspective, the fewer the number of collector lines the better. However, from an operational side and technical limitation perspective the number of 66 kV transmission lines will increase.
- f. Historically, many of the single wood pole 66 kV transmission lines constructed by NL Hydro consist of 266.8 kcmil, 26/7, ACSR, PARTRIDE. Newfoundland Power has erected single wood pole 66 kV transmission lines with conductors up to the 715.5 kcmil Authorized Supply Capacity conductor size within the city of St. John's, for example where span lengths are limited. Deer Lake Power has installed both 500 kcmil and 900 kcmil aluminum conductors on 66 kV lines consisting of steel structures.
- g. For preliminary analyses it is common for the transmission planner to consider aluminum conductor steel-reinforced cable-type (ACSR) conductors to determine required electrical properties and subsequently work with the transmission designer to optimize conductor size as the Project evolves.
 - i. To this end, a 715.5 kcmil, 26/7, ACSR, STARLING conductor is used as a reasonable "maximum size" conductor for a single wood pole design.
 - ii. Further, it was assumed that the 230/66 kV substation for the connection of the 66 kV collector system is situated somewhat "central" such that the longest distance between the substation 66 kV bus and the furthest wind turbine is limited to a nominal 15 km.
 - iii. Page 3-19 of the Aluminum Association "Aluminum Electrical Conductor Handbook" second edition 1982 states: *The usual maximum operating temperature for tensioned bare conductors is 70°C to 85°C, with 100°C and over permissible only in limited emergencies.* Further, Figure 6-3 of the Aluminum Electrical Conductor Handbook indicates that operation of an ACSR conductor at 100°C for more than 1.5 hours is expected to result in degradation of the initial strength of the conductor.
 - iv. The ampacity of the 715.5 kcmil, ACSR STARLING conductor for a 30°C ambient temperature and 85°C conductor temperature equals 890 A, or 101 MVA at 66 kV for the Port au Port location at 2 ft/sec wind. Note "calm" wind is assumed in the conductor ampacity calculation to account for a potentially sheltered span.
 - v. A preliminary voltage drop calculation assuming:
 - 1. 12 wind turbines (73.2 MW) are connected to the remote end of a 15 km long 66 kV line. This is a simplification for hand calculation and provides a pessimistic result.
 - 2. The delivered power factor at the 66 kV substation bus is set at unity.
 - 3. The calculation shows a 2.5% voltage drop along the 66 kV transmission line and a required sending end power factor of 0.99.

4. What the simplified calculation shows is that a 15 km long 66 kV collector line with 12 x 6.1 MW turbines is appears to be a reasonable starting point for detailed analysis, assuming a single wood pole 66 kV structure design with a relatively large 715.5 kcmil ACSR conductor.
5. The analysis demonstrates that 66 kV transmission losses are anticipated to be on the order of 1.4 MW per collector line.
6. Detailed analysis and modeling will be required to firm up the voltage drop and losses associated with the collector system, as well as, any requirement for voltage support equipment.

- h. Preliminary analysis indicates that 66 kV collector lines with 12 x 6.1 MW turbines per circuit and a circuit length of 15 km each will provide reasonable voltages and loss values in the collector system. The 66 kV collector system will therefore include approximately 14 x 66 kV collector lines to a centrally located 230/66 kV station.
- i. At 12 x 6.1 MW turbines or 73.2 MW of capacity per collector line this is well within the 155 MW loss of generation criterion.
- j. With 73.2 MW of generation capacity per 66 kV circuit, it is possible to double circuit 66 kV collector lines in congested areas without violating the loss of largest generator criterion. Note from the NL Hydro perspective, loss of a double circuit transmission line (i.e., tower) is considered a single contingency. To meet the loss of generation criterion, no more than 25 wind turbines can be connected to a single 66 kV transmission line structure.

