8.0 Groundwater Resources

8.1 Scope of Assessment

Groundwater is the water held beneath the earth's surface in the pores, fractures, crevices, and seams of bedrock and overlying surficial material. Groundwater originates from the percolation of rain, snowmelt, or surface water as it infiltrates ground surfaces. This infiltrating water fills voids between individual grains in unconsolidated materials and fills fractures developed in consolidated materials, such as bedrock. Groundwater generally flows from areas of high elevation (recharge areas) to areas of low elevation (discharge areas), where it exits the sub-surface as springs, wetlands, or as baseflow to streams and lakes. The upper surface of the saturated zone is called the water table. The water table intersects the surface environment at springs, lakes, streams, and wetlands, where interaction between the groundwater and surface water environment can occur. An aquifer is a saturated formation or group of formations that can store or yield useable volumes of groundwater to wells or springs. Natural groundwater quality is directly influenced by the geochemical composition of the geological material that forms the aquifer, and the time the water resides within that material.

For this assessment, the Groundwater Resources Valued Environmental Component (VEC) is defined as the value and function of groundwater resources in maintaining baseflow to streams for ecological habitat, and in supplying fresh water for human and industrial / commercial uses.

The rationale for the selection of groundwater resources as a VEC includes the following:

- its importance to ecosystem function:
- concerns regarding potential effects on quantity and quality of groundwater in potable water supply wells;
- possible lowering of water table and effects on surface water and groundwater interactions; and
- provisions of the Newfoundland and Labrador (NL) *Water Resources Act* .

The Groundwater Resources VEC is closely linked to other VECs including Surface Water Resources (Chapter 9), Fish and Fish Habitat (Chapter 10), and Wetlands and Vegetation, including Rare Plants (Chapter 12). The potential environmental effects of changes to groundwater resources on these VECs are discussed in their respective sections.

8.1.1 Regulatory and Policy Setting

In addition to the NL *Environmental Protection Act, 2002*, and associated *Environmental Assessment Regulations*, the Project is subject to federal and other provincial legislation, policies, and guidance. This section identifies the primary regulatory requirements and policies of the federal and provincial authorities that influence the scope of the assessment on groundwater resources.

8.1.1.1 Federal Regulatory Requirements

Guidelines for Canadian Drinking Water Quality (2022)

Guidelines for potable water are established by Health Canada in collaboration with the Federal-Provincial-Territorial Committee on Drinking Water. *Guidelines for Canadian Drinking Water Quality* (GCDWQ) are applicable as aesthetic and health-based guidelines for a variety of chemical parameters for potable water sources.

Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life (2018)

The Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life (CWQG-FAL) are established by the Canadian Council of Ministers of the Environment (CCME). These guidelines are developed collaboratively among provincial, territorial, and federal jurisdictions and regularly updated to reflect current toxicology information and guideline derivation approaches.

8.1.1.2 Provincial Regulatory Requirements

Water Resources Act (2002)

The *Water Resources Act* gives the Water Resource Management Division of the NL Department of Environment and Climate Change (NLDECC) the responsibility and legislative power for the management of water resources in the province.

The *Environmental Control Water and Sewer Regulations*, under the *Water Resources Act* defines effluent concentration limits for discharge to surface water.

Water supply well construction for various Project components (e.g., concrete batch plant and workforce accommodations) is regulated under the *Well Drilling Regulations* (2003), NLR 63/03 under the *Water Resources Act*.

Water well abandonment is regulated under section 18 (3) of the *Well Drilling Regulations*.

Management of Impacted Sites (2014)

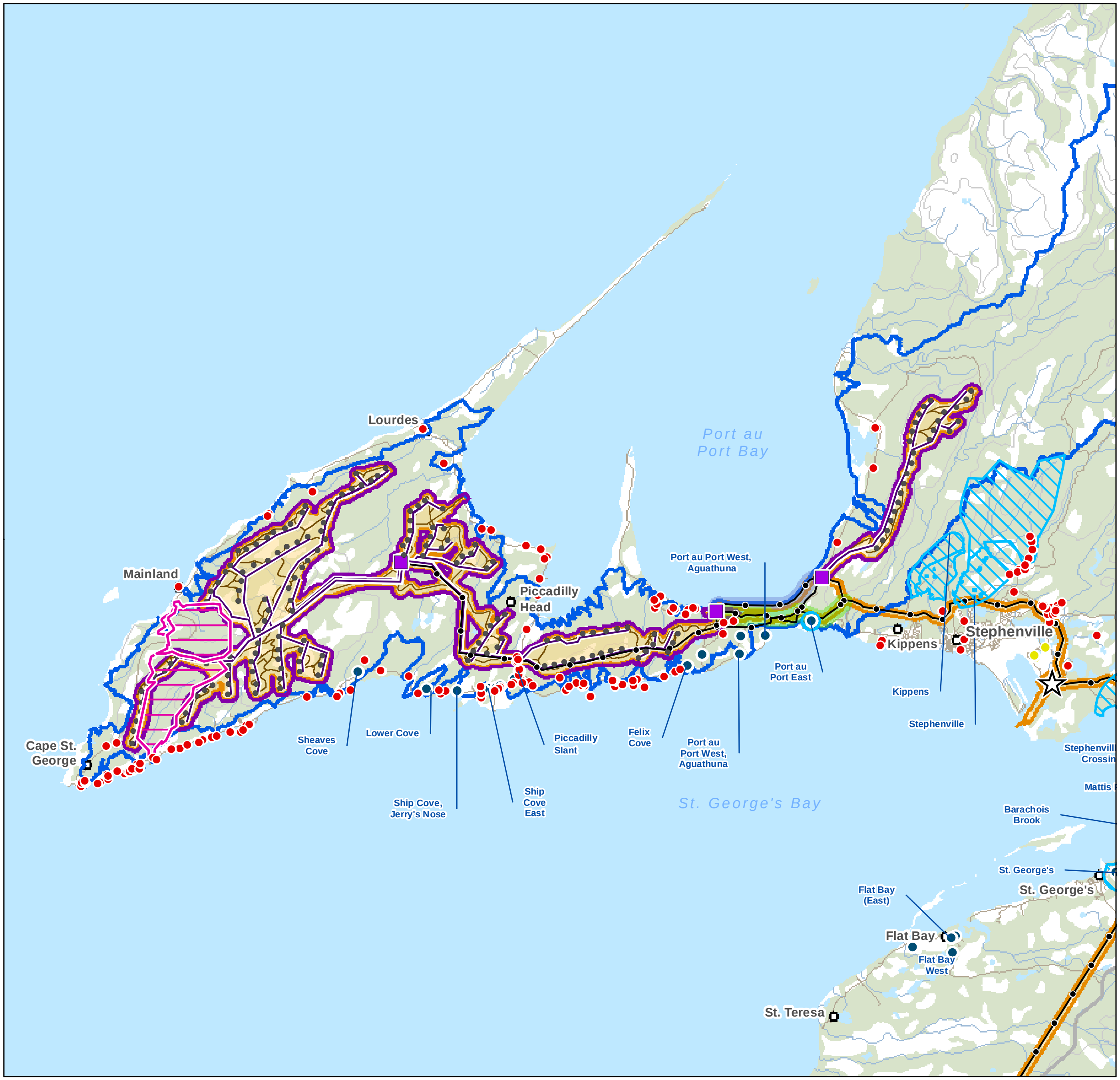
The NLDECC's *Guidance Document for the Management of Impacted Sites* outlines the specific process to be followed for all contaminants of concern that have been released into the environment that may require assessment, remediation and/or risk management to promote protection of human health and the environment. The NLDECC guidance document recommends the current version of the Atlantic RBCA (Risk-Based Corrective Action) guidance. The current version of the Atlantic RBCA guidance is the Version 4.0 User Guidance Document (July 2021). Tier I Environmental Quality Standards (EQS) and Tier II Pathway-Specific Standards (PSS) were developed and released by Atlantic PIRI in 2021 and follow a hierarchy of jurisdictional sources based on collective experience at impacted sites in Atlantic Canada. Ecological Tier II pathway specific screening (PSS) for Groundwater (>10 metres from Surface Water), Fresh Water are guidelines protective of freshwater aquatic life, under the assumption that there is groundwater discharge from an impacted site to a receiving water body.

8.1.2 Boundaries

8.1.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on groundwater resources in areas surrounding the Project components (Figures 8.1, 8.2, and 8.3):

- Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of following distinct areas: the Port au Port Wind Farm, the Codroy wind farm, the Hydrogen/Ammonia Production and Storage Facility (hydrogen / ammonia plant), Port Facilities, and the 230 kV Transmission Lines, as well as associated infrastructure including roads, substations, and water supply infrastructure. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project. In addition to encompassing the immediate area in which Project components and activities will occur, the Project Area also includes a buffer of up to 300 m for access roads and turbines and a 350 m corridor to accommodate the 70 to 75 m wide RoW for the transmission line. These buffers allow flexibility for the micro-siting of Project components during detailed design, based on technical considerations as well as the avoidance of environmentally sensitive areas, where practicable.
- Local Assessment Area (LAA): The area adjacent to the Project Area where there is the potential for direct Project-related effects on groundwater resources. The potential effects related to water table drawdown during construction and operational activities were used as a basis for delineating the LAA. To estimate the potential area of influence of a dewatering well, a fixed-radius approach consistent with that used to generate wellhead protection areas (WHPAs) for small municipal supply wells in the province was used. A WHPA generated using a fixed-radius approach usually encompasses the area within 100 to 300 m of the wellhead (NLDMAE 2017). Given that water taking(s) associated with the above activities are of shorter duration and expected to be at a lower rate than a municipal taking, a 100 m buffer was added to the Project Area to define the LAA, excluding portions which are exclusively related to transmission lines as no Project-related dewatering is expected in these areas. To evaluate potential effects on groundwater from the operation of Mine Pond as an industrial water supply, Mine Pond and a 100-m buffer from the ponds edge is also included in the groundwater resources LAA. The LAA is divided into the Port au Port LAA, the Codroy LAA, and the Stephenville LAA.
- The Regional Assessment Area (RAA): The area adjacent to the LAA where there is the potential for indirect and/or cumulative Project-related effects on groundwater resources. As the environmental effects of the Project on groundwater resources are not expected to extend to the boundaries of the RAA, the RAA for groundwater resources was chosen to be consistent with the RAA for surface water resources and is based on the boundaries of watersheds which contribute to the Project Area. The RAA is divided into the Port au Port RAA, the Codroy RAA, and the Stephenville RAA.



Stantec

- Northern Harvest Smolt Drilled Well
- Drilled Well
- Public Groundwater Supply

Public Water

- Protected Water Supply
- Other Public Water Supply
- ILUC Water

Proposed Project Features

- Turbine Location
- Substation
- Hydrogen / Ammonia Plant Location
- Collector Line (Proposed)
- Access Road (Proposed)
- Transmission Line 230 kV (Proposed)

Port au Port Interconnection

- Proposed Route
- Alternate Route

- Project Area
- Local Assessment Area
- Regional Assessment Area

Other Features

- Trans-Canada Highway
- Road

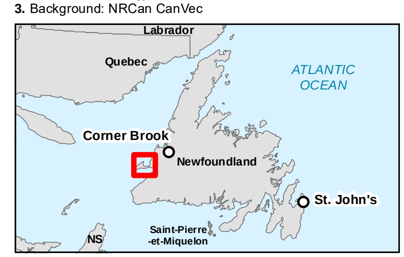
N

0 5 10 km

(At original document size of 8.5x11) 1:340,000

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: NLECC Water Resources Management Division, World Energy GH2, NRCan CanVec
3. Background: NRCan CanVec



Project Location
Stephenville
NL

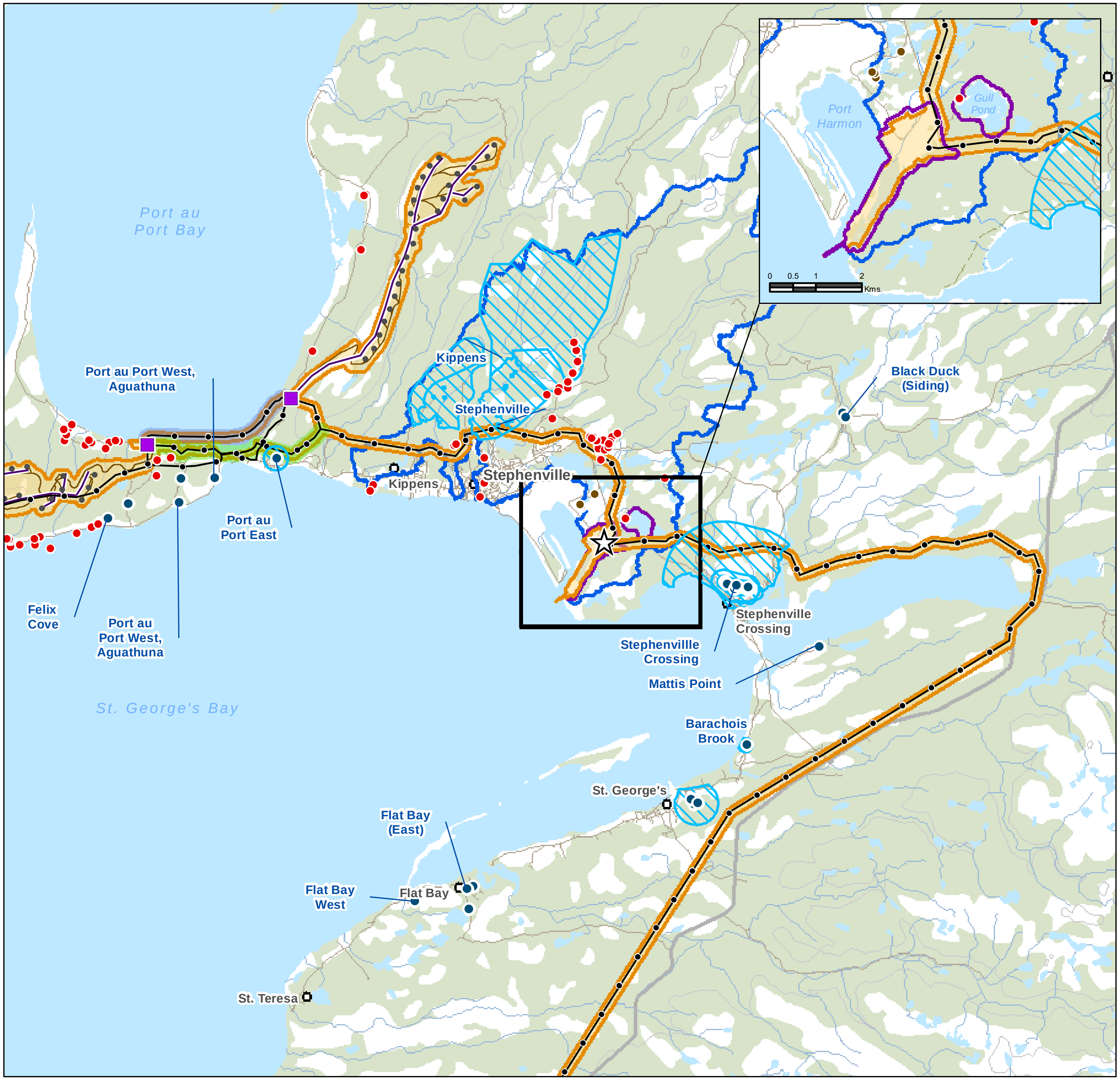
Prepared by AC on 2023-05-11
Rev. by NW on 2023-07-04
QR by AW on 2023-07-17

Client/Project
World Energy GH2
Project Nujio'qonik

121417233_042a

Figure No.
8.1

Title
Port au Port Assessment Area and Water Supply Wells



Stantec

- Drilled Well
- Northern Harvest Smolt Drilled Well
- Public Groundwater Supply

Public Water

- Protected Water Supply
- Other Public Water Supply

Proposed Project Features

- Turbine Location
- Substation
- Hydrogen / Ammonia Plant Location
- Collector Line (Proposed)
- Access Road (Proposed)
- Transmission Line 230 kV (Proposed)

Port au Port Interconnection

- Proposed Route
- Alternate Route

- Project Area
- Local Assessment Area
- Regional Assessment Area

Other Features

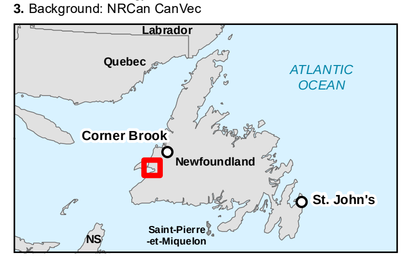
- Trans-Canada Highway
- Road
- Resource Road / Trail
- Watercourse
- Waterbody
- Forested

N

0 2.5 5 km
(At original document size of 8.5x11)
1:250,000

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: NLECC Water Resources Management Division, World Energy GH2, NRCan CanVec
3. Background: NRCan CanVec



Project Location
Stephenville
NL

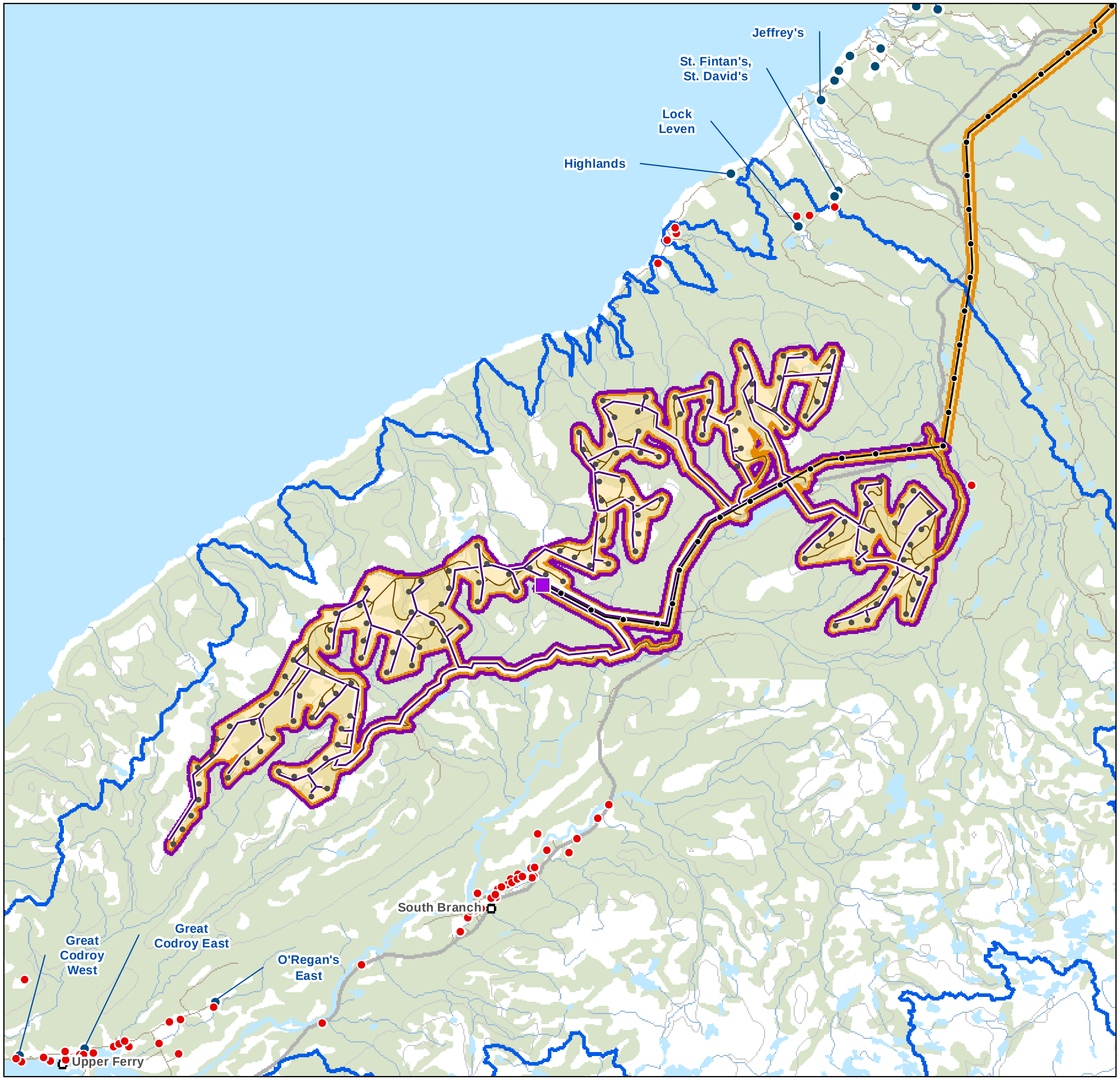
Prepared by AC on 2023-05-11
Rev. by NW on 2023-07-04
QR by AW on 2023-07-17

Client/Project
World Energy GH2
Project Nujio'qonik

121417233_042b

Figure No.
8.2

Title
Stephenville Assessment Area and Water Supply Wells



Stantec

- Drilled Well Record
- Public Groundwater Supply

Public Water Supplies

- Protected Water Supply
- Other Public Water Supply
- ILUC Water Supply

Proposed Project Features

- Turbine Location
- Substation (Proposed)
- Collector Line (Proposed)
- Access Road (Proposed)
- Transmission Line 230 kV (Proposed)
- Project Area
- Local Assessment Area
- Regional Assessment Area

Other Features

- Trans-Canada Highway
- Road
- Resource Road / Trail
- Watercourse
- Waterbody
- Wetland
- Forested Area

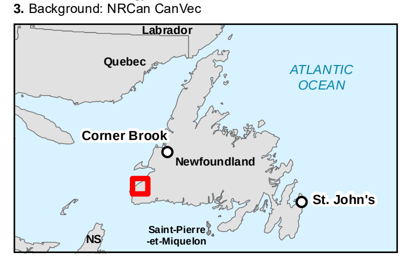
N

0 2.5 5 km

(At original document size of 8.5x11)
1:250,000

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: NLECC Water Resources Management Division, World Energy GH2, NRCan CanVec
3. Background: NRCan CanVec



Project Location
Stephenville
NL

Prepared by AC on 2023-05-11
Rev. by NW on 2023-07-04
QR by AW on 2023-07-17

Client/Project
World Energy GH2
Project Nujio'qonik

121417233_042c

Figure No.
8.3

Title
Codroy Assessment Area and Water Supply Wells

V:\1214\active\121417233\03_data\gis_cad\gis_data\mapping\mxd\general\aquatics\121417233_042c_Fig_8_3_Codroy_Water_Supply_Wells.mxd Revised: 2023-08-02 By: acuff

8.1.2.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on groundwater resources include:

- Construction: Overall the construction phase of the Project will be from Q4 2023 through Q2 2027, pending EA approval and receipt of other required permits and approvals. Early civil works are planned to start Q4 2023 through Q3 2024. Construction of the Port au Port Wind Farm and associated infrastructure is expected to start in Q3 2024 with completion of the construction in Q4 2026. Construction of the Codroy Wind Farm and associated infrastructure is expected to start Q4 2025 with completion in Q1 2027. The hydrogen / ammonia plant will be constructed in phases from Q2 2024 to Q1 2026. Grid power sources are planned for hydrogen production in 2025 until March 2026, when the electrolyzer is commissioned.
- Operation and maintenance: Wind farm commissioning is anticipated to start Q1 2026 at the Port au Port Wind Farm and Q2 2027 at the Codroy wind farm. The 600 MW electrolyzer expected to be commissioned in Q1 2026. The operational life of the Project is 30 years at each site.
- Decommissioning and rehabilitation: After a 30-year operational life, the decommissioning phase is anticipated to occur during 2057 and 2058. Decommissioning is anticipated to begin Q1 2057 at the Port au Port Wind Farm, with completion in Q3 2058 at the Codroy wind farm.

8.2 Existing Environmental Conditions

8.2.1 Methods

Existing groundwater conditions were assessed using publicly available data sources and, in the case of the Hydrogen/Ammonia Production and Storage Facility, site-specific studies. Public data sources included provincial webservices such as the Geoscience OnLine Atlas (bedrock and surficial geology mapping) and the Water Resources Portal (protected groundwater area mapping, water quality reports for municipal supply wells); regional hydrogeologic reports; and data from real-time water quality monitoring stations. Reports by Fracflow Consultants Inc. describing groundwater investigations at the Hydrogen/Ammonia Production and Storage Facility were used to support the groundwater resources baseline characterization for that portion of the LAA and RAA. Full details of data sources used to establish existing conditions are provided in the Aquatics Environment Baseline Study in BSA-2.

8.2.2 Existing Conditions

The geology of the portions of the RAA associated with the Port au Port Wind farm and the Codroy Wind farm (Port au Port RAA and Codroy RAA, respectively) consists of bedrock exposed at surface or beneath thin overburden (thicker in low lying areas and at the base of steep rock faces). Overburden is thicker in the Stephenville RAA and consists of sands and gravels within the LAA, and till blankets further upstream in the watershed. Areas of till veneer and exposed bedrock are associated with poor infiltration rates; greater recharge potential is expected where sands and gravels are present at surface (Acres 1992).

There are eight public groundwater supply wells within the Port au Port RAA, serving the communities of Piccadilly Slant – Abraham's Cove, Port Au Port West – Aguathuna – Felix Cove, and Sheaves Cove. These wells are considered Protected Public Water Supplies (PPWSAs), with the exceptions of the Piccadilly Slant and Abraham's Cove wells. The public groundwater supply wells for the Town of Stephenville are located within the Stephenville RAA. There are no public groundwater supply wells in the Codroy RAA.

Four bedrock groundwater supply wells are located within the Port au Port LAA in the community of Piccadilly with yields of between 1 and 27 L/min. There are no wells reported in the NLDECC Drilled Water Well Database within the Codroy or Stephenville LAAs. The closest reported wells to the Codroy LAA are three domestic wells located in the community of Bay St. George South. Two of the wells are screened in the overburden, with one completed in bedrock. The three wells have reported yields of approximately 5 L/min. The closest wells to the Stephenville LAA are operated by Northern Harvest Smolt Ltd. under Water Use License (WUL) for a commercial aquaculture facility. The WUL permits withdrawal of up to 4,493,880 m^3/year of groundwater from freshwater wells and 2,102,400 m^3/year of groundwater from saltwater wells. The freshwater wells are located approximately 1.5 km west and 300 m south of the Stephenville LAA. The saltwater wells are located approximately 1.5 km southwest of the Stephenville LAA. The public groundwater supply wells for the Town of Stephenville are located approximately 6.5 km northwest of the Stephenville LAA.

Groundwater levels measured within the Stephenville LAA in 2006 and 2007 indicate that the water table is present in the coarse overburden deposits at depths ranging from –0.15 (artesian) to 10.4 metres below ground surface (mbgs). Static water levels reported in the Drilled Water Well Database (NLDECC 2023) range from 3 metres below ground surface (mbgs) to 24 mbgs (, median 8 mbgs for the Port au Port RAA, and from 0.3 mbgs to 27 mbgs, median 6 mbgs for the Codroy RAA.

8.3 Assessment Criteria and Methods

This section describes the criteria and methods used to assess environmental effects on groundwater resources. Residual environmental effects (Section 8.5) are assessed and characterized using criteria defined in Section 8.3.1, including direction, magnitude, geographic extent, timing, duration, frequency, reversibility, and ecological or socio-economic context. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for groundwater resources is provided in Section 8.3.2. Section 8.3.3 identifies the environmental effects to be assessed for groundwater resources, including effect pathways and measurable parameters. This is followed by the identification of potential Project interactions with groundwater resources (Section 8.3.4). Analytical assessment techniques employed for the assessment of potential Project-related environmental effects on groundwater resources are provided in Section 8.3.5. The assumptions that were made to support a conservative approach to the assessment of residual effects on groundwater resources are described in Section 8.3.5.1.

8.3.1 Residual Effects Characterization

Table 8.1 presents definitions for the predicted environmental effects characterization of the undertaking on groundwater resources. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 8.1 Characterization of Predicted Environmental Effects of the Undertaking on Groundwater Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Nature	The long-term trend of the residual effect	• **Neutral –** No net change in the measurable parameter(s) for groundwater resources relative to baseline. • **Positive –** A residual effect that moves the measurable parameter(s) in a direction beneficial to groundwater resources relative to baseline. • **Adverse –** A residual effect that moves the measurable parameter(s) in a direction detrimental to groundwater resources relative to baseline.
Magnitude	The amount of change in measurable parameter(s) or the VEC relative to existing conditions.	• **Negligible –** no measurable change to groundwater resources relative to baseline. • **Low –** a measurable change is detectable but within the normal variability that would be expected relative to baseline. • **Moderate –** measurable change occurs that is considered elevated above, or depressed below, baseline but within acceptable limits. • **High –** measurable change occurs that is considered elevated above acceptable limits or regulatory objectives.
Geographic Extent	The geographic area in which a residual effect of a defined magnitude occurs	• **Project Area –** Residual effect is restricted to the Project Area. • **LAA –** Residual effect extends into the LAA. • **RAA –** Residual effect extends into the RAA.
Timing	The sensitivity of residual effects on the VEC to expected seasonal changes in groundwater (*e.g.*, consideration of expected annual groundwater level fluctuations)	• **No Sensitivity –** Residual effect is not sensitive to seasonality. • **Moderate Sensitivity –** Residual effect may be influenced by seasonality, but the categorization of characterization is unchanged (i.e., magnitude, geographic extent, duration, frequency, reversibility) • **High Sensitivity –** The characterization of the residual effect (i.e., magnitude, geographic extent, duration, frequency, reversibility) is changed based on seasonality.

Table 8.1 Characterization of Predicted Environmental Effects of the Undertaking on Groundwater Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter(s) of the VEC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	• **Short term –** residual effect restricted to construction or decommissioning, rehabilitation and closure phases. • **Medium term –** residual effect extends through project operations but is expected to subside when operations cease. • **Long term –** residual effect extends beyond the life of the project. • **Permanent –** recovery to baseline conditions unlikely.
Frequency	Identifies how often the residual effect occurs during the Project, during a specific phase of the Project, or during another specified time period	• **Single event** • **Multiple irregular event –** Occurs at no set schedule • **Multiple regular event –** Occurs at regular intervals • **Continuous –** Occurs continuously
Reversibility	Describes whether a measurable parameter(s) or the VEC can return to its existing condition after the Project activity ceases, including through active management techniques	• **Reversible –** Residual effect is likely to be reversed after activity completion and rehabilitation • **Irreversible –** Residual effect is unlikely to be reversed
Ecological / Socio-economic Context	Existing conditions and trends in the area where the residual effect occurs	• **Undisturbed –** Area is relatively undisturbed or not adversely affected by human activity • **Disturbed –** Area has been substantially previously disturbed by human development or human development is still present

8.3.2 Significance Definition

A significant residual adverse effect on groundwater resources is defined as a residual Project-related change to the environment that results in any of the following:

- Decrease in the yield from an existing and otherwise adequate groundwater supply well to the point where it is inadequate for its intended use.
- Change in groundwater quality, such that the quality of groundwater from an otherwise adequate water supply well that meets applicable guidelines deteriorates to the point where it becomes non-potable or cannot meet the GCDWQ (Health Canada 2022) for a consecutive period exceeding 30 days.
- Physical or chemical alteration to an aquifer to the extent that interaction with local surface water results in streamflow or surface water chemistry changes that adversely affect aquatic life or a down-stream surface water supply.

8.3.3 Potential Environmental Effects, Project Pathways, and Measurable Parameters

Table 8.2 lists the potential Project effects on groundwater resources and provides a summary of the Project effect pathways and measurable parameters and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for large development projects in NL, renewable energy projects in other parts of Canada, comments provided during engagement, and professional judgment.

Table 8.2 Environmental Effects, Effect Pathways, and Measurable Parameters for Groundwater Resources

Environmental Effect(s)	Effect Pathway(s)	Measurable Parameter(s) and Units of Measurement
Change in groundwater quantity	• Direct loss or alteration of habitat arising from reduced baseflow to surface water features. • Reduced groundwater availability for existing well users	• Reduction in baseflow (%) in surface water features supporting ecological habitat. • Well yield (L/min) for existing well users in the Project Area
Change in groundwater quality	• Direct loss or alteration of habitat arising from chemistry of groundwater discharging to surface water features. • Degradation of groundwater quality in potable water supplies	• Concentration of chemical parameters (various) in groundwater compared to applicable guidelines

8.3.4 Project Interactions with Groundwater Resources

Table 8.3 uses checkmarks to indicate the routine Project activities that could interact with the VEC and result in the identified environmental effect(s) to be assessed. Immediately following Table 8.3, environmental effects pathways are briefly described for potential routine Project-related environmental effects and justification is provided in cases where no Project interaction with the VEC (and therefore no potential environmental effect on the VEC) is predicted.

Table 8.3 Project Interactions with Groundwater Resources, Environmental Effects, and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed	
	Change in Groundwater Quantity	Change in Groundwater Quality
Construction		
Site Preparation and Civil Works (including turbine foundations, road construction, quarries, clearing, grubbing, blasting, cement production, and watercourse crossings)	X	X
Transportation of Resources and Equipment (includes trucking, shipping and barging of materials)	-	-
Construction / Installation, Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	X	-
Installation and Commissioning of Wind Turbines	-	-
Installation and Commissioning of Collector Systems	-	-
Installation and Commissioning of Transmission Lines and Substations (including marine cable crossing)	-	-
Installation and Commissioning of Hydrogen / Ammonia Production, and Storage Facilities and Associated Infrastructure (including Industrial water supply infrastructure)	X	-
Restoration of Existing Port Facilities (including pile driving and dredging)	-	-
Emissions, Discharges, and Wastes[1]	-	X
Employment and Expenditures[2]	-	-
Operation and Maintenance		
Presence, Operation, and Maintenance of wind farms (including wind turbines, access roads, and collector systems)	-	-
Presence, Operation, and Maintenance of Transmission Lines and Substations		
Presence, Operation, and Maintenance of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure (includes marine discharge from treatment plant)	X	-
Presence, Operation, and Maintenance of Port Facilities (includes loading of ammonia and vessel maneuvering within Port)	-	-
Emissions, Discharges, and Wastes[1]	-	X
Employment and Expenditures[2]	-	-

Table 8.3 Project Interactions with Groundwater Resources, Environmental Effects, and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed	
	Change in Groundwater Quantity	**Change in Groundwater Quality**
Decommissioning and Rehabilitation		
Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	X	-
Decommissioning and Rehabilitation of wind farms (including wind turbines, access roads, and collector systems)	-	-
Decommissioning and Rehabilitation of Transmission Lines and Substations	-	-
Decommissioning and Rehabilitation of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure	-	-
Decommissioning and Rehabilitation of Port Facilities	-	-
Emissions, Discharges, and Wastes[1]	-	X
Employment and Expenditures[2]	-	-

Notes:
X= Potential interaction
– = No interaction
1 Emissions (e.g., light, noise, vibration, air contaminants and GHGs), discharges (e.g., wastewater and other liquid effluents), and hazardous and non-hazardous wastes are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, "Emissions, Discharges, and Wastes" is listed as a separate item under each phase of the Project.
2 Project employment and expenditures are generated by most Project activities and are the main drivers of many potential socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, "Employment and Expenditures" is listed as a separate item under each phase of the Project.

In the absence of mitigation, the Project may interact with groundwater resources in the following ways:

- If dewatering is required for turbine or Hydrogen/Ammonia Production and Storage Facility foundation installation, there could be localized lowering of the water table, potentially reducing availability of groundwater for existing well users (if any are present) and reducing baseflow (and therefore habitat) in fish-bearing streams. Discharge of the groundwater from dewatering activities could result in changes to groundwater quality.
- If groundwater supply wells are used as a source of water for concrete production during construction, there could be localized lowering of the water table in the vicinity of supply wells, potentially reducing availability of groundwater for existing well users (if any are present) and reducing baseflow (and therefore habitat) in fish-bearing streams.

- Taking of groundwater for potable supply for the Codroy temporary work camp could result in lowering of the water table, potentially reducing availability of groundwater for existing well users (if any are present) and reducing flow (and therefore habitat) in fish-bearing streams.
- The use of Mine Pond as an industrial water supply could affect groundwater levels in the vicinity of the pond.
- Discharge of treated domestic sewage from septic systems at the Codroy temporary work camp and the Hydrogen/Ammonia Production and Storage Facility could result in effects on local groundwater quality.
- Accidental releases of hazardous substances can also locally affect groundwater resources, as assessed in Accidents and Malfunctions (Chapter 24).

The following activities will not interact in a substantive way with groundwater resources, and effects from these activities are not considered further in the EIS:

- Transportation of Resources and Equipment will not interact with groundwater resources except for accidental spills, which are discussed in Chapter 24.
- Installation, commissioning, operation, and decommissioning of wind turbines, collector systems, or transmission lines and substations.
- Commissioning, operation, and decommissioning of hydrogen/ammonia production, storage facilities, and associated infrastructure.
- Restoration, operation, and decommissioning port facilities.
- Presence, operation, and maintenance of wind farms (including wind turbines, access roads, and collector systems) may result in limited, local changes in recharge rates based on reduced infiltration on compacted and/or paved surfaces. However, changes are not expected to be measurable, and no cumulative effects are anticipated.
- Employment and expenditures will not directly result in changes to the physical environment, including groundwater resources.

8.3.5 Analytical Assessment Techniques and Level of Knowledge

Groundwater taking anticipated during the Project includes dewatering of the excavations for wind turbine and the Hydrogen/Ammonia Production and Storage Facility foundations, a camp supply well for the Codroy temporary accommodations camp, and a supply well(s) for concrete production at the batch plant(s). The environmental effects analysis for construction dewatering was carried out using analytical solutions to estimate of the zone of influence (Powers et al. 2007). Environmental effects analysis for water supply wells for the accommodations camp and concrete batch plant(s) will be conducted following aquifer test analyses as required under the *Water Resources Act* (2002). Environmental effects for septic fields and construction dewatering with respect to groundwater quality are assessed using engineering design and a variety of provincial and federal standards and codes of practice.

8.3.5.1 Assumptions and Conservative Approach

The analytical solution used to determine the zone of influence from dewatering for wind turbine and the Hydrogen/Ammonia Production and Storage Facility foundation construction included the following conservative assumptions:

- The groundwater level at the site of excavation was estimated using the 10th percentile of depths to static water level within the Port au Port and Codroy RAAs as reported in the Drilled Water Well Database (NLDECC 2023). Using the median or mean depths to groundwater would result in a less conservative assumption that no dewatering is required to lower the water table below the base of the excavation.
- The hydraulic conductivity of surficial material to be dewatered for the construction of the wind turbine and the Hydrogen/Ammonia Production and Storage Facility foundations was set to the highest value used to delineate wellhead protection areas (NLDECC 2015). A higher hydraulic conductivity results in a larger zone of influence around an excavation.

8.4 Mitigation Measures

A series of environmental management plans will be developed by WEGH2 to mitigate the effects of Project development on the environment. A full list of mitigation measures to be applied throughout Project construction, operation and maintenance, and decommissioning and rehabilitation is provided in Section 8.4. Key measures to mitigate the potential effects of the Project on groundwater resources are listed in Table 8.4, by category and Project phase.