230/66 kV Substation Mitigation

1. It is assumed that with the wind farm located onshore on the Port au Port Peninsula, the 230/66 kV substation will be centrally located within the wind farm to reduce 66 kV transmission losses and 66 kV line length.
2. The 230/66 kV Substation will be receiving a nominal 1,000 MW from the wind farm (less losses) via 14 x 66 kV transmission lines.
3. The installed transformer capacity in the 230/66 kV substation must be such that the wind farm capacity can be delivered to the H₂ Plant site with one 230/66 kV transformer out of service.
4. The largest 230/66 kV transformer that has been successfully energized on the NL transmission system on the Island with no significant adverse impact on the system has been a 150/200/250 MVA unit.
5. To ensure an acceptable level of reliability in the 230/66 kV wind farm substation it is proposed to install five 230/66 kV, H.V. WYE-GND/L.V. ZIG-ZAG-GND, 150/200/250 MVA transformers with a high voltage On Load Tap Changers to assist in voltage control/support of the 66 kV collector system. It is expected that neutral grounding devices will be added to the 66 kV ZIG-ZAG-GND neutrals to limit the prospective 66 kV line-to-ground short circuit levels in final design.
6. The 230/66 kV substation will also require two independently connected station service transformers, potentially ABB Station Service Voltage Transformer units connected to the 230 kV bus, or 66/0.6 kV units.

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7. The 66 kV side of the station will be breaker-and-one-third with two 66 kV collector lines connected on opposite ends of the individual diameter, or leg, with the 66 kV winding of the 230/66 kV transformer connected to the center position in the diameter, or leg. See Figure 1 below.
8. There will be a minimum of seven beaker-and-one-third diameters, or legs, in the 66 kV bus configuration to accommodate the required equipment.
9. The 230 kV side of the wind farm substation will be required to connect the 230 kV windings of the five 230/66 kV transformers, the 230 kV windings of the synchronous condenser transformers (to be discussed below), plus the 230 kV transmission lines required to connect the wind farm location to the H₂ Plant. A breaker-and-one-third arrangement is proposed. See Figure 1.

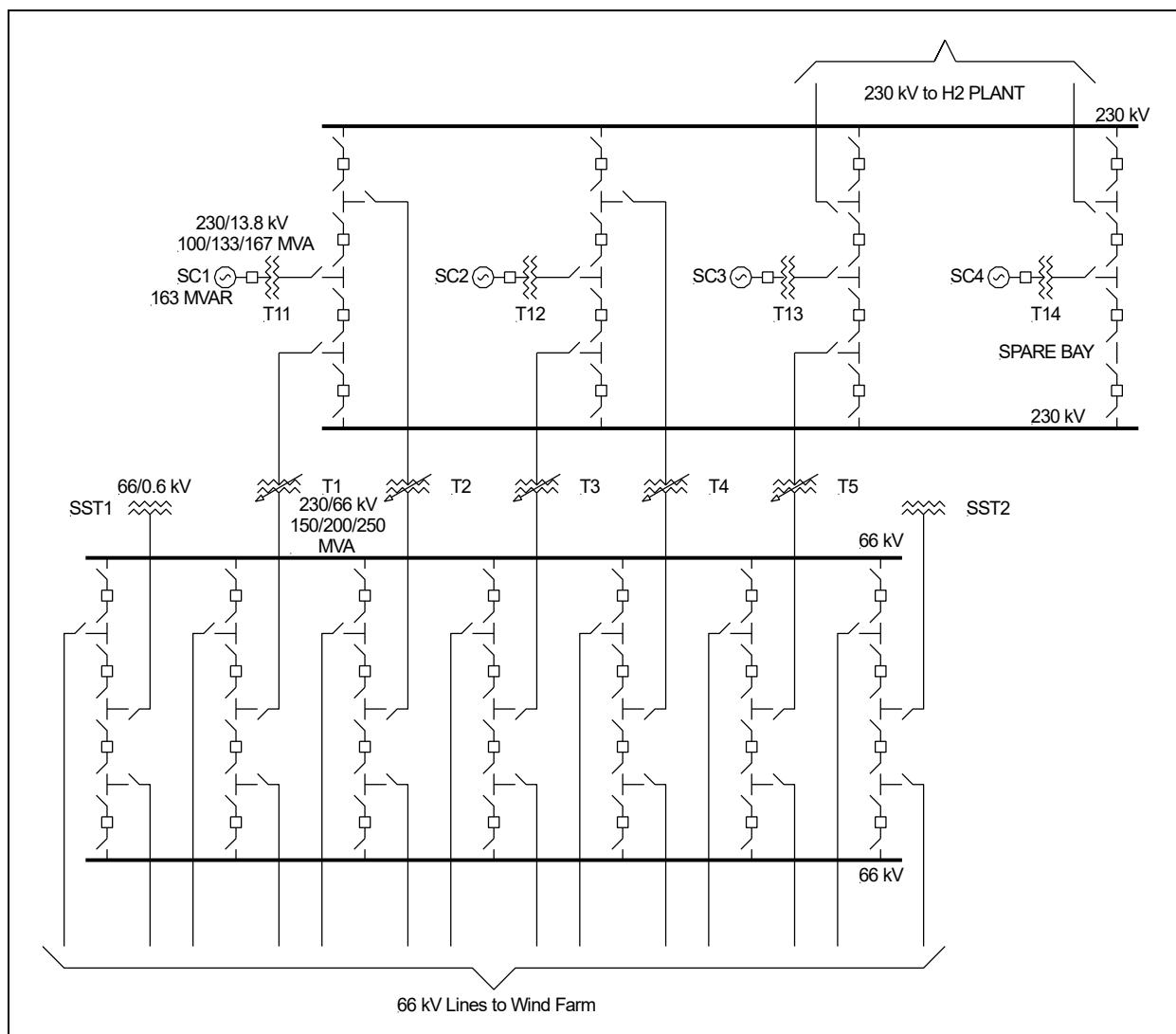


Figure 1 Wind Farm 230/66 kV Station Single Line Diagram for Discussion Purposes

230 kV Line Routing

1. The 230 kV transmission system connecting the wind farm and the H₂ Plant/Stephenville Gas Turbine location must be capable of transmitting 1,000 MW with one circuit out of service.
2. Similar to the 66 kV system, the length of line, conductor size and voltage drop will be key issues.
3. Typical 230 kV conductors on the Island of Newfoundland include:
 - a. 636 kcmil, 26/7, ACSR, PARTRIDGE
 - b. 795 kcmil, 26/7, ACSR, DRAKE
 - c. 1192.5 kcmil, 54/19, ACSR, GRACKLE
 - d. 1431 kcmil, 54/19, ACSR, PLOVER
 - e. 1590 kcmil, 54/19, ACSR, FALCON
4. On the Island of Newfoundland, the standard line design at 230 kV has been single conductor per phase as there are areas on the Island that experience significant ice accumulation such that ice bridging across the conductor bundle has been of concern.
5. If a single conductor per phase was used in this application, preliminary analysis indicates that up to four single circuit transmission lines would be required.
6. The 230 kV transmission corridor between the wind farm and the H₂ Plant must cross the isthmus of the Port au Port peninsula and route around the town of Port au Port located on the eastern side of the isthmus.
7. The isthmus is very narrow and, at present, there is a 66 kV transmission line owned and operated by Newfoundland Power crossing the isthmus.
8. Given the obvious limited space for a 230 kV transmission corridor, the following mitigations are proposed:
 - a. The 2 x 230 kV single circuit transmission RoW will be reduced to 2 x 230 kV single circuit transmission lines using a two-conductor bundle per phase.
 - b. Preliminary analysis indicates that a two-conductor bundle of 1431 kcmil, 54/19, ACSR PLOVER will provide the necessary transmission line current rating and reasonable voltage drop performance.
 - c. To mitigate the visual impact it is proposed to use tubular steel structures rather than the typical steel lattice tower design where applicable.
 - d. At the isthmus it is proposed to utilize 230 kV direct bury cables (i.e., duct banks in concrete and backfilled) for a distance of approximately 4.25 km across the isthmus and through the town of Port au Port generally following the existing 66 kV transmission line RoW.
9. Detailed design and power system analysis is required to finalize overhead conductor and buried cable sizes along with structure layout and placement.