Table 8.4 Mitigation Measures: Groundwater Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
2	Erosion and Sedimentation	Work will be performed so that materials such as sediment, fuel or other hazardous materials do not enter watercourses and waterbodies through implementation of erosion and sediment control measures and hazardous materials management practices.	X	X	X
3	Erosion and Sedimentation	Work will be conducted in a manner to protect watercourses and wetlands from siltation and disturbance in accordance with Best Management Practices or as otherwise agreed upon with the regulator.	X	X	X
4	Biophysical Environment	Sensitive areas (e.g., wetlands, rare plant occurrences, hibernacula, mineral licks, roosts) identified prior to Project activities will be flagged and appropriate buffers maintained around these areas, where feasible.	X	X	X

Table 8.4 Mitigation Measures: Groundwater Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
5	Mitigation	Clearing for temporary road construction will be limited to the width required for road embankment, drainage requirements, and safe line of sight requirements. Trees will be cut close to ground level, and only large tree stumps will be removed, where practicable. Low ground shrubs will be left in place for soil stability and erosion protection purposes, where possible.	X	-	-
6	Mitigation	Where crossing of wetlands beyond the area to be cleared is unavoidable, protective layers such as matting or biodegradable geotextile and clay ramps, or other approved materials, will be used between wetland root / seed bed and construction equipment if ground conditions are encountered that create potential for rutting, admixing or compaction.	X	-	-
7	Mitigation	Grading will be directed away from wetlands, where possible, and will be reduced within wetland boundaries unless required for site specific purposes.	X	-	-
8	Mitigation	Project staff and contractors will adhere to the waste management procedures to be included in the EPP and the Waste Management Plan.	X	X	X
9	Mitigation	Construction areas will be kept clear of rubbish and debris. Rubbish and debris will be appropriately stored and managed.	X	-	-
10	Mitigation	Waste materials and debris will be collected and stored in acceptable containers on-site and disposed of off-site in an environmentally acceptable and approved site. Materials that can be recycled will be sorted and taken to an approved facility.	X	X	X
11	Mitigation	Volatile wastes and materials, such as fuel, mineral spirits, oil, or paint thinner will be stored appropriately and will not be permitted to enter into waterways or storm drains. They will be disposed of at an approved site.	X	X	X
12	Mitigation	Where portable toilets are required, waste will be removed from the site by the supplier in a timely manner for appropriate disposal. These toilets will be located more than 30 m from the boundaries of wetlands or watercourses.	X	X	X
13	Mitigation	Burning of rubbish and waste materials on-site will not be permitted. Rubbish and waste materials will not be buried on-site.	X	X	X
14	Mitigation	Bulk fuel and lubricants will be stored in secure areas (i.e., with bund walls and impervious flooring) that have the capacity to trap more than the volume of petroleum hydrocarbons being stored; this will serve as a secondary containment should the primary containment fail. Other petroleum hydrocarbon products will not be stored in large quantities on-site, and secondary containment (e.g., drip trays) will be used in areas of storage and transfer.	X	X	X

Table 8.4 Mitigation Measures: Groundwater Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	**O**	**D**
15	Mitigation	Hazardous products will be stored according to industrial requirements and standards, and safely secured so that access is limited to authorized personnel.	X	X	X
16	Mitigation	Fuelling and servicing will be conducted using appropriate containment equipment, including spill kits.	X	X	X
17	Mitigation	Fuelling and servicing areas will be sited more than 100 m away from watercourses, coastlines, waterbodies, and wetlands.	X	X	X
18	Mitigation	The potential for spills will be reduced through the use of standard good practices, such as the use of appropriate containers, and avoiding overfilling.	X	X	X
19	Mitigation	Vehicles, heavy equipment, and machinery will be properly maintained to reduce the risk of leakage. Routine preventative maintenance and inspection of hydraulic equipment and machinery will be undertaken to avoid a hazardous material release.	X	X	X
33	Mitigation	Areas to be cleared will have sediment and erosion control measures implemented per the site-specific Erosion & Sediment Control Plan prior to the initiation of clearing activities. The sediment and erosion control measures will be adapted to suit the field conditions associated with the specific construction activities as construction proceeds.	X	-	-
34	Erosion and Sedimentation	Construction areas will be routinely monitored to identify areas of potential erosion and to apply appropriate mitigation. Best practice erosion and sediment control measures will be implemented, as required.	X	-	-
35	Mitigation	The drainage system for the site will be designed to appropriately manage stormflows considering impacts to on-site downstream watercourses, and coastlines, and infrastructure. Additionally, the site drainage system will consider the variable and seasonal up-stream drainage needs to provide adequate access to downstream watercourses without adverse impact on the plant site or other nearby infrastructure.	X	-	-
36	Mitigation	In the event that project activities occur in any designated water supply areas, the work will be completed in conjunction with the jurisdiction having authority.	X	-	-
70	Mitigation	Waste generated on-site will be removed on a regular basis and disposed of appropriately at an approved facility.	X	X	X
71	Mitigation	A hazardous waste inventory will be developed to support the management of general and hazardous operational waste streams.	X	X	X
77	Mitigation	Best practices for the proper handling, storage, and disposal of spilled hazardous chemicals and fuels will be included in the EPP and implemented by the Project personnel and contractors.	X	-	-

Table 8.4 Mitigation Measures: Groundwater Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
80	Mitigation	Emergency response plans will be developed, including spill prevention and response, emergency response measures, training, responsibilities, clean-up equipment and materials, and contact and reporting procedures.	X	X	X
81	Mitigation	Appropriate Project personnel will be trained in fuel handling, equipment maintenance, and fire prevention and response measures.	X	X	X
83	Mitigation	Spill response kits will be available on-site. Project vehicles will be equipped with appropriately sized spill kits.	X	X	X
84	Mitigation	In the event of a spill, dry clean up and mopping techniques will be used, as appropriate. The area will not be "washed down" as this could cause the spills to spread to the surrounding environment and potentially enter drainage works or environmentally sensitive areas.	X	X	X
85	Mitigation	Soil that may have become contaminated will be remediated. This may be done on-site or removed from site for disposal at an approved location.	X	X	X
86	Mitigation	The potential effects of extreme weather, including storms, precipitation, and drought will be considered in Project planning, design, and operation and maintenance strategies, including the selection of materials and equipment, and design of components. These designs will consider projected climate change conditions over the life of the Project.	X	X	X
87	Mitigation	WEGH2 will regularly inspect and monitor Project infrastructure and equipment that may be impacted by the environment (in addition to its normal function) and take required action to maintain, repair, and upgrade infrastructure / equipment as needed.	X	X	X
132	Mitigation	The Project will be designed and constructed to meet applicable engineering codes, standards and best management practices (e.g., such as the National Building Code of Canada, and the Canadian Standards Association Guide to Canadian Wind Turbine Codes and Standards, National Fire Code of Canada). The codes and standards account for safety features that address hazards from power outages, sudden system upset/disruption and weather variables, including extreme conditions, that could affect the structural integrity of buildings and infrastructure. Designs will also consider projected climate change over the life of the Project. For example, the National Building Code of Canada contains design requirements to account for extreme weather on infrastructure such as: (1) Critical structures and steel selection to prevent brittle fracture at low ambient temperatures; (2) Electrical grounding structures for lightning protection; (3) Maximum motor ambient temperature; and (4) Ice and freeze protection	X	-	-

Table 8.4 Mitigation Measures: Groundwater Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
135	Mitigation	The Project will be designed and constructed to meet applicable engineering codes, standards, and best management practices, including the National Building Code of Canada, which provides standards of safety to account for geological hazards, including seismic activity in accordance with the applicable requirements.	X	X	X
136	Mitigation	Site-specific erosion and sedimentation control plans will be developed during detailed design phase of the Project and will be implemented.	X	-	-
137	Mitigation	To address the risk of slope instability, a detailed terrain mapping assessment, including ground-truthing, for the final Project Area will be completed to identify both construction constraints and geohazards that may impact the Project. Slope stability assessments will be completed as part of the design, particularly at locations where there is proposed re-grading and glacio-fluvial deposits that are susceptible to erosion and undermining as seen in Stephenville.	X	-	-
138	Mitigation	To address the risk of subsidence a detailed terrain mapping assessment using LiDAR from the Project Area to assess for karst formation that may be present will be completed.	X		-
139	Mitigation	To address the risk of landslide/rock fall a detailed terrain mapping assessment will be used to identify historical landslides and rock fall activity within the Project Area. Identification of naturally occurring past events may necessitate further investigation or avoidance. For human-made rock cuts, or largescale re-grading of rock slopes, geotechnical investigation and design will be conducted so that the final cuts / grading are stable and will not cause potential instability during construction or long term..	X	-	-
144	Mitigation	Approval from NLDECC will be obtained to establish the required concrete batch plants at each Site. Plant operations will comply with the conditions outlined in the approvals and requirements under air pollution control regulations.	X	-	-
145	Mitigation	The Environmental Code of Practice for Concrete Batch Plant and Rock Washing Operations, 1992 will be adhered to during concrete production activities.	X	-	-
146	Mitigation	Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems will be handled using the procedures outlined in Section 3.0 of the Environmental Code of Practice for Concrete Batch Plant and Rock Washing Operations.	X	-	-

Table 8.4 Mitigation Measures: Groundwater Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
147	Mitigation	Rinsing activities will be carried out at the site of the concrete batch plant, except rinsing of the chute and applicable concrete placement equipment.	X	-	-
150	Mitigation	Explosives will be used in a manner that will reduce damage or defacement of landscape features, trees, ecologically sensitive areas such as wetlands, and other surrounding objects, by controlling through standard best practice (including precisely calculated explosive loads and adequate stemming), the scatter of blasted material beyond the limits of activity. Outside of cleared areas, inadvertently damaged trees will be cut, removed, and salvaged, if merchantable (refer to Section, "Clearing of Vegetation"). Fly rock, which inadvertently enters a waterbody, watercourse, or ecologically sensitive area and that can be recovered without further damage to the environment, will be removed. Instances where larger fly rocks (boulders) enter these areas or deep waterbodies, recovery of this will be discussed with the OSEM.	X	-	-
152	Mitigation	Blasting will not occur in the vicinity of fuel storage facilities.	X	-	-
156	Mitigation	Blasting associated debris, such as explosive boxes and used blasting wire, must be collected for proper disposal as soon as possible following blasting activity.	X	-	-
157	Mitigation	Waste rock that is suitable for usage at the site will be set aside for subsequent use. Waste rock not suitable for site use will be deposited in the designated stockpile area.	X	-	-
158	Mitigation	Previous testing on selected samples of bedrock has shown the samples to be Non-Potentially Acid Generating (NPAG). As a precautionary measure, the OSEM will inspect all areas of blasted rock and rock stockpiles so no evidence of PAG material exists.	X	-	-
328	Mitigation	Water from dewatering activities will be discharged through a geotextile filter bag or equivalent. If the filter bag is overwhelmed by sediment or quantity of water, a sediment removal basin will be constructed, which may consist of a temporary enclosure constructed with straw bales, geotextile fabric or both.	X	-	-
329	Mitigation	Maintain minimum 16 m setback from temporary workforce camp septic system and supply well from other groundwater users, including the temporary workforce accommodations' potable supply well.	X	-	X
330	Mitigation	WEGH2 will conduct annual inspections of the septic system to monitor septic system functionality.	X	-	X

Table 8.4 Mitigation Measures: Groundwater Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
331	Mitigation	Septic system best management practices to be observed (e.g., harsh cleaners, paint, solvents not to be disposed of in accommodation camp drains).	X	-	X
332	Mitigation	Continuous monitoring of surface water levels in Mine Pond to observe effects on adjacent groundwater levels, if present.	-	X	-

* Notes:
"ID #' denotes the mitigation master identification number, Appendix 26-A.
"C" denotes the construction phase of the Project.
"O" denotes the operation and maintenance phase of the Project.
"D" denotes the decommissioning and rehabilitation phase of the Project.
"X" denotes the relevant Project phase for the mitigation measure

8.4.1 Application of the Precautionary Principle to Project Mitigation Measures

WEGH2 will incorporate avoidance with respect to potential effects of the Project on groundwater resources and use before construction begins. Early in the EA process, and based on engagement and consultation with regulators, Indigenous groups, and stakeholders, WEGH2 completed a review and update of the Project design and layout to address specific concerns and issues. The Project layout will continue to evolve during the EA process as various stages of conceptual and detail design are completed.

The main Project components and activities that are anticipated to interact with groundwater resources are construction dewatering, water supply wells, and the operation of Mine Pond as an industrial water supply. The mitigation measures in Section 8.4 have been selected in consideration of the environmental effects pathways and include standard proven mitigation measures They also incorporate NLDECC measures to protect groundwater, and consider permits, regulations, and guidelines that govern potential groundwater interactions from water supplies and septic systems. As such, the mitigation measures presented here and in the EPP are adequate to reduce potential groundwater effects to levels which are not significant. and to thresholds at levels below what would be considered an unacceptable effect.

8.5 Residual Environmental Effects

8.5.1 Groundwater Quantity

8.5.1.1 Construction

Foundation Excavation Dewatering

If dewatering is required for turbine or Hydrogen/Ammonia Production and Storage Facility foundation installation during construction, there could be localized lowering of the water table. The distance over which water table drawdown could be measurable in response to dewatering for the construction of foundations is known as zone of influence (ZOI). The ZOI was estimated using the Sichardt and Kryieleis method (Powers et al. 2007) as follows and the parameters listed in Table 8.5:

$$ZOI = 3000(H - h_w)\sqrt{K}$$

Where:

ZOI	=	radius of influence of dewatering from the edge of the excavation (m)
H	=	depth of the excavation (m)
h_w	=	depth to water table (m)
K	=	hydraulic conductivity of aquifer (m/s)

Table 8.5 Summary of Zone of Influence Calculations

Project Component	Depth of Foundation Excavation (H) (m)	Depth to Water Table (h_w) (m) [3]	Hydraulic Conductivity of Aquifer (K) (m/s) [4]	Zone of Influence (ZOI) (m)
Port au Port Wind Farm Foundations	5.0 [1]	1.5	5×10^{-5}	32
Codroy Wind Farm Foundations	5.0 [1]	3.5	5×10^{-5}	74
Hydrogen/Ammonia Production and Storage Facility Foundation	5.0 [2]	3.0	5×10^{-5}	42

Notes:
1 Excavation depth of 5 m for wind turbine foundations (DNV GL 2018)
2 Conservative estimate of 5 m for the Hydrogen/Ammonia Production and Storage Facility foundation (to be reassessed following final design)
3 10th percentile depth to water table for each RAA (NLDECC 2023)
4 Highest value assigned for delineation of municipal wellhead protection areas (NLDECC 2015)

Using the estimated aquifer thickness to be dewatered (H-hw; Table 8.5), the ZOI related to dewatering for construction of wind turbine foundations is approximately 32 m for the Port au Port Wind Farm and 74 m for the Codroy Wind Farm (measured from the edge of each excavation). As the LAA includes a buffer of 100 m around planned infrastructure, no effects on groundwater resources related to dewatering for wind turbine foundation constructions are predicted outside the LAA.

The ZOI related to dewatering for construction of the Hydrogen/Ammonia Production and Storage Facility foundations is approximately 42 m (measured from the edge of the excavation) for an assumed foundation depth of 5 m (to be reassessed following final design). As the LAA includes a buffer of 100 m around planned infrastructure, no effects on groundwater resources related to dewatering for the Hydrogen/Ammonia Production and Storage Facility foundation constructions are predicted outside the LAA.

Effects of foundation excavation dewatering during Project Construction on groundwater quantity are expected to be adverse, low in magnitude, restricted to the LAA, moderately sensitive to timing, short-term, occur at multiple irregular intervals, and reversible (Table 8.6).

Water Supply Wells

The temporary workforce accommodations within the Stephenville LAA will be supplied by existing municipal water sources. Due to the distance and remote nature of the Codroy Wind Farm, a separate workforce accommodations camp may be required to house workers during construction of the Codroy Wind Farm. It is anticipated that this camp would house up to approximately 500 workers, with a corresponding water demand of approximately 200 m^3/day, or 139 L/min, which may be provided by a new potable water supply well(s).

Concrete production for wind turbine foundations is estimated to require up to 160 m^3 of water per foundation. With a design target of one foundation per day, this is equivalent to approximately 111 L/min of water (with additional storage to meet peak demand). This demand may be provided by a new water supply well(s).

Under Section 58 of the *Water Resources Act* (2002), construction of a non-domestic well requires a permit. The standard terms and conditions of the *Permit to Construct a Non-Domestic Well* include siting restrictions, construction standards, wellhead completion requirements, and aquifer testing. ,An evaluation of effects to existing wells and surface water bodies is required as part of reporting conditions of the permit. An evaluation of quantitative environmental effects of a water supply well cannot practicably be completed without site-specific data collected during testing of an individual well. As such, quantitative residual environmental effects of new supply wells will be assessed as part of provincial guidelines at the time of supply well construction.

Although quantitative residual environmental effects of new supply wells can only be assessed at the time of supply well construction, based on *Guidance for Delineation of Wellhead Protection Areas (WHPAs) For Municipal Groundwater Supply Wells* (NLDMAE 2017) and professional experience with drilled wells in Newfoundland and Labrador, effects of water supply wells during Project Construction on groundwater quantity are expected to be moderate in magnitude, restricted to the LAA, moderately sensitive to timing, short-term, continuous, and reversible (Table 8.6).

Table 8.6 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Port au Port wind farm and Associated Infrastructure	Temporary lowering of the water table by up to 1.5 m within a 32 m radius from the edges of each wind turbine foundation
Codroy Wind Farm and Associated Infrastructure	Temporary lowering of the water table by up to 3.5 m within a 74 m radius from the edges of each wind turbine foundation
Temporary Workforce Accommodations	Possible lowering of water table in the vicinity of the Codroy accommodations camp water supply well(s). To be assessed as part of commissioning of supply wells.
Concrete Batch Plant	Possible lowering of water table in the vicinity of the batch plant water supply well(s). To be assessed as part of commissioning of supply wells.
230 kV Transmission Lines and Substations	No effect anticipated
Hydrogen / Ammonia Production and Storage Facilities	Possible lowering of water table by up to 2 m within a 42 m radius of the edges of building foundation excavation.
Port Facilities	No effect anticipated

8.5.1.2 Operation and Maintenance

The use of Mine Pond as an industrial water supply could affect groundwater levels in the vicinity of the pond. Based on the current depth of the water supply intake and the elevation of the overflow structure in the pond, water level fluctuations in the pond are expected to be on the order of 2 m (Fracflow 2023a).

It is noted that water levels in Mine Pond will be controlled by on-demand flow from the Muddy Pond pump house to Mine Pond through a large-diameter pipeline as described in Section 2.6. Further, there is evidence that Mine Pond is a perched pond (e.g., not directly connected to groundwater; Fracflow 2022, Fracflow 2023b; Appendix 8-A), which would indicate limited interaction between water levels in the pond and the surrounding aquifer. As the LAA includes a buffer of 100 m around Mine Pond, no effects on groundwater resources related to the use of Mine Pond as an industrial water supply are predicted outside the LAA.

Groundwater modelling conducted as part of the industrial water supply assessment support the conclusion that changes in water level in Mine Pond will have limited effects on local groundwater (Fracflow 2023b).

Effects of Project Operation and Maintenance on groundwater quantity are expected to be adverse, low in magnitude, restricted to the LAA, moderately sensitive to timing, medium-term, continuous, and reversible. Based on the information above, a summary of residual effects on groundwater quantity during the operation and maintenance phase is provided in Table 8.7.

Table 8.7 Summary of Effects by Project Component During Operation and Maintenance

Project Site	Summary of Effect during Operation and Maintenance
Port au Port wind farm and Associated Infrastructure	No effect anticipated
Codroy Wind Farm and Associated Infrastructure	No effect anticipated
230 kV Transmission Lines and Substations	No effect anticipated
Hydrogen / Ammonia Production and Storage Facilities	Water level changes in Gull (Mine) Pond of 1 to 3 m are anticipated and will have no significant impacts on the groundwater system as the lake does not appear to be directly connected to groundwater (Fracflow 2023b).
Port Facilities	No effect anticipated

8.5.1.3 Decommissioning and Rehabilitation

Decommissioning and Rehabilitation of the Project will require temporary workforce accommodations in the Stephenville LAA and the Codroy LAA. The temporary workforce accommodations within the Stephenville LAA will be supplied by existing municipal water sources. Due to the distance and remote nature of the Codroy Wind Farm, a separate workforce accommodations camp will be required to house workers during decommissioning of the Codroy Wind Farm. It is anticipated that WEGH2 will construct two temporary accommodations camps; one in the Stephenville area which will house up to 1,500 workers, and one in the Codroy area to house up to 500 workers. Both camps will be available during the construction and decommissioning and rehabilitation phases. A corresponding water demand at the Codroy Camp will require approximately 200 m^3/day, or 139 L/min, which may be provided by a new potable water supply well(s) or re-use of the well(s) from the accommodations camp established during the construction phase of the project. The water use figure was conservatively estimated using a camp size of 600.

Under Section 58 of the *Water Resources Act* (2002), construction and/or commissioning of a non-domestic well requires a permit. The standard terms and conditions of the *Permit to Construct a Non-Domestic Well* include siting restrictions, construction standards, wellhead completion requirements, and aquifer testing. As part of reporting required under the permit, an evaluation of effects to existing wells and surface water bodies is completed. An evaluation of quantitative environmental effects of a water supply well cannot practicably be completed without site-specific data collected during testing of an individual well. As such, quantitative residual environmental effects of new supply wells will be assessed as part of provincial guidelines at the time of supply well construction.

Although quantitative residual environmental effects of new supply wells can only be assessed at the time of supply well construction, based on *Guidance for Delineation of Wellhead Protection Areas (WHPAs) For Municipal Groundwater Supply Wells* (NLDMAE 2017) and professional experience with drilled wells in Newfoundland and Labrador, effects of water supply wells during Project Decommissioning and Rehabilitation on groundwater quantity are expected to be moderate in magnitude, restricted to the LAA, moderately sensitive to timing, short-term, continuous, and reversible. Based on the information above, a summary of residual effects on groundwater quantity during the decommissioning and rehabilitation phase is provided in Table 8.8.

Table 8.8 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Site	Summary of Effect during [Project Phase]
Temporary Workforce Accommodations	Possible lowering of water table in the vicinity of the Codroy Accommodations camp water supply well(s). To be assessed as part of commissioning of supply wells.
Port au Port wind farm and Associated Infrastructure	No effect anticipated
Codroy Wind Farm and Associated Infrastructure	No effect anticipated
230 kV Transmission Lines and Substations	No effect anticipated
Hydrogen / Ammonia Production and Storage Facilities	No effect anticipated
Port Facilities	No effect anticipated

8.5.2 Groundwater Quality

8.5.2.1 Construction

Pathways that affect groundwater quality during construction, as outlined in Section 8.3.4, include discharge of groundwater from construction dewatering, and the release of treated waste from the Codroy temporary accommodations camp septic system.

For construction dewatering, potential effects to groundwater from widespread silted infiltration are limited by proper erosion and sediment control, including progressive mitigative measures including the use of natural low-lying areas, silt fencing, and/or settling basins, as required. These measures are discussed further in *Environmental Guidelines for General Construction Practices* (NLDECC 2018) and in the Surface Water Resources VEC Chapter (Chapter 10).

Potential effects to groundwater from treated waste discharged as part of regular operation of septic fields and other sewerage works from the Codroy temporary accommodations camp are limited through engineering design and regulatory setbacks defined in *Guidelines for the Design, Construction and Operation of Water and Sewerage Systems* (NLDECC 2005) and the *Well Drilling Regulations* (2003) of the *Water Resources Act* (2002). Design considerations that mitigate potential effects to groundwater include, but are not limited to, a separation distance from the bottom of the tile field and the maximum expected elevation of groundwater and/or bedrock, and selection of proper fill material for preferred infiltration rates as determined by percolation testing.

Effects of Project Construction on groundwater quality are expected to be adverse, moderate in magnitude, restricted to the LAA, not timing-sensitive, short-term, continuous, and reversible. Based on the information above, a summary of residual effects on groundwater quality during the construction phase is provided in Table 8.9.

Table 8.9 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	Release of treated waste to groundwater as part of regular operation of septic fields and other sewerage works from the Codroy temporary accommodations camp is expected to adversely affect groundwater quality in the vicinity of the disposal field.
Port au Port Wind Farm and Associated Infrastructure	Turbid water infiltrating to groundwater during construction dewatering for turbine foundation installation. Standard mitigation practices will prevent effects from being realized.
Codroy Wind Farm and Associated Infrastructure	Turbid water infiltrating to groundwater during construction dewatering for turbine foundation installation
230 kV Transmission Lines and Substations	No effect anticipated
Hydrogen / Ammonia Production and Storage Facilities	Turbid water infiltrating to groundwater during construction dewatering for turbine foundation installation
Port Facilities	No effect anticipated

8.5.2.2 Operation and Maintenance

Pathways that affect groundwater quality during Operation and Maintenance, as outlined in Section 8.3.4, include the release of treated waste from the Hydrogen/Ammonia Production and Storage Facility septic system.

The effects related to septic fields and other sewerage works required for the Hydrogen/Ammonia Production and Storage Facility during operations are similar to the construction phase and are limited through engineering design and regulatory setbacks defined in provincial guidelines.

Effects of Project Operation and Maintenance on groundwater quality are expected to be moderate in magnitude, restricted to the LAA, not timing-sensitive, medium-term, continuous, and reversible. Based on the information above, a summary of residual effects on groundwater quality during the operation and maintenance phase is provided in Table 8.10.

Table 8.10 Summary of Effects by Project Component During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	No effect anticipated
Codroy Wind Farm and Associated Infrastructure	No effect anticipated
230 kV Transmission Lines and Substations	No effect anticipated
Hydrogen / Ammonia Production and Storage Facilities	Release of treated waste to groundwater as part of regular operation of septic fields and other sewerage works from Hydrogen/Ammonia Production and Storage Facility is expected to adversely affect groundwater quality in the vicinity of the disposal field.
Port Facilities	No effect anticipated

8.5.2.3 Decommissioning and Rehabilitation

Pathways that affect groundwater quality during Decommissioning and Rehabilitation, as outlined in Section 8.3.4, include the release of treated waste from the Codroy temporary accommodations camp septic system.

The effects related to septic fields and other sewerage works required for the Codroy temporary accommodations camp septic system are similar to construction and are limited through engineering design and regulatory setbacks defined in provincial guidelines.

Effects of Project Decommissioning and Rehabilitation on groundwater quality are expected to be moderate in magnitude, restricted to the LAA, not timing-sensitive, short-term, continuous, and reversible. Based on the information above, a summary of residual effects on groundwater quality during the decommissioning and rehabilitation phase is provided in Table 8.11.

Table 8.11 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	Release of treated waste to groundwater as part of regular operation of septic fields and other sewerage works from the Codroy temporary accommodations camp is expected to adversely affect groundwater quality in the vicinity of the disposal field.
Port au Port Wind Farm and Associated Infrastructure	No effect anticipated
Codroy Wind Farm and Associated Infrastructure	No effect anticipated
230 kV Transmission Lines and Substations	No effect anticipated
Hydrogen / Ammonia Production and Storage Facilities	No effect anticipated
Port Facilities	No effect anticipated

8.5.3 Residual Environmental Effects Summary

8.5.3.1 Residual Environmental Effects Characterization

Overall, residual effects of the Project on groundwater resources are predicted to be adverse and low to moderate in magnitude given that there will be measurable changes greater than the range of natural variability (*e.g.*, expected drawdown from water supply wells is greater than seasonal fluctuations in groundwater levels). However, that does not change the use of groundwater for adjacent groundwater users (*e.g.*, existing water supply wells and surface water bodies receiving groundwater recharge). Residual effects are anticipated to be limited to the LAA and range in duration from short-term to medium-term. Residual effects will occur either as multiple irregular events or continuously, be reversible following decommissioning and rehabilitation, and occur in areas that range from primarily undisturbed (i.e., at the wind farm sites) to previously disturbed (i.e., at the site of the Hydrogen/Ammonia Production and Storage Facility). Table 8.12 summarizes the predicted environmental effects (residual effects) of the undertaking on groundwater.

8.5.3.2 Summary of Predicted Environmental Effects

During construction, if groundwater is encountered in excavations for wind turbine and Hydrogen/Ammonia Production and Storage Facility foundation installation, temporary dewatering may be required. Conservative estimates indicate a zone of influence (i.e., the distance over which water table drawdown could be measurable in response to dewatering) of up to 74 m from an excavation.

Water supply wells may be used for the Codroy accommodations camp and for concrete production for wind turbine foundations, which could result in localized lowering of the water table in the vicinity of each water supply well. These effects are quantified as part of regulatory requirements following installation and testing of supply wells.

Water levels in Mine Pond will be controlled by on-demand flow from the Muddy Pond pump house to Mine Pond through a large-diameter pipeline. Further, there is evidence that Mine Pond is a perched pond, which would indicate limited interaction between surface water levels in the pond and the surrounding aquifer. Potential effects to groundwater quality from discharge of groundwater from construction dewatering and the release of treated waste from septic systems are mitigated through a variety of provincial and federal standards and codes of practice. Residual effects will be localized to setback distances defined in these regulations.

Table 8.12 Summary of Predicted Environmental Effects of the Undertaking on Groundwater Resources

Residual Effect	Residual Effects Characterization							
	Nature	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Construction								
Groundwater Quantity	A	M	LAA	MS	ST	IR/C	R	U
Groundwater Quality	A	M	LAA	NS	ST	C	R	U
Operation and Maintenance								
Groundwater Quantity	A	L	LAA	MS	MT	C	R	U
Groundwater Quality	A	M	LAA	NS	MT	C	R	D
Decommissioning and Rehabilitation								
Groundwater Quantity	A	M	LAA	MS	ST	C	R	U
Groundwater Quality	A	M	LAA	NS	ST	C	R	U

KEY:

Nature:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Timing:
NS: No Sensitivity
MS: Moderate Sensitivity
HS: High Sensitivity

Frequency:
S: Single Event
IR: Irregular Event
R: Regular Event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

8.6 Determination of Significance

A significant residual adverse effect on groundwater resources is defined as a residual Project-related change to the environment that results in any of the following:

- Decrease in the yield from an existing and otherwise adequate groundwater supply well to the point where it is inadequate for its intended use.
- Change in groundwater quality, such that the quality of groundwater from an otherwise adequate water supply well that meets applicable guidelines deteriorates to the point where it becomes non-potable or cannot meet the GCDWQ (Health Canada 2022) for a consecutive period exceeding 30 days.
- Physical or chemical alteration to an aquifer to the extent that interaction with local surface water results in streamflow or surface water chemistry changes that adversely affect aquatic life or a down-stream surface water supply.

In consideration of the VEC-specific significance criteria defined above, and with application of mitigations defined in Section 8.4, the residual effects of routine Project activities on groundwater resources (i.e., groundwater quantity and quality) are predicted to be not significant.

As foundations depths are relatively shallow in comparison to the depth to the water table, and construction dewatering is a temporary activity, the zone of influence for dewatering activities related to foundation construction is not predicted to extend beyond the LAA.

Potential water supply wells for the Codroy temporary accommodations and the concrete batch plant will have aquifer testing completed as part of the *Permit to Construct a Non-Domestic Well* once locations are chosen and construction begins. As part of reporting required under the permit, an evaluation of effects to existing wells and surface water bodies is completed. If the operation of the well is anticipated to cause a significant residual effect on groundwater quantity or quality, the permit may be rejected.

The use of Mine Pond as an industrial water supply will have limited effects on groundwater due to the relatively small fluctuations in operational water levels expected throughout the Project. Effects on groundwater are further reduced by water level controls from the industrial pipeline, the perched nature of the pond, and the lack of adjacent groundwater users.

Septic systems are designed and constructed such that affected groundwater is limited to the appropriate setback distance (16 m for drilled wells [NLDHCS 2010]). Since there are no groundwater users within this distance, the effect of the septic system on groundwater quality is not significant. Effects on groundwater quality due to the discharge of water from construction dewatering activities will be of short duration and mitigated through an Erosion & Sediment Control Plan and are not considered significant.

The level of confidence in this prediction is discussed in Section 8.7.

8.7 Prediction Confidence

The predicted effects to groundwater quantity from the Project are based on analytical groundwater flow solutions and a numerical model prepared by Fracflow. The inputs to the analytical solution were based on the baseline groundwater study which consisted of a review of existing reports and did not include field investigations. As such, the confidence in the prediction of effects on groundwater quantity is considered moderate.

As discussed in Section 8.3.5.1, predictions made using the analytical solution are based on several conservative assumptions to reduce the influence of uncertainty in the predictions, including the assumption of aquifer hydraulic conductivity being equal to the highest value used in provincial wellhead protection area mapping, and the water table depth being equal to the 10^{th} percentile depth from records in the NLDECC Drilled Water Well Database. These assumptions result in a conservative prediction of the zone of influence of water takings associated with Project activities.

The predicted effects to groundwater quality from the Project are based on the well documented, routine nature of construction dewatering and septic design in Newfoundland and Labrador. Mitigation will be in accordance with a variety of provincial and federal standards and codes of practice. As such, the confidence in the prediction of effects on groundwater quality is considered high.

8.8 Follow-Up and Monitoring

Follow-up and monitoring are intended to verify the accuracy of predictions made during the EA, to assess the implementation and effectiveness of mitigation, and to manage adaptively, if required. A Groundwater and Surface Water Monitoring Plan will be submitted for review and approval prior to the start of construction. Compliance monitoring, where required by permitting or regulations, will be conducted to confirm that mitigation measures are properly implemented. Should an unexpected deterioration of the environment be observed as part of follow-up and/or monitoring, intervention mechanisms will include the adaptive management process. This may include identification of existing and/or new mitigation measures to be implemented to address it (*e.g.*, increased sediment and erosion control, setting limits on water supply pumping rates). Follow-up or monitoring required by applicable permits will be provided, as appropriate, to regulators. Follow-up and monitoring to be implemented includes:

- Maintenance of erosion and sediment control measures used at each turbine foundation site, including documentation and response to uncontrolled release.
- Record of pumping volumes from water supply wells installed for the Codroy temporary accommodations camp and concrete batch plant to confirm sustainable yields and identify potential well interference.

- Installation of monitoring wells, or use of existing monitoring wells, in the vicinity of Mine Pond to confirm changes in aquifer water levels induced by the operation of Mine Pond as an industrial water supply.
- Inspection records for septic fields and other sewerage works associated with the Codroy temporary accommodations camp and the Hydrogen/Ammonia Production and Storage Facility.

8.9 Capacity of Renewable Resources and Effects on Biological Diversity

The assessment above concluded that routine Project activities are not likely to result in significant residual adverse effects on groundwater resources. Therefore, adverse Project-related effects on the capacity of renewable resources to meet the needs of the present and those of the future are not anticipated with respect to groundwater resources. Similarly, adverse Project-related effects on biological diversity that exceed the limits of natural variability or affect the long-term viability of biological diversity in the RAA are not anticipated with respect to groundwater resources.

8.10 Predicted Future Environmental Conditions if the Project Does Not Proceed

If the project is not allowed to proceed, the existing conditions as described in the baseline section will continue to prevail, including current land use and natural conditions. It is possible that future development may occur in the area, including wind energy (given those Project areas are designated for wind farm development), but neither the likelihood nor extent of such development can be reasonably predicted at this time based on currently known information. Future projects are anticipated to have similar effects on groundwater resources. Should the wind reserves remain undeveloped, the predicted future condition of groundwater resources would be relatively unchanged from what is discussed in the existing environment portion of this assessment, although groundwater resources could change over time as a result of other development or climate change.

8.11 References

8.11.1 Literature Cited

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9.0 Surface Water Resources

9.1 Scope of Assessment

Surface water is an integral part of the hydrological cycle and effects of the Project will be considered for both surface water quantity and quality, and how changes in these two characteristics may influence human and ecological use. Surface water was assessed as a valued environmental component (VEC) because it can both influence and be influenced by Project activities.

Specifically, surface water resources was selected as a VEC for the following reasons:

- Importance as an ecosystem (recreation and aquatic life habitat)
- Potential for Project-related effects on both surface water quality and quantity, including or resulting from:
  - Potential changes to surface water quality associated with surface water runoff during construction
  - Potential changes to surface water quality associated with project effluent discharging from the hydrogen / ammonia facility during operations
  - Potential changes to hydrological or hydrometric conditions, and effects of lowering the water table on aquatic ecosystems

Surface water is closely linked to other VECs including Groundwater Resources (Chapter 8); Fish and Fish Habitat (Chapter 10); and Wetlands and Vegetation (Chapter 12). The potential environmental effects of changes to surface water resources on these VECs are discussed in their respective sections of the Environmental Impact Statement (EIS).

9.1.1 Regulatory and Policy Setting

In addition to the NL *Environmental Protection Act, 2002*, and associated Environmental Assessment Regulations, the Project is subject to federal and other provincial legislation, policies and guidance. This section identifies the primary regulatory requirements and policies of the federal and provincial authorities that influence the scope of the assessment on groundwater resources.

9.1.1.1 Federal Regulatory Requirements

Guidelines for Canadian Drinking Water Quality (2022)

Guidelines for potable water are established by Health Canada in collaboration with the Federal-Provincial-Territorial Committee on Drinking Water. Guidelines for Canadian Drinking Water Quality (GCDWQ) are applicable as aesthetic and health-based guidelines for a variety of chemical parameters for potable water sources (Health Canada 2022).

Canadian Water Quality Guidelines for Protection of Aquatic Life (2018)

The Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life (CWQG-FAL) and Marine Aquatic Life (CWQG-MAL) are established by the Canadian Council of Ministers of the Environment (CCME). These guidelines are developed collaboratively among provincial, territorial, and federal jurisdictions and regularly updated to reflect current toxicology information and guideline derivation approaches.

Fisheries Act

The federal *Fisheries Act* is administered primarily by Fisheries and Oceans Canada (DFO) with some provisions administered by Environment and Climate Change Canada (ECCC). The *Fisheries Act* protects fish and fish habitat and addresses national interests in marine and fresh waters with the goal of protecting the long-term sustainability of aquatic resources. The *Fisheries Act* includes prohibitions against works, undertakings or activities that result in the harmful alteration, disruption or destruction (HADD) of fish habitat (section 35(1)). Works can be approved by and carried on in accordance with conditions established by the Minister of Fisheries, Oceans and the Canadian Coast Guard (Fisheries Minister) (section 35(2)(b)). Such work requires an authorization with an appropriate offsetting of residual adverse effects after avoidance and mitigation steps have been taken. HADD of fish habitat is defined under the *Fisheries Act* policies as "any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life processes of fish."

The *Fisheries Act* also prohibits the carrying out of a work, undertaking or activity, other than fishing, that results in the death of fish (section 34.4(1)), subject to certain exemptions including under an authorization from the Fisheries Minister (section 34.4(2)(b)). Additionally, section 34.3(2) provides provisions for maintaining adequate flow and respecting the free passage of fish. The Framework for Assessing Ecological Flow Requirements to Support Fisheries in Canada (DFO 2013) provides guidance on the management of flows required to maintain the ecological functions that sustain fisheries in streams and rivers potentially affected by water withdrawals.

Sections 36(3) and (4) of the federal *Fisheries Act* prohibits the deposition of deleterious substances into waters frequented by fish in Canada unless authorized by regulation.

9.1.1.2 Provincial Regulatory Requirements

NL *Environmental Protection Act*

A certificate of approval (CofA) under the NL *Environmental Protection Act* is issued by the Pollution Prevention Division of the Newfoundland and Labrador Department of Environment and Climate Change (NLDECC) for both construction and operation phases and sets concentration limits for specific parameters in the discharge effluent. The CofA also grants approval for the construction and operation of the Project.

NL *Water Resources Act* (2002)

The *Water Resources Act* gives the NL Water Resource Management Division (NLWRMD) of the NL DECC the responsibility for the management of water resources in the province. The NL *Water Resources Act* provides regulations surrounding the alteration of a body of water. These include changing the direction of flow, altering the quantity of water, impoundment or displacement, or changing of drainage characteristics for the purposes of water crossings structures (e.g., culverts).

The NL *Water Resources Act* includes the Environmental Control Water and Sewage Regulations (ECWSR), which provides regulations surrounding the discharge of sewage and other effluent (NLDECC 2003). As this Project does not fall within one of the established industry classes outlined in the ECWSR, a list of parameters of potential concern (POPCs) from these regulations were selected as applicable effluent limits for the Project. These POPC constituents include phosphorus (0.0005 mg/L), nitrates (10 mg/L), nitrogen (ammonia) (2.0 mg/L), pH ($5.5 \leq pH < 9.0$) and temperature (65°C max.) (NLDECC 2003).

9.1.2 Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for the Surface Water VEC were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur on the VEC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VEC. The spatial and temporal boundaries associated with the effects assessment for the Surface Water VEC are described in the following sections.

9.1.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on surface water resources in areas surrounding the Project components (Figure 9.1 and Figure 9.2):

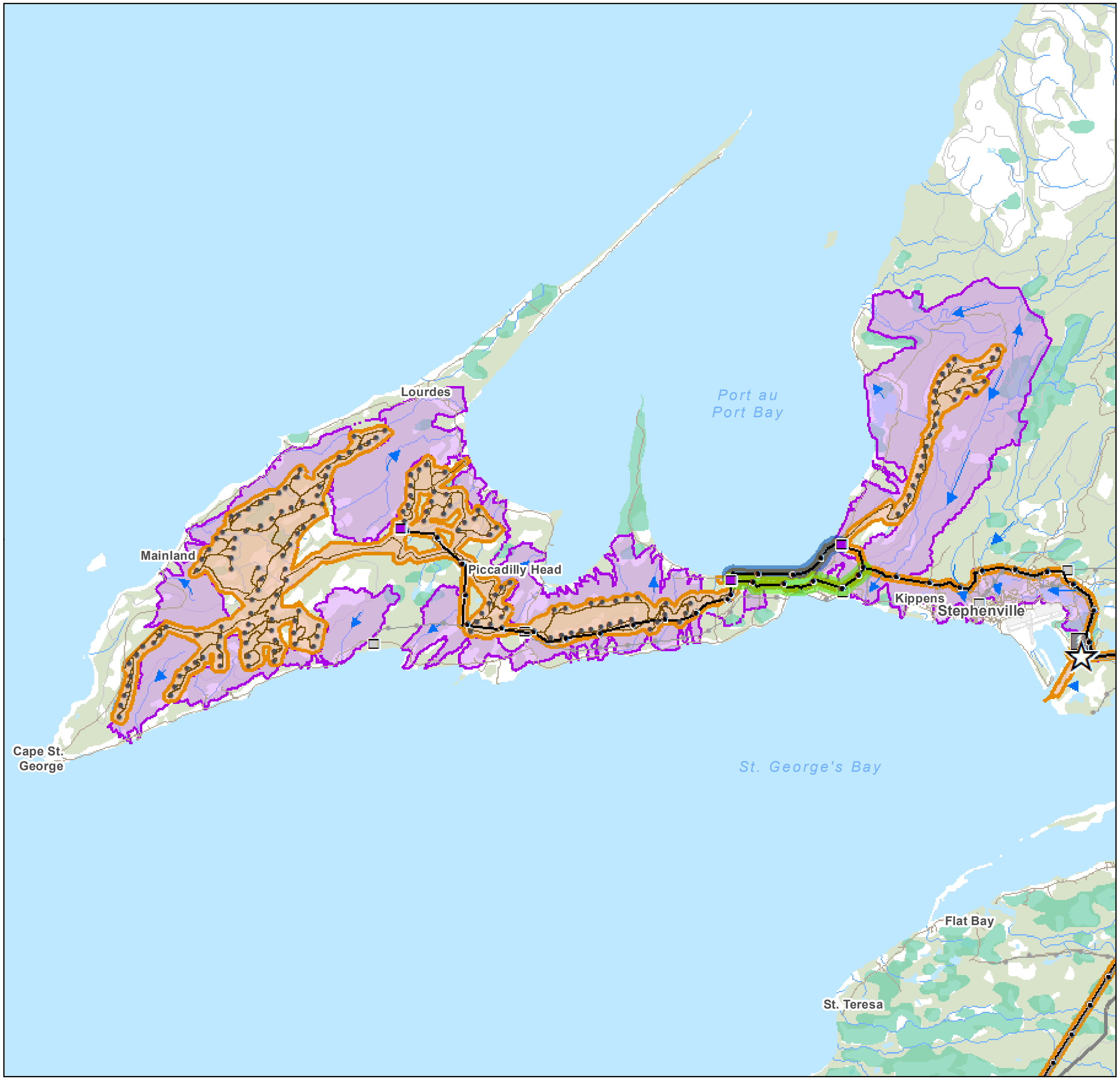
- Project Area: The Project Area encompasses the immediate area in which the Project activities and components occur and is comprised of the following distinct areas: the Port au Port Wind Farm, the Codroy Wind Farm, the Hydrogen/Ammonia Production and Storage Facility (hydrogen / ammonia plant), Port Facilities, and the 230 kilovolt (kV) Transmission Lines, as well as associated infrastructure including roads, substations, and water supply intake infrastructure. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project. In addition to encompassing the immediate area in which Project components and activities will occur, the Project Area also includes a buffer of up to 300 m for access roads and turbines and a 350 m corridor to accommodate the 70 to 75 m wide RoW for the transmission line. These buffers allow flexibility for the micro-siting of Project components during detailed design, based on technical considerations as well as the avoidance of environmentally sensitive areas, where practicable.