H₂ Plant Substation

1. Consideration must be given to the required connections at the substation near the H₂ Plant. This equipment will include:
 - a. Two 230 kV transmission line terminations from the 230/66 kV wind farm substation
 - b. 230/13.8 kV transformers for the H₂ Plant
 - c. Two station service transformers that may be supplied from the 13.8 kV bus or 230 kV SSVTs
 - d. 230 kV Connection to the NL transmission system
 - e. Gas turbine(s) for energy firming
 - f. 230 kV capacitor banks for reactive power support
2. H₂ Plant transformation
 - a. The size of the 230/13.8 kV transformers may very well be a function of the current ratings of the 13.8 kV switchgear for the H₂ Plant. That said, assuming a 3000 A, 15 kV circuit breaker rating for 13.8 kV application the 13.8 kV winding would be limited to the 71.7 MVA range. Having a three winding transformer (two 13.8 kV windings will limit the total number of transformers. The CAN/CSA C88-M90 preferred rating would be 75/100/125 MVA on the 230 kV winding and each 13.8 kV winding rated 37.5/50/62.5 MVA. This size transformer exists on the NL Transmission System today.
 - b. Given a 500 MW plant then a minimum of four 230/13.8 kV transformers would be required. To ensure no loss of load for loss of a transformer it is proposed that five 230/13.8/13.8 kV transformers be added each rated H.V. 75/100/125 MVA & L.V.1 = L.V.2 at 37.5/50/62.5 MVA. Each transformer will be equipped with an On Load Tap Changer to regulate the 13.8 kV bus
3. 230 kV Connection to the NL Transmission System
 - a. Based upon geography the obvious Point of Interconnection for the Project is the 230 kV bus at Stephenville Gas Turbine Terminal Station (SVLTS). The Abitibi Bowater paper mill was supplied by a very short (i.e., <1 km) 230 kV transmission line connected to SVLTS. The transmission line was numbered TL238. It is proposed to use this same transmission line RoW for the connection of the Project.
 - b. At peak wind production in the winter, the wind capacity will exceed the requirements of the H₂ Plant by up to 500 MW (final analysis of wind data and production profile to confirm). This means that up to 500 MW could be flowing from the Project into the NL Transmission System via a single 230 kV transmission line. Sudden loss of this transmission line would exceed the 155 MW maximum generator loss.
 - c. A second 230 kV transmission line connecting the Project to, say, Massey Drive Terminal Station (MDRTS) is warranted to assist in maintenance of overall IIS reliability and stability. The conductor size for both 230 kV connections to the NL Transmission System must be investigated once the final wind production profile is known to ensure adequate thermal ratings for the seasonal flow.
 - d. Additionally, for loss of a 230 kV transmission line to the NL System during peak deliveries, the notion of a transfer trip of a block of wind turbines may be warranted to avoid thermal overload of NL Hydro 230 kV transmission.