- The local assessment area (LAA) is the area adjacent to the Project Area where there is the potential for direct Project-related effects on surface water. The potential effects related to surface water quantity and surface water quality during construction activities were used as a basis for delineating the LAA. For this VEC, the LAA encompasses the topographic catchment area of site watercourses and waterbodies located downstream of project infrastructure.
- The regional assessment area (RAA) is the area adjacent to the LAA where there is the potential for indirect and/or cumulative Project-related effects on surface water. As the environmental effects of the Project on surface water resources are not expected to extend to the boundaries of the RAA, the RAA for this VEC is based on the delineated watershed area contributing surface flow to defined watercourses and waterbodies, from headwater to defined outlet point, in which project infrastructure is contained.

9.1.2.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on groundwater resources include:

- Construction: Overall the construction phase of the Project will be from Q4 2023 through Q2 2027, pending EA approval and receipt of other required permits and approvals. Early civil works are planned to start Q4 2023 through Q3 2024. Construction of the Port au Port Wind Farm and associated infrastructure is expected to start in Q3 2024 with completion of the construction in Q1 2026. Construction of the Codroy Wind Farm and associated infrastructure is expected to start Q4 2025 with completion in Q1 2027. The hydrogen / ammonia Production and Storage Facility will be constructed in phases from Q2 2024 to Q1 2026. Grid power sources are planned for hydrogen production in 2025 until March 2026, when the electrolyzer is commissioned.
- Operation and maintenance: Wind farm commissioning is anticipated to start Q1 2026 at the Port au Port Wind Farm and Q2 2027 at the Codroy Wind Farm. The 600 MW electrolyzer expected to be commissioned in Q1 2026. The operational life of the Project is 30 years at each site.
- Decommissioning and rehabilitation: After a 30-year operational life, the decommissioning phase is anticipated to occur during 2057 and 2058. Decommissioning is anticipated to begin Q1 2057 at the Port au Port Wind Farm, with completion in Q3 2058 at the Codroy Wind Farm.



Stantec

Project Area

Local Assessment Area

Proposed Project Features
- Turbine Location
- Substation
- Hydrogen / Ammonia Plant Location
- Transmission Line 230 kV

Port au Port Interconnection
- Proposed Route
- Alternate Route
- Access Road

Other Features
- Substation, Existing
- Electrical Generation, Existing
- Transmission Line, Existing
- Trans-Canada Highway
- Road
- Contour (100 m)
- Flow Direction
- Watercourse
- Waterbody
- Wetland
- Forested Area

N

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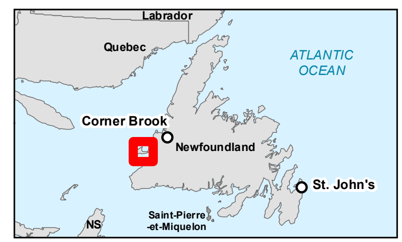
Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: Stantec, GovNL IET, World Energy GH2, NRCan CanVec, OpenStreetMap
3. Background: NRCan CanVec



Project Location
Stephenville
NL

Prepared by XX on 7/31/2023
QR by AW on 2023-07-31

Client/Project
World Energy GH2
Project Nujio'qonik

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Figure No.
9.1

Page 1 of 3

Local Assessment Area (Port au Port Wind Farm)

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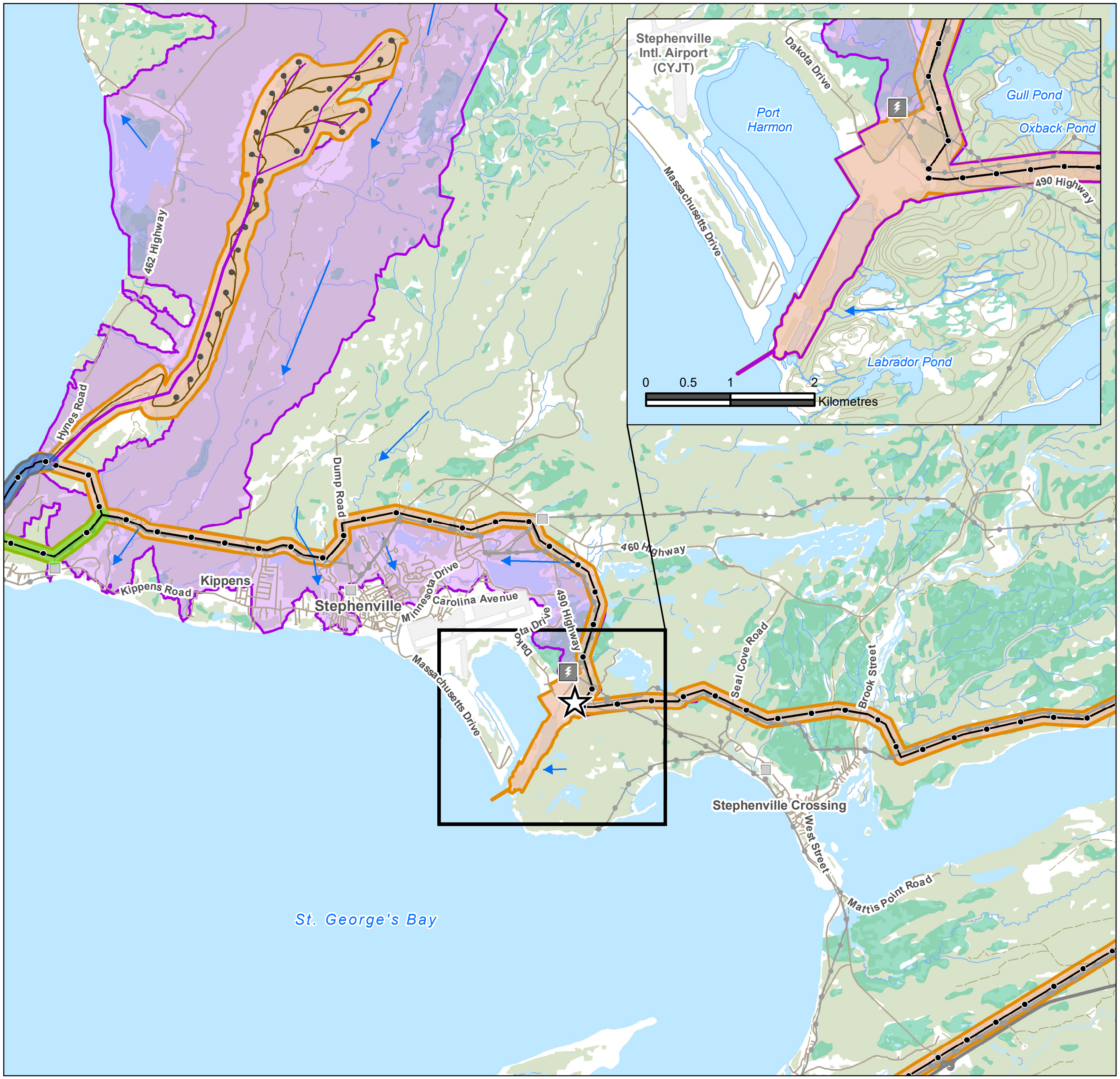

Stantec

Project Area

Local Assessment Area

Proposed Project Features

- Turbine Location
- Hydrogen / Ammonia Plant Location
- Transmission Line 230 kV

Port au Port Interconnection

- Proposed Route
- Alternate Route
- Collector Line
- Access Road

Other Features

- Substation, Existing
- Electrical Generation, Existing
- Transmission Line, Existing
- Trans-Canada Highway
- Road
- Resource Road / Trail
- Contour (20 m)
- Flow Direction
- Watercourse
- Waterbody
- Wetland
- Forested Area

N

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Notes

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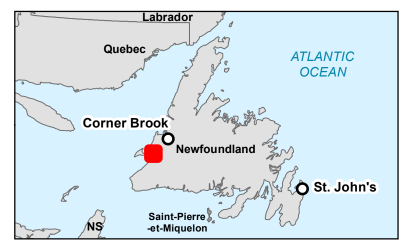
3. Background: NRCan CanVec



Project Location
Stephenville
NL

Prepared by NW on 2023-07-13
QR by AW on 2023-07-31

Client/Project
World Energy GH2
Project Nujio'qonik

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Figure No.
9.1

Page 2 of 3

Local Assessment Area (Stephenville Plant Location)

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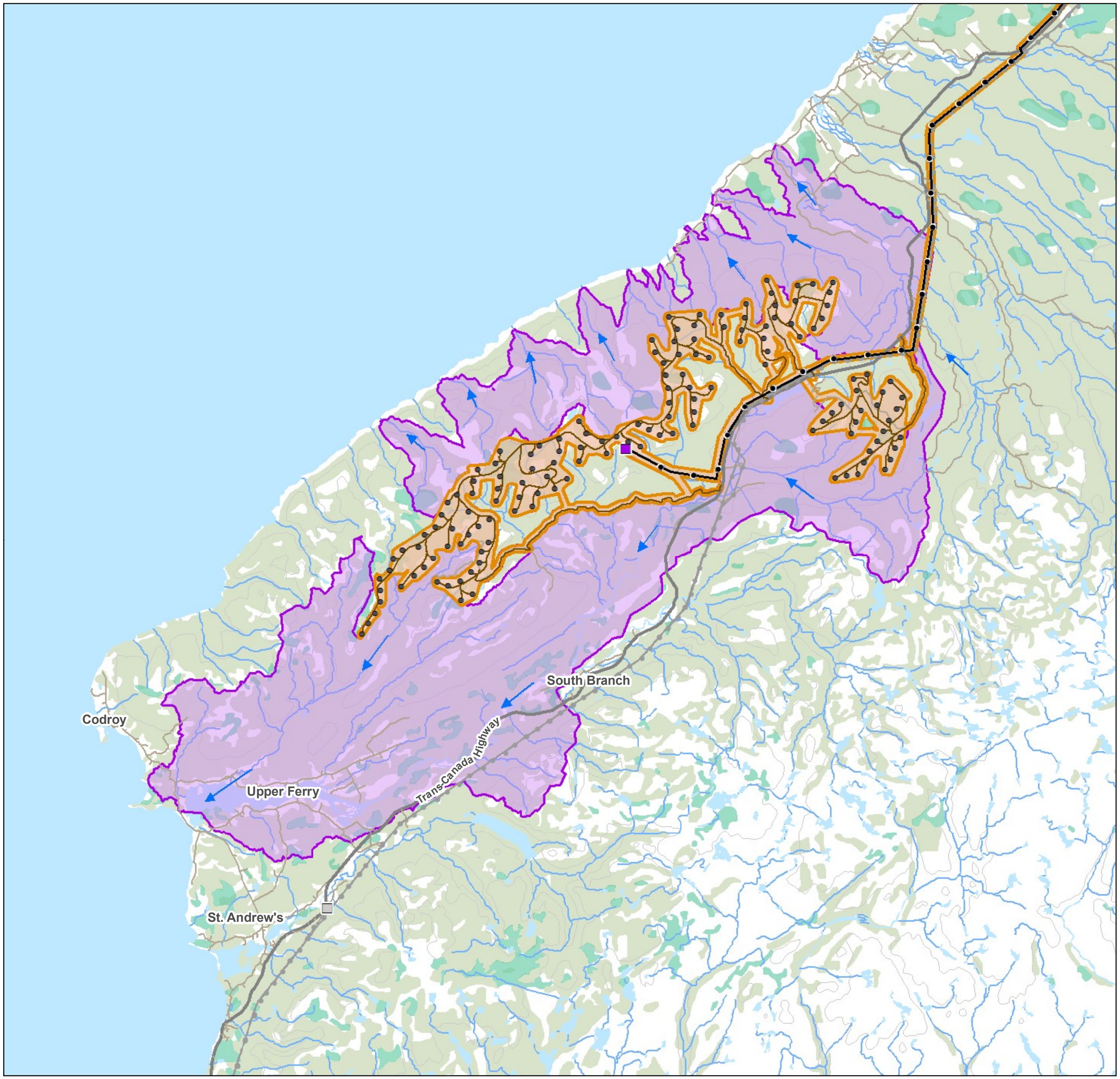

Stantec

Legend	
Project Area	
Local Assessment Area	
Proposed Project Features	
Turbine Location	
Substation	
Transmission Line 230 kV	
Access Road	

Other Features

- Substation, Existing
- Transmission Line, Existing
- Trans-Canada Highway
- Road
- Contour (100 m)
- Flow Direction
- Watercourse
- Waterbody
- Wetland
- Forested Area

N

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2. Data Sources: Stantec, GovNL IET, World Energy GH2, NRCan CanVec, OpenStreetMap
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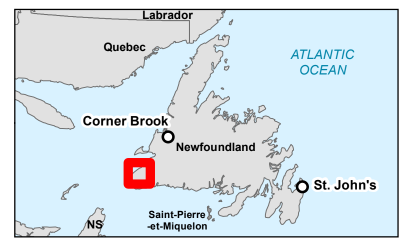

Project Location
Stephenville
NL

Prepared by NW on 2023-07-13
QR by AW on 2023-07-31

Client/Project
World Energy GH2
Project Nujio'qonik

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Figure No.
9.1

Page 3 of 3

Local Assessment Area (Codroy Wind Farm)

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Stantec

Regional Assessment Area

Proposed Project Features

- Hydrogen / Ammonia Plant Location
- Transmission Line 230 kV
- Project Area

Other Features

- Transmission Line, Existing
- Trans-Canada Highway
- Road
- Watercourse
- Waterbody
- Forested Area

N

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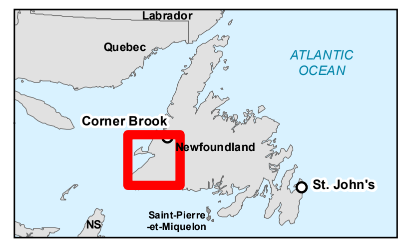

Project Location
Stephenville
NL

Prepared by NW on 2023-07-13
QR by AW on 2023-07-31

Client/Project
World Energy GH2
Project Nujio'qonik

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Figure No.
9.2

Regional Assessment Area

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9.2 Existing Environmental Conditions

A characterization of the existing conditions within the spatial boundaries defined in Section 9.1.2 is provided in the following sections. This includes a high-level discussion of the influences of past and present physical activities on the VEC, leading to the current conditions. An understanding of the existing conditions for the VEC within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 9.3.

Baseline surface water quantity and quality data will be used for comparison and compliance during each Project phase. These data will be used for monitoring potential interactions between Project activities and the VEC. Data collection sites for water quality may also be used for compliance monitoring, particularly during the construction phase.

The following is a summary of the methods and results of the baseline study. For more information, see the Aquatic Environment Baseline Study (BSA-2).

9.2.1 Methods

Existing surface water conditions were assessed using publicly available data and supporting design and planning studies specific to the Project. The following publicly available data sources were used to support the Aquatics Environment Baseline Study (BSA-2) of surface water resources:

- Publicly available Geographic Information Systems (GIS) data, including hydro network and topographic contours (CANVEC 2023, NLFFAFSB 2018
- Hydrometric regional regression for the Province of Newfoundland (AMEC 2014)
- Real-Time Water Quality Monitoring Station Data (NLDECC 2021)
- Surface water quantity data (Water Survey of Canada (WSC) hydrometric network)
- Regional surface water quality data (Water Quality Monitoring Agreement (WQMA) Sites)
- Surface source water supply mapping (Water Resources Portal)

This chapter also references the following supporting design and planning studies prepared for the Project:

- Fracflow (2023a), Industrial Water Supply Infrastructure, Stephenville, NL
- Fracflow (2022), Active Storage and Water Quality in Water Supply Ponds, Stephenville, NL
- Fracflow (2023b), Industrial Water Requirements, Stephenville, NL

9.2.1.1 Surface Water Quantity

Climate, physiography, topography, soils, vegetation cover and drainage area dictate surface water quantity in the LAA and RAA. Surface water quantity is estimated using regional regression relationship developed for the Province of Newfoundland and Labrador. The Project is located within Subregion D, a hydrologic zone encompassing the southwestern region of the island of Newfoundland (AMEC 2014). The regression relationships are developed using hydrometric station data from the WSC gauged watercourses located in Subregion D.

Stantec conducted regional analysis using the same regional boundaries and hydrometric stations to be consistent with previous efforts in regional analysis for the province (AMEC 2014). Estimates of mean monthly flow (MMF) and mean annual flow (MAF) were determined for each studied watershed using the Subregion D regional regression relationships.

MMF estimates for each watershed are compared to a threshold value of 30% of the MAF, as per the 2013 Department of Fisheries and Oceans (DFO) Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. Per the framework, changes to a flow regime that result in flows <30% of the MAF represent a heightened risk of impact to fisheries. In instances where the threshold value is exceeded, flows are compared to Environmental Flows defined by the NL Department of Municipal Affairs and Environment (NLDMAE) (2017). Environmental low flows were established, as outlined in Zadeh (2012), using relationships between the MAF and in-stream flow needs for the winter and summer periods. Recommended minimum flows for the winter and summer periods are 50% MAF and 30% MAF respectively, based on 'excellent' river conditions, as per Zadeh (2012).

Similarly, estimates of the 1:100 year flow event, the theoretical recurrence interval of a peak flow event that occurs once in century (Q100), was established for each watershed of interest. The Q100 value is a useful benchmark to estimate flow rates that have potential to mobilize sediment, erode channel banks, and induce geomorphological change.

9.2.1.2 Surface Water Quality

Baseline surface water quality data were obtained from various sources in the LAA. In the Port au Port Wind Farm region, data were collected from Community Water Resources Reports available on the Water Resources Portal (NLDECC 2023) for the communities Lourdes (Victor's Brook), Mainland (Caribou Brook), West Bay (Unnamed Brook), Port au Port/West-Aguathuna-Felix Cove (Jim Rowe's Brook) and Cape St. George (Rouzes Brook). These communities and water supplies are Protected Public Water Supply Areas (PPWSAs), and closely monitored for public safety. Although project infrastructure is not located within any of the PPWSAs, water quality from these sources was used in lieu of baseline data for the site as the baseline surface water monitoring program did not commence until mid-July 2023.

In the Codroy Wind Farm, no PPWSAs exist, and a single water quality monitoring station is located on the Grand Codroy River. This is a provincially monitored site, and samples are collected quarterly. A summary of the historical station data was completed in 2021 by the Water Resources Management Division of NLDECC (NLDECC 2021).

The Port of Stephenville has three ponds, Noels Pond, Muddy Pond, and Gull (Mine) Pond, that were monitored for water quality. Water from these ponds will be the source water used in the hydrogen and ammonia production facility, which will be on the site of a former paper mill with remaining industrial wastewater treatment and conveyance infrastructure. Pre-existing water quality data of the ponds are available from the paper mill's water monitoring program. The water quality monitoring program was continued in 2022 by Fracflow (Fracflow 2022). Three locations within each body of water are sampled: the inflow, outflow, and mid-pond. At each location, samples were collected at the surface and 1.5 m above the pond bed, where sufficient depth allowed.

Another consideration of water quality at the Port of Stephenville is the effluent treatment of wastewater from the hydrogen / ammonia production facility. Effluent will be released into the marine waters of St. George's Bay 500 m from the shoreline, bypassing Port Harmon and increasing mixing within the receiving environment. An Assimilative Capacity Assessment for the dilution capacity of the marine waters is included in Appendix 11-A. The Assimilative Capacity Assessment contains the following:

- Characterization of the effluent water from the hydrogen / ammonia plant, receiving water of the mixing zone, and diffuser outlet.
- Description of the re-dilution process of wastewater using a limited marine mixing zone with the commitment to meet the CCME Guidelines for the Protection of Marine Aquatic Life at the extent of the mixing zone.
- Mixing Zone Study completed using a Cornell Mixing Zone Expert System (CORMIX) modeling software that considers inputs determined in previous phases, including proposed reject process water quality, background water quality in receiving waters, and current profile of the receiving water.
- Development of end-of-pipe discharge criteria considering effluent quality required to meet environmental quality objectives (EQOs), CWQG-MAL, and ECWSR (see Section 9.1.1.2).

Analysis of available surface water quality data includes comparing available data to applicable guideline values, specifically the CCME guidelines (CWQG-FAL). Where surface water is used as a source of potable water supply, raw water quality is also screened using the Health Canada GCDWQ, which monitors different parameters and has more stringent limitations. Data for each location and parameter are presented with the minimum, mean, and maximum measurements. Effluent from the ammonia/hydrogen facility will be compared to POPC constituents (Section 9.1.1.2) including phosphorus (0.0005 mg/L), nitrates (10 mg/L), nitrogen (ammonia) (2.0 mg/L), pH ($5.5 \leq pH < 9.0$) and temperature (65°C max.) (NLDECC 2003).

In addition to the existing baseline water quality data sources, an additional surface water quality monitoring field program (SWMP) will be carried out within watersheds at the Port au Port and Codroy wind farms and associated infrastructure in conjunction with fish habitat assessment work in the Spring/Summer of 2023. The Aquatics Baseline Study proposed 11 surface water quality sites will be established to increase the density of data and provide pre-project baseline data. These stations can stay operational through the construction phase and act as monitoring compliance points. Monitoring locations will include watercourses within identified Protected Public Water Supply Areas (PPWSAs) providing surface water supply and a subset of select watercourses in major catchment areas at locations upstream and downstream of the proposed project infrastructure. The SWMP will be an adaptive management plan and may change upon completion of fieldwork and initial sample analysis. A separate report on the results of the SWMP will be prepared after data collection and analysis have been completed.

9.2.2 Existing Conditions

9.2.2.1 Surface Water Quantity

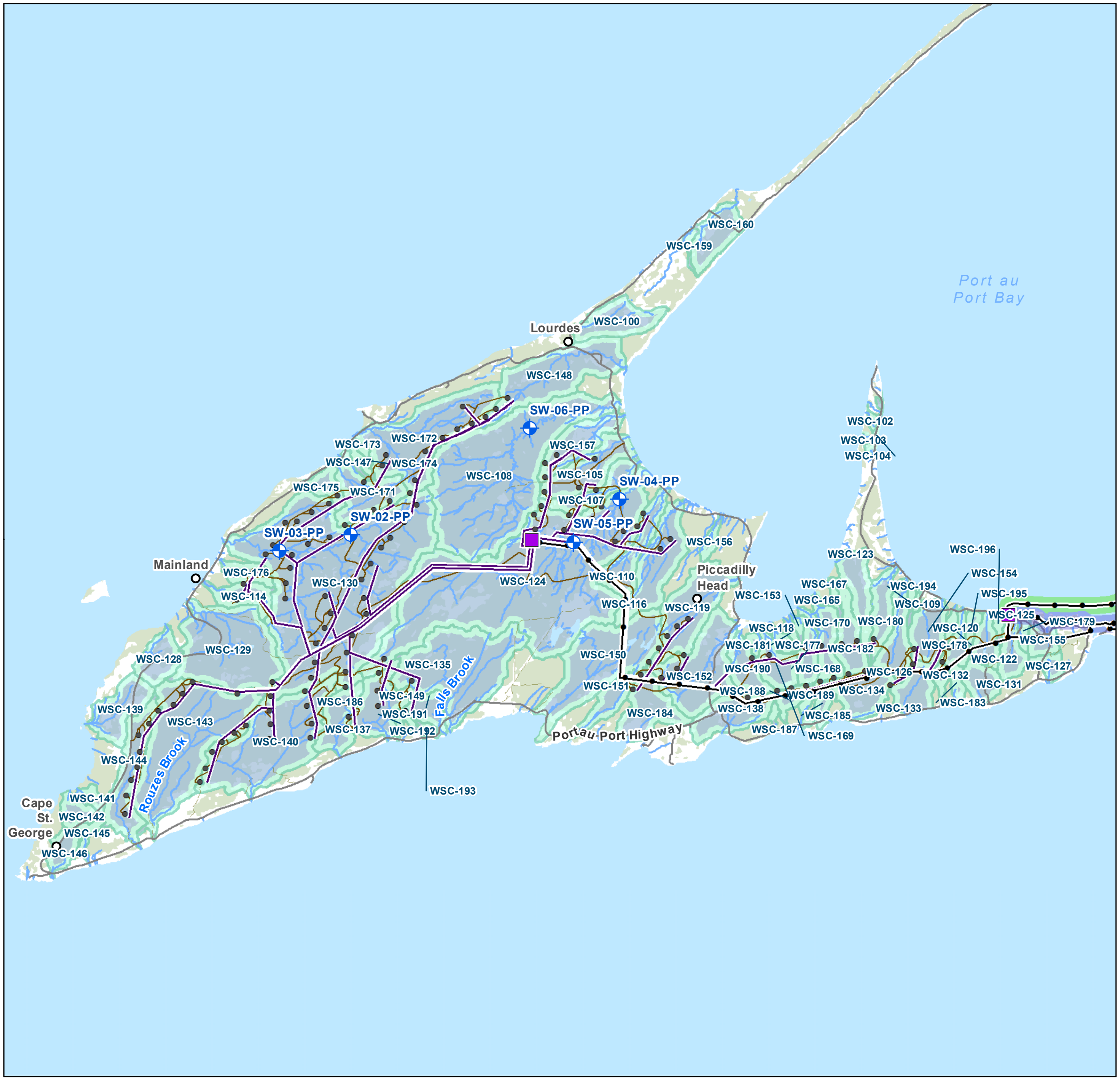
Surface water quantity was estimated for ten primary watersheds of the Port au Port Wind Farm. The ten primary watersheds are comprised of Rouzes Brook, Caribou Brook, Cointres Brook, Victor's Brook, Unnamed Brook-Piccadilly Head, Jim Rowe's Brook, Harry's Brook, Mainland Brook, Unnamed Brook-Cape St. George, and Falls Brook. Additionally, roughly 115 small coastal watersheds drain directly to the Gulf of St Lawrence on the western coast of the Port au Port peninsula; as these watersheds drain directly to the ocean, they were not considered in this analysis (Figure 9.3 and Figure 9.4). Land use in these watersheds primarily consists of forested land, with some developed areas in the form of roads and buildings near the shore and areas of wetlands and shrubs.

Surface water quantity was estimated for twelve project-related watersheds in the Codroy Wind Farm area. Two watersheds, the Grand Codroy and Rainy Brook, have large drainage areas (932 km^2, and 160 km^2, respectively) compared to the other ten watersheds with drainage areas of <30 km^2 and drain directly into the Gulf of St. Lawrence. The ten smallest watersheds include Little Spout Brook, French Brook, Shoal Point Brook, Butter Brook, and six more unnamed watersheds (A, B, C, D, E, F). The land type of all the watersheds is primarily forested, wetland, and shrubland, with little to no development. The region is mountainous with a natural watershed divided north of the wind farm site and divides the Grand Codroy River watershed from the other eleven coastal watersheds (Figure 9.5).

Surface water quantity at the Port of Stephenville was estimated for the Blanche Brook, Cold Brook, Warm Creek, and Gull Pond. Watershed areas range from 3.6 km^2 at Gull Pond to 129 km^2 at Blanche Brook (Figure 9.6).

Using the regression equations from the regional analysis, the MMFs and MAF for watersheds of interest were determined. Similarly, environmental low flows for the summer and winter months, represented by 30% and 50% MAF, respectively, were established. These environmental low flows are minimum flow thresholds, initially developed by Tennant (1976), that maintain "Excellent" habitat conditions for most aquatic life forms. Zadeh (2012) showed that Tennant's method provides the criteria for environmental low flows in NL compared to several other methodologies while maintaining reasonable flows for water extraction. Regression equations were also used to estimate the Q100 flow event. Table 9.1 includes MMF, MAF, seasonal environmental low flows, and the 1:100 year return period flood flow (Q100) for each watershed of interest.

Key findings for the Project watersheds in the baseline study are found in Table 9.2.



Stantec

Sampling Station

Proposed Project Features

- Hydrogen / Ammonia Plant Location
- Turbine Location
- Substation
- Access Road
- Collector Line
- Transmission Line 230 kV
- Proposed Route
- Alternate Route

Other Features

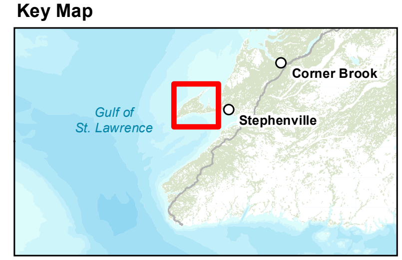
- Trans-Canada Highway
- Road / Highway
- Resource Road / Trail
- Watercourse
- Waterbody
- Watershed

N

0 2.5 5 Kilometres
(At original document size of 8.5x11)
1:225,000

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: Stantec; World Energy GH2; NL ECC Water Resources Management Division; NL Fisheries, Forestry and Agriculture; NRCan CanVec; OpenStreetMap
3. Background: NRCan CanVec

Key Map



Project Location
Stephenville
NL

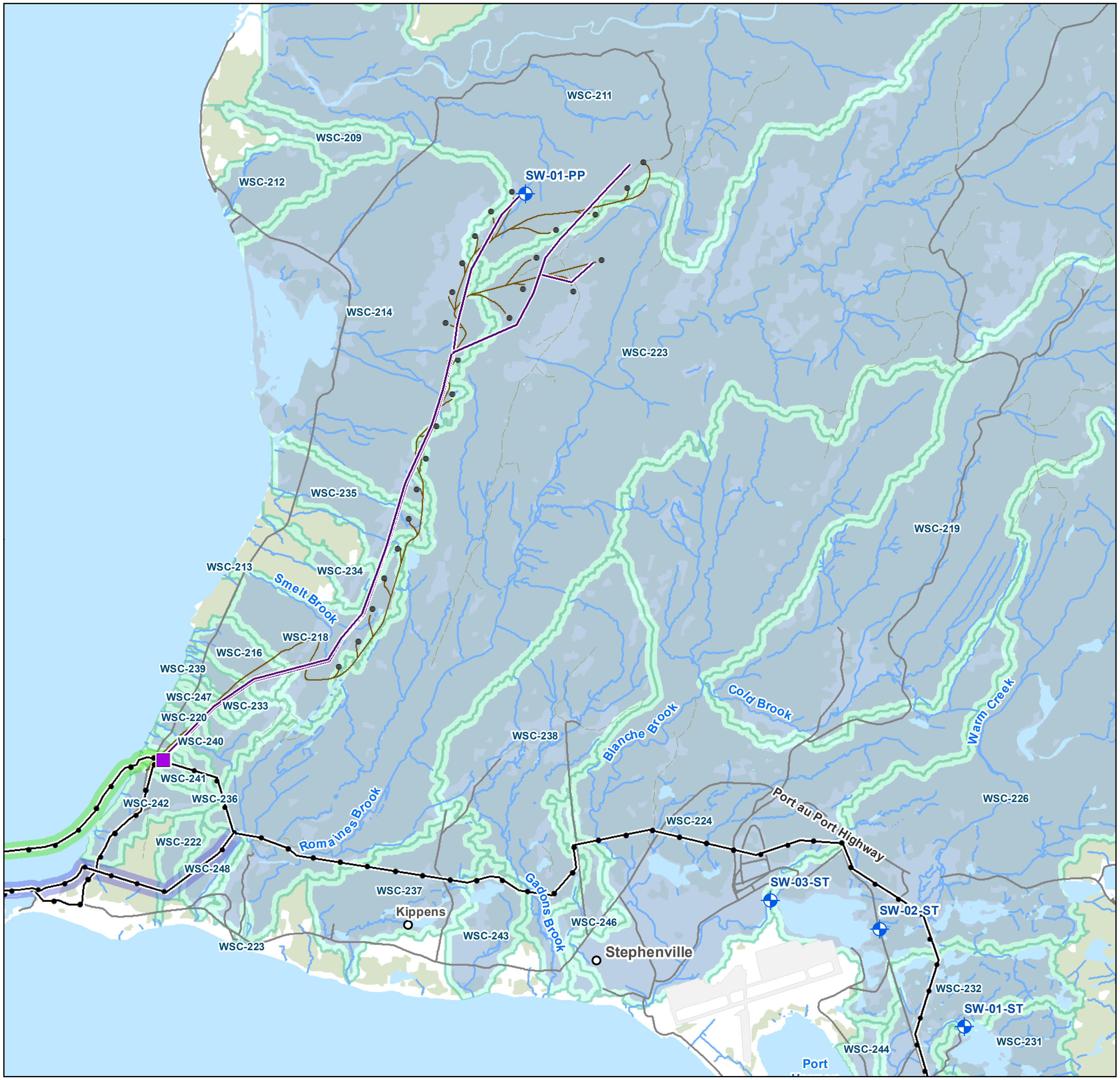
Prepared by NW on 2023-06-01
QR by AW on 2023-07-31

Client/Project
World Energy GH2
Project Nujio'qonik

Figure No.
9.3
121417233_071

Port au Port Wind Farm
Surface Water Sampling Stations

\\ca0151-PPFSS01\work_group\1214\active\121417233\03_data\gis_cad\gis_data\mapping\mxd\general\aquatics\121417233_071_SW_Sample_Stations_REVC.mxd Revised: 2023-08-04 By: NWhite



Stantec

Sampling Station

Proposed Project Features

Hydrogen / Ammonia Plant Location

Turbine Location

Substation

Access Road

Collector Line

Transmission Line 230 kV

Proposed Route

Alternate Route

Other Features

Trans-Canada Highway

Road / Highway

Resource Road / Trail

Watercourse

Waterbody

Watershed

N

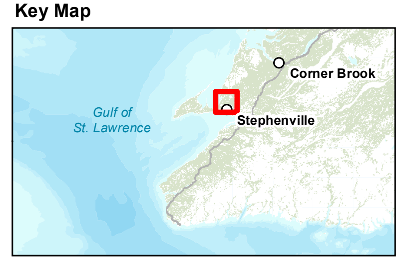
0 1 2 Kilometres

(At original document size of 8.5x11)
1:106,000

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: Stantec; World Energy GH2; NL ECC Water Resources Management Division; NL Fisheries, Forestry and Agriculture; NRCan CanVec; OpenStreetMap
3. Background: NRCan CanVec

Key Map



Project Location
Stephenville
NL

Prepared by NW on 2023-06-01
QR by AW on 2023-07-31

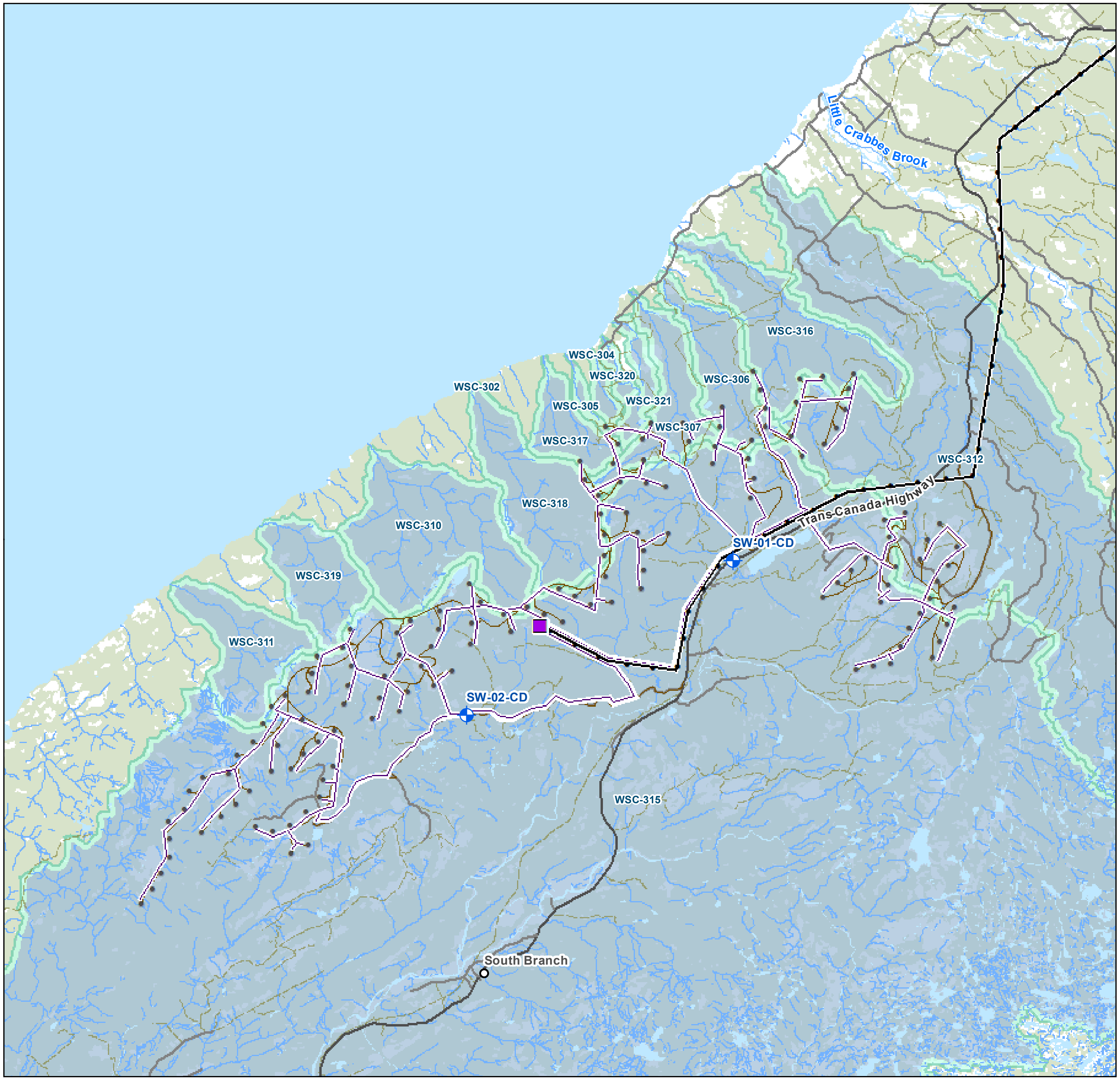
Client/Project
World Energy GH2
Project Nujio'qonik

Figure No.
9.4

121417233_071

Port au Port Wind Farm (East)
Surface Water Sampling Stations

\\ca0151-PPFSS01\work_group\1214\active\121417233\03_data\gis_cad\gis_data\mapping\mxd\general\aquatics\121417233_071_SW_Sample_Stations_REVC.mxd Revised: 2023-08-04 By: NWhite



Sampling Station

Proposed Project Features

Hydrogen / Ammonia Plant Location

Turbine Location

Substation

Access Road

Collector Line

Transmission Line 230 kV

Other Features

Trans-Canada Highway

Road / Highway

Resource Road / Trail

Watercourse

Waterbody

Watershed

N

0 2.5 5 Kilometres

(At original document size of 8.5x11)

1:232,000

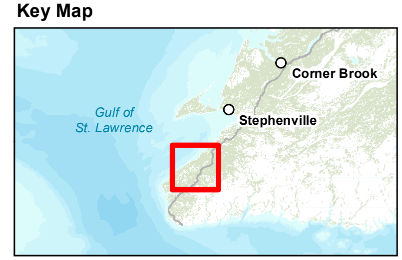
Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 21N

2. Data Sources: Stantec; World Energy GH2; NL ECC Water Resources Management Division; NL Fisheries, Forestry and Agriculture; NRCan CanVec; OpenStreetMap

3. Background: NRCan CanVec

Key Map



Project Location
Stephenville
NL

Prepared by NW on 2023-06-01
QR by AW on 2023-07-31

Client/Project
World Energy GH2
Project Nujio'qonik

Figure No.
9.5 121417233_071

Codroy Wind Farm
Surface Water Sampling Stations

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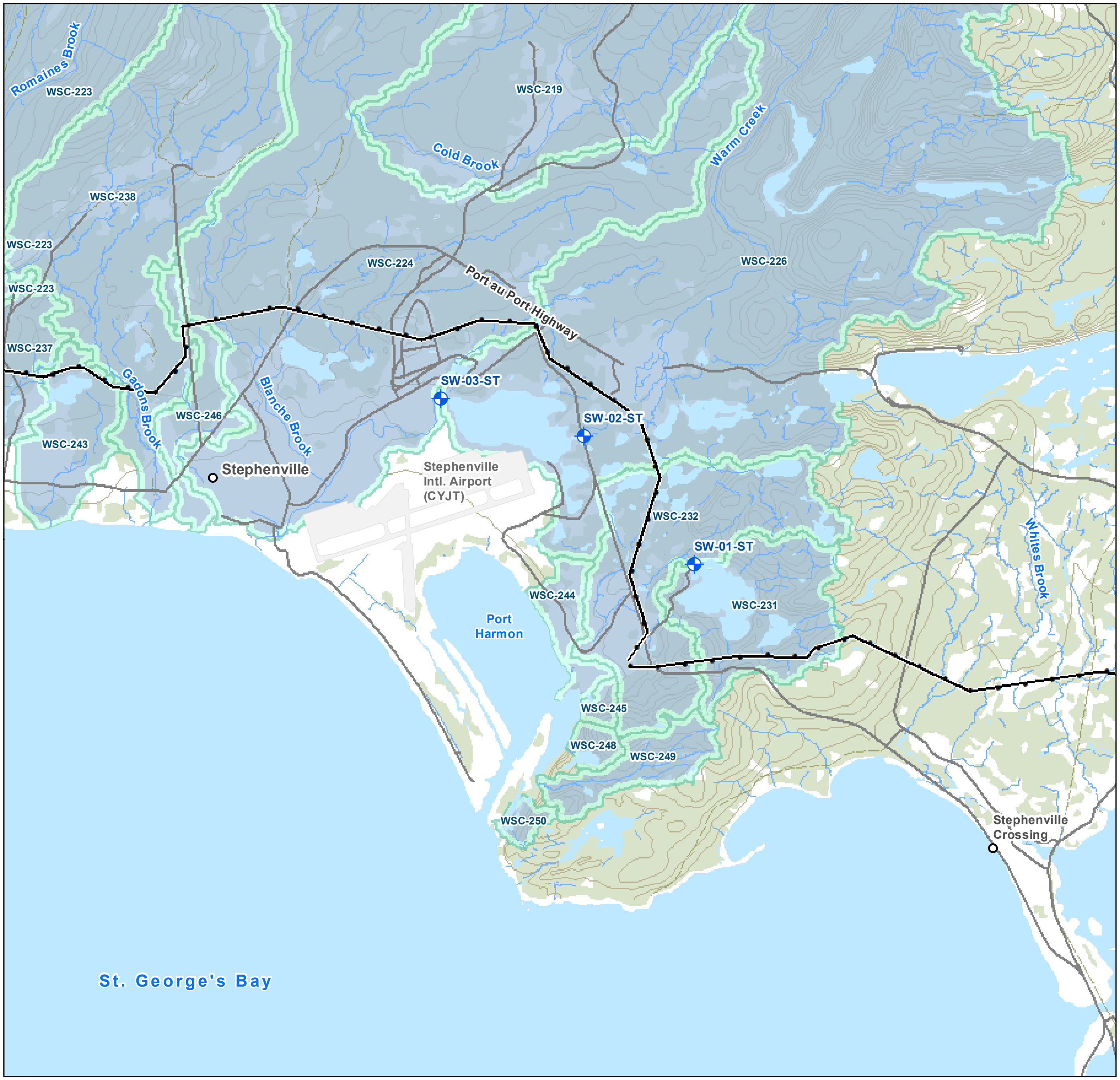


Stantec

Sampling Station

Proposed Project Features

Transmission Line 230 kV

Other Features

Trans-Canada Highway

Road / Highway

Resource Road / Trail

Watercourse

Waterbody

Watershed

N

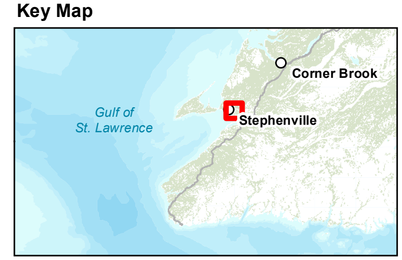
0 1 2 Kilometres

(At original document size of 8.5x11)
1:81,000

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: Stantec; World Energy GH2; NL ECC Water Resources Management Division; NL Fisheries, Forestry and Agriculture; NRCan CanVec; OpenStreetMap
3. Background: NRCan CanVec

Key Map



Project Location
Stephenville
NL

Prepared by NW on 2023-06-01
QR by AW on 2023-07-31

Client/Project
World Energy GH2
Project Nujio'qonik

Figure No.
9.6

121417233_071

Port of Stephenville
Surface Water Sampling Stations

\\ca0151-PPFSS01\work_group\1214\active\121417233\03_data\gis_cad\gis_data\mapping\mxd\general\aquatics\121417233_071_SW_Sample_Stations_REVC.mxd Revised: 2023-08-04 By: NWhite

Table 9.1 Pre-development Watershed Areas, MAF, MMF, Environmental Flows, and Flood Flows

Project Site	Watershed ID	Watershed Name	Watershed Area (km²)	MAF (m³/s)	MMF (m3/s)												Summer Env. Flow[1] (m³/s)	Winter Env. Flow[2] (m³/s)	Q100 (m³/s)
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Port au Port Wind Farm	WSC-108	Victors Brook	21.19	0.97	0.83	0.74	0.84	1.90	1.38	0.68	0.45	0.45	0.78	1.13	1.35	1.10	0.29	0.48	6.67
	WSC-116	Unnamed Brook	5.29	0.26	0.22	0.20	0.23	0.52	0.32	0.17	0.11	0.11	0.22	0.33	0.37	0.29	0.08	0.13	2.15
	WSC-124	Harrys Brook	34.01	1.52	1.30	1.16	1.30	2.94	2.28	1.10	0.72	0.72	1.20	1.73	2.11	1.73	0.46	0.76	9.80
	WSC-127	Jim Rowe's Brook	0.88	0.05	0.04	0.04	0.04	0.10	0.05	0.03	0.02	0.02	0.04	0.07	0.07	0.05	0.01	0.02	0.50
	WSC-128	Caribou Brook	2.40	0.12	0.10	0.10	0.11	0.25	0.14	0.08	0.05	0.05	0.11	0.16	0.17	0.14	0.04	0.06	1.13
	WSC-129	Cointres Brook	10.42	0.49	0.42	0.38	0.43	0.98	0.65	0.33	0.22	0.22	0.41	0.60	0.69	0.56	0.15	0.25	3.74
	WSC-130	Mainland Brook	34.83	1.56	1.33	1.19	1.32	3.01	2.34	1.13	0.73	0.74	1.22	1.77	2.16	1.77	0.47	0.78	10.00
	WSC-135	Falls Brook	10.73	0.51	0.43	0.39	0.45	1.01	0.67	0.34	0.23	0.23	0.42	0.62	0.71	0.58	0.15	0.25	3.83
	WSC-143	Rouzes Brook	14.02	0.65	0.56	0.51	0.57	1.29	0.89	0.45	0.30	0.30	0.54	0.78	0.92	0.74	0.20	0.33	4.76
	WSC-144	Unnamed Brook	4.70	0.23	0.20	0.18	0.21	0.47	0.28	0.15	0.10	0.10	0.20	0.29	0.33	0.26	0.07	0.12	1.96
Stephenville	WSC-219	Cold Brook (Sub)	30.5	1.37	1.17	1.05	1.17	2.66	2.03	0.99	0.64	0.65	1.09	1.57	1.90	1.56	0.41	0.69	8.97
	WSC-224/225	Blanche Brook	129.2	5.47	4.64	4.07	4.45	10.16	9.38	4.26	2.71	2.72	3.98	5.72	7.39	6.16	1.64	2.74	29.07
	WSC-226	Warm Creek (Sub)	48.4	2.14	1.82	1.62	1.79	4.09	3.32	1.58	1.02	1.03	1.65	2.38	2.94	2.42	0.64	1.07	13.09
	WSC-231	Gull Pond	3.8	0.19	0.16	0.15	0.17	0.38	0.22	0.12	0.08	0.08	0.17	0.24	0.27	0.21	0.06	0.09	1.65
Codroy Wind Farm	WSC-304	Unnamed-A	2.21	0.11	0.10	0.09	0.10	0.23	0.13	0.07	0.05	0.05	0.10	0.15	0.16	0.13	0.03	0.06	1.06
	WSC-305	Little Spout Brook	1.47	0.08	0.06	0.06	0.07	0.16	0.08	0.05	0.03	0.03	0.07	0.10	0.11	0.09	0.02	0.04	0.76
	WSC-306	French Brook	13.80	0.64	0.55	0.50	0.56	1.27	0.88	0.44	0.29	0.30	0.53	0.77	0.90	0.73	0.19	0.32	4.70
	WSC-310	Unnamed-B	30.35	1.37	1.17	1.04	1.17	2.65	2.02	0.98	0.64	0.65	1.08	1.56	1.89	1.55	0.41	0.68	8.94
	WSC-311	Unnamed-E	15.61	0.72	0.62	0.56	0.63	1.43	1.00	0.50	0.33	0.33	0.59	0.86	1.01	0.82	0.22	0.36	5.20
	WSC-312	Rainy Brook	160.59	6.74	5.71	4.99	5.44	12.44	11.82	5.30	3.36	3.38	4.84	6.95	9.07	7.58	2.02	3.37	34.71
	WSC-315	Grand Codroy River	963.46	37.77	31.52	26.84	28.48	65.64	78.85	32.47	20.04	19.96	24.31	34.51	48.91	41.76	11.33	18.89	149.31
	WSC-317	Unnamed-C	7.85	0.38	0.32	0.29	0.33	0.75	0.48	0.25	0.17	0.17	0.32	0.47	0.53	0.43	0.11	0.19	2.97
	WSC-318	Unnamed-D	21.47	0.98	0.84	0.75	0.85	1.92	1.40	0.69	0.45	0.46	0.79	1.15	1.37	1.12	0.29	0.49	6.74
	WSC-319	Unnamed-F	13.28	0.62	0.53	0.48	0.54	1.23	0.84	0.43	0.28	0.29	0.51	0.75	0.87	0.71	0.19	0.31	4.56
	WSC-320	Shoal Point Brook	1.77	0.09	0.08	0.07	0.08	0.19	0.10	0.06	0.04	0.04	0.08	0.12	0.13	0.10	0.03	0.05	0.88
	WSC-321	Butter Brook	4.54	0.22	0.19	0.18	0.20	0.45	0.27	0.14	0.10	0.10	0.20	0.29	0.32	0.25	0.07	0.11	1.90

[1] Summer Environmental Flow is equivalent to 30% MAF as described by Zadeh (2012)
[2] Winter Environmental Flow is equivalent to 30% MAF as described by Zadeh (2012)

Table 9.2 Key Findings of Water Quantity Estimates in the Project Area.

Project Location	Key Findings
Port au Port	• MAF values range from 1.56 m^3/s at Mainland Brook to 0.09 m^3/s at Jim Rowe's Brook, with an average of 0.70 m^3/s between the nine described watersheds. • Estimates of MMF for each catchment and sub-catchment show seasonal fluctuations in flow, with peak runoff occurring during the spring and fall months. • Mainland Brook and Harry's Brook watersheds range in MMF flows from 0.7 m^3/s (August) to 3.0 m^3/s (April). • Flows are above the 30% MAF threshold for all subject watersheds, including during the low-flow period. The Jim Rowe Brook came closest to exceeding reaching the threshold.
Codroy Wind Farm	• MAF values range from 37.78 m^3/s at Grand Codroy River and 0.08 m^3/s at Little Spout Brook, with an average of 4.26 m^3/s between the twelve watersheds. • Peak flows are the largest in Grand Codroy, with MMF estimated at 78.8 m^3/s. • For the smaller catchment areas, the MAF values range between 0.08 and 1.37 m^3/s for Little Spout Brook and Unnamed Brook-B, respectively. • Flows are above the 30% MAF threshold for all subject watersheds, including during the low-flow period.
Port of Stephenville	• MAF values range from 7.12 m^3/s at Blanche Brook to 0.20 m^3/s at Gull Pond, with an average of 2.72 m^3/s between the four watersheds. • Seasonal fluctuations are more pronounced in the Blanche Brook watershed, with a flow range from 3.5 m^3/s to 13 m^3/s. • Seasonal changes in flow are dampened in Gull (Mine) Pond, with a flow range of 0.15 to 0.40 m^3/s. • Flows are above the 30% MAF threshold for all subject watersheds, including during the low-flow period. • Bathymetric data from Fracflow 2023 shows a similar range in maximum depths of 18 to 29 m for Noels, Muddy, and Gull Ponds.

9.2.2.2 Surface Water Quality

Surface water quality values from the NLDECC sites were compared to CWQG-FAL thresholds for Port as Port Wind Farm and Codroy Wind Farm. Surface water quality data from FracFlow at Port of Stephenville were also compared to CWQG-FAL guidelines. The PPSWA sites near the Port au Port Windfarm were compared to the GCDWQ guideline thresholds. Full results can be found in Section 2.3 of the Aquatic Environment Baseline Study (BSA-2). Surface water quality data key findings, including where samples were found to exceed guideline limits, can be found in Table 9.3.

Table 9.3 Key Findings on Baseline Water Quality in the Project Area

Project Location	Key Findings
Port au Port Wind Farm	• GCDWQ guidelines were exceeded for color at least once at each public water supply area, and the public water supply areas for West Bay, Port au Port/West-Auguathuna-Felix Cove, and Lourdes consistently exceeded the GCDWQ guideline for color. • Values for turbidity exceeded the GCDWQ guideline for at least one sampling event at the Mainland, Port au Port/West-Auguathuna-Felix Cove, Lourdes, and West Bay stations. • Maximum pH values at the Port au Port/West-Auguathuna-Felix Cove and Cape St. George stations exceeded the upper limit of the GCDWQ guideline during one sampling event. • Maximum concentration values exceeded the CWQG-FAL guidelines for Aluminum for at least one sampling event at the Cape St. George, Mainland, Lourdes, and West Bay; mean values exceeded for at least one sampling event at the West Bay. • maximum concentration values exceeded the CWQG-FAL guidelines for fluoride at the Port au Port/West Auguathuna-Felix Cove and West Bay public water supply for at least one sampling event.
Codroy Wind Farm	• Turbidity ranges from 0.1 to 14 NTU with a mean value of 0.83, indicating natural fluctuations occurring outside the range of CWQG-FAL guidelines. • The phosphorus concentrations of the samples show a ranging trophic status, from ultraoligotrophic to eutrophic.
Port of Stephenville	• Iron and aluminum concentrations exceeded the CWQG-FAL guidelines in a single Noels Pond sample. • Total aluminum exceeded CWQG-FAL guidelines in a single Gull (Mine) Pond sample. • Gull (Mine) Pond is low in suspended solids and turbidity, nitrate, and total phosphorous concentrations range from 20 to 30 ug/L, classifying the pond as meso-eutrophic. Color and total dissolved solids are elevated, with color ranging from 30 to 40 TCU. • Noels Pond is low in suspended solids and turbidity, nitrate, and total phosphorous concentrations range from 20 to 30 ug/L, classifying the lake as meso-eutrophic. Color and total dissolved solids are elevated, with color ranging from 39 to 53 TCU. • Muddy Pond is low in suspended solids and turbidity, nitrate, and total phosphorous concentrations range from 20 to 30 ug/L, classifying the lake as meso-eutrophic. Color and total dissolved solids are elevated, with color ranging from 44 to 72 TCU.

9.3 Assessment Criteria and Methods

This section describes the criteria and methods for assessing environmental effects on surface water resources. Residual environmental effects (Section 9.5) are assessed and characterized using criteria defined in Section 9.3.1, including direction, magnitude, geographic extent, timing, duration, frequency, reversibility, and ecological or socio-economic context. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant.

9.3.1 Residual Effects Characterization

Table 9.4 presents definitions for the predicted environmental effects characterization of the undertaking on surface water resources. The criteria describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 9.4 Characterization of Predicted Environmental Effects of the Undertaking on Surface Water Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Nature	The long-term trend of the residual effect	• **Neutral –** No net change in the measurable parameter(s) for surface water resources relative to baseline • **Positive –** A residual effect that moves the measurable parameter(s) in a direction beneficial to surface water resources relative to baseline • **Adverse –** A residual effect that moves the measurable parameter(s) in a direction detrimental to surface water resources relative to baseline
Magnitude	The amount of change in measurable parameter(s) or the VEC relative to existing conditions	• **Negligible –** No measurable change • **Low –** effect occurs that is detectable but is within normal variability of baseline conditions • **Moderate –** effect occurs that would cause an increase/decrease with respect to baseline but is within regulatory limits and objectives • **High –** effect occurs that would cause exceedances of objectives or regulator limits
Geographic Extent	The geographic area in which a residual effect of a defined magnitude occurs	• **Project Area –** Residual effect is restricted to the Project Area • **LAA –** Residual effect extends into the LAA • **RAA –** Residual effect extends into the RAA

Table 9.4 Characterization of Predicted Environmental Effects of the Undertaking on Surface Water Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period required until the measurable parameter(s) or the VEC returns to its existing (baseline) condition or the residual effect can no longer be measured or otherwise perceived	• **Short-term –** Residual effect is restricted to construction or decommissioning, rehabilitation, and closure phases • **Medium-term –** Residual effect extends through Project operation and is expected to subside when operations cease • **Long-term –** Residual effect extends beyond the life of the Project • **Permanent –** recovery to baseline conditions unlikely
Frequency	Identifies how often the residual effect occurs during the Project, during a specific phase of the Project, or during another specified time period	• **Single event** • **Multiple irregular event –** Occurs at no set schedule • **Multiple regular event –** Occurs at regular intervals • **Continuous –** Occurs continuously
Reversibility	Describes whether a measurable parameter(s) or the VEC can return to its existing condition after the Project activity ceases, including through active management techniques	• **Reversible –** Residual effect is likely to be reversed after activity completion and rehabilitation • **Irreversible –** Residual effect is unlikely to be reversed
Ecological / Socio-economic Context	Existing conditions and trends in the area where the residual effect occurs	• **Undisturbed –** Area is relatively undisturbed or not adversely affected by human activity • **Disturbed –** Area has been substantially previously disturbed by human development or human development is still present

9.3.2 Significance Definition

A significant residual adverse effect is defined in consideration of the federal and provincial regulations, policies, and guidelines identified in Section 9.1.1 and residual effects characterization criteria presented in Section 9.3.1.

A significant adverse residual effect on surface water quantity is defined as a measurable and persistent change in the hydrologic regime that:

- Does not meet established instream flow needs (environmental flow thresholds); and/or
- Contravenes a watershed management target including:
  - An uncompensated loss in fish habitat
  - Changes to flow that increase sedimentation and erosion above regulatory guidance in waterbodies receiving surface water runoff

  - Changes to flows that cause flooding downstream of the Project beyond existing conditions
  - Changes to pond and lake levels outside the Project Area to the point that it affects their ability to support existing ecological functions

A significant adverse residual effect on surface water quality is defined as a measurable and persistent change in water quality that:

- Exceeds an implemented water quality requirement such as CWQG-FAL or a site-specific water quality guideline for the protection of aquatic life.
- Effluent being discharged into receiving waterbodies exceeds the water quality regulations outlined in the *NL Environmental Control Water and Sewage Regulations (2003)* for temperature, pH, and other applicable POPC limits including nitrates, nitrogen (ammonia), and phosphorus.
- Deteriorates potable water in PPWSAs for communities in Port au Port to the point where it becomes non-potable or cannot meet the GCDWQ (Health Canada 2022).
- Contravenes a watershed management target including:
  - Degrading water quality that causes acute or chronic toxicity to aquatic life
  - Changes the trophic status of a lake or stream, or
  - Exceeds the generally accepted total suspended solids (TSS) monitoring guideline (CWQG-FAL) applied for Project activities.

9.3.3 Potential Environmental Effects, Project Pathways, and Measurable Parameters

Table 9.5 lists the potential Project effects on surface water resources and summarizes the Project effect pathways and measurable parameters and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for large development projects in NL, renewable energy projects in other parts of Canada, comments provided during engagement, and professional judgment.

Table 9.5 Environmental Effects, Effect Pathways, and Measurable Parameters for Surface Water Resources

Environmental Effect(s)	Effect Pathway(s)	Measurable Parameter(s) and Units of Measurement
Change in Surface Water Quantity	Project activities may have an effect or alter the natural flow regime through changes to surface vegetation cover, imperviousness, topography and drainage divides, and management of surface water runoff, temporary watercourse diversion.	• Reduction in watershed area (ha) • Changes to MAF at the Hydrogen / Ammonia Production Facility resulting in flows below environmental low flows
Change in Surface Water Quality	Project activities may affect or alter water quality through changes to the natural flow regime, sedimentation and erosion rates, process water discharges, and accidents and contamination, which are discussed in detail in Chapter 24. Effluent discharge from the hydrogen / ammonia plant also has the potential to exceed CWQG-MAL but will meet POPC of ECWSR.	• Concentration of chemical parameters (various) in surface water compared to applicable guidelines

The connection between project activities and changes in water quantity can occur in several ways. Road building, general development, and deforestation can increase surface runoff rates, increasing peak flow response to precipitation in a given catchment. This occurs through soil compaction and loss of preferred pathways and loss of tree root systems that provide for water to flow subsurface. Significant alteration of land type, such as a large portion of total catchment area being deforested and developed within a watershed, can change the hydrologic regime and produce cascading effects on water quantity.

Similar to water quantity, water quality may be altered by road building and general development. Exposure of soils and fine particles, either within or adjacent to watercourses, may increase downstream turbidity and alter water colour. This also can potentially increase dissolved metals or other compounds in solution. Road building equipment can introduce hazardous chemicals to the watershed. Water quality may also be affected by alteration to water quantity if changes in peak flow induce bank instability and erosion rates. This can result in increases in turbidity and color of downstream water.

9.3.4 Project Interactions with Surface Water Resources

Table 9.6 uses checkmarks to indicate the routine Project activities that could interact with the VEC and result in the identified environmental effect(s) to be assessed. Immediately following Table 9.6, environmental effects pathways are briefly described for potential routine Project-related environmental effects, and justification is provided in cases where no Project interaction with the VEC (and therefore no potential environmental effect on the VEC) is predicted.

Table 9.6 Project Interactions with Surface Water Resources, Environmental Effects, and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed	
	Change in Surface Water Quantity	**Change in Surface Water Quality**
Construction		
Site Preparation and Civil Works (including turbine foundations, road construction, quarries, clearing, grubbing, blasting, cement production, and watercourse crossings)	X	X
Transportation of Resources and Equipment (includes trucking, shipping and barging of materials)	-	X
Construction / Installation, Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	-	-
Installation and Commissioning of Wind Turbines	X	X
Installation and Commissioning of Collector Systems	X	X
Installation and Commissioning of Transmission Lines and Substations (including marine cable crossing)	X	X
Installation and Commissioning of Hydrogen / Ammonia Production, Storage Facilities and Associated Infrastructure (including Industrial water supply infrastructure)	X	X
Restoration of Existing Port Facilities (including pile driving and dredging)	-	X
Emissions, Discharges, and Wastes[1]	X	X
Employment and Expenditures[2]	-	-
Operation and Maintenance		
Presence, Operation, and Maintenance of Wind Farms (including wind turbines, access roads, and collector systems)	-	-
Presence, Operation, and Maintenance of Transmission Lines and Substations	-	-
Presence, Operation, and Maintenance of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure (includes marine discharge from treatment plant)	X	X
Presence, Operation, and Maintenance of Port Facilities (includes loading of ammonia and vessel maneuvering within the Port)	-	-
Emissions, Discharges, and Wastes[1]	-	X
Employment and Expenditures[2]	-	-

Table 9.6 Project Interactions with Surface Water Resources, Environmental Effects, and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed	
	Change in Surface Water Quantity	**Change in Surface Water Quality**
Decommissioning and Rehabilitation		
Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	-	-
Decommissioning and Rehabilitation of Wind Farms (including wind turbines, access roads, and collector systems)	X	X
Decommissioning and Rehabilitation of Transmission Lines and Substations	X	X
Decommissioning and Rehabilitation of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure	X	X
Decommissioning and Rehabilitation of Port Facilities	-	-
Emissions, Discharges, and Wastes[1]	-	-
Employment and Expenditures[2]	-	-

Notes:
✓ = Potential interaction
– = No interaction
[1] Emissions (e.g., light, noise, vibration, air contaminants and GHGs), discharges (e.g., wastewater and other liquid effluents), and hazardous and non-hazardous wastes are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, "Emissions, Discharges, and Wastes" is listed as a separate item under each phase of the Project.
[2] Project employment and expenditures are generated by most Project activities and are the main drivers of many potential socio-economic effects. Rather than acknowledging this by placing a checkmark against each activity, "Employment and Expenditures" is listed as a separate item under each phase of the Project.

In the absence of mitigation, the Project may interact with surface water resources in the following ways:

- Site Preparation and civil works and construction / installation, presence, operation, and maintenance of temporary workforce accommodations and associated infrastructure, including clearing vegetation, stripping soils and grading for access road and turbine pad construction, which may alter surface water quantity and quality related to the quantity and quality of surface water runoff.
- Installation and commissioning of collector systems, transmission lines and substations, and presence, operation, and maintenance of transmission lines and substations, including clearing riparian vegetation which may alter surface water runoff.
- As part of the installation and commissioning of the hydrogen / ammonia plant, surface water resources may be affected by changes in flow and water levels downstream of the industrial water source.

- As part of the presence, operation, and maintenance of the hydrogen / ammonia plant, water withdrawal activities could cause impingement on environmental maintenance flows, water availability, and water quality.
- Emissions, discharges, and wastes could occur during construction, operation and maintenance, decommissioning, and rehabilitation which may alter surface water quality and quantity.
- Alteration of total percentage of watershed area land use from natural to developed due to roads construction and wind turbine pads can affect surface water quantity.
- Restoration of existing port facilities (including pile driving and dredging) has the potential to impact surface water quality near the plant site.
- Decommissioning and closure rehabilitation may alter water quantity and quality by changing runoff patterns and by reducing the amount of exposed soil

The following Project activities are not expected to result in a change in surface water quantity or surface water quality:

- Presence, operation, and maintenance of temporary workforce accommodations and associated infrastructure will occur away from watercourses and waterbodies and will not interact with surface water resources.
- Installation and commissioning of wind turbines will occur on land, away from watercourses and waterbodies and will not interact with surface water resources.
- Presence, operation and maintenance of port facilities, and decommissioning and rehabilitation of port facilities will occur in the marine environment, away from freshwater watercourses and waterbodies. They will not interact with surface water resources.
- Employment and expenditures will not directly result in changes to the physical environment, including surface water resources.

Accidents and malfunctions that could result in spills of hazardous materials are mitigated for and described in further detail in chapter 24. This will cover all phases of the Project and all Project Areas.

9.3.5 Analytical Assessment Techniques and Level of Knowledge

Where applicable, the environmental effects analyses for changes in surface water quantity and quality were carried out using quantitative and qualitative methods. Potential effects of the Project on surface water resources were assessed quantitatively, including:

- A GIS analysis of the Project footprint overlain with maps of watersheds, watercourses, and waterbodies to delineate areas of Project impact.

- Comparison of water withdrawal rates to baseline stream discharges in consideration of the federal "Framework for Assessing Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013) to determine changes in surface water quantity at the hydrogen / ammonia plant meet an environmental low flow criteria of 30% MAF during the summer and 50% MAF during the winter. Water use assessments were performed by FracFlow (2023b) to assess sustainable yield at the hydrogen / ammonia plant.
- A CORMIX model was developed as part of an Assimilative Capacity Assessment (Appendix 11-A) to evaluate effluent quality leaving the hydrogen / ammonia plant into the marine receiving environment. The near-field mixing model CORMIX (Version 12.0) was used to predict water quality under winter and summer conditions for water temperature and salinity. The modelling results were compared to the CCME marine water quality guidelines. The mixing zones were determined in terms of assimilation or dilution ratios for the maximum effluent flow rate expected to enter the receiving waterbody. Results of this model are presented in the Assimilative Capacity Study (Appendix 11-A) and summarized in the Change in Surface Water Quality section (Section 9.5.2).

Potential effects of the Project on surface water resources were assessed qualitatively using the best-available aerial imagery, professional judgement based on an understanding of the Project and potential effects from similar civil works projects, and the likely effectiveness of mitigation measures supported by literature, industry best management practices, and regulatory guidelines, as applicable.

9.3.5.1 Assumptions and Conservative Approach

A conservative approach was applied to assess surface water quantity and quality changes. This approach leads to conservative predictions of potential effects (i.e., overstating rather than understating effects), and corresponding mitigation to address those potential effects. The following assumptions regarding the conservative approach and uncertainty were applied in the assessment of potential changes in surface water quantity and quality:

- Watershed areas were delineated to capture upstream Project infrastructure throughout the phases of the Project. The watersheds were delineated such that the relative changes to watershed areas were maximized, thus allowing for a conservative approach.
- The Assimilative Capacity Assessment (Appendix 11-A) used conservative ambient and effluent conditions for the CORMIX model including conservative estimates of ocean water density, temperature, current speed, and average and outfall water depths. These characteristics affect the near-field transport and shape of the resulting plume geometry of the effluent discharge.

9.4 Mitigation Measures

WEGH2 will develop a series of environmental management plans to mitigate the effects of Project development on the environment. A complete list of mitigation measures to be applied throughout Project construction, operation and maintenance, and decommissioning and rehabilitation is provided in Chapter 26. Key measures to mitigate the potential effects of the Project on surface water resources are listed in Table 9.7 by category and Project phase. Control ID # in the first column are associated with mitigation measures from the complete list of mitigation commitments in Chapter 26.

Table 9.7 Mitigation Measures: Surface Water Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
2	Mitigation	Work will be performed so that materials such as sediment, fuel or other hazardous materials do not enter watercourses and waterbodies through implementation of erosion and sediment control measures and hazardous materials management practices.	x	x	x
3	Mitigation	Work will be conducted in a manner to protect watercourses and wetlands from siltation and disturbance in accordance with Best Management Practices or as otherwise agreed upon with the regulator.	x	x	x
6	Mitigation	Where crossing of wetlands beyond the area to be cleared is unavoidable, protective layers such as matting or biodegradable geotextile and clay ramps, or other approved materials, will be used between wetland root / seed bed and construction equipment if ground conditions are encountered that create potential for rutting, admixing or compaction.	x	-	-
7	Mitigation	Grading will be directed away from wetlands, where possible, and will be reduced within wetland boundaries unless required for site specific purposes.	x	-	-
8	Mitigation	Project staff and contractors will adhere to the waste management procedures to be included in the EPP and the Waste Management Plan.	x	x	x
11	Mitigation	Volatile wastes and materials, such as fuel, mineral spirits, oil, or paint thinner will be stored appropriately and will not be permitted to enter into waterways or storm drains. They will be disposed of at an approved site.	x	x	x
12	Mitigation	Where portable toilets are required, waste will be removed from the site by the supplier in a timely manner for appropriate disposal. These toilets will be located more than 30 m from the boundaries of wetlands or watercourses.	x	x	x
14	Mitigation	Bulk fuel and lubricants will be stored in secure areas (i.e., with bund walls and impervious flooring) that have the capacity to trap more than the volume of petroleum hydrocarbons being stored; this will serve as a secondary containment should the primary containment fail. Other petroleum hydrocarbon products will not be stored in large quantities on-site, and secondary containment (e.g., drip trays) will be used in areas of storage and transfer.	x	x	x
33	Mitigation	Areas to be cleared will have sediment and erosion control measures implemented per the site-specific Erosion & Sediment Control Plan prior to the initiation of clearing activities. The sediment and erosion control measures will be adapted to suit the field conditions associated with the specific construction activities as construction proceeds.	x	-	-

Table 9.7 Mitigation Measures: Surface Water Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
34	Mitigation	Construction areas will be routinely monitored to identify areas of potential erosion and to apply appropriate mitigation. Best practice erosion and sediment control measures will be implemented, as required.	x	-	-
35	Mitigation	The drainage system for the site will be designed to appropriately manage stormflows considering impacts to on-site downstream watercourses, and coastlines, and infrastructure. Additionally, the site drainage system will consider the variable and seasonal up-stream drainage needs to provide adequate access to downstream watercourses without adverse impact on the plant site or other nearby infrastructure.	x	-	-
36	Mitigation	In the event that project activities occur in any designated water supply areas, the work will be completed in conjunction with the jurisdiction having authority.	x	-	x
84	Mitigation	In the event of a spill, dry clean up and mopping techniques will be used, as appropriate. The area will not be "washed down" as this could cause the spills to spread to the surrounding environment and potentially enter drainage works or environmentally sensitive areas.	x	x	x
85	Mitigation	Soil that may have become contaminated will be remediated. This may be done on-site or removed from site for disposal at an approved location.	x	x	x
86	Mitigation	The potential effects of extreme weather, including storms, precipitation, and drought will be considered in Project planning, design, and operation and maintenance strategies, including the selection of materials and equipment, and design of components. These designs will consider projected climate change conditions over the life of the Project.	x	x	x
90	Mitigation	Weather forecasts (including marine forecasts) will be considered when planning construction and operation activities that may be affected by adverse conditions, such as receipt of materials and supplies, and product deliveries, particularly deliveries of products and diesel fuel. Where required, these activities will be scheduled for periods of favourable weather conditions.	x	x	x
136	Mitigation	Site-specific erosion and sedimentation control plans will be developed during detailed design phase of the Project and will be implemented.	x	-	-
137	Mitigation	To address the risk of slope instability, a detailed terrain mapping assessment, including ground-truthing, for the final Project Area will be completed to identify both construction constraints and geohazards that may impact the Project. Slope stability assessments will be completed as part of the design, particularly at locations where there is proposed re-grading and glacio-fluvial deposits that are susceptible to erosion and undermining as seen in Stephenville.	x	-	-

Table 9.7 Mitigation Measures: Surface Water Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
138	Mitigation	To address the risk of subsidence a detailed terrain mapping assessment using LiDAR from the Project Area to assess for karst formation that may be present will be completed.	x	-	-
139	Mitigation	To address the risk of landslide/rock fall a detailed terrain mapping assessment will be used to identify historical landslides and rock fall activity within the Project Area. Identification of naturally occurring past events may necessitate further investigation or avoidance. For human-made rock cuts, or largescale re-grading of rock slopes, geotechnical investigation and design will be conducted so that the final cuts / grading are stable and will not cause potential instability during construction or long term.	x	-	-
145	Mitigation	The Environmental Code of Practice for Concrete Batch Plant and Rock Washing Operations, 1992 will be adhered to during concrete production activities.	x	-	-
146	Mitigation	Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems will be handled using the procedures outlined in Section 3.0 of the Environmental Code of Practice for Concrete Batch Plant and Rock Washing Operations.	x	-	-
147	Mitigation	Rinsing activities will be carried out at the site of the concrete batch plant, except rinsing of the chute and applicable concrete placement equipment.	x	-	-
150	Mitigation	Explosives will be used in a manner that will reduce damage or defacement of landscape features, trees, ecologically sensitive areas such as wetlands, and other surrounding objects, by controlling through standard best practice (including precisely calculated explosive loads and adequate stemming), the scatter of blasted material beyond the limits of activity. Outside of cleared areas, inadvertently damaged trees will be cut, removed, and salvaged, if merchantable (refer to Section, "Clearing of Vegetation"). Fly rock, which inadvertently enters a waterbody, watercourse, or ecologically sensitive area and that can be recovered without further damage to the environment, will be removed. Instances where larger fly rocks (boulders) enter these areas or deep waterbodies, recovery of this will be discussed with the OSEM.	x	-	-
158	Mitigation	Previous testing on selected samples of bedrock has shown the samples to be Non-Potentially Acid Generating (NPAG). As a precautionary measure, the OSEM will inspect all areas of blasted rock and rock stockpiles so no evidence of PAG material exists.	x	-	-
310	Mitigation	Continuous monitoring of surface water levels in Mine Pond to maintain ecological maintenance flows downstream of the Project site	X	X	X

Table 9.7 Mitigation Measures: Surface Water Resources

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
311	Mitigation	Access roads will be maintained in good condition. This will include periodically regrading and ditching to improve water flow, reduce erosion, and manage vegetation growth.	X	X	X
313	Mitigation	Existing drainage patterns will be maintained, to the extent feasible, with the use of culverts and bridges.	X	X	-
315	Mitigation	Non-contact water will be diverted away from development areas, where possible. Channels and berms will be constructed, as needed, to divert natural precipitation and surface runoff away from contact with exposed earth.	X	X	-
316	Mitigation	Effluent will be treated prior to discharge to the receiving environment, as required, to meet regulatory effluent criteria as outlined in the Assimilative Capacity Assessment (Appendix 11-A).	-	X	-

* Notes:
"ID #" denotes the mitigation master identification number, Appendix 26-A.
"C" denotes the construction phase of the Project.
"O" denotes the operation and maintenance phase of the Project.
"D" denotes the decommissioning and rehabilitation phase of the Project.
"X" denotes the Project phase relevant to the mitigation measure.

9.4.1 Application of the Precautionary Principle to Project Mitigation Measures

WEGH2 will continue to incorporate avoidance of sensitive surface water features, where practicable, during Project planning prior to construction. Early in the EA process, and based on engagement and consultation with regulators, Indigenous groups, and stakeholders, WEGH2 completed a review and update of the Project design and layout to address specific concerns and issues. The Project layout will continue to evolve during the EA process as various stages of conceptual and detail design are completed.

The main Project components that interact with surface water resources are construction activities and the operation of Mine Pond, Noels Pond, and Muddy Pond as the industrial water supply. The mitigation measures in Section 9.4 have been selected in consideration of the environmental effects pathways and include standard proven mitigation measures, incorporate NLDECC measures to protect surface water quantity and quality, and consider permits, regulations, and guidelines that govern potential surface water interactions from water supplies. These mitigation measures are more than adequate to reduce effects to acceptable levels.

9.5 Residual Environmental Effects

9.5.1 Change in Surface Water Quantity

Pathways that affect surface water quantity, as outlined in Section 9.3.4, are related to the direct placement of Project infrastructure in watercourses and water extraction for the industrial water supply at the hydrogen / ammonia plant. The residual effects on surface water resources are directly related to Fish and Fish Habitat (Chapter 10) and Groundwater Resources (Chapter 8).

9.5.1.1 Construction

The Project has been designed to limit effects on surface water quantity through planning of the placement of infrastructure and shifting locations of activities away from waterbodies/watercourses. Where avoidance is not feasible, the Environmental Guidelines for General Construction Practices developed by the NL Water Resources Management Division (NLWRMD) (2018) will be implemented with standard mitigation measures (Section 9.4) to reduce the potential for effects on surface water quantity. A summary of watercourse crossings is provided in Chapter 10, Fish and Fish Habitat. Localized changes in surface water quantity at watercourse crossings may occur because of ROW clearing and culvert installation.

For the wind farm locations (Port au Port and Codroy), direct effects on surface water quantity are likely to be most prominent during construction as the clearing of vegetated surfaces and exposure of soil may increase flows within the watersheds. However, with the implementation of Environmental Guidelines for General Construction Practices (NLWRMD 2018), mitigation measures (Section 9.4), and monitoring, Project effects on surface water quantity are expected to be reduced. Table 9.1 presents the environmental flow thresholds and Q100 flood flows for each watershed. Monitoring of flows exiting the Project site during construction should be completed to ensure flows remain above the environmental flow thresholds to maintain fish habitat, and below the Q100 flood flows to eliminate erosion and scouring potential downstream.

As discussed in Section 9.2.2.1, the hydrogen / ammonia plant will be supported by water intake from local waterbodies: Muddy Pond, Noels Pond and Gull (Mine) Pond. The existing infrastructure of the previous industrial water supply system will be used, as available. The Gull (Mine) Pond water outflow structure will be raised and will have short berms added to allow the water level in Gull (Mine) Pond to fluctuate by approximately 1.5 m relative to its current level (FracFlow 2023b). The existing water control structure at the Noels Pond outflow will be refurbished and the outflow to Warm Brook (downstream from Noels Pond) will be controlled to maintain ecological flows for fish migration. There will be no water taking during the construction period therefore there will be no effects to surface water quantity related to water withdrawal during the construction phase.

Based on the information above, a summary of residual effects on surface water quantity during the construction phase is provided in Table 9.8.

Table 9.8 Summary of Surface Water Quantity Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	There are no anticipated residual effects to surface water quantity from the temporary workforce accommodations as watercourses and waterbodies will be avoided during Project construction.
Port au Port Wind Farm and Associated Infrastructure	Effects to surface water quantity during construction of the Port au Port windfarm and associated infrastructure will be limited through Project design and siting components. The potential effects will be managed through application of best practices in accordance with the Environmental Guidelines for General Construction Practices (NLWRMD 2018), and standard mitigation measures described in Section 9.4.
Codroy Wind Farm and Associated Infrastructure	Effects to surface water quantity during construction of the Codroy windfarm and associated infrastructure will be limited through Project design and siting components. The potential effects will be managed through application of best practices in accordance with the Environmental Guidelines for General Construction Practices (NLWRMD 2018), and standard mitigation measures described in Section 9.4.
230 kV Transmission Lines and Substations	No residual effects are anticipated as watercourses/waterbodies will be spanned and no in-water work is planned.
Hydrogen / Ammonia Production and Storage Facilities	There will be no water taking during the construction period; therefore no anticipated Project effects to surface water quantity are anticipated at the hydrogen / ammonia plant during construction.
Port Facilities	As there are no interactions anticipated between the port facilities and surface water quantity, no residual effects are anticipated.