4. Gas Turbine(s) for Energy Firming

- a. The notion of using a gas turbine to firm up wind generation is no longer a novel concept. GE touts its aero derivative gas turbines as the solution to firming up wind resources. Given its fast start capability and quick ramp rates, the aero derivative gas turbine is well suited to back stop wind variability during the day.
- b. For the Project, the notion of a green energy project (i.e., wind energy used to produce hydrogen) being firmed up by a gas turbine may raise eyebrows. Historically gas turbines within the NL transmission system have been operated using a blend of diesel and jet fuels. This type of fuel supply for a gas turbine on the Project site may be considered a serious public relations issue. As a result, World Energy GH2 plans on utilizing hydrogen fired gas turbines at the H₂ Plant site.
- c. Discussions with ProEnergy have revealed that the company has experience in firing the GE LM6000 gas turbine on hydrogen.
 - i. The start-up begins on distillate (such as diesel) and switchover to hydrogen occurs once up and running
 - ii. The LM6000 is rated at 53 MW
 - iii. For firming up purposes the Project is proposing three LM6000s with provisions for a fourth based on further analysis of the wind profile
 - iv. Each LM6000 will be connected to the system via its own 13.8/230 kV generator step-up transformer.
 - v. To meet NL Hydro's transformer criterion, a spare generator step-up transformer will be located at the site
 - vi. Each gas turbine will be equipped with a triple S clutch to enable synchronous condenser operation to provide valuable reactive power control to the site as well as additional inertia for the system.
- d. An alternative to a gas turbine for firming up wind may be the application of a Battery Energy Storage System (BESS).
 - i. A BESS rated 150 MW and 150 MWh is being installed in Australia. This will provide a capacity of 150 MW for up to 1 hour. A second BESS rated 200 MW and 800 MWh is under study in the same country.
 - e. The concept of firming up wind and the appropriate technology requires additional work as it relates to the wind farm production profile and the energy flow between wind farm and NL Transmission System.

5. 230 kV Shunt Capacitor Banks

- a. Preliminary analysis using 2 x 230 kV transmission lines with two-conductor bundle between the Wind Farm and the H₂ Plant indicates that under high exports to the NL Transmission System reactive power demand from the IIS increases. To mitigate this increase in reactive power it is proposed to incorporate up to 120 MVAR of shunt capacitors at the H₂ Plant.
- b. Detailed power system analysis is required to determine final size and requirement from the NL Transmission System,

6. H₂ Plant Substation Configuration

- a. The 230 kV substation at the H₂ Plant will connect:
 - i. Two 230 kV transmission lines from the 230/66 kV wind farm substation
 - ii. Five 230/13.8/13.8 kV transformers
 - iii. Four 230/13.8 kV generator step-up transformers for the LM6000 gas turbines
 - iv. Two 230 kV transmission lines to the NL transmission system
 - v. Two 230 kV capacitor banks for reactive power support
- b. A breaker-and-one-third arrangement is proposed using a minimum of five diameters, as shown in the Figure 2 below.

System Strength

For inverter based renewables such as the wind farm being considered in this project, industry experience indicates that the minimum short circuit ratio at the point of interconnection should be 3.0. Given a nominal rating of 1000 MW, this means that the three-phase short circuit level at the point of interconnection must be at least 3000 MVA.

1. For preliminary analysis it is assumed that the point of interconnection is actually the 230 kV bus at the 230/66 kV Wind Farm Station. This point is selected as it is viewed that the 230 kV transmission from the Stephenville and MDRTS through the H₂ Plant and on to the Wind Farm is an extension of the existing NL Transmission System.
2. Preliminary short circuit analysis indicates that the three-phase short circuit level on the Wind Farm 230 kV bus will be well below 3000 MVA.
3. To increase the three-phase short circuit level it is proposed to add synchronous condensers to the Wind Farm Station.
4. Analysis indicates that four synchronous condensers in the range of 162 MVAR each with an X_d of 18% will be required.
5. Each synchronous condenser will be connected to the 230 kV bus via a dedicated 230/13.8 kV, 100/133/167 MVA transformer.
 - a. A spare synchronous condenser transformer will be required.
6. Detailed short circuit and stability studies are required to finalize the MVAR ratings of the synchronous condensers.