9.5.1.2 Operation and Maintenance

During operation and maintenance, the primary source of interaction between the Project and surface water quantity will be through the water withdrawal to support the hydrogen / ammonia plant. Changes in downstream flow may occur during operations phase as a result of water withdrawal from Noels Pond, Muddy Pond and Gull (mine) Pond for the industrial water supply and potable water supply at the plant. Cumulative flow alterations that result in watercourse flows of 30% of the MAF, or less, have a heightened risk of impacts to aquatic ecosystems (DFO 2013).

Land use changes as a percent of total watershed area are not expected to adversely affect water quantity. However, the three watersheds with the highest concentration of Project infrastructure, Mainland Brook (WSC-130), Harry's Brook (WSC-124), and an unnamed brook on Cape St. George (WSC-144), are suggested to be monitored for changes in water quantity and quality, to ensure peak discharge events stay below Q100 flow event. As a result of the industrial water supply withdrawals, a reduction in MAF is anticipated for watersheds at the hydrogen / ammonia plant. Table 9.9 outlines the anticipated changes in flows due to the industrial water supply withdrawals and a comparison with the environmental low flows for the summer and winter periods, which are minimum flow thresholds to maintain aquatic habitat downstream of surface water withdrawals for plant operations. A 19% reduction in MAF is anticipated in Noels Pond in WSC-226 (Warm Creek sub-watershed) and an estimated 25% loss in MAF is anticipated for Gull (Mine) Pond in WSC- 231 (Gull (Mine) Pond watershed) because of the industrial water supply withdrawals. These withdrawals are well above the environmental low flows, which are 30% MAF in the summer and below 50% in the winter.

Table 9.9 Mean Annual Flow Changes - Operations

Watershed ID	Baseline MAF (m^3/s)	Water Withdrawal Rate (m^3/s)	Operational MAF (m^3/s)	Change in MAF (%)	Summer Environmental Flow (30% MAF) (m^3/s)	Winter Environmental Flow (50% MAF) (m^3/s)
WSC-226	2.20	0.42	1.78	19%	0.66	1.10
WSC-231	0.20	0.05	0.15	25%	0.06	0.10

Effects of Project operation and maintenance on surface water quantity are expected to be moderate (an effect that would cause an increase/decrease with respect to baseline but is within regulatory limits and objectives) in magnitude, be restricted to the LAA, have moderate timing sensitivity, occur as a continual event, and be reversible. Based on the information above, a summary of residual effects on a change in surface water quantity during the operation and maintenance phase is provided in Table 9.10.

Table 9.10 Summary of Surface Water Quantity Effects by Project Component During Operation and Maintenance

Project Site	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	As there are no interactions anticipated between the Port au Port Wind Farm and associated infrastructure and surface water resources (Table 9.4), no residual effects are anticipated during operation
Codroy Wind Farm and Associated Infrastructure	As there are no interactions anticipated between the Codroy Wind Farm and Associated Infrastructure and surface water resources (Table 9.4), no residual effects are anticipated during operation
230 kV Transmission Lines and Substations	As there are no interactions anticipated between the 230 kV Transmission Lines and Substations and surface water resources (Table 9.4), no residual effects are anticipated during operation
Hydrogen / Ammonia Production and Storage Facilities	The quantity of water being withdrawn is predicted to cause a change in MAF 19% and 25% for WSC-226 and WSC-231, respectively. However, the operational MAFs remain above the 30% change in flow threshold and the summer and winter environmental flow thresholds. Therefore, with the implementation of mitigation measures and standard best practices, residual effects on surface water quantity are predicted to be low.
Port Facilities	As there are no interactions anticipated between the Port Facilities and surface water resources (Table 9.4), no residual effects are anticipated during operation.

9.5.1.3 Decommissioning and Rehabilitation

The effects of decommissioning and rehabilitation activities on surface water quantity are anticipated to be similar to construction; however, it is anticipated there will be no in-water work associated with this phase of the Project. For the purposes of this assessment, it is assumed that physical infrastructure will be removed from the site (i.e., turbines, transmission poles). It is assumed that roads will not be decommissioned and associated culverts will remain in place. At the hydrogen / ammonia plant site, it is assumed that the pond water level control systems will remain in place, however the pipes and intake structures will be removed, or if value to municipality of Stephenville, sold or relinquished to their authority.

Effects of Project decommissioning and rehabilitation on surface water quantity are anticipated to be negligible as no change in watershed area is anticipated. Based on the information above, a summary of residual effects on a change in surface water quantity during the decommissioning and rehabilitation phase is provided in Table 9.11.

Table 9.11 Summary of Surface Water Quantity Effects by Project Component During Decommissioning and Rehabilitation

Project Site	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	As there are no interactions anticipated between the Temporary Workforce Accommodations and surface water resources (Table 9.4), no residual effects are anticipated during decommissioning and rehabilitation
Port au Port Wind Farm and Associated Infrastructure	As there are no interactions anticipated between the Port au Port Wind Farm and Associated Infrastructure and surface water resources (Table 9.4), no residual effects are anticipated during decommissioning and rehabilitation
Codroy Wind Farm and Associated Infrastructure	As there are no interactions anticipated between the Codroy Wind Farm and Associated Infrastructure and surface water resources (Table 9.4), no residual effects are anticipated during decommissioning and rehabilitation
230 kV Transmission Lines and Substations	As there are no interactions anticipated between the 230kV Transmission lines and substations, and surface water resources (Table 9.4), no residual effects are anticipated during decommissioning and rehabilitation
Hydrogen / Ammonia Production and Storage Facilities	Project effects will be managed through the implementation of best practices and mitigation measures described in Section 9.4. There may be minor alterations to surface water quantity during the removal of project infrastructure, however this will be short-term in duration.
Port Facilities	As there are no interactions anticipated between the port facilities and surface water resources (Table 9.4), no residual effects are anticipated during decommissioning and rehabilitation

9.5.2 Change in Surface Water Quality

9.5.2.1 Construction

Pathways that affect surface water quality as outlined in Section 9.3.4 are related to work in or near water, and include construction of access roads, turbine laydown areas, collector and transmission lines, and water extraction for the industrial water supply. These works include the use of industrial equipment, clearing and grubbing of vegetation, excavating and grading, construction and installation of stream crossing structures and fording. These activities can increase the potential for changes to surface water quality because of erosion and sedimentation, introduction of deleterious substances, and increased TSS concentrations. Project infrastructure has avoided PPSWs watersheds to prevent contamination of water supply areas.

The Project has been designed to avoid these pathways to the extent practicable through shifting placement of infrastructure away from waterbodies and watercourses. Where avoidance is not feasible, mitigation (Section 9.4) will be used to reduce the potential for effects during construction. During the construction phase, the Environmental Guidelines for General Construction Practices (NLWRMD 2018) will be implemented with standard mitigation measures to reduce the potential for effects on surface water quality.

With the implementation of sedimentation and erosion control measures, the construction of sedimentation ponds may be required downstream of project infrastructure to capture contact water from the Project construction. These sedimentation ponds will allow water quality to improve prior to release to the downstream environment. Monitoring of the water quality in these sedimentation ponds would be conducted to ensure water quality meets the CWQG-FAL upon release.

With mitigation, the Project will result in a temporary reduction in surface water quality (e.g., increased erosion and sedimentation) in the Project Area. This change will occur one time during the construction phase. Overall, effects of Project construction on surface water quality are expected to be moderate in magnitude (an effect occurs that would cause an increase/decrease with respect to baseline but is within regulatory limits and objectives), restricted to the LAA, have moderate timing sensitivity, occur as a single event, and be reversible. Based on the information above, a summary of residual effects on surface water quality during the construction phase is provided in Table 9.12.

Table 9.12 Summary of Surface Water Quality Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	No residual effects anticipated.
Port au Port Wind Farm and Associated Infrastructure	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).
Codroy Wind Farm and Associated Infrastructure	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).
230 kV Transmission Lines and Substations	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).
Hydrogen / Ammonia Production and Storage Facilities	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4). Following mitigation no residual effects are anticipated.
Port Facilities	As there are no interactions anticipated between the Port Facilities and surface water resources (Table 9.4), no residual effects are anticipated during construction.

9.5.2.2 Operation and Maintenance

Operation and maintenance of the wind farms will require use of access roads by Project vehicles and could result in suspended sediments and dust from the unpaved roadbed being carried into adjacent waterbodies, thereby affecting water quality.

Changes to surface water quality may occur during operation of the hydrogen / ammonia plant operations. During operations, the electrolysis process uses electricity and water to produce hydrogen and oxygen, which is then sent to the ammonia unit. The hydrogen from the electrolyzers is combined with nitrogen to then produce ammonia as described in Section 2.3.4. The excess process water (effluent) from the hydrogen / ammonia plant is discharged to St. George's Bay 500 m from the shoreline through a wastewater treatment plant. The industrial wastewater flow component is proposed at a rate of 3,000 m^3/day requiring treatment (FracFlow 2023b), or 0.0936 m^3/s during the winter and 0.0875 m^3/s during the summer, as per Table 6 in ARUP (2023).

Effluent is expected to have a similar composition of its source water (Noels Pond, Muddy Pond and Gull (Mine) Pond). An analysis of the raw water from the source water locations indicates the waters are low in suspended solids (TSS <10 mg/L) and associated turbidity (<5 NTU) with colour ranging from 31.4 to 71.6 TCU. Total Dissolved Solids (TDS) ranged between 44 and 104 mg/L with an average concentration of 70 mg/L. Nitrate concentrations (<0.06 mg/L) and phosphorous concentrations were less than 30 µg/L which is low in comparison to seawater (Bricker et al. 1999). Total metals in the source water were all below the CWQG-MAL (CCME 1999) (Fracflow 2022 in Stantec 2023). The treatment of source water is therefore not anticipated to result in effluent that exceeds TSS, nutrients or metals concentrations of applicable CWQG-MAL guidelines and remains below applicable POPC effluent limits from the ECWSR.

The effluent is expected to range from 15 °C to 25 °C, the design temperatures for the electrolysis process. The ECWSR regulation is a limit of 32 °C for effluent being released into a body of water and so effluent will meet provincial ECWSR temperature regulations at the point of discharge (Appendix 11-A) (NLDECC 2003). The mixing zone is less than 1 m for temperature and salinity in most scenarios. The worst-case scenario is in winter when the average current speed is higher and mixing zone for temperature and salinity can extend up to 3 m from the outfall before meeting the respective CCME guidelines.

In addition to effluent temperature being dissimilar from ambient marine environment conditions, the effluent will have a salinity closer to fresh water. A conservative estimation of 55 mg/L of TDS for the effluent was used in the CORMIX model, which is much lower than the average measured salinity at Port-aux-Basques in the winter of 31,300 mg/L and 30,200 mg/L in the summer (Galbraithe 2022). ECWSR on TDS has a limit 1000 mg/L, suggesting the regulations are intended for freshwater and the predicted effluent concentrations will be in compliance for ECWSR at the point of discharge.

The CORMIX model from the Assimilative Capacity Assessment (Appendix 11-A) was used to derive the mixing zone, the three-dimensional area around the end of the outfall where mixing of effluent and receiving water is occurring and effluent water remains more than CWQG-MAL standards. In most scenarios, the mixing zone is less than 1 m for temperature and salinity. The worst-case scenario is winter with an average current speed when the mixing zone for temperature and salinity can extend up to 3 m from the outfall before meeting the respective CCME guidelines. Using the conservative modelling parameters, it can be concluded that ECWSR effluent limits for all POPCs will be met at the point of discharge and that no exceedances of CWQG-MAL will be observed outside the 3 m mixing zone.

With mitigation, the Project is anticipated to result in a reduction in water quality (e.g., effluent discharge, increased TSS) in the LAA. This change will occur continuously during the operation and maintenance phase. Overall, the effects of Project operation and maintenance on surface water quality are expected to be low in magnitude (an effect that is detectable but is within normal variability of baseline conditions), restricted to the LAA, have medium-term duration (residual effect extends through Project operation and is expected to subside when operations cease), occur continuously, and be reversible. Based on the information above, a summary of residual effects on change in surface water quality during the operation and maintenance phase is provided in Table 9.13.

Table 9.13 Summary of Surface Water Quality Effects by Project Component During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).
Codroy Wind Farm and Associated Infrastructure	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).
230 kV Transmission Lines and Substations	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).

Table 9.13 Summary of Surface Water Quality Effects by Project Component During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Hydrogen / Ammonia Production and Storage Facilities	Effluent from the hydrogen / ammonia production facilities is dependent on influent water quality from the Gull, Noels, and Muddy Ponds, which is expected to meet CWQG-MAL for effluent except for temperature and salinity. However, the effluent is expected to meet ECWSR effluent limits for all POPCs at the outlet. Implementation of standard mitigation measures and water quality monitoring of effluent will be conducted during operations. Residual effects on surface water quality are anticipated to fall within CWQG-MAL within 1-3 meters of point of discharge and have negligible effect during operations.
Port Facilities	As there are no interactions anticipated between the Port Facilities and surface water resources (Table 9.4), no residual effects are anticipated during operations.

9.5.2.3 Decommissioning and Rehabilitation

Transportation along the access road and site roads during decommissioning, rehabilitation and closure could result in suspended sediments from dust and roadbed being carried into adjacent waterbodies, thereby affecting water quality. Mitigation measures as described above for construction will be implemented as applicable during decommissioning to reduce the potential for adverse effects on fish habitat.

With mitigation, the Project is anticipated to result in a reduction in surface water quality (e.g., erosion and sedimentation) in the Project Area during the decommissioning phase. This change will occur as an isolated event during the decommissioning and rehabilitation phase. Based on past evidence, this residual environmental effect will be reversible following decommissioning and rehabilitation as exposed areas become re-vegetated. Overall, effects of Project decommissioning and rehabilitation on surface water quality are expected to be low in magnitude, restricted to the LAA, have moderate timing sensitivity, occur as a single event, and be reversible. Based on the information above, a summary of residual effects on change in surface water quality during the decommissioning and rehabilitation phase is provided in Table 9.14.

Table 9.14 Summary of Surface Water Quality Effects by Project Component During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	As there are no interactions anticipated between the Temporary Workforce Accommodations and surface water resources (Table 9.4), no residual effects are anticipated during decommissioning and rehabilitation
Port au Port Wind Farm and Associated Infrastructure	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).

Table 9.14 Summary of Surface Water Quality Effects by Project Component During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Codroy Wind Farm and Associated Infrastructure	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).
230 kV Transmission Lines and Substations	Effects will be managed through application of best practices in accordance with NLWMD Environmental Guidelines for General Construction Practices (2018) and other standard mitigation measures (Section 9.4).
Hydrogen / Ammonia Production and Storage Facilities	Project effects will be managed through the implementation of best practices and mitigation measures described in Section 9.4. There may be minor alterations to surface water quality during the removal of project infrastructure, however this will be short-term in duration.
Port Facilities	As there are no interactions anticipated between the Port Facilities and surface water resources (Table 9.4), no residual effects are anticipated during decommissioning and rehabilitation

9.5.3 Residual Environmental Effects Summary

9.5.3.1 Residual Environmental Effects Characterization

Overall, residual effects of the Project on surface water resources are predicted to be adverse and low to moderate in magnitude (an effect that is detectable but is within normal variability of baseline conditions or would cause an increase/decrease with respect to baseline but is within regulatory limits and objectives). However, this does not affect the availability and quality of water long term as the duration of Project effects is predicted to be short-term and limited to the LAA. Residual effects will occur continuously throughout the construction and operations phases and irregularly during the decommissioning phase. Residual project effects are anticipated to be reversible and occur in areas that range from primarily undisturbed (i.e., wind farm locations) to previously disturbed (i.e., at the hydrogen / ammonia plant site). Table 9.15 summarizes the predicted environmental effects (residual effects) of the undertaking on surface water resources.

The baseline study identified existing baseline water quality issues in the Port au Port Wind Farm consisting of naturally occurring exceedances of GCDWQ and CWQG-FAL thresholds (Table 9.3). Elevated levels for water color, turbidity, pH and aluminum were found to exceed guidelines and give context to existing water quality issues.

Table 9.15 Summary of Predicted Environmental Effects of the Undertaking on Surface Water Resources

Residual Effect	Residual Effects Characterization							
	Nature	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Ecological and Socio-Economic Context
Construction								
Surface Water Quantity	A	M	LAA	MS	ST	C	R	U
Surface Water Quality	A	M	LAA	MS	ST	C	R	U
Operation and Maintenance								
Surface Water Quantity	A	M	LAA	MS	MT	C	R	U
Surface Water Quality	A	L	LAA	MS	ST	IR	R	U
Decommissioning and Rehabilitation								
Surface Water Quantity	A	L	LAA	MS	ST	IR	R	U
Surface Water Quality	A	L	LAA	MS	ST	IR	R	U

KEY:

Nature:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Timing:
NS: No Sensitivity
MS: Moderate Sensitivity
HS: High Sensitivity

Frequency:
S: Single Event
IR: Irregular Event
R: Regular Event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

9.5.3.2 Summary of Predicted Environmental Effects

WEGH2 incorporated avoidance with respect to potential effects of the Project on surface water resources during Project planning. Implementation of appropriate mitigation measures and best practices will be followed to reduce Project-related effects on surface water quality and quantity. The mitigation measures in Section 9.4 have been selected in consideration of the environmental effects pathways and include standard and proven mitigation measures for sedimentation and erosion control, incorporate the Environmental Guidelines for General Construction Practices (NLWMD 2018), and consider regulations and guidelines that govern the protection of fish and fish habitat. Standard mitigation measures, and best management practices will be followed for work in the Project Area watersheds to mitigate potential effects on surface water quality and quantity, to the extent practically feasible.

Water withdrawal from the Project Area, specifically in relation to water supply to the hydrogen / ammonia plant, can affect downstream flow rates and subsequently change the flow regime for surface water quantity. The proposed water withdrawal rates still allow for summer and winter environmental flows within the affected watersheds (WSC-226 and WSC-231), therefore losses in surface water quantity are predicted to be low to moderate and reversible during decommissioning. During operation, water usage by the plant will be limited, so as not consume all inflows to the source ponds, and to maintain ecological maintenance flows downstream of Project infrastructure (FracFlow 2023).

Effluent from the plant is expected to have a similar composition to that of warm freshwater, which is different in temperature and salinity than that of the receiving environment. Effluent discharge from the hydrogen / ammonia plant are expected to exceed CWQG-MAL standards for approximately 1 m to 3 m around the effluent discharge point however, the effluent is expected to meet provincial ECWSR effluent limits for these POPCs.

9.6 Determination of Significance

For the purposes of this environmental assessment, a significant residual environmental effect on surface water quantity and quality is defined as a Project-related environmental effect that results in a measurable and persistent change to surface water quality and quantity, as defined in Section 9.3.2.

The only residual effect that could not be completely mitigated at source is the hydrogen / ammonia plant effluent during operation. The Assimilative Capacity Assessment indicates that effluent treatment is expected to meet CWQG-MAL for all parameters except for temperature and salinity (Appendix 11-A). The mixing zone, or radius of non-compliant temperature and salinity around the effluent outfall discharge port, is expected to be a maximum of 3 m, which is sufficiently small to not adversely affect marine habitat.

In consideration of the VEC-specific significance criteria defined above, and with the application of mitigation measures defined in Section 9.4, the residual effects of routine Project activities on the surface water resources (quantity and quality) are predicted to be not significant. The level of confidence in this prediction is discussed in Section 9.7.

9.7 Prediction Confidence

The confidence in the predictions of environmental effects due to Project activities on surface water quantity and quality is moderate. The hydrological response of watersheds with the highest concentration of Project infrastructure contributes to the degree of uncertainty. In particular three watersheds in the Port au Port wind farm - Mainland Brook (WSC-130), Harry's Brook (WSC-124), and an unnamed brook on Cape St. George (WSC-144) - are expected to have a total change in surface topography of 30% to 50%. Application of best practices to limit land clearing to areas necessary and implement erosion and sedimentation controls are expected to mitigate and limit potential effects during construction. However, during operations, the alteration of land surface by road and wind turbine pad construction could alter infiltration rates and lead to increased surface water generation. Monitoring for these three watersheds will be conducted to mitigate for uncertainty in the hydrologic response of the watersheds. All other watersheds will have a much lower percentage change in land use, and the pathway of effect will be substantially reduced. For these watersheds, a high degree of confidence exists that watershed management targets will be met.

Quantitative predictions of surface water runoff, watershed area, and water supply at the hydrogen and ammonia production facility all have a high degree of confidence. This analysis was undertaken with generally accepted engineering practices and conservative assumptions to reduce the influence of uncertainty in the predictions.

Construction methods for construction activities around environmentally sensitive areas are well understood and can be found in government documents (NLWRMD 2018). Following guidelines during construction will ensure watershed management targets are met, and no significant adverse effects occur. These mitigation efforts are crucial for the Project to achieve its environmental goals, and construction efforts should be regularly monitored by environmental professionals.

9.8 Follow-Up and Monitoring

Follow-up and monitoring are intended to verify the accuracy of predictions made during the EA, to assess the implementation and effectiveness of mitigation, and to manage adaptively, if required. Compliance monitoring, where required by permitting or regulations, will be conducted to confirm that mitigation measures are properly implemented. Should an unexpected deterioration of the environment be observed as part of follow-up and/or monitoring, intervention mechanisms will include the adaptive management process. This may include identification of existing and/or new mitigation measures to be implemented to address it e.g., increased sediment and erosion control). Follow-up or monitoring required by applicable permits, will be reported to regulators, as necessary. Follow-up and monitoring for surface water resources to be implemented includes:

- Maintenance of erosion and sediment control measures used at each turbine foundation site, including documentation and response to uncontrolled release.
- Groundwater and Surface Water Monitoring Program to include surface water quality monitoring at the 11 proposed surface water quality (SWQ) sites throughout the Project Area as described in the Aquatics Environment Baseline Study (BSA-2)

- Environmental monitoring to follow up on effectiveness of the Erosion and Sediment Control Plan (e.g., surface water quality monitoring for TSS or turbidity, physical inspections of culverts). Surface water quality will continue to be monitored as required at the 11 proposed SWQ sites established in the Aquatics Baseline Study to ensure downstream water quality meets the CWQG-FAL.
- Effluent quantity and quality monitoring in compliance with ECWSR. Suggested parameters for monitoring are temperature, salinity, and TSS.
- Water level and flow monitoring in the industrial water supply ponds.
- Implementation of a hydrometric and geomorphic monitoring plan for the watersheds with the highest density of infrastructure, Mainland Brook (WSC-130), Harry's Brook (WSC-124), and an unnamed brook on Cape St. George (WSC-144) if erosion and sedimentation control measures are not sufficient in maintaining flow regimes in the watersheds.
- As part of operations, discharge effluent volumes will be recorded on a daily basis. Installation of flow monitoring equipment at the outlet of the hydrogen/ ammonia facility to outflows from the plant to ensure the ecological maintenance flows are met.

9.9 Capacity of Renewable Resources and Effects on Biological Diversity

The potential environmental effects of the Project on surface water resources were thoroughly assessed. The assessment concluded that routine Project activities are not likely to result in significant residual adverse effects on surface water resources . Therefore, adverse Project-related effects on the capacity of renewable resources to meet the needs of the present and those of the future are not anticipated with respect to surface water resources . Similarly, adverse Project-related effects on biological diversity that exceed the limits of natural variability or affect the long-term viability of biological diversity in the RAA are not anticipated with respect to surface water resources.

9.10 Predicted Future Environmental Conditions if the Project Does Not Proceed

If the project is not allowed to proceed, the existing conditions as described in the baseline section will continue to prevail, including current land use and natural conditions. It is possible that future development may occur in the area, including wind energy (given those Project areas are designated for wind farm development), but neither the likelihood nor extent of such development can be reasonably predicted at this time based on currently known information. Future projects are anticipated to have similar effects on the surface water environment. Should the Project Area remain undeveloped, the predicted future condition of surface water resources would be relatively unchanged from what was documented during the existing environment assessment presented in Section 9.2.

9.11 References

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10.0 Freshwater Fish and Fish Habitat

10.1 Scope of Assessment

Freshwater Fish and Fish Habitat have been assessed as a valued environmental component (VEC) because they provide ecological, cultural, recreational, and economic value to stakeholders including the public, Indigenous groups, local businesses, and government agencies. As fish are valued by resource users for recreational fishing activities and as a source of food, it is important to maintain stable populations within the region. Fish and fish habitat are protected by federal and provincial legislation, with the scope of the assessment being guided by the provincial Environmental Impact Statement (EIS) Guidelines (Table E.1), as well as applicable legislation, policies and guidance protecting fish and fish habitat in Canada and Newfoundland and Labrador (NL).

Fish and fish habitat occur within the Project Area and will be affected by planned Project activities. For the purposes of the assessment, the Fish and Fish Habitat VEC includes freshwater fish and fish habitat and fisheries, which are defined under the federal *Fisheries Act* as follows:

- Fish includes (i) parts of fish, (ii) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and (iii) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals
- Fish habitat means waters frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas
- Fishery includes any place where of period during which fishing may be carried out; any method of fishing used, any type of fishing gear, equipment, or fishing vessel used; and any species, populations, assemblages and stocks, whether the fish is fished or not

Freshwater fish and fish habitat have the potential to be affected by Project-related changes to Groundwater Resources (Chapter 6), Surface Water Resources (Chapter 7), and Wetlands and Vegetation, including Rare Species (Chapter 9) through effects such as the direct removal of riparian vegetation (affecting water quality via reduced shade or increased nutrient/energy inputs), alterations to stream flow, the introduction of sediments and contaminants, direct injury or death from in-water work, and industrial water usage that may result in changes in water levels in surrounding watercourses. Therefore, residual effects predicted for surface water, ground water, and vegetation and wetlands were used to inform potential Project effects on fish and fish habitat.

The Fish and Fish Habitat VEC is also linked to:

- Other Wildlife VEC (Chapter 15) - while the Freshwater Fish and Fish Habitat VEC considers changes in fish and fish habitat that may affect fish populations, the Other Wildlife VEC considers Project-related changes to large mammals, furbearers, and small mammals that may rely on fish for food.

- Land and Resource Use (Chapter 20) – while the Freshwater Fish and Fish Habitat VEC considers changes in fish and fish habitat that may affect fisheries, the Land and Resource Use VEC considers Project-related changes to the use of land and the associated resources (including fisheries) resulting from change in access to the Project Area and sensory disturbance to users
- Indigenous Fisheries (Chapter 21) – changes in fish and fish habitat have the potential to affect existing and potential Indigenous fisheries.

10.1.1 Regulatory and Policy Setting

In addition to the NL *Environmental Protection Act* (NL EPA), the Project is subject to other federal and provincial legislation, policies and guidance. This section identifies the primary regulatory requirements and policies which influence the scope of the assessment on fish and fish habitat and govern the management and protection of fish and fish habitat in Canada and NL.

10.1.1.1 Federal

Fisheries Act

The federal *Fisheries Act* is administered primarily by Fisheries and Oceans Canada (DFO) with some provisions administered by Environment and Climate Change Canada (ECCC). The *Fisheries Act* protects fish and fish habitat and addresses national interests in marine and fresh waters with the goal of protecting the long-term sustainability of aquatic resources. The *Fisheries Act* includes prohibitions against works, undertakings or activities that result in the harmful alteration, disruption or destruction (HADD) of fish habitat (section 35(1)). Works can be approved by and carried out in accordance with conditions established by the Minister of Fisheries, Oceans and the Canadian Coast Guard (Fisheries Minister) (section 35(2)(b)). Such work requires an authorization with an appropriate offsetting of residual adverse effects after avoidance and mitigation steps have been taken. HADD of fish habitat is defined under the *Fisheries Act* policies as “any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat’s capacity to support one or more life processes of fish.”

The *Fisheries Act* also prohibits the carrying out of a work, undertaking or activity, other than fishing, that results in the death of fish (section 34.4(1)), subject to certain exemptions including under an authorization from the Fisheries Minister (section 34.4(2)(b)). Additionally, section 34.3(2) provides provisions for maintaining adequate flow and respecting the free passage of fish. DFO’s Fisheries Protection Policy Statement (DFO 2019) provides guidance on fish and fish habitat protection provisions, and the Framework for Assessing Ecological Flow Requirements to Support Fisheries in Canada (DFO 2013) provides guidance on the management of flows required to maintain the ecological functions that sustain fisheries in streams and rivers potentially affected by water withdrawals.

Sections 36(3) and (4) of the federal *Fisheries Act* prohibits the deposition of deleterious substances into waters frequented by fish in Canada unless authorized by regulation.

Species at Risk Act

The federal *Species at Risk Act* (SARA) provides protection for species at risk (SAR) in Canada. The legislation provides a framework to facilitate recovery of species listed as Threatened, Endangered or Extirpated, and to prevent species listed as special concern from becoming threatened or endangered. SAR and their habitats are protected under SARA, which prohibits: 1) the killing, harming, or harassing of endangered or threatened SAR (sections 32 and 36), and 2) the destruction of critical habitat of an endangered or threatened SAR (sections 58, 60 and 61).

SAR species are listed in Schedule 1 of SARA. Species identified in Schedule 1 with the potential to occur in the Project Area are considered in this EIS. No approvals under SARA are likely to be required with respect to the Project.

10.1.1.2 Provincial

While the primary legislation protecting fish and fish habitat is the federal *Fisheries Act*, provincial legislation is also considered in the assessment of effects on fish and fish habitat. This includes the NL EPA, the NL *Water Resources Act,* and the NL *Endangered Species Act* (NL ESA).

The NL *Water Resources Act* gives the Water Resource Management Division (WRMD) of the NL Department of Environment and Climate Change (NLDECC) the responsibility and legislative power for the management of water resources in the province. The *NL Water Resources Act* provides regulations surrounding the alteration of a body of water. These includes changing the direction of flow, altering the quantity of water, impoundment or displacement, or changing of drainage characteristics for the purposes of water crossings structures (e.g., culverts). The *NL Water Resources Act* includes the *Environmental Control Water and Sewage Regulations*, which provides regulations surrounding the discharge of sewage and other effluent.

The NL ESA provides protection for plant and animal species considered to be Endangered, Threatened or Vulnerable. The NL ESA applies to species, sub-species and populations that are native to NL, however not to marine fishes. The designation under the NL ESA follows the recommendations of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Species Status Advisory Committee.

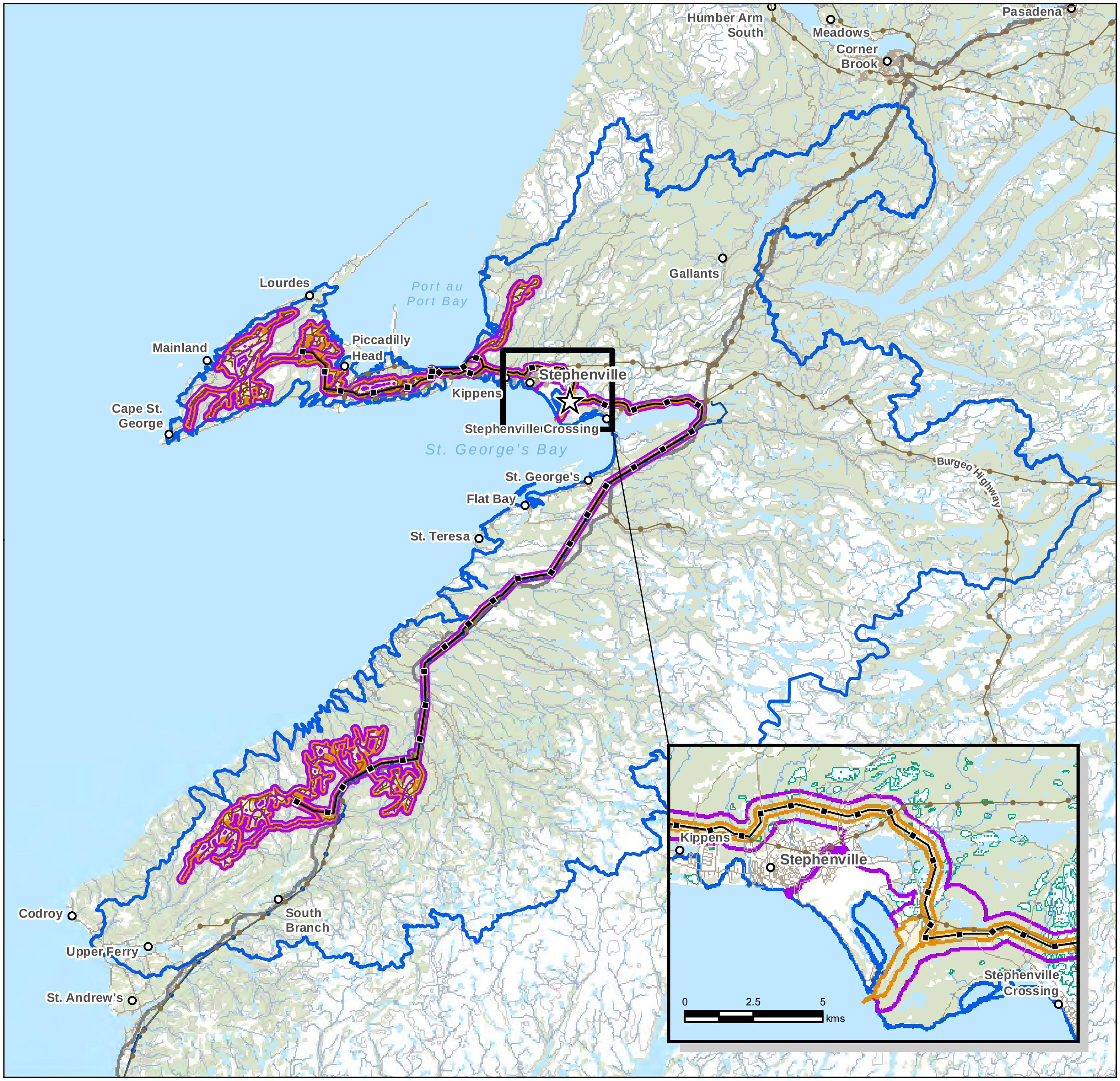
10.1.2 Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for the Freshwater Fish and Fish Habitat VEC were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur on the VEC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VEC. The spatial and temporal boundaries associated with the effects assessment for the Freshwater Fish and Fish Habitat VEC are described in the following sections.

10.1.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on Freshwater Fish and Fish Habitat in areas surrounding the Project components (Figure 10.1):

- Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of following distinct areas: the Port au Port wind farm, the Codroy wind farm, the hydrogen / ammonia production and storage facility (hydrogen / ammonia plant), port facilities, and the 230 kV transmission lines, as well as associated infrastructure including roads, substations, and water supply infrastructure. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project. In addition to encompassing the immediate area in which Project components and activities will occur, the Project Area also includes a buffer of up to 300 m for access roads and turbines and a 350 m corridor to accommodate the 70 to 75 m wide RoW for the transmission line. These buffers allow flexibility for the micro-siting of Project components during detailed design, based on technical considerations as well as the avoidance of environmentally sensitive areas, where practicable.
- Local Assessment Area (LAA): The LAA for fish and fish habitat incorporates the Project Area and watercourses and waterbodies that intersect with the Project Area, as shown in Figure 10.1. The LAA also includes Noel Pond, Muddy Pond, Gull (Mine) Pond and their downstream tributaries, within the proposed area of the industrial water supply. A 500 m buffer has also been applied to the access roads, collector lines and transmission line RoW to capture potential upstream and downstream effects related to placement of culverts and bridges, clearing of the RoW, and operation and maintenance of the access road and RoWs.
- Regional Assessment Area (RAA): The RAA for fish and fish habitat incorporates the Project Area and LAA and extends from the headwaters of the watershed to the head of tide where tributaries discharge into the marine environment. This area encompasses the area within which accidental events (Chapter 24) are assessed and informs the assessment of cumulative effects (Chapter 23).



Stantec

Project Area
Local Assessment Area
Regional Assessment Area

Proposed Project Features

Hydrogen / Ammonia Plant Location
Transmission Line 230 kV
Collector Line
Access Road

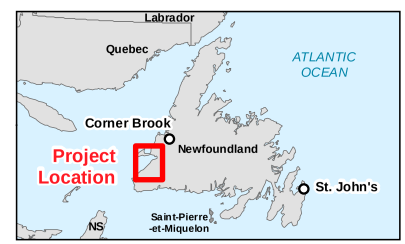
Other Features

Existing Transmission Line
Maritime Link
Trans Canada Highway
Road
Watercourse
Waterbody
Wooded Area

N

0 10 20 Kilometres
(At original document size of 8.5x11)
1:820,000

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: World Energy GH2, NL Fisheries, Forestry, and Agriculture; NRCan CanVec
3. Background: NRCan CanVec



Project Location
Stephenville
NL

Prepared by NW on 2023-06-02
QR by AW on 2023-07-07

Client/Project
World Energy GH2
Project Nujio'qonik

121417233_070c

Figure No.
10.1

Local and Regional Assessment Areas

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10.1.2.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on the Fish and Fish Habitat VEC include:

- Construction: Overall the construction phase of the Project will be from Q4 2023 through Q2 2027, pending EA approval and receipt of other required permits and approvals. Early civil works are planned to start Q4 2023 through Q3 2024. Construction of the Port au Port wind farm and associated infrastructure is expected to start in Q3 2024 with completion of the construction in Q4 2025. Construction of the Codroy wind farm and associated infrastructure is expected to start Q4 2025 with completion in Q1 2027. The hydrogen / ammonia plant will be constructed in phases from Q2 2024 to Q1 2026. Grid power sources are planned for hydrogen production in 2025 until March 2026, when the electrolyzer is commissioned.
- Operation and maintenance: Wind farm commissioning is anticipated to start Q1 2026 at the Port au Port wind farm and Q3 2027 at the Codroy wind farm. The 600 MW electrolyzer is expected to be commissioned in Q1 2026. The operational life of the Project is 30 years at each site.
- Decommissioning and rehabilitation: The decommissioning phase is anticipated to take two years, occurring between 2056 and 2058. Decommissioning is anticipated to begin Q1 2056 at the Port au Port wind farm, with completion in Q3 2058 at the Codroy wind farm.

10.2 Existing Environmental Conditions

A characterization of the existing conditions within the spatial boundaries defined in Section 10.1.2 is provided in the following sections. This includes a high-level discussion of the influences of past and present physical activities on the VEC, leading to the current conditions. An understanding of the existing conditions for the VEC within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 10.3.

For a more in-depth description of the existing environmental conditions, please refer to the Aquatics Environment Baseline Study (BSA-2).

10.2.1 Methods

A desktop analysis of digital satellite imagery was used to characterize fish habitat at the proposed crossing locations or potentially affected waterbodies. The fish habitat parameters assessed included channel status (visible or not visible), habitat type, estimated width, riparian vegetation, dominant substrate, slope, and adjacent relevant features.

Satellite imagery, publicly available information, watercourse connectivity, existing literature and professional knowledge was used to inform the presence of fish and species potentially present in watercourses and waterbodies within the Project Area.

Publicly available literature, aquatic SAR mapping, and data from Atlantic Canada Conservation Data Centre (AC CDC) were used to assess the potential for aquatic SAR.

More details about the methods used to characterize the existing conditions are available in the Aquatics Environment Baseline Study (BSA-2).

Fish and fish habitat field surveys (including data collection related to SAR/species of conservation concern (SOCC) are being conducted in summer 2023 to characterize fish habitat at road crossings and confirm the results of the desktop assessment. The field surveys and eDNA will also verify the presence or absence of fish-bearing watercourses within the road and transmission line RoWs or within Project infrastructure footprints, prior to clearing and to confirm the existing fish communities in support of subsequent permitting activities.

10.2.2 Existing Conditions

10.2.2.1 Fish Habitat

Port au Port Wind Farm

There are 244 potential watercourse/waterbody crossings associated with the Port au Port wind farm (112 access roads and 132 collector line RoWs), 86 watercourses/waterbodies are assumed to be fish-bearing as there appears to be connectivity with downstream watercourses or waterbodies, and 158 are considered unlikely or not fish-bearing. The vast majority of small (less than 5 m bankfull width) and medium (5 to 10 m bankfull width) watercourses are anticipated to have riffle/run habitats, with primarily coarse substrates, and riparian vegetation consisting of trees. Ponds were generally small, anticipated to have fine substrates and had riparian vegetation consisting primarily of trees. Ponds were generally small (range 34 to 122 m in width), anticipated to have fine substrates and had riparian vegetation consisting primarily of trees. Detailed fish habitat information is available in Appendix E of the Aquatics Environment Baseline Study (BSA-2).

Codroy Wind Farm

There are 177 potential watercourse/waterbody crossings associated with the Codroy wind farm (90 access road and 87 collector line RoWs). Of these, 143 watercourses/waterbodies are assumed to be fish-bearing as there appears to be connectivity with downstream watercourses or waterbodies, and 34 are considered unlikely or not fish-bearing. The majority of small watercourses are anticipated to have riffle/run habitats, with mixed (fine and coarse) or coarse substrates, and riparian vegetation consisting of shrubs or trees. The only pond was small and anticipated to have fine substrates and riparian vegetation consisting primarily of wetland vegetation. Detailed fish habitat information is available in Appendix E of the Aquatics Environment Baseline Study (BSA-2).

230 kV Transmission Line

There are 147 potential watercourse/waterbody crossings associated with the 230 kV transmission line. Of these, 106 potential watercourses/waterbodies are assumed to be fish-bearing as there appears to be connectivity with downstream watercourses or waterbodies, and 41 are unlikely or not considered to be fish-bearing. The vast majority of small and medium watercourses are anticipated to have riffle/run habitats, with primarily coarse substrates, and riparian vegetation consisting of trees or shrubs. Ponds were small (approximately 16 to 260 m in width), were anticipated to have fine substrates and had riparian vegetation consisting primarily of shrubs or trees. Detailed fish habitat information is available in Appendix E of the Aquatic Environment Baseline Report (BSA-2).

Hydrogen / Ammonia Plant

The potential sources of freshwater for the industrial water supply at the hydrogen / ammonia plant are Muddy Pond, Noels Pond and Gull (Mine) Pond. Muddy Pond, Noels Pond, and Gull (Mine) Pond range in size from 0.1 to 1.0 km^2 and maximum depth ranges from 18 to 28 m. Riparian vegetation surrounding the ponds is primarily forest and/or shrubs. Substrates in the littoral area appear to be primarily coarse (e.g., gravel, cobble) with substrates in the profundal zone likely being fine. Additional fish habitat information is available in Appendix E of the Aquatics Environment Baseline Study (BSA-2).

Warm Creek (outlet of Noel's Pond) is approximately 4.4 km in length with an average width of 10 m. It flows through the Town of Stephenville. Based on satellite imagery the outlet has coarse substrates, swift-flowing water velocities (e.g., riffle-run habitats) and riparian vegetation consisting of grass, shrubs and trees.

The outlet of Gull (Mine) Pond is approximately 2.6 km in length with an average width of 5 m. The outlet and its inflowing tributaries flow through the plant site into Port Harmon. It is disturbed by an existing access road, a piped stream diversion and the existing plant site. The watercourses are anticipated to have mixed substrates, swift-flowing water velocities (e.g., riffle-run habitats) and riparian vegetation consisting of shrubs. The outlet of Gull (Mine) Pond is intermittent or ephemeral during low flow period or during periods of low rainfall (Frac Flow 2023).

10.2.2.2 Fish Communities

Based on the flowing habitat characteristics associated with the vast majority of the crossings, brook trout (*Salvelinus fontinalis*), Atlantic salmon (*Salmo salar*), American eel (*Anguilla rostrata*), threespine stickleback (*Gasterosteus aculeatus*), and ninespine stickleback (*Pungitius pungitius*) are likely to be the most common and abundant fish species to be encountered within the RoW. There is the potential for banded killfish (*Fundulus diaphanus*), mummichog (*Fundulus heteroclitus*), rainbow smelt (*Osmerus mordax*), Arctic char (*Salvelinus alpinus*), and blackspotted stickleback (*Gasterosteus wheatlandi*). Field surveys conducted to date have confirmed the presence of brook trout and American eel on the Port au Port Peninsula (Stantec unpublished).

Freshwater habitat within the RAA provides spawning, nursery, rearing, feeding and migratory habitats on a local scale for brook trout, threespine stickleback, ninespine stickleback, and banded killifish to carry out their life processes. Brook trout are most likely to be found in small streams with coarse substrates, while Atlantic salmon and American eel are most likely to be found in medium streams with coarse substrates (Grant and Lee 2004; Scott and Crossman 1998; Stanley and Trial 1995). Sticklebacks and banded killifish are most likely to be found in ponds or streams flowing through wetlands with fine substrates (Grant and Lee 2004; Scott and Crossman 1998). Mummichogs are found in estuarine areas, close to the marine environment (Scott and Crossman 1998).

Additional details can be found in the Aquatics Environment Baseline Study (BSA-2).

10.2.2.3 Aquatic Species at Risk and Species of Conservation Concern

Three aquatic SAR/SOCC are known to inhabit watersheds within the RAA or have the potential to be present within the RAA: American Eel, banded killifish, and mummichog (Table 10.1; COSEWIC 2012; NLDFFA n.d.; DFO 2022, AC CDC 2023). No critical habitats (as defined by SARA or NS ESA) for these species were identified in the RAA.

Table 10.1 Aquatic Species at Risk and/or Species of Conservation Concern that may occur in the RAA

Species	Conservation Status			
	SARA[1]	COSEWIC[1]	NL ESA[2,3]	ACCDC S-Rank
American Eel (*Anguilla rostrata*)	No status (under consideration)	Threatened (2012)	Vulnerable (2006)	S3 (Vulnerable)
Banded Killifish (*Fundulus diaphanous*) – Newfoundland population	Special Concern, Schedule 1	Special Concern (2003)	Vulnerable (2003)	S3 (Vulnerable)
Mummichog (*Fundulus heteroclitus*)	No status	No status	Vulnerable	S3 (Vulnerable)

Notes:
Source: Government of Canada 2021.
Newfoundland and Labrador Fisheries, Forestry and Agriculture (no date) https://www.gov.nl.ca/ffa/wildlife/endangeredspecies/fish/
SSAC 2016

In Newfoundland, eels are found in almost all lakes and rivers that flow to the sea (NLDFFA n.d.). American eel is catadromous; adults move downstream in late summer or autumn to marine waters and migrate to the Sargasso Sea to spawn (COSEWIC 2012). As young eels grow, they drift toward the continental shelf and eventually move into inshore waters, migrating to brackish waters or back to freshwater habitats. There has been a general decline in eel abundance over time (Veinott and Clark 2010). Based on habitat characteristics, American eel are most likely to occur at 70 potential Project crossings associated with medium watercourses.

Populations of banded killifish are distributed in the Regional Assessment Area at Loch Leven (Highlands River), Flat Bay Brook, Little Barachois Brook, Bottom Brook, St. George's Bay, Harry's River and Noel's Pond (DFO 2022, AC CDC 2023). Based on these known populations, banded killifish have the potential to occur at 23 potential Project crossings, though this species prefers slow moving reaches of rivers or pond habitats and are therefore more likely to occur at one proposed transmission line crossings with habitat that fits their preferences (WCT-556). Banded killifish are also present within Noel's Pond (and likely Muddy Pond based on connectivity) which is associated with the industrial water supply for with the hydrogen / ammonia plant (AC CDC 2023).

Mummichog occur in brackish waters, usually, in saltmarsh flats, estuaries and tidal areas where there is submergent aquatic vegetation (Scott and Crossman 1998). They are tolerant of a wide range of salinities and temperatures (Scott and Crossman 1998). Populations are known to occur in White's Brook and Gravel's Pond on the Port au Port (AC CDC 2023), which are within the LAA.

10.2.2.4 Freshwater Fisheries

The Land and Resource Use Study for this Project identified that the majority of freshwater fish and/or aquatic species activities in the areas are for recreational/food purposes or traditional/cultural purposes (Stantec 2023). Species fished include American eel, Arctic char (*Salvelinus alpinus*), Atlantic salmon, brook trout, rainbow smelt as well as other species. Fishing activities typically take place once or twice a week when the seasons are open, and fish are consumed one or twice a week (Stantec 2023). The majority of rivers in the RAA are Class 2 with one river being Class 4 (Great Codroy River and its tributaries). The RAA comprises part of Trout Angling Zone 1 and a few outfitters operate within the RAA, offering guided, salmon and brook trout fishing, in addition to hunting other wildlife. Overall, freshwater fisheries in the LAA are likely limited due to the steep terrain and lack of road access to watercourses and waterbodies.

While the majority of activities in the areas relating to freshwater fish and/or aquatic species involve fishing for recreational/food purposes or traditional/cultural purposes (Stantec 2023), local Indigenous groups also have allocations for Food, Social, and Ceremonial (FSC) purposes. Commercial fishing for American eel exists in estuarine and inland waters near the Project (L. Hawkins, pers. comm., personal communication, July 27, 2023). Commercial smelt fisheries also have the potential to occur although there has been no activity in more than a decade (L. Hawkins, personal communication, July 27, 2023).

10.3 Assessment Criteria and Methods

This section describes the criteria and methods used to assess environmental effects on Freshwater Fish and Fish Habitat. Residual environmental effects (Section 10.5) are assessed and characterized using criteria defined in Section 10.3.1, including direction, magnitude, geographic extent, timing, duration, frequency, reversibility, and ecological or socio-economic context. The assessment also considers potential mitigation measures that will be applied where effects are identified. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for Freshwater Fish and Fish Habitat is provided in Section 10.3.2. Section 10.3.3 identifies the environmental effects to be assessed for the VEC, including effect pathways and measurable parameters. This is followed by the identification of potential Project interactions with the VEC (Section 10.3.4). Analytical assessment techniques employed for the assessment of potential Project-related environmental effects on Freshwater Fish and Fish Habitat are provided in Section 10.3.5. The assumptions that were made to support a conservative approach to the assessment of residual effects on Freshwater Fish and Fish Habitat are described in Section 10.3.5.1.

10.3.1 Residual Effects Characterization

Table 10.2 presents definitions for the predicted environmental effects characterization of the undertaking on Freshwater Fish and Fish Habitat. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 10.2 Characterization of Predicted Environmental Effects of the Undertaking on Freshwater Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Nature	The long-term trend of the residual effect	• **Neutral –** No net change in the measurable parameter(s) for Freshwater Fish and Fish Habitat relative to baseline • **Positive –** A residual effect that moves the measurable parameter(s) in a direction beneficial to Freshwater Fish and Fish Habitat relative to baseline • **Adverse –** A residual effect that moves the measurable parameter(s) in a direction detrimental to Freshwater Fish and Fish Habitat relative to baseline
Magnitude	The amount of change in measurable parameter(s) of the VEC relative to existing conditions	**Change in Fish Habitat Quality / Quantity:** • **Negligible –** No measurable change • **Low –** a measurable change in habitat area, flows or habitat quality that is within the range of natural variability • **Moderate –** a measurable change in habitat area, flow (<10%) or habitat quality that is greater than the range of natural variability, however, that does not affect the ability of fish to use this habitat to carry out one or more of their life processes • **High –** a measurable change in habitat area, flow (>10%) or habitat quality that is greater than the range of natural variability and large enough that fish can no longer rely on this habitat to carry out one or more of their life processes
		Change in Fish Health and Survival: • **Negligible –** No measurable change • **Low –** a measurable change in the abundance or survival of local fish populations that is within the range of natural variability • **Moderate –** a measurable change in the abundance or survival of local fish populations that is greater than the range of natural variability, however, does not affect the sustainability of fish populations • **High –** a measurable change in abundance or survival of local fish populations that is greater than the range of natural variability and is large enough to potentially affect the sustainability of fish populations

Table 10.2 Characterization of Predicted Environmental Effects of the Undertaking on Freshwater Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Geographic Extent	The geographic area in which a residual effect of a defined magnitude occurs	• **Project Area –** Residual effect is restricted to the Project Area • **LAA –** Residual effect extends into the LAA • **RAA –** Residual effect extends into the RAA
Timing	Considers when the residual environmental effect is expected to occur, where applicable or relevant to the VEC.	• **No Sensitivity –** Residual effect occurs in un-scheduled waters or outside timing windows. • **Moderate Sensitivity –** Residual effect may occur during fish migratory periods (May 1 to September 30, in scheduled waters) • **High Sensitivity –** Residual effect occurs during fish spawning, incubating or hatching period (October 1 to May 31, in scheduled waters)
Duration	The period of time required until the measurable parameter(s) or the VEC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	• **Short-term –** Residual effect extends less than three years (one generation of local salmonid species) • **Medium-term –** Residual effect extends three to nine years (one to three generations of local salmonid species, based on fish being able to spawn at age 3 years) • **Long-term –** Residual effect extends more than nine years (three generations) of local salmonid species or beyond the life of the Project
Frequency	Identifies how often the residual effect occurs during the Project, during a specific phase of the Project, or during another specified time period	• **Single event** • **Multiple irregular event –** Occurs at no set schedule • **Multiple regular event –** Occurs at regular intervals • **Continuous –** Occurs continuously
Reversibility	Describes whether a measurable parameter(s) or the VEC can return to its existing condition after the Project activity ceases, including through active management techniques	• **Reversible –** Residual effect is likely to be reversed after activity completion and rehabilitation • **Irreversible –** Residual effect is unlikely to be reversed
Ecological / Socio-economic Context	Existing conditions and trends in the area where the residual effect occurs	• **Undisturbed –** Area is relatively undisturbed or not adversely affected by human activity • **Disturbed –** Area has been substantially previously disturbed by human development or human development is still present

10.3.2 Significance Definition

A significant residual adverse effect on Fish and Fish Habitat is defined as a residual Project-related change to the environment that results in any of the following:

- HADD of fish habitat or the death of fish, as defined by the *Fisheries Act*, that cannot be mitigated, authorized or offset
- an activity restricting the free passage of fish, as defined by the *Fisheries Act*
- a change to the productivity or sustainability of fish populations or fisheries within the LAA where recovery to baseline is unlikely, or is contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans
- contravention of any of the prohibitions stated in Sections 32-36 of the *Species at Risk Act* or relevant provincial acts regarding SAR

10.3.3 Potential Environmental Effects, Project Pathways, and Measurable Parameters

Table 10.3 lists the potential Project effects on Freshwater Fish and Fish Habitat and provides a summary of the Project effect pathways and measurable parameters and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for large development projects in NL, renewable energy projects in other parts of Canada, comments provided during engagement, and professional judgment.

Potential environmental effects to fish and fish habitat are anticipated to occur primarily within the construction and decommissioning phases, with the greatest potential for interaction during the construction phase of the Project. The potential effects of environmental stressors on fish, fish habitat and fisheries are typically intertwined in that changes to the quality or quantity of fish habitat can influence fish populations and/or fisheries.

Table 10.3 Environmental Effects, Effect Pathways, and Measurable Parameters for Freshwater Fish and Fish Habitat

Environmental Effect(s)	Effect Pathway(s)	Measurable Parameter(s) and Units of Measurement
Change in Fish Habitat Quantity	• In-water work • Change in fish passage • Change in flow or water level	• Area (m^2) of habitat
Change in Fish Habitat Quality	• In-water work • Alteration of riparian vegetation • Erosion and sedimentation • Release of deleterious substances • Change in flow or water level	• Water quality, including but not limited to total suspended solids (TSS) (mg/L); dissolved oxygen (DO) (mg/L); water temperature (°C); pH; metals; nutrients • Fish habitat (physical characteristics including substrate, velocity, cover)
Change in Fish Health and Survival	• Use of industrial equipment in or near water • In-water work • Release of deleterious substances • Change in water level • Entrainment • Fishing pressure	• Abundance (numbers of fish) • Community structure (proportion of each species) • Mortality (numbers of fish)

10.3.4 Project Interactions with Fish and Fish Habitat

Table 10.4 uses checkmarks to indicate the routine Project activities that could interact with the VEC and result in the identified environmental effect(s) to be assessed. Immediately following Table 10.3, environmental effects pathways are briefly described for potential routine Project-related environmental effects and justification is provided in cases where no Project interaction with the VEC (and therefore no potential environmental effect on the VEC) is predicted.

Table 10.4 Project Interactions with Fish and Fish Habitat, Environmental Effects, and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed		
	Change in Fish Habitat Quantity	Change in Fish Habitat Quality	Change in Fish Health and Survival
Construction			
Site Preparation and Civil Works (including turbine foundations, road construction, quarries, clearing, grubbing, blasting, cement production, and watercourse crossings)	✓	✓	✓
Transportation of Resources and Equipment (includes trucking, shipping and barging of materials)	-	✓	✓
Construction / Installation, Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	-	✓	✓
Installation and Commissioning of Wind Turbines	-	-	-
Installation and Commissioning of Collector Systems	-	✓	✓
Installation and Commissioning of Transmission Lines and Substations (including marine cable crossing)	-	✓	✓
Installation and Commissioning of Hydrogen / Ammonia Production, and Storage Facilities and Associated Infrastructure (including Industrial water supply infrastructure)	✓	✓	✓
Restoration of Existing Port Facilities (including pile driving and dredging)	-	-	-
Emissions, Discharges, and Wastes[1]	-	-	-
Employment and Expenditures[2]	-	-	✓
Operation and Maintenance			
Presence, Operation, and Maintenance of Wind Farms (including wind turbines, access roads, and collector systems)	-	✓	✓
Presence, Operation, and Maintenance of Transmission Lines and Substations	-	✓	✓
Presence, Operation, and Maintenance of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure (includes marine discharge from treatment plant)	✓	✓	✓
Presence, Operation, and Maintenance of Port Facilities (includes loading of ammonia and vessel maneuvering within Port)	-	-	-
Emissions, Discharges, and Wastes[1]	-	-	-
Employment and Expenditures[2]	-	-	✓

Table 10.4 Project Interactions with Fish and Fish Habitat, Environmental Effects, and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed		
	Change in Fish Habitat Quantity	Change in Fish Habitat Quality	Change in Fish Health and Survival
Decommissioning and Rehabilitation			
Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	-	-	-
Decommissioning and Rehabilitation of Wind Farms (including wind turbines, access roads, and collector systems)	-	✓	✓
Decommissioning and Rehabilitation of Transmission Lines and Substations	-	✓	✓
Decommissioning and Rehabilitation of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure	✓	✓	✓
Decommissioning and Rehabilitation of Port Facilities	-	-	-
Emissions, Discharges, and Wastes[1]	-	-	-
Employment and Expenditures[2]	-	-	✓

Notes:
✓ = Potential interaction
– = No interaction
[1] Emissions (e.g., light, noise, vibration, air contaminants and GHGs), discharges (e.g., wastewater and other liquid effluents), and hazardous and non-hazardous wastes are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, "Emissions, Discharges, and Wastes" is listed as a separate item under each phase of the Project.
[2] Project employment and expenditures are generated by most Project activities and are the main drivers of many potential socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, "Employment and Expenditures" is listed as a separate item under each phase of the Project.

Avoidance measures will reduce potential direct interactions between Project components or activities and fish and fish habitat by physically relocating these components and activities away from fish and fish habitat, where practicable.

In the absence of mitigation, the Project may interact with Freshwater Fish and Fish Habitat in the following ways:

- Site preparation and civil works including clearing vegetation, stripping soils and grading for access road and turbine pad construction may alter fish habitat quality related to run off, which may in term effect fish health and survival. Fish habitat may be lost as a result of construction of watercourse crossings.

- Installation and commissioning of collector systems, transmission lines and substations and presence, operation, and maintenance of transmission lines and substations includes clearing riparian vegetation which may alter fish habitat quality related to run off or cover, which may in turn affect fish health and survival.
- As part of the installation and commissioning of hydrogen / ammonia production and storage facilities, fish habitat may be altered by changes in flow and water levels downstream of the industrial water source. Conversely, fish habitat may be increased during operation as a result of the raising of water levels in ponds associated with the industrial water supply.
- As part of the presence, operation, and maintenance of hydrogen / ammonia production and storage, facilities water withdrawal activities could cause impingement and thereby affect fish health and survival.
- The presence, operation, and maintenance of wind farms may alter fish habitat quality related to run off from access roads, which may in turn affect fish health and survival.
- Over the life of the Project, employment and expenditure could interact with fish health and survival if the presence of Project workers or improved access results in increased angling activity in the area.

The following Project activities are not expected to result in a change in fish habitat quantity and quality or fish health and survival:

- Construction / installation, presence, operation, and maintenance of temporary workforce accommodations and associated infrastructure, and presence, operation, and maintenance of temporary workforce accommodations and associated infrastructure will occur on land, away from watercourses and waterbodies and will not interact with freshwater fish and fish habitat
- Installation and commissioning of wind turbines, will occur on land, away from watercourses and waterbodies and will not interact with freshwater fish and fish habitat
- Restoration of existing port facilities during construction, presence, operation, and maintenance of port facilities, and decommissioning and rehabilitation of port facilities will occur in the marine environment, away from freshwater watercourses and waterbodies and will not interact with freshwater fish and fish habitat
- Emissions, discharges, and wastes that will occur as a result of construction, operation, maintenance decommissioning and rehabilitation will occur on land, away from watercourse and waterbodies

10.3.5 Analytical Assessment Techniques and Level of Knowledge

Potential effects of the Project on fish and fish habitat were assessed quantitatively where information or model results were available, and qualitatively where information or model results were not available. Quantitative assessments included:

- GIS analysis of the Project footprint overlain with maps of watercourses and waterbodies to delineate potential habitat alterations under watercourse crossings
- Comparison of water withdrawal predictions to baseline stream discharges in consideration of the federal "Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013) to determine potential habitat loss associated with flow reduction

Qualitative assessments were conducted using a weight-of-evidence approach. This entailed the use of the best available aerial imagery, professional judgement based on an understanding of the Project and potential effects from similar civil works projects, the habitat use and life history of potentially affected fish species in the LAA and RAA, and the likely effectiveness of mitigation measures, supported by scientific literature, industry best management practices, and regulatory guidelines, as available.

10.3.5.1 Assumptions and Conservative Approach

Several assumptions were employed in the assessment of Project effects on fish and fish habitat, resulting in conservative predictions of residual effects:

- Watercourses were assumed to be fish-bearing if they had visible connectivity with downstream watercourses or waterbodies, which is a conservative approach
- Where substrates were not visible, substrate was assigned based on the type of riparian vegetation present at the crossing. These assumptions were based on professional experience from numerous field surveys in Atlantic Canada, where substrate type was found to be generally related to the type of riparian vegetation present and/or channel slope.
- The Water Quantity models in the Surface Water Resources VEC (Chapter 9) were used to support the assessment of a potential change in habitat quantity
- Species presence in the Project Area was determined based on the habitat characteristics of the desktop fish habitat assessments. These assumptions are informed by the freshwater habitat preferences of various fish species reported in the literature and by previous studies of species that occur in similar habitat types on the Island of Newfoundland and field studies.

10.4 Mitigation Measures

A series of environmental management plans will be developed by WEGH2 to mitigate the effects of Project development on the environment. A full list of mitigation measures to be applied throughout Project construction, operation and maintenance, and decommissioning and rehabilitation is provided in Section 26.2. Key measures to mitigate the potential effects of the Project on Freshwater Fish and Fish Habitat are listed in Table 10.5, by category and Project phase.

Table 10.5 Mitigation Measures: Freshwater Fish and Fish Habitat

ID # *	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
1	Mitigation	Existing riparian vegetation will be maintained according to buffer specifications in permits and regulations.	X	-	X
2	Mitigation	Work will be performed so that materials such as sediment, fuel or other hazardous materials do not enter watercourses and waterbodies through implementation of erosion and sediment control measures and hazardous materials management practices.	X	X	X
3	Mitigation	Work will be conducted in a manner to protect watercourses and wetlands from siltation and disturbance in accordance with Best Management Practices or as otherwise agreed upon with the regulator.	X	X	X
4	Mitigation	Sensitive areas (e.g., wetlands, rare plant occurrences, hibernacula, mineral licks, roosts) identified prior to Project activities will be flagged and appropriate buffers maintained around these areas, where feasible.	X	X	X
8	Mitigation	Project staff and contractors will adhere to the waste management procedures to be included in the EPP and the Waste Management Plan.	X	X	X
9	Mitigation	Construction areas will be kept clear of rubbish and debris. Rubbish and debris will be appropriately stored and managed.	X	X	X
10	Mitigation	Waste materials and debris will be collected and stored in acceptable containers on-site and disposed of off-site in an environmentally acceptable and approved site. Materials that can be recycled will be sorted and taken to an approved facility.	X	X	X
11	Mitigation	Volatile wastes and materials, such as fuel, mineral spirits, oil, or paint thinner will be stored appropriately and will not be permitted to enter into waterways or storm drains. They will be disposed of at an approved site.	X	X	X
12	Mitigation	Where portable toilets are required, waste will be removed from the site by the supplier in a timely manner for appropriate disposal. These toilets will be located more than 30 m from the boundaries of wetlands or watercourses.	X	X	X

Table 10.5 Mitigation Measures: Freshwater Fish and Fish Habitat

ID # *	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
14	Mitigation	Bulk fuel and lubricants will be stored in secure areas (i.e., with bund walls and impervious flooring) that have the capacity to trap more than the volume of petroleum hydrocarbons being stored; this will serve as a secondary containment should the primary containment fail. Other petroleum hydrocarbon products will not be stored in large quantities on-site, and secondary containment (e.g., drip trays) will be used in areas of storage and transfer.	X	X	X
15	Mitigation	Hazardous products will be stored according to industrial requirements and standards, and safely secured so that access is limited to authorized personnel.	X	X	X
16	Mitigation	Fuelling and servicing will be conducted using appropriate containment equipment, including spill kits.	X	X	X
17	Mitigation	Fuelling and servicing areas will be sited more than 100 m away from watercourses, coastlines, waterbodies, and wetlands.	X	X	X
19	Mitigation	Vehicles, heavy equipment, and machinery will be properly maintained to reduce the risk of leakage. Routine preventative maintenance and inspection of hydraulic equipment and machinery will be undertaken to avoid a hazardous material release.	X	X	X
20	Mitigation	Project footprint and disturbed areas will be limited to the extent practicable.	X	X	X
21	Mitigation	The limits for approved clearing, grubbing and topsoil overburden removal will be clearly identified (flagging/survey stakes) in the field prior to the commencement of work.	X	-	X
24	Mitigation	Dust from Project activities will be controlled where required by using applications of water or other approved agents. Waste oil will not be used for dust controls.	X	-	X
26	Mitigation	Re-seeding of areas will follow standard methods in compliance with permit conditions. These methods will be included the Project EPP.	X	-	X
27	Mitigation	Specific stockpiles of topsoil, overburden, and other potentially dust-generating materials will be kept covered, where practical, and used as soon as practical, or will be appropriately temporarily vegetated.	X	-	X
32	Mitigation	An Explosives and Blasting Management Plan will be developed by the blasting contractor to provide direction for the safe storage, handling and use of explosives and explosive components at the Project site, to address the safety of the public and Project personnel, and protection of both the environment and Project components.	X	-	-

Table 10.5 Mitigation Measures: Freshwater Fish and Fish Habitat

ID # *	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
33	Mitigation	Areas to be cleared will have sediment and erosion control measures implemented per the site-specific Erosion & Sediment Control Plan prior to the initiation of clearing activities. The sediment and erosion control measures will be adapted to suit the field conditions associated with the specific construction activities as construction proceeds.	X	X	X
34	Mitigation	Construction areas will be routinely monitored to identify areas of potential erosion and to apply appropriate mitigation. Best practice erosion and sediment control measures will be implemented, as required.	X	X	X
35	Design	The drainage system for the site will be designed to appropriately manage stormflows considering impacts to on-site downstream watercourses, and coastlines, and infrastructure. Additionally, the site drainage system will consider the variable and seasonal up-stream drainage needs to provide adequate access to downstream watercourses without adverse impact on the plant site or other nearby infrastructure.	X	X	-
43	Mitigation	To reduce the risk of introducing or spreading exotic and/or invasive vascular plant species, equipment will arrive at the construction site clean and free of soil and vegetative debris. Equipment will be inspected by Project personnel or designate and either approved for use or cleaned, re-inspected and approved for use.	X	-	X
77	Mitigation	Best practices for the proper handling, storage, and disposal of spilled hazardous chemicals and fuels will be included in the EPP and implemented by the Project personnel and contractors.	X	X	X
83	Mitigation	Spill response kits will be available on-site. Project vehicles will be equipped with appropriately sized spill kits.	X	X	X
84	Mitigation	In the event of a spill, dry clean up and mopping techniques will be used, as appropriate. The area will not be "washed down" as this could cause the spills to spread to the surrounding environment and potentially enter drainage works or environmentally sensitive areas.	X	X	X
85	Mitigation	Soil that may have become contaminated will be remediated. This may be done on-site or removed from site for disposal at an approved location.	X	X	X
86	Design	The potential effects of extreme weather, including storms, precipitation, and drought will be considered in Project planning, design, and operation and maintenance strategies, including the selection of materials and equipment, and design of components. These designs will consider projected climate change conditions over the life of the Project.	X	X	X

Table 10.5 Mitigation Measures: Freshwater Fish and Fish Habitat

ID # *	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
90	Mitigation	Weather forecasts (including marine forecasts) will be considered when planning construction and operation activities that may be affected by adverse conditions, such as receipt of materials and supplies, and product deliveries, particularly deliveries of products and diesel fuel. Where required, these activities will be scheduled for periods of favourable weather conditions.	X	X	X
136	Mitigation	Site-specific erosion and sedimentation control plans will be developed during detailed design phase of the Project and will be implemented.	X	X	X
147	Mitigation	Rinsing activities will be carried out at the site of the concrete batch plant, except rinsing of the chute and applicable concrete placement equipment.	X	-	-
149	Mitigation	Blasting patterns and procedures will be used to reduce shock or instantaneous peak noise levels, in accordance with a Blast Management Plan that will be developed for the Project.	X	-	-
150	Mitigation	Explosives will be used in a manner that will reduce damage or defacement of landscape features, trees, ecologically sensitive areas such as wetlands, and other surrounding objects, by controlling through standard best practice (including precisely calculated explosive loads and adequate stemming), the scatter of blasted material beyond the limits of activity. Outside of cleared areas, inadvertently damaged trees will be cut, removed, and salvaged, if merchantable (refer to Section, "Clearing of Vegetation"). Fly rock, which inadvertently enters a waterbody, watercourse, or ecologically sensitive area and that can be recovered without further damage to the environment, will be removed. Instances where larger fly rocks (boulders) enter these areas or deep waterbodies, recovery of this will be discussed with the OSEM.	X	-	-
151	Mitigation	Time delay blasting cycles or blasting mats will be used, if necessary, to control the scatter of blasted material.	X	-	-
161	Mitigation	Movement of equipment / vehicles will be restricted to defined work areas and roads, and specified corridors between work areas.	X	X	X
162	Mitigation	Machinery will be operated above the high-water mark or inside of isolated areas.	X	-	X
163	Mitigation	In-water work will be planned to respect DFO timing windows to protect fish in Newfoundland and Labrador (DFO 2019), as required through a letters of advice, *Fisheries Act* authorizations, or in consultation with DFO.	X	-	-
164	Mitigation	The duration of instream works will be reduced to the extent possible.	X	-	X

Table 10.5 Mitigation Measures: Freshwater Fish and Fish Habitat

ID # *	Mitigation Type	Mitigation Measure	Project Phase*		
			C	**O**	**D**
165	Mitigation	In-water worksites will be isolated from flowing water (i.e., by using a cofferdam) to contain or reduce suspended sediment, where possible. Clean, low permeability material and rockfill will be used to construct cofferdams, as required.	X	-	X
166	Mitigation	New culverts will be sized appropriately and designed to be passable to fish to maintain fish passage.	X	-	-
167	Mitigation	New culverts will be embedded to a minimum of 20% with appropriately sized substrates, or arch culverts will be installed.	X	-	-
168	Mitigation	Use of explosives in, or near, water will be avoided, however, if required, will follow DFO blasting guidelines.	X	-	-
169	Mitigation	Siting of Project infrastructure will be designed to avoid fish habitat to the extent practicable.	X	-	-
170	Mitigation	Fish screens will be installed and maintained to prevent fish from entering water intakes.	X	X	X
172	Mitigation	If fording is required, it will follow the DFO temporary ford code of practice (DFO 2020).	X	X	X
173	Mitigation	Best efforts will be made by a qualified environmental professional to relocate fish from areas of in-water works to an appropriate location in the same watershed.	X	-	-
174	Mitigation	Site and access roads will be maintained in good condition. This will include periodically regrading and ditching to improve water flow, reduce erosion, and to manage vegetation growth.	X	X	X
175	Mitigation	Herbicide application will be prohibited within watercourse buffers.	-	X	-
176	Mitigation	A minimum ecological flow will be maintained in watercourses and waterbodies where water is diverted during construction or extracted during commissioning and operation.	X	X	-

* Notes:
"ID #" denotes the master identification number for a mitigation in Appendix 26-A.
"C" denotes the construction phase of the Project.
"O" denotes the operation and maintenance phase of the Project.
"D" denotes the decommissioning and rehabilitation phase of the Project.
"X" denotes the relevant Project phase for the mitigation measure

10.4.1 Application of the Precautionary Principle to Project Mitigation Measures

WEGH2 incorporated avoidance with respect to potential effects of the Project on freshwater fish and fish habitat during Project planning. Early in the EA process, and based on consultation with regulators (including DFO, NAV Canada, and NLDECC), Indigenous groups, and stakeholders, WEGH2 completed a review and update of the Project design and layout to address specific concerns and issues. The Project layout will continue to evolve during the EA process as various stages of conceptual and detail design are completed.

The main Project components which interact with freshwater fish and fish habitat are water crossing structures, collector lines and transmission lines. Their interactions with freshwater fish habitat are well known, and include use of industrial equipment near water, clearing, excavating and grading near water and in-water work associated with water crossing structure placement (i.e., culverts). The mitigation measures in Section 10.4 have been selected in consideration of the environmental effects pathways and include standard proven mitigation measures for sediment and erosion control, incorporate DFO measures to protect fish habitat, standards and best management practices, and consider regulations and guidelines that govern fish and fish habitat protection. As such, the mitigation measures presented are more than adequate for reducing effects to acceptable levels.

10.5 Residual Environmental Effects

10.5.1 Change in Fish Habitat Quantity

Pathways that affect fish habitat quantity as outlined in Section 10.3.4 are related to the direct placement of infrastructure in fish habitat (i.e., culverts), fish passage, and water extraction for the industrial water supply.

The residual effects on fish habitat quantity are dependent on the results of the assessment of Project effects on Surface Water Resources (Chapter 9). For Surface Water Resources, changes to surface water quantity are anticipated during the operation phase.

10.5.1.1 Construction

The Project has been designed to avoid loss of fish habitat through careful planning of the placement of infrastructure and shifting locations of activities away from waterbodies/watercourses. Where avoidance is not feasible, the application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat", DFO standards and codes of practices and other standard mitigation will be employed to reduce the potential for effects.

There are approximately 600 watercourses across the proposed RoWs associated with the two wind farms (including roads and collector lines) and transmission lines, which may be spanned by the transmission line or crossed by a road. The final number of watercourse crossings will be determined as the Project layout progresses. Prior to construction, the proposed RoWs will be surveyed and additional watercourses will be flagged and included in permit applications as applicable.

Stream crossings have the potential to result in an obstruction to fish passage if not properly designed, which could limit access to upstream habitats that are required to carry out life processes (Khan and Colbo 2008; Dunham et al. 1997). The installation of water crossing structures at road crossings will be designed to allow fish passage, and where slopes allow, be embedded to retain fish habitat characteristics. In streams with higher slopes, arch culverts will be installed to maintain streambed substrates. While the combination of embedding culverts and the use of arched bottomless culverts are expected to retain fish habitat characteristics in the majority of crossings.

As discussed in Section 10.2.2.1, the hydrogen / ammonia plant will be supported by water intake from local waterbodies: Muddy Pond, Noels Pond and Gull (Mine) Pond. The existing infrastructure of the previous industrial water supply system will be used, as available. It is anticipated that a new concrete channel at the entrance to the pump station in Gull (Mine) Pond and high-density polyethylene (HDPE) pipe into Noel Pond may be required as part of the water supply system. Short berms will be added at Gull (Mine) Pond. As a result of these upgrades, the water level in Gull (Mine) Pond will rise approximately 1.5 m, thereby increasing the available habitat for fish. There is currently no fish passage at the outlet of Gull (Mine) Pond and therefore fish passage will not be adversely affected by these modifications.

WEGH2 will mitigate effects to fish habitat quantity through the mitigation described in Section 10.4 above and be compliant with applicable approvals under the *Water Resources Act* and/or *Fisheries Act*. WEGH2's goal is to avoid or mitigate loss to fish habitat, to the extent practically feasible. Where avoidance is not feasible, the application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat", DFO standards and codes of practices and other standard mitigation will be employed to reduce the potential for effects. Where residual adverse effects remain, these will be counterbalanced by offsetting through a required authorization pursuant to the *Fisheries Act*, as required by DFO. The Fish Habitat Offsetting Plan will take into account input from consultation and engagement and will be developed and implemented in consultation with DFO and in consideration of the "Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act" (DFO 2019b).

Effects of Project construction on fish habitat quantity are expected to be low in magnitude, restricted to the Project Area, have moderate timing sensitivity, occur as a single event and be reversible. Based on the information above, a summary of residual effects on fish habitat quantity during the construction phase is provided in Table 10.6.

Table 10.6 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• There are no anticipated residual effects to fish habitat quantity as a result of the temporary workforce accommodations as watercourses/waterbodies will be avoided during Project design
Port au Port Wind Farm and Associated Infrastructure	• Effects to fish habitat quantity during construction of the Port au Port wind farm and associated infrastructure will be limited through Project design and siting of components. Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. A small alteration in fish habitat quantity is anticipated during the installation of stream crossings (culverts) along access roads.
Codroy Wind Farm and Associated Infrastructure	• Effects to fish habitat quality during construction of the Codroy wind farm and associated infrastructure will be limited through Project design and siting of components. Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. A small alteration in fish habitat quantity is anticipated during the with installation of stream crossings (culverts) along access roads.
230 kV Transmission Lines and Substations	• No residual effects are anticipated as watercourses/waterbodies will be spanned and no in-water work is planned
Hydrogen / Ammonia Production and Storage Facilities	• Effects to fish habitat quantity during construction of the hydrogen / ammonia production and storage facilities will be limited through use of existing industrial water supply infrastructure. There will be some loss of fish habitat as a result of in-water works associated with the upgraded industrial water supply intake structures.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.1.2 Operation and Maintenance

During operation and maintenance, the primary source of interaction between the Project and freshwater fish and fish habitat will be through water withdrawal to support the hydrogen / ammonia plant. Changes in downstream flow may occur during operations as a result of water withdrawal from Noels Pond, Muddy Pond, and Gull (Mine) Pond for the industrial water supply and potable water supply at the hydrogen / ammonia plant. Flow alterations of less than +/- 10% of the flow relative to an unaltered flow regime have a low probability of detectable negative effects to ecosystems including those that support fisheries (DFO 2003). Cumulative flow alterations that result in flows less than 30% of the Mean Annual Flow (MAF) have a heightened risk of effects to aquatic ecosystems (DFO 2003).

A 19% reduction in MAF is anticipated in Warm Brook (outlet from Noels Pond) and an estimated 25% loss in flow is anticipated from Gull (Mine) Pond as a result of the industrial water supply withdrawals. The effects to fish habitat are predicted to be greatest during the summer low flow period when stream discharges are naturally closer to 30% of MAF. Streams experiencing indirect loss are anticipated to continue to support fisheries at a reduced level of productivity for the duration of the Project and further assessment is required to evaluate potential effects on ecosystem structure and function that support fisheries. There is the potential that fish habitat may be indirectly lost from the outflows of Noels Pond and Gull (Mine) Pond as a result of decreased instream flows from the industrial water supply withdrawal during operations and maintenance. However, the outflow to Warm Brook will be controlled to maintain ecological flows for fish migration (Fracflow 2023) and therefore the loss of habitat is likely to be reduced. Where residual adverse effects remain to fish habitat within the outlet of Noel's Pond or Gull (Mine) Pond, these will be counterbalanced by offsetting through a required authorization pursuant to the *Fisheries Act*, as required.

It should be noted that the withdrawal rates proposed for the Project are lower than those associated with the former Abitibi Mill which operated at the site from the early 1970s to 2005 (FracFlow 2023). The magnitude of changes in MAF as a result of the water withdrawal are described in more detail in Chapter 7.

Effects of Project operation and maintenance on fish habitat quantity are expected to be moderate in magnitude, restricted to the LAA, have moderate timing sensitivity, occur as a continual event, and be reversible." Based on the information above, a summary of residual effects on Fish Habitat Quantity during the operation and maintenance phase is provided in Table 10.7.

Table 10.7 Summary of Effects by Project Component During Operation and Maintenance

Project Site	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• As there are no interactions anticipated between the Port au Port Wind Farm and Associated Infrastructure and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated during operation
Codroy Wind Farm and Associated Infrastructure	• As there are no interactions anticipated between the Codroy Wind Farm and Associated Infrastructure and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated during operation
230 kV Transmission Lines and Substations	• As there are no interactions anticipated between the wind farms and associated infrastructure and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated during operation
Hydrogen / Ammonia Production and Storage Facilities	• The quantity of water being withdrawn for the Hydrogen/Ammonia Production and storage facilities has the potential to result in indirect loss to fish habitat. Streams are anticipated to continue to support fisheries at a reduced level of productivity for the duration of the Project. However, the outflow to Warm Brook will be controlled to maintain ecological flows for fish migration (FracFlow 2023) and therefore the loss of habitat is likely to be reduced.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.1.3 Decommissioning and Rehabilitation

The effects of decommissioning and rehabilitation activities on fish habitat are anticipated to be similar to construction, however it is anticipated there will be no in-water work associated with this phase of the Project. For the purposes of assessment, it is assumed that physical infrastructure will be removed from the site (i.e., turbines, transmission poles). It is assumed that roads will not be decommissioned and associated culverts / bridges will be left in place. For the hydrogen / ammonia plant it is assumed that the water level control systems will remain in place though the intake structure and pipes will be removed.