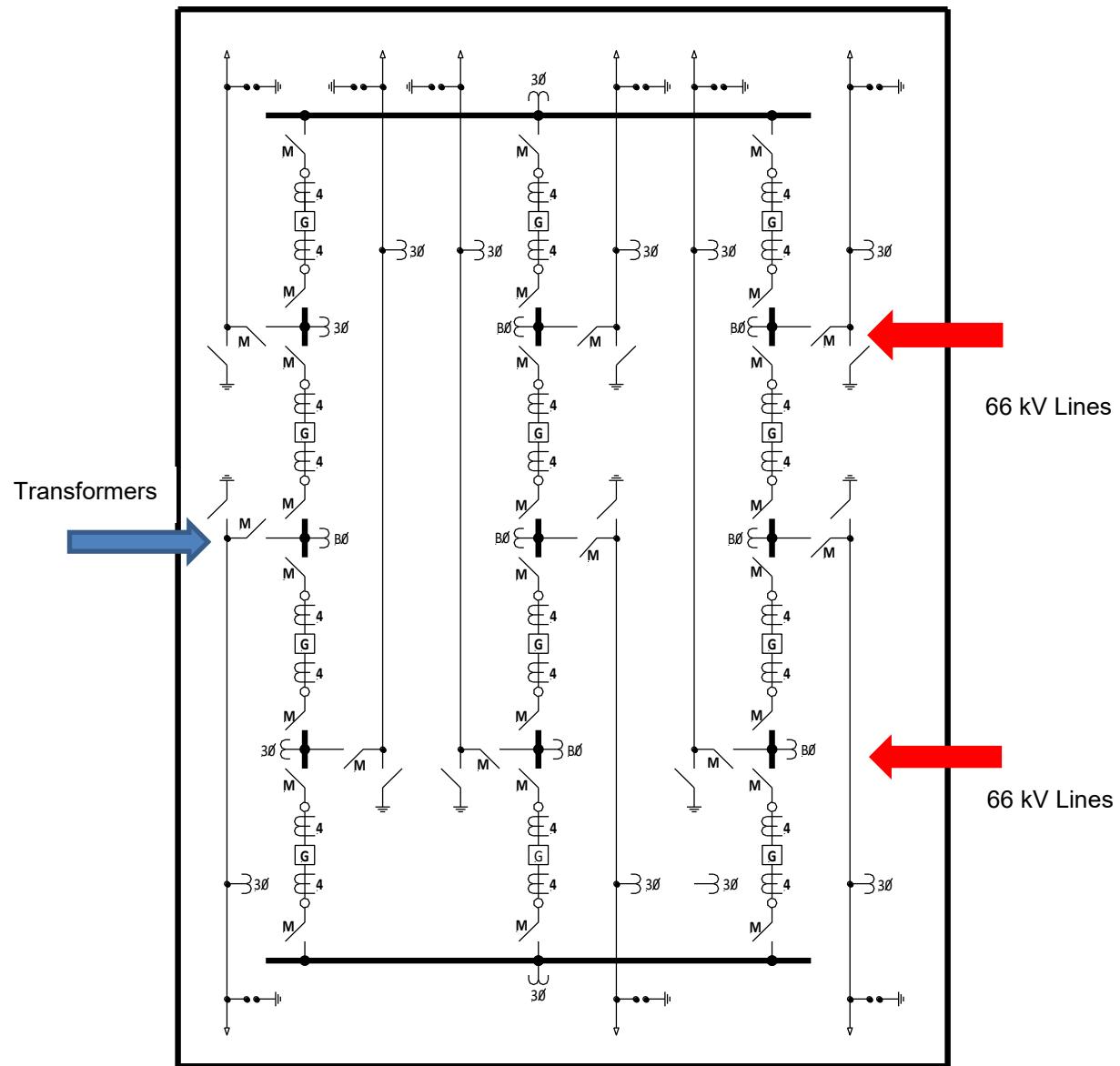


Figure 2 H₂ Plant Station Single Line Diagram for Discussion Purposes