Effects of Project decommissioning and rehabilitation on fish habitat quantity are expected to be negligible, as no habitat loss is anticipated. Based on the information above, a summary of residual effects on Fish Habitat Quantity during the decommissioning and rehabilitation phase is provided in Table 10.8.

Table 10.8 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Site	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• As there are no interactions anticipated between the temporary workforce accommodations and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.
Port au Port Wind Farm and Associated Infrastructure	• As there are no interactions anticipated between the Port au Port wind Farm and Associated Infrastructure and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated
Codroy Wind Farm and Associated Infrastructure	• As there are no interactions anticipated between the Codroy Wind Farm and Associated Infrastructure and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated
230 kV Transmission Lines and Substations	• As there are no interactions anticipated between the wind farms and associated infrastructure and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated
Hydrogen / Ammonia Production and Storage Facilities	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. There may be minor alterations to the shorelines and pond substrate when removing the water intake structure.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.2 Change in Fish Habitat Quality

10.5.2.1 Construction

Pathways that affect fish habitat quality as outlined in Section 10.3.4 are related work in or near water, and includes construction of access roads, turbine laydown areas, collector and transmission lines, and water extraction for the industrial water supply. Those works include the use of industrial equipment, vegetation clearing, excavating and grading near watercourses/waterbodies, construction and installation of stream crossing structures and fording. These activities can increase the potential for changes in fish habitat quality as a result of erosion and sedimentation, introduction of deleterious substances, temperature, riparian vegetation and overhead cover.

The Project has been designed to avoid these pathways to the extent practicable through shifting the placement of infrastructure away from waterbodies/watercourses. Where avoidance is not feasible, mitigation (Table 10.5) will be used to reduce the potential for effects during in or near water works. When working near water, interactions for fish and fish habitat are well known and documented, and DFO's *Measures to Protect Fish and Fish Habitat*, codes of practice, Project EPP will be followed.

Within the RoWs associated with the wind farms (roads, collector systems) and transmission lines, there will be residual effects to fish habitat quality related to clearing of riparian vegetation and loss of overhead cover along watercourses/waterbodies with forested or shrub riparian areas. It is anticipated that forested riparian vegetation may be replaced by shrubs or grasses and may result in an increase in overhead cover. Areas with shrub riparian vegetation may experience temporary changes in riparian cover during clearing and as it regenerates. In addition, there will be alterations to the bed and banks at the watercourse crossings as a result of culvert placement and embedding. Potential effects will be mitigated (i.e., banks stabilized, culverts embedded) and residual effects will be localized to the Project Area.

Consequently, with the application of best practices and DFO guidance, residual Project related effects are anticipated to be low in magnitude for fish habitat quality.

With mitigation, the Project will result in a reduction in fish habitat quality (e.g., riparian vegetation and overhead cover) in the Project Area. This change will occur one time during the construction phase. Based on past evidence, this residual environmental effect will be reversible following decommissioning and rehabilitation. Overall, effects of Project construction on fish habitat quality are expected to be moderate in magnitude, restricted to the Project Area, have moderate timing sensitivity, occur as a single event, and be reversible. Based on the information above, a summary of residual effects on Fish Habitat Quality during the construction phase is provided in Table 10.9.

Table 10.9 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• No residual effects anticipated
Port au Port Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated within the RoW and there may be small alterations of bed and banks of stream crossings during in-water work
Codroy Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated within the RoW and there may be small alterations of bed and banks of stream crossings during in-water work
230 kV Transmission Lines and Substations	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat", DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated within the RoW as a result of clearing.
Hydrogen / Ammonia Production and Storage Facilities	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat", DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Following mitigation no residual effects are anticipated.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.2.2 Operation and Maintenance

Presence, operation and maintenance of wind farms may result in changes to fish habitat. Operation and maintenance of the wind farms will require use of access roads by Project vehicles and could result in suspended sediments and dust from the unpaved roadbed being carried into adjacent waterbodies, thereby affecting water quality. Accessing the collector and transmission line RoWs for repairs and vegetation management (application of herbicides and manual cutting of brush) may require the use of temporary fords and may result in vehicles entering the watercourse, which could result in changes in fish habitat through instream or riparian disturbances (e.g., bank erosion and sedimentation).

The need for spraying and manual cutting will be assessed after initial RoW clearing and will be at a reduced frequency during operation and maintenance. Herbicide application will be prohibited within the watercourse buffer zone and will be applied in a manner consistent with the Project EPP. Alteration to riparian vegetation during manual cutting could affect fish habitat by disrupting habitat structure along banks, water quality, and overhead cover (Pusey and Arthington 2003). However, given the infrequent occurrence and adherence to best management practices, effects to fish habitat are anticipated to be negligible to low.

Changes to stream flow may occur during operation of the hydrogen/ammonia plant operations, as described in Section 10.5.1, and these changes in habitat quantity can result in indirect effects to habitat quality including changes to water velocities and depths in outflowing streams (e.g., Warm Brook).

With mitigation, the Project is anticipated to result in a reduction in fish habitat quality (e.g., riparian vegetation and overhead cover) in the Project Area. This change will occur infrequently and irregularly during the operation and maintenance phase. Based on past evidence, this residual environmental effect will be reversible following decommissioning and rehabilitation. Overall, the effects of Project operation and maintenance on fish habitat quality are expected to be moderate in magnitude, restricted to the Project Area, have moderate timing sensitivity, occur as a single event, and be reversible." Based on the information above, a summary of residual effects on Fish Habitat Quality during the operation and maintenance phase is provided in Table 10.10.

Table 10.10 Summary of Effects by Project Component During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated during RoW maintenance.
Codroy Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated during ROW maintenance
230 kV Transmission Lines and Substations	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat", DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated during RoW maintenance.
Hydrogen / Ammonia Production and Storage Facilities	• Effects of water withdrawals will be managed to maintain ecological flows. Minor changes in habitat quality are anticipated including changes to water velocities and depths in outflowing streams. These changes are not anticipated to result in a change in habitat use by fish species within the LAA.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.2.3 Decommissioning and Rehabilitation

Transportation along the access road and site roads during decommissioning, rehabilitation and closure could result in suspended sediments from dust and roadbed being carried into adjacent waterbodies, thereby affecting water quality.

As described above for the construction phase, it may be necessary to use temporary stream crossings during decommissioning, which include fords to access the RoW during decommissioning. Fording has the potential to harm stream banks and beds, release of sediments or other deleterious substances and result in damage to riparian vegetation. Although it may be necessary to ford smaller watercourses during decommissioning, there will be numerous access points along the RoW to reduce the requirement for fording. Where fording is required, a single designated location will be adhered to for crossing purposes. Mitigation measures as described above for construction will be implemented as applicable during decommissioning to reduce adverse effects on fish habitat.

With mitigation, the Project is anticipated to result in a reduction in fish habitat quality (e.g., riparian vegetation and overhead cover) in the Project Area during the decommissioning phase. This change will occur as a single event during the decommissioning and rehabilitation phase. Based on past evidence, this residual environmental effect will be reversible following decommissioning and rehabilitation as riparian vegetation and overhead cover are re-established. Overall, effects of Project decommissioning and rehabilitation on fish habitat quality are expected to be moderate in magnitude, restricted to the PA, have moderate timing sensitivity, occur as a single event, and be reversible." Based on the information above, a summary of residual effects on Fish Habitat Quality during the decommissioning and rehabilitation phase is provided in Table 10.11.

Table 10.11 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• As there are no interactions anticipated between the temporary workforce accommodations and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.
Port au Port Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated during RoW clearing prior to decommissioning. There may be small alterations to the bed and banks of stream crossings during fording
Codroy Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated during RoW clearing prior to decommissioning. There may be small alterations to the bed and banks of stream crossings during fording

Table 10.11 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
230 kV Transmission Lines and Substations	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. Changes in riparian vegetation and cover are anticipated during RoW clearing prior to decommissioning. There may be small alterations to the bed and banks of stream crossings during fording
Hydrogen / Ammonia Production and Storage Facilities	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. There may be minor alterations to the shorelines and pond substrate when removing the water intake structure.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.3 Change in Fish Health and Survival

10.5.3.1 Construction

Pathways that affect fish health and survival as outlined in Section 10.3.4 are related work in or near water, and includes construction of access roads, turbine laydown areas, collector and transmission lines, and water extraction for the industrial water supply. Those works include the use of industrial equipment, vegetation clearing, excavating and grading near watercourses/waterbodies, construction and installation of stream crossing structures and fording. In general, effects to fish habitat quantity and quality can also affect fish health and survival. Changes to habitat quantity and quality can increase the potential for changes in fish health and survival as a result of introduction of sediments during periods of high rainfall and introduction of deleterious substances (e.g., grease, fuel) from machinery operating near water.

The Project has been designed to avoid these pathways to the extent practicable through shifting the placement of infrastructure away from waterbodies/watercourses. Where avoidance is not feasible, mitigation (Table 10.4.1) will be used to reduce the potential for effects during in or near water works. When working near water, interactions for fish and fish habitat are well known and documented, and DFO's *Measures to Protect Fish and Fish Habitat* and codes of practice will be followed. Key mitigation will be sediment and erosional control and preventing the introduction of deleterious substances.

The timing of construction could influence the environmental effects of the Project on fish health and survival (i.e., in-water work or sedimentation which may affect spawning adults, incubating eggs, or juveniles). Work will be conducted to respect DFO timing windows and vary for the Island of Newfoundland by waterbody/watercourse (DFO 2019a). Timing windows and associated activity restrictions will be included in the Project EPP.

Fish health and survival could be affected directly or indirectly through injury due to industrial equipment working in or near waterbodies. In-water work areas will be isolated and fish rescues will be conducted to remove fish from areas of in-water work, as required by DFO.

It may be necessary to use temporary stream crossings, which include fords to access the RoW during clearing and construction. Fording has the potential to result in injury or death of fish during wet fording. Although it may be necessary to ford smaller watercourses during RoW clearing and construction, the requirement for fording will be limited. Where fording is required, a single designated location will be adhered to for crossing purposes and the DFO code of practice for temporary fords will be adhered to.

Removal of riparian vegetation during construction could affect fish health due to changes in shade, protective cover, and/or external nutrient/energy inputs (Zalewski et al. 2001). Changes in fish habitat may affect predation rates, however, are unlikely to substantially alter water or affect primary and secondary productivity upon which fish rely as food sources given the limited area of disturbance (Zalewski et al. 2001).

The use of explosives in or near water during construction of access road crossings and turbine foundations could result in instantaneous changes in pressure, and changes to fish health and survival through injury or instantaneous death. Appropriate setbacks will be maintained, in consultation with DFO. Alternately fish may be temporarily relocated if appropriate setbacks cannot be maintained.

Fish health and survival could also be affected if fish passage to essential habitat (e.g., for rearing, spawning) becomes blocked (Khan and Colbo 2008; Dunham et al. 1997). Fish passage will be maintained for watercourse crossing structures.

Improved road access to the interior portions of the Port au Port peninsula and Anguille Mountains, and more workers on site during construction may result in an increase in recreational fishing that could cause increased pressures on fish populations. Fishing by Project workers will be prohibited on the Project site. Fishing pressure by the public will be regulated through existing fishing regulations for the Island of Newfoundland. However, the majority of watercourses in the interior of the wind farm sites that will have improved access are small headwater watercourses with relatively limited value for recreational fisheries.

With mitigation, the Project is anticipated to result in a reduction in fish health and survival in the LAA. This change will occur continually during the construction phase as access to waterbodies is increased by road networks. Based on past evidence, this residual environmental effect is unlikely to be reversible following decommissioning and rehabilitation as the access roads will likely remain. Effects of Project construction on fish health and survival are expected to be low in magnitude, restricted to the LAA, have moderate timing sensitivity, occur as a single event, and be reversible. Based on the information above, a summary of residual effects on Fish Health and Survival during the construction phase is provided in Table 10.12.

Table 10.12 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• As there are no interactions anticipated between temporary workforce accommodations and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated
Port au Port Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. It is anticipated there may be an increase in predation of fish due to loss of riparian vegetation and overhead cover and an increase in fishing pressure due to improved road access to interior portions of the Port au Port peninsula.
Codroy Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. It is anticipated there may be an increase in predation of fish due to loss of riparian vegetation and overhead cover and an increase in fishing pressure due to improved road access to the Anguille Mountains
230 kV Transmission Lines and Substations	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. It is anticipated there may be an increase in predation of fish due to loss of riparian vegetation and overhead cover and an increase in fishing pressure due to improved road access long the new transmission line RoW.
Hydrogen / Ammonia Production and Storage Facilities	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. No residual effects are anticipated.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.3.2 Operation and Maintenance

A change in fish health and survival could result from the introduction of sediments or contaminants from surface water runoff, maintenance of riparian vegetation within RoWs and improved access for fishing. These pathways could result in sublethal or lethal effects to fish.

As described previously, it may be necessary to use temporary stream crossings, such as fords, to access the RoW during operation and maintenance which could result in the death of fish. Where fording is required, a single designated location will be used for crossing purposes and the DFO code of practice for temporary fords will be adhered to.

Riparian vegetation will be managed within the RoWs, including near waterbodies. Herbicide application will be prohibited within the watercourse buffer zone, but manual cutting may be required. Spraying and manual cutting will decrease in frequency during operation and maintenance. Effects to fish habitat (Section 10.1.5.1) resulting from alteration to riparian vegetation during manual cutting could cause indirect effects on fish health and survival by increasing predation. Some herbicides have also been shown to have sublethal effects on fish (Solomon et al. 2013). Indirect effects may also occur if herbicide runoff results in the removal of aquatic vegetation that provides oxygen or food for fish (Solomon et al. 2013). However, given the infrequent use of herbicides, the prohibited application of herbicides in the watercourse buffer zone, effects from herbicide application and manual cutting within the watercourse buffer zone are anticipated to be negligible.

Improved access to the interior portions of the Port au Port peninsula and Anguille Mountains, and more workers / residents in the region during operation with time to pursue recreational activities, may result in an increase in recreational fishing that could cause increased pressures on fish populations. Fishing pressure by the public will be regulated through existing fishing regulations for the Island of Newfoundland. However, the majority of watercourses in the interior of the wind farm sites that will have improved access are small headwater watercourses with relatively limited value for recreational fisheries.

Water intakes for the hydrogen / ammonia plant site and pumps during dewatering of in-water work areas (e.g., at watercourse crossings) have the potential to impinge and entrain fish, affecting their health and survival. Young, small-bodied fish with poor swimming (avoidance) ability are more susceptible to impingement and entrainment than are larger adult fish (DFO 1995). Intakes will be designed in consideration of site-specific parameters, including resident fish species and associated life stages. Design of intakes will be in accordance with the *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO 1995), DFO End-of-Pipe Screen Size Tool (DFO 2023), and/or the "Interim Code of Practice: End-of-Pipe Fish Protection Screens for Small Water Intakes in Freshwater" (DFO 2022b), as applicable.

With mitigation, the Project is anticipated to result in a reduction in fish health and survival in the Project Area as a result of increased fishing pressure. This change will occur continually during the operation and maintenance phase. Based on past evidence, this residual environmental effect is unlikely to be reversible following decommissioning and rehabilitation as the access roads will likely remain. Effects of Project operation and maintenance on fish health and survival are expected to be moderate in magnitude, restricted to the LAA, have moderate timing sensitivity, occur as a continual event, and be reversible. Based on the information above, a summary of residual effects on fish health and survival during the operation and maintenance phase is provided in Table 10.13.

Table 10.13 Summary of Effects by Project Component During Operation and Maintenance

Project Component	Summary of Effect during [Project Phase]
Temporary Workforce Accommodations	• No residual effects anticipated
Port au Port Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. It is anticipated there will be an increase in predation due to loss of riparian vegetation and overhead cover and an increase in fishing pressure due to improved road access to interior portions of the Port au Port peninsula.
Codroy Wind Farm and Associated Infrastructure	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. It is anticipated there will be an increase in predation due to loss of riparian vegetation and overhead cover and an increase in fishing pressure due to improved road access to the interior portions of the Anguille Mountains
230 kV Transmission Lines and Substations	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. It is anticipated there may be an increase in predation due to loss of riparian vegetation and overhead cover an increase in fishing pressure due to improved road access.
Hydrogen / Ammonia Production and Storage Facilities	• Effects will be managed through application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat," DFO standards and codes of practices and other standard mitigation measures which are described in Section 10.4 and the Project EPP. No residual effects are anticipated.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.3.3 Decommissioning and Rehabilitation

Decommissioning activities have the potential to interact with fish in that heavy equipment may require the use of temporary crossings to remove infrastructure, wind turbines, poles, conductors, and hardware. These activities can increase the potential for changes in fish health and survival as a result of introduction of sediments during periods of high rainfall and introduction of deleterious substances (e.g., grease, fuel) from machinery operating near water. When working near water, interactions for fish and fish habitat are well known and documented, and DFO's Measures to Protect Fish and Fish Habitat and codes of practice will be followed. Key mitigation will be sediment and erosion control and preventing the introduction of deleterious substances. In areas where soil disturbance due to decommissioning causes erosion, measures will be taken to stabilize the affected area to prevent effects to fish health and survival as described in Section 10.5.3.1 and in accordance with the Project EPP. Following decommissioning, riparian vegetation and cover will be re-established and predation will return to baseline conditions.

The timing of decommissioning activities could influence fish health and survival (i.e., in-water work or sedimentation which may affect spawning adults, incubating eggs, or juveniles). Work will be conducted to respect DFO timing windows, which vary throughout the Island of Newfoundland by waterbody/watercourse (DFO 2019a).

With mitigation, the Project is anticipated to result in a reduction in fish health and survival in the LAA as a result of increased fishing pressure. This change will occur following the decommissioning and rehabilitation phase. Fishing by Project workers will be prohibited on the Project site during decommissioning and rehabilitation, and fishing pressure by the public will be regulated through existing fishing regulations for the Island of Newfoundland. As access roads will be left in-place, the effect of increased availability for fishing will continue post-decommissioning. Based on past evidence, this residual environmental effect is unlikely to be reversible following decommissioning and rehabilitation as the access roads will likely remain. However, the majority of watercourses in the interior of the wind farm sites that will have improved access are small headwater watercourses with relatively limited value for recreational fisheries.

Overall, the effects of Project decommissioning and rehabilitation on fish health and survival are expected to be low in magnitude, restricted to the LAA, have moderate timing sensitivity, occur as a continual long-term event, and be reversible." Based on the information above, a summary of residual effects on fish health and survival during the decommissioning and rehabilitation phase is provided in Table 10.14.

Table 10.14 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• As there are no interactions anticipated between the temporary workforce accommodations and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.
Port au Port Wind Farm and Associated Infrastructure	• Reduction in predation as riparian vegetation and overhead cover are re-established • Increase in fishing pressure
Codroy Wind Farm and Associated Infrastructure	• Reduction in predation as riparian vegetation and overhead cover are re-established • Increase in fishing pressure
230 kV Transmission Lines and Substations	• Reduction in predation as riparian vegetation and overhead cover are re-established • Increase in fishing pressure
Hydrogen / Ammonia Production and Storage Facilities	• As there are no interactions anticipated between the hydrogen / ammonia production and storage facilityes and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.
Port Facilities	• As there are no interactions anticipated between the port facilities and freshwater fish and fish habitat (Table 10.4), no residual effects are anticipated.

10.5.4 Residual Environmental Effects Summary

10.5.4.1 Residual Environmental Effects Characterization

WEGH2 incorporated avoidance with respect to potential effects of the Project on freshwater fish and fish habitat during Project planning. Where the RoW and associated access is unable to avoid waterbodies, appropriate mitigation measures and best practices will be followed to reduce Project-related effects. The mitigation measures in Section 10.4 have been selected in consideration of the environmental effects pathways and include standard and proven mitigation measures for sediment and erosion control, incorporate DFO measures to protect fish habitat, standards and best management practices, and consider regulations and guidelines that govern fish and fish habitat protection.

Overall, residual effects of the Project on Freshwater Fish and Fish Habitat are predicted to be adverse and be low to moderate in magnitude given that there will be a measurable change greater than the range of natural variability, however, that does not affect the ability of fish to use this habitat to carry out one or more of their life processes. Residual effects are anticipated to be limited to the LAA and range in duration from short-term to long-term. Residual effects will generally occur continuously, be reversible following rehabilitation, and occur in areas that range from primarily undisturbed (i.e., at the wind farm sites) to previously disturbed (i.e., at the site of the hydrogen / ammonia plant). Table 10.15 summarizes the predicted environmental effects (residual effects) of the undertaking on Freshwater Fish and Fish Habitat.

Table 10.15 Summary of Predicted Environmental Effects of the Undertaking on Freshwater Fish and Fish Habitat

Residual Effect	Residual Effects Characterization							
	Nature	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Construction								
Fish Habitat Quantity	A	L	PA	MS	ST	S	R	U/D
Fish Habitat Quality	A	M	PA	MS	ST	S	R	U/D
Fish Health and Survival	A	M	LAA	MS	LT	C	R	U/D
Operation and Maintenance								
Fish Habitat Quantity	A	M	LAA	MS	LT	C	R	U/D
Fish Habitat Quality	A	M	PA	MS	ST	IR	R	U/D
Fish Health and Survival	A	M	LAA	MS	LT	C	R	U/D
Decommissioning and Rehabilitation								
Fish Habitat Quantity	N	-	-	-	-	-	-	U/D
Fish Habitat Quality	A	L	PA	MS	ST	S	R	U/D
Fish Health and Survival	A	L	LAA	MS	LT	C	R	U/D

KEY:

Nature:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Timing:
NS: No Sensitivity
MS: Moderate Sensitivity
HS: High Sensitivity

Frequency:
S: Single Event
IR: Irregular Event
R: Regular Event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

10.5.4.2 Summary of Predicted Environmental Effects

DFO's "Measures to Protect Fish and Fish Habitat" (DFO 2019a), standard mitigation measures, and best management practices will be followed for work in or near water to mitigate effects to freshwater fish and fish habitat, to the extent practically feasible. Fish habitat that may be lost as a result of the Project will be counterbalanced through implementation of a Fish Habitat Offsetting Plan, to be developed in consultation with DFO. If required, the Offsetting Plan will be submitted as part of a *Fisheries Act* Authorization for the Project, to mitigate the loss of fish habitat in the LAA. The Offsetting Plan will include a follow-up monitoring commitment to confirm that the required offset is achieved, and contingency measures that can be implemented if the offsetting is not as successful as planned. Water withdrawal from the Project Area, specifically in relation to water supply to the hydrogen / ammonia plant, has the potential to affect downstream flow rates and subsequently change the volume of water available for fish. The outflow to Warm Brook will be controlled to maintain ecological flows for fish migration (Fracflow 2023) and therefore the loss of habitat in Noels Pond is likely to be limited, however further assessment is required to evaluate the potential effects on the ecosystem and determine if offsetting will be required. These analyses will be conducted prior to construction and offsetting requirements will be determined in consultation with DFO.

Localized changes in riparian vegetation and cover, and alterations to the bed and banks are anticipated at watercourse crossings as a result of RoW clearing and culvert installation. These effects will be mitigated (i.e., banks stabilized, culverts embedded) and residual effects will be localized to the Project Area.

Improved road access to the Project Area and influx of workers may result in an increase in recreational fishing, placing increased pressures on fish populations. However, fishing by Project workers will be prohibited on the Project site and fishing pressure by the public will be regulated through existing fishing regulations for the Island of Newfoundland. Water intakes for the plant site and pumps during dewatering of in-water work areas (i.e., watercourse crossings) have the potential to impinge and entrain fish and affect fish health and survival. Intakes will be designed in consideration of DFO guidance to mitigate effects to fish.

10.6 Determination of Significance

For the purposes of this environmental assessment, a significant residual environmental effect on fish and fish habitat is defined as a Project-related environmental effect that results in:

- HADD of fish habitat or the death of fish, as defined by the *Fisheries Act*, that cannot be mitigated, authorized or offset
- an activity restricting the free passage of fish, as defined by the *Fisheries Act*
- a change to the productivity or sustainability of fish populations or fisheries within the LAA where recovery to baseline is unlikely, or is contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans
- contravention of any of the prohibitions stated in Sections 32-36 of the *Species at Risk Act* or relevant provincial acts regarding SAR

In consideration of the VEC-specific significance criteria defined above, and with application of avoidance (through Project design), mitigation, and offsetting if required, the residual effects of routine Project activities on Freshwater Fish and Fish Habitat (i.e., Fish Habitat Quantity, Fish Habitat Quality, and Fish Health and Survival) are predicted to be not significant.

The Project has been designed to avoid the net loss of fish habitat through careful planning of the placement of infrastructure and shifting locations of activities away from waterbodies/watercourses. Where avoidance was not feasible, the application of best practices in accordance with DFO's "*Measures to Protect Fish and Fish Habitat*", DFO standards and codes of practices and other standard mitigation will be employed to reduce the potential for effects. Work in and near water will be reduced to the extent practical. The potentially affected fish species are widely distributed, and their habitat preferences are well known to allow for prediction of effects.

Therefore, the overall determination is made with a high level of confidence, given that best management practices and standard mitigation will be in place when working in and around water. The level of confidence in this prediction is discussed in Section 10.7.

10.7 Prediction Confidence

The overall determination of significance is made with a high level of confidence for fish habitat quantity, fish habitat quality and fish health and survival, given that effects are well known and documented. Mitigation will be in accordance with DFO's "*Measures to Protect Fish and Fish Habitat*", DFO standards and codes of practices and other standard mitigation working in and around water. The potentially affected fish species are well studied, and their habitat preferences are well known to allow for prediction of effects.

10.8 Follow-Up and Monitoring

Follow-up and monitoring are intended to verify the accuracy of predictions made during the EA, to assess the implementation and effectiveness of mitigation, and to manage adaptively, if required. Compliance monitoring, where required by permitting or regulations, will be conducted to confirm that mitigation measures are properly implemented. Should an unexpected deterioration of the environment be observed as part of follow-up and/or monitoring, intervention mechanisms will include the adaptive management process. This may include identification of existing and/or new mitigation measures to be implemented to address it (i.e., increased sediment and erosion control). Follow-up or monitoring required by applicable permits, will be provided, as appropriate to regulators. Follow-up and monitoring to be implemented includes:

- Field verification of the results of the desktop analysis for fish habitat characteristics
- Field verification of fish communities and aquatic species at risk within the RAA through eDNA and fish sampling
- Confirmation that watercourse crossings are designed to facilitate fish passage

- Environmental monitoring to follow up on effectiveness of the Erosion and Sediment Control Plan (e.g., surface water quality monitoring for TSS or turbidity, physical inspections of culverts)
- Physical inspection of stream crossings following construction

10.9 Capacity of Renewable Resources and Effects on Biological Diversity

The potential environmental effects of the Project on Freshwater Fish and Fish Habitat were thoroughly assessed. The assessment concluded that routine Project activities are not likely to result in significant residual adverse effects on Freshwater Fish and Fish Habitat. Therefore, adverse Project-related effects on the capacity of renewable resources (e.g., fisheries) to meet the needs of the present and those of the future are not anticipated with respect to Freshwater Fish and Fish Habitat. Ultimately, fishing activities (including seasons, quotas and species fished) in Newfoundland and Labrador are regulated by federally and provincially jurisdictions and Project-related effects on fish and fisheries is anticipated to be similar to other rural areas of Newfoundland which have been developed for resource extraction.

Similarly, adverse Project-related effects on biological diversity of fish species that exceed the limits of natural variability or affect the long-term viability of biological diversity of fish species in the RAA are not anticipated with respect to Freshwater Fish and Fish Habitat, as no change in the number of fish species that reside within the RAA is anticipated.

10.10 Predicted Future Environmental Conditions if the Project Does Not Proceed

If the Project is not allowed to proceed, the existing conditions as described in the baseline section will continue to prevail, including current land use and natural conditions. It is possible that future development may occur in the area, including wind energy (given those Project areas are designated for wind farm development), but neither the likelihood nor extent of such development can be reasonably predicted at this time based on currently known information. Should the Project Area remain undeveloped, the predicted future condition of fish and fish habitat would be relatively unchanged from that discussed in the existing environment portion of this assessment (Section 10.2).

The productivity of fish and fish habitat within the Project Area is dependent on the quantity and quality of fish habitat available. Fisheries productivity and populations of fish in the Project area are anticipated to remain stable over the long-term; however, changes in the distribution of salmonids, particularly brook trout, may be influenced in the long term by climate change and associated increases in water temperature, which may approach their maximum thermal tolerances (Cornell 2023). The fish species that are present within the LAA make localized movements to carry out their life processes. These species are widely dispersed and abundant in streams, ponds and lakes on the Island of Newfoundland.

Banded killifish and mummichogs have disconnected populations on the Island of Newfoundland as a result of a lack of accessibility and connectivity associated with estuarine dispersal (COSEWIC 2014). Whereas the American eel is threatened by global climate change thought to be in part due to changes in the Gulf Stream system and reducing oceanic productivity (Castonguay et al. 1994b; Knights 2003), existing barriers to migration, hydroelectric turbine mortality, contaminants, and introduced parasites (COSEWIC 2012). Should the Project Area remain undeveloped, the predicted future condition of these species would be relatively unchanged from that discussed in the existing environment portion of this assessment (Section 10.2).

10.11 References

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11.0 Marine Environment and Use

11.1 Scope of Assessment

The marine environment and use have been assessed as a valued ecological component (VEC) because of its ecological, cultural, recreational, and economic value to stakeholders within Newfoundland and Labrador (NL), including the public, Indigenous groups, local businesses, and government agencies. The marine environment is also protected by federal and provincial legislation, with the scope of the assessment being guided by the Provincial Environmental Impact Statement (EIS) Guidelines (Table E.1), as well as applicable legislation, policies, and guidance.

The marine environment in western Newfoundland supports a wide variety of marine species and habitats, including unique, special, and critical habitats for various species or species assemblages, including Species at Risk (SAR). For the purposes of the assessment, the Marine Environment VEC will assess effects to:

- Biophysical Environment – marine fish and shellfish and their habitats (i.e., the water column and benthos), marine mammals (cetaceans and seals), and sea turtles. The assessment also incorporates SAR from each group as well as sensitive areas (e.g., eelgrass beds) identified in marine waters near the Project.
- Marine Commercial Fisheries – Commercial fishing is an economic contributor for western Newfoundland communities and is managed by Fisheries and Oceans Canada (DFO). Marine waters near the Project are productive for commercial fishing, including inshore portions of Port au Port and St. George's Bay. Several Small Craft Harbours also exist in this area.
- Marine Recreational Fisheries – Recreational fishing exists in marine waters adjacent to the Project through the NL recreational groundfish fishery and is managed by DFO. The fishery is open to residents, non-residents, and boat tour operators during specified dates during the summer and fall months for groundfish species.
- Aquaculture – Aquaculture activity is limited in marine waters near the Project. Three marine-based farms exist approximately 5 km beyond the project area within Piccadilly Bay along the coast of Port au Port Peninsula for shellfish species (scallop and mussels). One land-based smolt hatchery exists near the proposed hydrogen / ammonia plant in Stephenville.
- Other Ocean Users – Marine use is another major component to this VEC and includes marine activities that are of economic, social, and cultural importance to members of the communities in western Newfoundland. Marine activities besides recreational and commercial fisheries and aquaculture that are typically assessed include marine shipping and traffic, military activity, science research activity, hunting, and petroleum activity.

These aspects of the Marine Environment have the potential to be adversely affected by planned Project marine activities during construction, operation and maintenance, and decommissioning and rehabilitation phases.

The Marine Environment and Use VEC is also linked to:

- Indigenous Fisheries (Chapter 21) – changes to and access to traditional food resources such as fish and shellfish have the potential to affect existing and potential Indigenous fisheries.
- Avifauna (Chapter 13) – changes to the marine environment through Project-related activities may have the potential to affect marine birds who occupy the same space.
- Surface Water Resources (Chapter 9) – while the Marine Environment and Use VEC considers the potential effects of wastewater discharge from the hydrogen / ammonia plant on the biological marine environment, the Surface Water Resources VEC considers the potential effects of the water quality of wastewater discharge from the hydrogen / ammonia plant on the receiving environment.

11.1.1 Regulatory and Policy Setting

In addition to the *Newfoundland and Labrador Environmental Protection Act*, the Project is subject to other federal and provincial legislation, policies, and guidance. This section identifies the primary regulatory requirements and policies that influence the scope of the assessment on the marine environment in Canada and NL.

11.1.1.1 Federal

***Canadian Navigable Waters Act* (CNWA)** – The CNWA is overseen by Transport Canada. This Act applies to navigable water in Canada and protects the public's right of navigation by regulating activities that could interfere with navigation. Activities that would apply to this Act include infilling, dredging, or removing materials from the bed of a navigable waters, as well as installation of moorings or outfalls. For works within Port au Port Bay, Port Harmon and surrounding area, a Major or Minor Works Order could be required, which would allow for works to be built if they meet the criteria for applicable classes of work, as well as specific terms and conditions of construction.

Canadian Environment Protection Act – This Act is overseen by Environment and Climate Change Canada (ECCC). Permits or authorizations are issued under this Act for emissions of ozone-depleting substances and halocarbon alternatives, disposal at sea, permits of equivalent levels of environmental safety, and transboundary permits. Disposal at Sea Authorization would apply to ocean disposal of dredged material from the port maintenance dredging program.

Canada Shipping Act, 2001–This Act and applicable regulations are overseen by Transport Canada and is the principle federal legislation governing safety of marine transportation and recreational boating, as well as the protection of the marine environment. It is linked to regulations that oversee the prevention of pollution from ships, management of ballast water, and management of hazardous chemicals. The *Canada Shipping Act* would be applicable to vessels underway as part of the program, including barges and tugs transporting Project components, and vessels shipping anhydrous ammonia.

Fisheries Act – The federal *Fisheries Act* is administered primarily by DFO, with some provisions administered by ECCC. The *Fisheries Act* protects fish and fish habitat and addresses national interests in marine and fresh waters, with the goal of protecting the long-term sustainability of aquatic resources. The *Fisheries Act* includes prohibitions against works, undertakings or activities that result in the harmful alteration, disruption or destruction (HADD) of fish habitat (section 35(1)). Works can be approved by and carried on in accordance with conditions established by the Minister of Fisheries, Oceans and the Canadian Coast Guard (Fisheries Minister) (section 35(2)(b)). Such work requires an authorization with an appropriate offsetting of residual adverse effects after avoidance and mitigation steps have been taken. HADD of fish habitat is defined under the *Fisheries Act* policies as "any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life processes of fish."

Sections 36(3) and (4) of the federal *Fisheries Act* prohibits the deposition of deleterious substances into waters frequented by fish in Canada unless authorized by regulation. The installation of the subsea cable and the construction of barge landing sites may result in an authorization under the Act. The process water effluent will be assessed in an Assimilative Capacity Study to determine the applicability as a deleterious substance.

***Species at Risk Act* (SARA)** – SARA provides protection of SAR in Canada. The legislation provides a framework to facilitate recovery of species listed as threatened, endangered or extirpated, and to prevent species listed as special concern from becoming threatened or endangered. SAR and their habitats are protected under SARA, which prohibits: 1) the killing, harming, or harassing of endangered or threatened SAR (sections 32 and 36), and 2) the destruction of critical habitat of an endangered or threatened SAR (sections 58, 60 and 61). SAR species are listed in Schedule 1 of SARA. Species identified in Schedule 1 with the potential to occur in the Project Area are considered in this EIS.

Transportation of Dangerous Goods Act – This Act is overseen by Transport Canada and applies to transportation of dangerous goods in Canada, including transportation, importing, manufacturing, shipping, and packaging of dangerous goods. The main purpose of this Act is to maintain public safety when dangerous goods are being handled, offered for transport, or transported by road, rail, air, or water. Hazardous waste generated by the Project may include paints, oils and lubricants, and batteries; anhydrous ammonia is considered a dangerous good under the *Transportation of Dangerous Goods Regulations*.

11.1.1.2 Provincial

NL *Endangered Species Act* (NL ESA) – SAR in NL are protected under the NL ESA. Designation under the Act follows the recommendations of the Species Status Advisory Committee on the appropriate assessment of a species and referring concerns about the status of species to the Committee on the Status of Endangered Wildlife in Canada, where the species is of national importance. While the Act does not apply to marine fish, it does apply to native freshwater fish who enter marine waters as a part of their life cycle.

The purpose of NL ESA is to:

- Prevent listed species from being extirpated from NL
- Provide for the recovery of species listed as extirpated, endangered, or threatened as a result of human activity
- Conserve species listed as vulnerable to prevent them from becoming endangered or threatened

Prohibitions of NL ESA include section 16, which states "a person shall not disturb, harass, injure, or kill an individual of a species designated as threatened, endangered or extirpated". Species are listed under the *Endangered Species List Regulations*.

NL *Water Resources Act* – This Act provides legislation to manage water resources in the province, with the intent of providing clean water for environmental, social, and economic well-being. Water resources management regulatory permits and licences are required for activities such as constructing and operating wastewater infrastructure, and altering a body of water through infilling, dredging and debris removal. The re-activation of the existing marine wastewater outfall and upgrades at the Port of Stephenville would likely require approval under this Act.

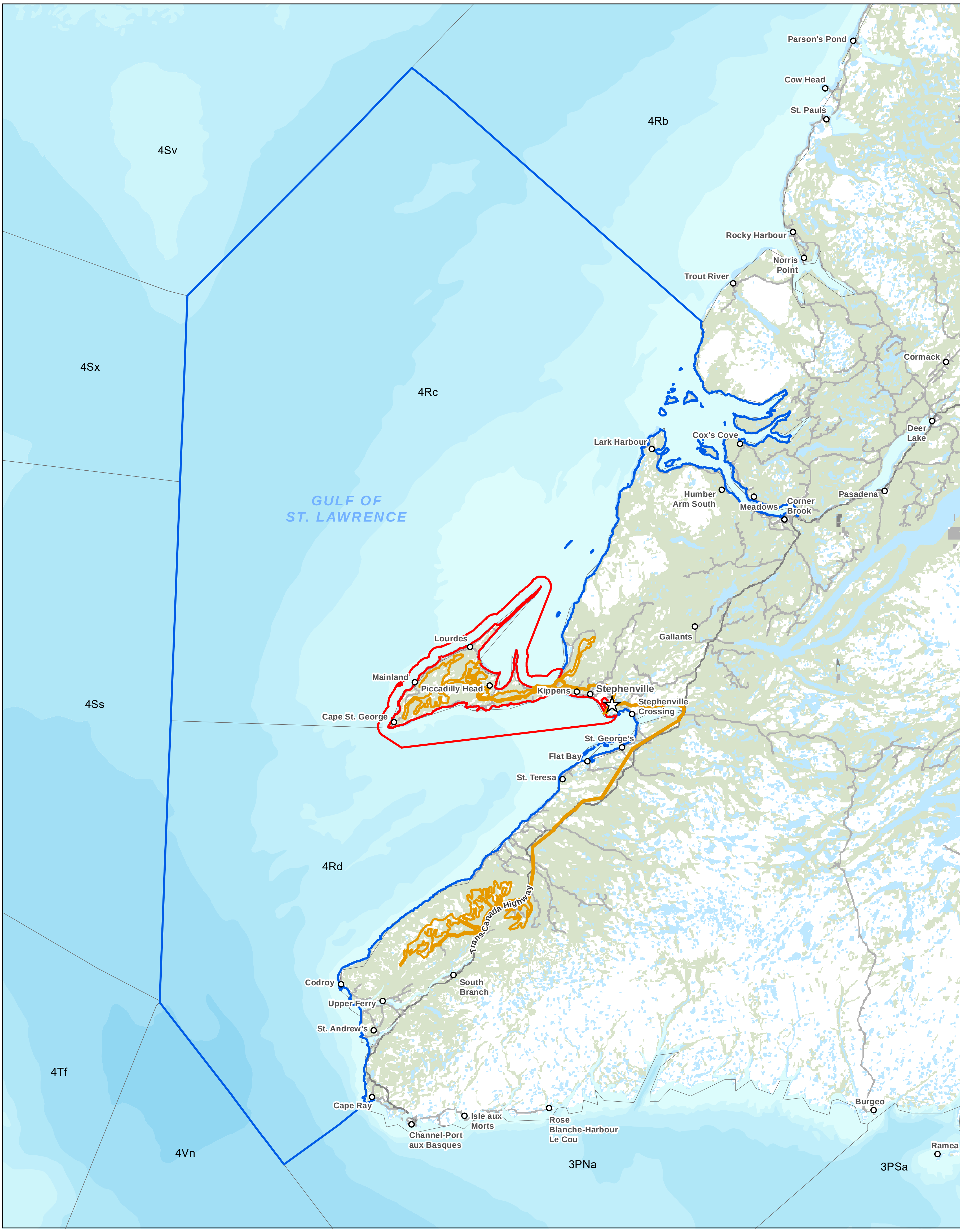
11.1.2 Boundaries

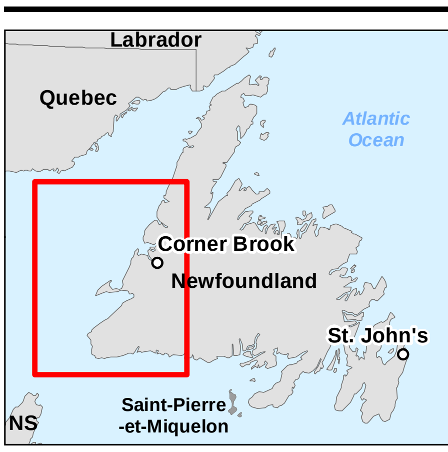
The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for the Marine Environment and Use VEC were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur on the VEC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VEC. The spatial and temporal boundaries associated with the effects assessment for the Marine Environment and Use VEC are described in the following sections.

11.1.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on Marine Environment and Use in areas surrounding the Project components (Figure 11.1):

- Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of following distinct areas: the Port au Port wind farm, the Codroy wind farm, the hydrogen / ammonia production and storage facility (hydrogen / ammonia plant), Port Facilities, and the 230 kV transmission lines, as well as associated infrastructure including roads, substations, and water supply infrastructure. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project. In addition to encompassing the immediate area in which Project components and activities will occur, the Project Area also includes a buffer of up to 300 m for access roads and turbines and a 350 m corridor to accommodate the 70 to 75 m wide right-of-way for the transmission line. These buffers allow flexibility for the micro-siting of Project components during detailed design, based on technical considerations, as well as the avoidance of environmentally sensitive areas, where practicable.
- Local Assessment Area (LAA): The LAA for this VEC encompasses the nearshore marine environments of St. George's Bay and Port au Port Bay and was selected to capture potential Project effects of marine-based activities occurring in these areas.
- Regional Assessment Area (RAA): The RAA for this VEC is defined as the Northwest Atlantic Fisheries Organization (NAFO) Division 4Rcd and was selected in recognition of biophysical features, including sensitive areas, in the region surrounding the Project Area / LAA and other projects and activities occurring in the region (e.g., commercial fishing and shipping).





Local Assessment Area
Regional Assessment
Hydrogen / Ammonia Plant Location
Project Area
NAFO Unit

0 20 40 Kilometres

(At original document size of 11x17)
1:1,000,000

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: Client, Province of Newfoundland and Labrador, ACCDC, Stantec
3. Background: Natural Resources Canada CanVec

Project Location
Stephenville
NL

Prepared by NW on 2023/07/20
QR by AW on 2023-07-20
IR by RK on 2023-08-01

Client/Project
121417233_035

World Energy GH2
Project Nujio'qonik

Figure No.
11.1

Title
Spatial Boundaries

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11.1.2.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on the Marine Environment and Use include:

- Construction: Overall the construction phase of the Project will be from Q4 2023 through Q2 2027, pending EA approval and receipt of other required permits and approvals. Early civil works are planned to start Q4 2023 through Q3 2024. Construction of the Port au Port wind farm and associated infrastructure is expected to start in Q3 2024, with completion of the construction in Q1 2026. Construction of the Codroy wind farm and associated infrastructure is expected to start Q4 2025, with completion in Q1 2027. The hydrogen / ammonia plant will be constructed in phases from Q2 2024 to Q1 2026.
- Operation and maintenance: Wind farm commissioning is anticipated to start Q1 2026 at the Port au Port wind farm and Q2 2027 at the Codroy wind farm. The 600 MW electrolyzer expected to be commissioned in Q1 2026. The operational life of the Project is 30 years at each site.
- Decommissioning and rehabilitation: After a 30-year operational life, the decommissioning phase is anticipated to occur during 2057 and 2058. Decommissioning is anticipated to begin Q1 2057 at the Port au Port wind farm, with completion in Q3 2058 at the Codroy wind farm.

11.2 Existing Environmental Conditions

The following sections provide an overview of the existing environmental conditions of the Marine Environment and its Use. This includes a discussion of the influences of past and present physical activities on the VEC, leading to the current conditions. An understanding of the existing conditions for the VEC within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 11.2. For a more in-depth description of the existing environmental conditions, please refer to the Chapter 6.0 – Marine Environment and Use Baseline within the Aquatics Environment Baseline Study; BSA-2.

11.2.1 Methods

A literature and data review was performed in 2023 to provide baseline information for the Aquatics Environment Baseline Study (BSA-2). The description of the existing marine environment and use was mainly sourced from previous EAs, literature, government reports, and online databases. Given that most marine-related Project activities will occur in the nearshore environment, descriptions of the existing environment were focused on areas in and near the LAA where possible and applicable.

Publicly available literature, aquatic SAR mapping, and data from Atlantic Canada Conservation Data Centre and DFO were used to assess the potential for aquatic SAR.

In addition to descriptions of the existing marine environment, information from a Land and Resource Use (LRU) Survey (Appendix 4-C) was also incorporated into relevant sections of the Aquatics Environment Baseline Study (BSA-2). The LRU Survey was developed to engage the public, learn about land / marine resource use activities in proposed Project locations, and identify public perceptions around the potential risks and/or benefits of the Project. Details on the methodologies and limitations are provided in the Project Nujio'qonik - Land and Resource Use Survey Results (Appendix 4-C).

More details about the methods used to characterize the existing conditions are available in the Aquatics Environment Baseline Study (BSA-2).

11.2.2 Existing Conditions

11.2.2.1 Marine Biophysical Environment

The Gulf of St. Lawrence's marine geological features date back millions of years and are an important component of marine habitats. The marine environment adjacent to the Project is situated on the boundary between the Anticosti Basin and Magdalen Basin, where Port-au-Port Bay lies above the Anticosti Basin and St. Georges Bay lies above the Magdalen Basin (Lavoie et al. 2009; Pinet and Lavoie 2015). St. George's Bay contains sediments with a thickness of 30 m, with up to 180 m of sediment overlying bedrock. Eight classes of sediment have been classified using a 30 kHz echosounder (Shaw and Forbes 1990).

The climate in the RAA is maritime temperate, influenced by the Gulf of St. Lawrence and continental air masses, with mean air temperatures ranging from -7°C in February to 18°C in August (Galbraith et al. 2022). Mean hourly wind speeds range from 5.3 m/s to 10.1 m/s throughout the year (AMEC 2014). The RAA has water depths ranging up to several hundred metres. St. George's Bay is characterized by a deep basin to the north of Flat Island and a smaller basin to the north off Stephenville, with a maximum depth of 97 m (Galbraith et al. 2022). Ocean currents are influenced by tides, regional meteorological events, freshwater runoff from the St. Lawrence River, and general ocean transport from the Strait of Belle Isle and Cabot Strait. Currents flow counterclockwise and are strongest near the surface, except in winter months. The wave climate in the Gulf is driven by dominant atmospheric forcing in areas within the RAA and farther offshore, causing seasonal variability with expected significant wave heights ranging from 4.3 in July up to 9.5 in December (AMEC 2014). Changes in the stratification of the water column is also observed on a seasonal basis, which highly influences water temperatures and salinity (Galbraith et al. 2022). Water temperatures are typically drop to 0°C during the winter months and rise to the mid-teens during the summer; salinity is less variable, ranging from 30 to 31 ppt (DFO 2021a). The Gulf experiences both sea ice and icebergs during winter and spring months, both of which mainly come through the Strait of Belle Isle (Canadian Coast Guard 2022; Canadian Ice Service 2023).

The marine biological environment in the Gulf of St. Lawrence is highly productive and contains a wide range of habitats that sustains a variety of marine species. Marine plankton play a major role in the marine environment, as they are the foundation of most food webs. Around 500 marine plankton species are thought to exist in the Gulf, including larva and eggs of important commercial fish (Dufour and Ouellet 2007; AMEC 2014). Phytoplankton (marine photosynthesizing plankton) peak periods occur during spring, when nutrient concentrations are high and the daily solar energy is increasing from winter lows (Dufour et al. 2010).

The Gulf of St. Lawrence is also home to a wide range of marine fish, including pelagic and demersal, with demersal species making up almost two-thirds of all species (Stantec 2011). Demersal species include Atlantic halibut (*Hippoglossus hippoglossus*), lumpfish (*Cyclopterus lumpus*), and Atlantic cod (*Gadus morhua)*, while pelagic species include Atlantic herring (*Clupea harengus)*, Atlantic soft pout (*Melanostigma atlanticum*), capelin (*Mallotus villosus*), and pollock (*Pollachius virens*). A wide range of shellfish species are also present in the Gulf, including species of shrimp (*Pandalus borealis*), scallop (*Placopecten magellanicus)*, bivalves (*Mytilus edulis),* crab (*Chionoecetes opilio*, *Cancer irroratus*), and lobster (*Homarus americanus*). Presence and timing of fish in or near the LAA varies, with some using the area to spawn (AMEC 2014; Stantec 2017; Bourdages et al. 2022).

The benthic environment is responsible for the majority of species diversity in the Gulf of St. Lawrence, including important commercial shellfish species, cold-water corals, and sponges. Benthic species are important to marine ecosystems, providing structural complexity, shelter, food, and substrate, and are sensitive to disturbances to the seabed (AMEC 2014).

Nearshore habitat in the LAA is predominantly sand, mud, and gravelly substrate, while subtidal and intertidal algal communities are influenced by warm summer seawater temperatures and seasonal sea ice scouring (South 1983). Algal distribution between the high-water mark and the shallow subtidal zone can be differentiated by wave exposure. Coastal areas with fine substrates can host a variety of salt tolerant plants and algae, such as eelgrass. Eelgrass requires sunlight and sufficient water clarity to grow. In NL, it is typically found in shallow coastal bays, including areas along the Port au Port Peninsula and areas between Stephenville and Port aux Basques (ECCC 2020). Eelgrass beds are classified by DFO as Ecological Significant Areas due to their importance to nearshore habitats. Saltmarshes are also present, supporting halophytic plants and organisms and function to stabilize the shore (Stantec 2011). Nearshore habitats along the Port du Port Peninsula and St. George's Bay also support a varied range of marine fish and shellfish, as well as important spawning and nursery sites for several commercially important species, most notably herring. The presence and timing of spawning varies depending on the species, though typically occurs in the spring or fall (LGL 2008; AMEC 2014; eCapelin 2017).

Aquatic invasive species (AIS) are fish, invertebrates, or plant species that have been brought outside of their native range and have the potential to outcompete and harm native species (DFO 2019a). Two aquatic invasive species (coffin box and European green crab) have been identified in areas within the LAA and four other AIS have been identified along other Newfoundland coastlines (DFO 2018a, 2018b, 2018c, 2018d, 2018e, 2018f). Vessels entering Newfoundland ports are subject to biosecurity protocols to prevent the spreading of AIS in the province.

Marine mammals are expected to occur in the Gulf of St. Lawrence and potentially within the LAA; Stantec (2017) identified 15 cetacean species and four pinniped species that occur in the Gulf. Many marine mammals are often seen on a seasonal basis or year-round, particularly in areas along the western shelf of Newfoundland and the entrance to St. George's Bay. The leatherback sea turtle (*Dermochelys coriacea)* and loggerhead sea turtle (*Caretta caretta)* are also expected to occur to some degree in the Gulf (Stantec 2017). The presence and timing of marine mammals and sea turtles varies in the RAA. According to the Ocean Biodiversity Information System Sightings Database 1913-2022, the most common marine mammal sighted throughout the RAA was the fin whale (*Balaenoptera physalus*). Within the LAA, only three marine mammal sightings have been recorded: two minke whales

(*Balaenoptera acutorostrata*) and one sperm whale (*Physeter macrocephalus*) near the Port au Port Peninsula, and there were no occurrences of sea turtle sightings within the RAA / LAA from the datasets reviewed.

A total of 22 marine fish that are protected under SARA were identified to potentially occur in or near the LAA (Stantec 2017). The American eel and the banded killifish are further protected under the NL ESA and are currently listed as vulnerable; these are discussed further in Chapter 10: Fish and Fish Habitat. The northern wolffish (*Anarhichas denticulatus*) and spotted wolffish (*Anarhichas minor*) are the only species to have critical habitats established within the RAA. There are no critical habitats defined under SARA within the LAA. Seven marine mammal and two sea turtle species that are protected under SARA were identified to potentially occur in or near the LAA. While these species may use the offshore habitats within the RAA, there has been no recorded observations of these seven species in the LAA. Of the species groups discussed, Atlantic cod (Laurentian South population), deepwater redfish (*Sebastes mentella*; Gulf of St. Lawrence – Laurentian Channel population), Acadian redfish (*Sebastes fasciatus*; Atlantic population), and American plaice (*Hippoglossus platessoides*; Maritime population) have the highest potential to occur within the LAA.

The marine RAA / LAA is in the Estuary and Gulf of St. Lawrence Marine Bioregion, which is one of the largest and most productive estuary/marine ecosystems worldwide (Government of Canada 2023). There are several sensitive areas within this bioregion that are close to or within LAA (Table 11.1).

Table 11.1 Details on Sensitive Areas in or near the LAA

Sensitive Area	Location Description	Importance of Area
Ecologically and Biologically Significant Areas		
West Coast of Newfoundland	• Covers 18,424 km² along the west coast of Newfoundland • Encompasses a portion of the western extent of the LAA	• Identified for having relatively higher ecological or biological significance than surrounding areas and are protected through DFO's *Ocean Act* • Important spawning area for the northern Gulf cod stock • Substantial quantities of fish larvae, particularly herring and capelin near Port au Port Peninsula • High congregations of juvenile northern Gulf cod, redfish, American plaice, and Atlantic wolffish • Overwintering areas and migration corridors for several fish species • Feeding area for marine mammals
Significant Benthic Areas (SiBAs)		
Significant Benthic Areas	• Several SiBAs are outside of the LAA; 3,364 km² total • Closest SiBA to the Project is 15.1 km from the LAA	• SiBAs are regional habitats that contain important cold-water corals and/or sponge dominated communities, which are vulnerable to proposed or ongoing fishing activities

Table 11.1 Details on Sensitive Areas in or near the LAA

Sensitive Area	Location Description	Importance of Area
SAR Critical Habitats		
Northern Wolffish	• One critical habitat area is close to the Project (35.6 km from the LAA; 1,172 km²)	• Critical habitat is established as part of the Northern Wolffish Recovery Strategy
Spotted Wolffish	• Two critical habitat areas are close to the Project (5.4 km to the west of the LAA; 2,625 km² total)	• Critical habitat is established as part of the Spotted Wolffish Recovery Strategy
Special Marine Areas		
Boswarlos	• Located within the LAA to the west of the Port au Port isthmus • Coastal area includes rocky ledges, low cliffs, cobbles, boulders, bedrock slabs and outcrops, with large sand gravel beaches	• Extensive eelgrass bed habitat that provides habitat for several shorebirds and songbirds • Shallow areas contain abundant scallop beds
Sandy Point	• A 1,000 ha sand spit that extends 2 km into St. George's Bay, located near the southern boundary of the LAA • Marine and coastal habitats include tidal sandy flats, salt marshes, eelgrass beds, beaches, and sand dunes	• Largest *Spartina* salt marsh and one of the largest eelgrass beds in the province • High numbers of migrating shorebirds in the summer • Important area for piping plover (15% to 20% of province's population) • Only known location in the province for willet (on Flat Island) • To some extent, the site is protected by environmental non-governmental organizations
St. George's Bay – Port au Port	• Encompasses the majority of the LAA • Bay contains glacio-marine mud and deposits of sand and gravel, with some rocky ledges • Coastal area includes sandy shorelines and mud flats	• St. George's Bay contains many eelgrass beds and salt marshes that provide important habitat for birds and other animals • Several rivers in the area are important for Atlantic salmon • St. George's Bay contains submarine / abyssal fans that have not been seen anywhere else in the region • Important spawning grounds for herring

Table 11.1 Details on Sensitive Areas in or near the LAA

Sensitive Area	Location Description	Importance of Area
Marine Mammal Sensitive Areas		
Important Area for Blue Whale	• The shelf waters south and southwest of Newfoundland	• Considered important foraging / feeding and socializing areas for blue whales. • Other identified areas in the North Atlantic: lower St. Lawrence Estuary, northwestern Gulf of St. Lawrence, the Mecatina Trough area, including the head of the Esquiman Channel, and the continental shelf of the Grand Banks, Newfoundland, and Nova Scotia. • Habitats were identified using information on blue whale distribution and where krill aggregations occur
Sources: DFO 2009, 2020; AMEC 2014; CPAWS 2018; Lesage et al. 2018		

11.2.2.2 Marine Commercial Fisheries

Commercial fishing vessels from Québec and the Atlantic provinces that operate in the Gulf are managed by DFO regional offices (AMEC 2014). Licenses and quotas are set by DFO for individual species management areas and NAFO divisions and subdivisions. Commercial fishing is an economic contributor for western Newfoundland communities. Data sets for the commercial fisheries baseline were acquired from the Canada Marine Planning Atlas for 2009 to 2018, showing distribution and composite landings and from the Economic Analysis and Statics DFO (2023) for 2011 to 2020, showing fish harvests in weight and value within the RAA for several commercially important fish and shellfish species including: Atlantic herring, Atlantic mackerel (*Scomber scombrus)*, capelin, snow crab, witch flounder *(Glyptocephalus cynoglossus)*, Greenland halibut (*Reinhardtius hippoglossiodes)*, redfish, Atlantic cod, and Atlantic halibut (Economic Analysis and Statics DFO 2023; Government of Canada 2023). Information illustrates that fishing activity for shellfish and fish species is prevalent in the LAA and RAA. Due to confidentiality reasons, information on fish landings and harvests was withheld from DFO data requests for several species within NAFO division 4Rcd (the RAA) and from publicly accessible datasets.

Within the LAA, commercial fisheries are present for Atlantic herring and capelin in the inshore portions of Port au Port and St. George's Bay, while queen / snow crab and witch flounder are fished along the southern margins of the LAA in St. George's Bay. Total weight (kg) of composite landings between 2009-2018 (Government of Canada 2023) recorded in St. George's Bay and Port au Port Bay and from fish harvest data from 2011-2022 within the RAA (Economic Analysis and Statics DFO 2023), indicate that the LAA is a productive area for a variety of commercial fish species.

11.2.2.3 Marine Recreational Fisheries

Marine recreational fisheries exist within the RAA through the NL recreational groundfish fishery (DFO 2022). This allows residents, non-residents, and tour boat operators to fish for groundfish species, including cod, during specified dates in the summer and fall months. There are several restrictions put in place including the type of fishing gear and retention limits. Retention of Atlantic halibut, spotted wolffish, northern wolffish and shark species are prohibited (DFO 2022).

The LRU survey (Stantec 2023b) included questions about marine fish and aquatic harvesting and consumption in or around Port au Port Bay, Bay St. George (a.k.a. St. George's Bay), and within or near the Port of Stephenville. Results indicated that marine species are harvested in the three areas for various purposes. The most harvested marine fish included Atlantic cod, capelin, mackerel, lobster, and halibut.

11.2.2.4 Aquaculture

Aquaculture activity within the LAA is limited; three marine-based aquaculture shellfish sites and one land-based aquaculture hatchery have been identified (Government of Canada 2023). Three marine shellfish sites are located in Piccadilly Bay along the coast of Port au Port Peninsula and produce sea scallops and blue mussel. The three sites are owned by the same company, Plastik Industries of Canada Ltd. Neither of the land- or marine-based aquaculture facilities overlap with proposed Project infrastructure or Project activities.

The Indian Head facility owned by Northern Harvest Smolt Ltd. provides smolt for the Northern Harvest Sea Farms saltwater farms, with a capacity of 4.5 million fish annually (Mowi Canada East 2023). The hatchery is located on the same road as the proposed hydrogen / ammonia plant. It currently has a non-exclusive right to withdraw water from nearby freshwater wells and saltwater wells. The maximum estimated annual withdrawal is 4,493,880 m^3 and 2,102,400 m^3 for freshwater wells and saltwater wells, respectively (NL Department of Municipal Affairs and Environment 2019). Potable water comes from the Town of Stephenville's groundwater supply system (Edwards and Associates Limited and Mel-Mor Science 2018).

11.2.2.5 Other Ocean Users

Hunting activities within the RAA include commercial seal hunting and bird hunting (DFO 2011). Seal harvesting has been practiced in Atlantic Canada for over 200 years, primarily for seal oil, but has since expanded into a larger industry for seal products. DFO manages and regulates the harvest, with two species harvested in the Gulf: grey (*Halichoerus grypus*); and harp seals *(Phoca groenlandica)*. The Project is adjacent to Sealing Area #10. Bird hunting is permitted in western Newfoundland under the *Migratory Birds Hunting Regulations* for various species of waterfowl and murres/turrs (ECCC 2023). The Project is adjacent to two bird hunting zones: Southwestern Newfoundland Coastal Zone; and Murre Zone No. 3.

Marine shipping and transport in the Gulf of St. Lawrence is essential for the economy of Canada's eastern provinces, connecting the Atlantic Ocean to areas such as the St. Lawrence River, the Great Lakes, and western Newfoundland. Most traffic enters through the Cabot Strait, but other vessels may enter through the Strait of Belle Isle and the Strait of Canso (Stantec 2011; AMEC 2014). The Port of Stephenville is the major port in the LAA. It serves a variety of industries, including fishing and aquaculture, and is a designated compulsory pilotage area (AMEC 2014; Port of Stephenville n.d.). The port receives vessel traffic from a number of sources, including coast guard vessels, fishing and aquaculture vessels, and shipping vessels (D. Merkel, pers. comm., 2023). A medium-sized port exists in Lower Cove, which is used as an export terminal for Atlantic Minerals' Lower Cove chemical-grade limestone and dolomite quarry (Atlantic Minerals Limited n.d.). Products are shipped year-round in their natural state to global markets. Apart from commercial shipping and transportation and fishing vessels, western Newfoundland waters are frequently traversed by other types of vessels for activities including scientific research, military, and marine tourism (AMEC 2014; Stantec 2017; NL Tourism n.d.).#

Six locations in the LAA were used historically for military activities such as training and weapons testing during conflicts such as World War I and World War II (AMEC 2014; DND 2021). These sites are now considered unexploded ordnances (UXO) legacy sites as UXOs may still exist, posing a risk to the public; none of these locations overlap with the Project Area. There are no shipwrecks documented in the LAA.

DFO oversees the national Small Craft Harbours program (DFO 2021b). Small Craft Harbours are designated as core fishing harbours (critical to fishing / aquaculture industries), non-core fishing harbours (supporting fishing and aquaculture industries), or recreational harbours (supporting recreational community). There were 14 core fishing harbours and two non-core fishing harbours were identified in the LAA, with another nine core fishing harbours outside of the LAA, within RAA boundaries (DFO 2021b).

The *Canadian Environmental Protection Act, 1999* (CEPA) states that approved substances cannot be disposed of at sea in Canadian territorial waters, by Canadian ships in international waters, or in waters under the control of a foreign government unless a permit has been granted by the ECCC's Disposal at Sea Program at an approved site (Government of Canada 2019). There are no active Disposal at Sea sites within the RAA, however there is one inactive Disposal at Sea site.

Western Newfoundland is considered an area of low activity for the petroleum industry. There is currently only one active exploration licence (EL-1070) in western Newfoundland; Shoal Point Energy Ltd. is the licence operator. The license covers onshore and offshore lands and overlaps with the LAA off the north coast of the Port au Port Peninsula (C-NLOPB 2023).

11.3 Assessment Criteria and Methods

This section describes the criteria and methods used to assess environmental effects on Marine Environment and Use. Residual environmental effects (Section 11.5) are assessed and characterized using criteria defined in Section 11.3.1, including nature, magnitude, geographic extent, timing, duration, frequency, reversibility, and ecological or socio-economic context. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for Marine Environment and Use is provided in Section 11.3.2. Section 11.3.3 identifies the potential environmental effects to be assessed for Marine Environment and Use, including effect pathways and measurable parameters. This is followed by the identification of potential Project interactions with this VEC (Section 11.3.4). Analytical assessment techniques employed for the assessment of potential Project-related environmental effects on Marine Environment and Use are provided in Section 11.3.5. The assumptions that were made to support a conservative approach to the assessment of residual effects on Marine Environment and Use are described in Section 11.3.5.1.

11.3.1 Residual Effects Characterization

Table 11.2 presents definitions for the predicted environmental effects characterization of the undertaking on Marine Environment and Use. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 11.2 Characterization of Predicted Environmental Effects of the Undertaking on Marine Environment and Use

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Nature	The long-term trend of the residual effect	• **Neutral –** No net change in the measurable parameter(s) for Marine Environment and Use relative to baseline • **Positive –** A residual effect that moves the measurable parameter(s) in a direction beneficial to Marine Environment and Use relative to baseline • **Adverse –** A residual effect that moves the measurable parameter(s) in a direction detrimental to Marine Environment and Use relative to baseline

Table 11.2 Characterization of Predicted Environmental Effects of the Undertaking on Marine Environment and Use

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in measurable parameter(s) or the VEC relative to existing conditions	**Change in Marine Habitat Quantity / Quality:** • **Negligible –** No measurable change • **Low –** a measurable change in habitat area or habitat quality that is within the range of natural variability • **Moderate –** a measurable change in habitat area or habitat quality that is greater than the range of natural variability, however, that does not affect the ability of marine species to use this habitat to carry out one or more of their life processes • **High –** a measurable change in habitat area or habitat quality that is greater than the range of natural variability and large enough that fish can no longer rely on this habitat to carry out one or more of their life processes
		Change in Marine Species Health and Survival: • **Negligible –** No measurable change • **Low –** a measurable change in the abundance or survival of local marine species populations* that is within the range of natural variability • **Moderate –** a measurable change in the abundance or survival of local marine species populations that is greater than the range of natural variability, however, does not affect the sustainability of marine species populations* • **High –** a measurable change in abundance or survival of local marine species populations that is greater than the range of natural variability and is large enough to potentially affect the sustainability of local marine species populations* *Species at risk are assessed at an individual level
Magnitude	The amount of change in measurable parameter(s) of the VEC relative to existing conditions	**Change in Fisheries / Aquaculture Grounds and Productivity:** • **Negligible –** No measurable change • **Low –** a temporary loss of fishable ground or resources up to less than or equal to one quarter of the LAA • **Moderate –** a temporary loss of fishable ground to fishers adding up to approximately one half of the LAA • **High –** a temporary loss of fishable ground to fishers across the entire LAA
		Change in Access for Other Ocean Users: • **Negligible –** No measurable change • **Low –** a temporary loss of access of up to less than or equal to one quarter of the LAA • **Moderate –** a temporary loss of access up to approximately one half of the LAA • **High –** a temporary loss of access across the entire LAA

Table 11.2 Characterization of Predicted Environmental Effects of the Undertaking on Marine Environment and Use

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Geographic Extent	The geographic area in which a residual effect of a defined magnitude occurs	• **Project Area –** Residual effect is restricted to the Project Area • **LAA –** Residual effect extends into the LAA • **RAA –** Residual effect extends into the RAA
Timing	Considers when the residual environmental effect is expected to occur, where applicable or relevant to the VEC.	• **No Sensitivity –** Residual effect does not occur during periods of known significance to local marine life and ocean users • **Moderate Sensitivity –** Residual effect may occur during fish migration periods • **High Sensitivity –** Residual effect occurs during fish spawning or nursing periods
Duration	The period of time required until the measurable parameter(s) or the VEC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	• **Short-term –** Residual effect is restricted to no more than the duration of the construction phase (4 years) • **Medium-term –** Residual effect extends through the operation and maintenance phase of the Project (30 years) • **Long-term –** Residual effect extends beyond the life of the Project (greater than 30 years)
Frequency	Identifies how often the residual effect occurs during the Project, during a specific phase of the Project, or during another specified time period	• **Single event** • **Multiple irregular event –** Occurs at no set schedule • **Multiple regular event –** Occurs at regular intervals • **Continuous –** Occurs continuously
Reversibility	Describes whether a measurable parameter(s) or the VEC can return to its existing condition after the Project activity ceases, including through active management techniques	• **Reversible –** Residual effect is likely to be reversed after activity completion and rehabilitation • **Irreversible –** Residual effect is unlikely to be reversed
Ecological / Socio-economic Context	Existing conditions and trends in the area where the residual effect occurs	• **Undisturbed –** Area is relatively undisturbed or not adversely affected by human activity • **Disturbed –** Area has been substantially previously disturbed by human development or human development is still present

11.3.2 Significance Definition

A significant residual adverse effect on Marine Environment and Use is defined as a residual Project-related change to the environment that results in one or more of the following:

- Marine Biological Environment
  - A Project-related HADD of fish habitat or the death of fish, as defined by the *Fisheries Act*, that cannot be mitigated, authorized or offset
  - A Project-related contravention of the prohibitions stated in sections 32-36 and 58 of SARA or relevant provincial acts regarding SAR
  - A change to the productivity or sustainability of marine species populations within the LAA where recovery to baseline is unlikely, or is contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans, and management plans
- Marine Socio-economic Environment
  - Uncompensated displacement of fishers from the areas traditionally fished for a particular fishing season
  - Demonstrated net income loss from aquaculture / fishing activities due to Project-related environmental effects for at least one fishing season
  - Displacement of other ocean users resulting in a long-term change in traffic patterns, or interference with ocean-based activities

11.3.3 Potential Environmental Effects, Project Pathways, and Measurable Parameters

Table 11.3 lists the potential Project effects on Marine Environment and Use and provides a summary of the Project effect pathways and measurable parameters and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for large development projects in NL, renewable energy projects in other parts of Canada, comments provided during engagement, and professional judgment.

Potential environmental effects to marine environment and use are anticipated to occur during construction and operation and maintenance phases of the Project. The effect pathways have the greatest potential for interaction during the construction phase of the Project. The potential effects of environmental stressors on shellfish, finfish, and fisheries are typically intertwined in that changes to the quantity and quality of marine habitat can influence marine species populations and/or fisheries.

Table 11.3 Environmental Effects, Effect Pathways, and Measurable Parameters for Marine Environment and Use

Environmental Effect(s)	Effect Pathway(s)	Measurable Parameter(s) and Units of Measurement
Change in Marine Habitat Quantity	• In-water work	• Area (m^2) of habitat
Change in Marine Habitat Quality	• Sedimentation • Hydrogen / ammonia production discharge from outfall • Noise generated from Project activities • Electromagnetic field (EMF) emissions from subsea cable • AIS introductions through vessel activity • Release of deleterious substances	• Concentration of chemical parameters (various) in receiving environment compared to applicable guidelines • Sound level in decibels, decibel reference value 1 micropascal (dB re 1 μPa) • EMF emissions, in μT (microTelsa) • Number of AIS introductions
Change in Marine Species Health and Survival	• Hydrogen / ammonia production discharge from outfall • Benthic disturbance and suspension of sediment from Project activities • Noise generated from Project activities	• Concentration of chemical parameters (various) in receiving environment compared to applicable guidelines • Number of collisions / allisions[1] with marine species • Mortality (loss of individuals)
Change in fishing / aquaculture grounds or productivity	• Displacement from fishing grounds due to Project infrastructure, vessel traffic, and safety exclusion zones • Change in marine habitat quantity / quality may alter fishing ground productivity • Fishing gear may be lost or damaged if snagged on Project infrastructure • AIS introductions through vessel activity	• Duration and extent of displacement of fishers / number of fishers affected • Net loss income to fishers / aquaculture operations • Number of collisions /allisions • Loss or damage to fishing gear from interactions with Project infrastructure
Change in access for other ocean users	• Displacement due to Project infrastructure, vessel traffic and safety exclusion zones • Hydrogen / ammonia production discharge may change use in the vicinity of the outfall	• Duration and extent of displacement of other ocean users / number of other ocean users affected • Number of collisions / allisions

[1] An allision is defined as a vessel striking a stationary object

11.3.4 Project Interactions with Marine Environment and Use

Table 11.4 uses checkmarks to indicate the routine Project activities that could interact with the VEC and result in the identified environmental effect(s) to be assessed. Immediately following Table 11.4, environmental effects pathways are briefly described for potential routine Project-related environmental effects and justification is provided in cases where no Project interaction with the VEC (and therefore no potential environmental effect on the VEC) is predicted.

Table 11.4 Project Interactions with Marine Environment and Use - Environmental Effects and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed			
	Change in Marine Habitat Quality / Quantity	Change in Marine Species Health and Survival	Change in Fishing / Aquaculture Grounds or Productivity	Change to Other Ocean Users
Construction				
Site Preparation and Civil Works (including turbine foundations, road construction, quarries, clearing, grubbing, blasting, cement production, and watercourse crossings)	-	-	-	-
Transportation of Resources and Equipment (includes trucking, shipping, and barging of materials)	✓	✓	✓	✓
Construction / Installation, Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	-	-	-	-
Installation and Commissioning of Wind Turbines	-	-	-	-
Installation and Commissioning of Collector Systems	-	-	-	-
Installation and Commissioning of Transmission Lines and Substations (including marine cable crossing)	✓	✓	✓	✓
Installation and Commissioning of Hydrogen / Ammonia Plant and Associated Infrastructure (including Industrial water supply infrastructure)	✓	✓	✓	✓
Restoration of Existing Port Facilities (including pile driving and dredging)	✓	✓	✓	✓
Emissions, Discharges, and Wastes[1]	✓	✓	✓	-
Employment and Expenditures[2]	-	-	-	-
Operation and Maintenance				
Presence, Operation, and Maintenance of Wind Farms (including wind turbines, access roads, and collector systems)	-	-	-	-
Presence, Operation, and Maintenance of Transmission Lines and Substations (including marine cable crossing)	✓	✓	✓	✓
Presence, Operation, and Maintenance of Hydrogen / Ammonia Plant and Associated Infrastructure (includes marine discharge from treatment plant)	✓	✓	✓	✓

Table 11.4 Project Interactions with Marine Environment and Use - Environmental Effects and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed			
	Change in Marine Habitat Quality / Quantity	Change in Marine Species Health and Survival	Change in Fishing / Aquaculture Grounds or Productivity	Change to Other Ocean Users
Presence, Operation, and Maintenance of Port Facilities (includes loading of ammonia and vessel maneuvering within Port)	✓	✓	✓	✓
Emissions, Discharges, and Wastes[1]	✓	✓	✓	-
Employment and Expenditures[2]	-	-	-	-
Decommissioning and Rehabilitation				
Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	-	-	-	-
Decommissioning and Rehabilitation of Wind Farms (including wind turbines, access roads, and collector systems)	-	-	-	-
Decommissioning and Rehabilitation of Transmission Lines and Substations	-	-	-	-
Decommissioning and Rehabilitation of Hydrogen / Ammonia Plant and Associated Infrastructure	-	-	-	-
Decommissioning and Rehabilitation of Port Facilities	✓	✓	✓	✓
Emissions, Discharges, and Wastes[1]	-	-	-	-
Employment and Expenditures[2]	-	-	-	-

Notes:

✓ = Potential interaction

– = No interaction

[1] Emissions (e.g., light, noise, vibration, air contaminants, and greenhouse gases), discharges (e.g., wastewater and other liquid effluents), and hazardous and non-hazardous wastes are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, "Emissions, Discharges, and Wastes" is listed as a separate item under each phase of the Project.

[2] Project employment and expenditures are generated by most Project activities and are the main drivers of many potential socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, "Employment and Expenditures" is listed as a separate item under each phase of the Project.

In the absence of mitigation, the Project may interact with Marine Environment and Use in the following ways:

- Transportation of resources and equipment in the marine environment increases the risk of vessel collisions with marine animals and ocean users. Vessel movement may affect habitat quality and disrupt commercial / recreational fishing activities. Marine shellfish aquaculture operations may be affected by the accidental introduction of AIS. Construction of barge landing sites may also and affect habitat quality and quantity, increase risk of mortality to marine species, and disrupt fishing activities
- Installation and commissioning followed by the presence, operation, and maintenance of the marine subsea cable crossing may reduce marine habitat quantity and/or quality, displace fishers and other ocean users, and disrupt fisheries resources
- Installation and commissioning of hydrogen / ammonia plant and associated infrastructure will result in the release of treated effluent, which may reduce marine habitat quantity and quality, increase risk of mortality to marine species, displace fishers and other ocean users, and disrupt fisheries resources
- Restoration of existing port facilities including upgrades to the dock, pile driving, installation of the jettyless mooring system, and dredging may reduce marine habitat quantity and quality, increase risk of mortality to marine species, displace fishers and other ocean users, and disrupt fisheries resources
- Presence, operation, and maintenance of port facilities including vessels maneuvering within the port and maintenance repairs as needed may affect habitat quality, increase risk of mortality to marine species, displace fishers and other ocean users, and disrupt fisheries resources
- During construction / installation and operation, and maintenance, emissions, discharges and other wastes generated from Project activities may affect habitat quality and marine species health and survival including EMF emissions from the subsea cable, noise emissions generated from vessels and construction / maintenance equipment, and wastewater discharge from the marine outfall
- The decommissioning and rehabilitation of port facilities will involve the removal of the jettyless mooring system and potentially the quay and associated mooring infrastructure, which may reduce habitat quality, and displace fishers and other ocean users.

The following Project activities are not expected to result in changes to marine habitat and quality / quantity, marine species health and survival, fisheries in aquaculture, or other ocean users:

- Site preparation and civil works during construction will occur on land and will not interact with the marine environment
- Construction / installation, presence, operation, and maintenance of temporary workforce accommodations and associated infrastructure will occur on land and will not interact with the marine environment
- Installation, commissioning, operation, and decommissioning of wind turbines, collector systems, and transmission lines and substations will occur on land and will not interact with the marine environment (except for the marine submarine cable crossing)
- Installation, commissioning, operation, and decommissioning of hydrogen / ammonia and associated infrastructure (except marine discharge from marine outfall)

- The presence, operation, and maintenance of the marine outfall is not anticipated to affect other ocean users
- Employment and expenditures will not directly result in changes to the marine environment and users.

11.3.5 Analytical Assessment Techniques and Level of Knowledge

Potential effects of the Project on marine environment and use were assessed quantitatively where information or model results were available, and qualitatively where information or model results were not available. Quantitative assessments included:

- GIS analysis of the Project footprint overlain with maps of the marine habitat to delineate potential habitat alterations (in Draft)
- Comparison of effluent quality parameters to water quality in the receiving environment to determine effects to habitat quality (in Draft)

Qualitative assessments were conducted using several sources of information. This entailed available mapping and databases, professional judgement based on an understanding of the Project and potential effects, the use of habitat and life history of potentially affected marine species in the LAA and RAA, the current and historical use of ocean users in the LAA and RAA, and the likely effectiveness approach of mitigation measures, supported by scientific literature, environmental assessments from similar Projects, industry best management practices, and regulatory guidelines, as available.

11.3.5.1 Assumptions and Conservative Approach

The following assumptions were employed in the assessment of Project effects on marine environment and use, resulting in conservative predictions of residual effects:

- While the Canada Marine Planning Atlas and Economic Analysis and Statistics DFO information provided commercial fisheries data within the RAA / LAA, several data gaps were identified. These included the exclusion of commercially fished species and privacy screening within the datasets. Moreover, since DFO was not able to provide requested 4Rcd commercial fisheries information due to confidentially reasons, it is assumed that there is more fishing activity ongoing within the RAA / LAA than what is publicly available.
- Species presence in the Project Area was determined based on the marine habitat characteristics established from a desktop assessment. These assumptions are informed by the marine habitat preferences of various fish species reported in the literature and by previous studies of species that occur in similar habitat types around the Island of Newfoundland.

11.4 Mitigation Measures

A series of environmental management plans will be developed by WEGH2 to mitigate the effects of Project development on the environment. A full list of mitigation measures to be applied throughout Project construction, operation and maintenance, and decommissioning and rehabilitation is provided in Section 26.2. Key measures to mitigate the potential effects of the Project on the Marine Environment and Use are listed in Table 11.5, by category and Project phase.

Table 11.5 Mitigation Measures: Marine Environment and Use

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
8	Mitigation	Project staff and contractors will adhere to the waste management procedures to be included in the EPP and the Waste Management Plan.	X	X	X
9	Mitigation	Construction areas will be kept clear of rubbish and debris. Rubbish and debris will be appropriately stored and managed.	X	-	-
10	Mitigation	Waste materials and debris will be collected and stored in acceptable containers on-site and disposed of off-site in an environmentally acceptable and approved site. Materials that can be recycled will be sorted and taken to an approved facility.	X	X	X
11	Mitigation	Volatile wastes and materials, such as fuel, mineral spirits, oil, or paint thinner will be stored appropriately and will not be permitted to enter into waterways or storm drains. They will be disposed of at an approved site.	X	X	X
14	Mitigation	Bulk fuel and lubricants will be stored in secure areas (i.e., with bund walls and impervious flooring) that have the capacity to trap more than the volume of petroleum hydrocarbons being stored; this will serve as a secondary containment should the primary containment fail. Other petroleum hydrocarbon products will not be stored in large quantities on-site, and secondary containment (e.g., drip trays) will be used in areas of storage and transfer.	X	X	X
15	Mitigation	Hazardous products will be stored according to industrial requirements and standards, and safely secured so that access is limited to authorized personnel.	X	X	X
16	Mitigation	Fuelling and servicing will be conducted using appropriate containment equipment, including spill kits.	X	X	X
17	Mitigation	Fuelling and servicing areas will be sited more than 100 m away from watercourses, coastlines, waterbodies, and wetlands.	X	X	X
18	Mitigation	The potential for spills will be reduced through the use of standard good practices, such as the use of appropriate containers, and avoiding overfilling.	X	X	X

Table 11.5 Mitigation Measures: Marine Environment and Use

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
19	Mitigation	Vehicles, heavy equipment, and machinery will be properly maintained to reduce the risk of leakage. Routine preventative maintenance and inspection of hydraulic equipment and machinery will be undertaken to avoid a hazardous material release.	X	X	X
20	Mitigation	Project footprint and disturbed areas will be limited to the extent practicable.	X	X	X
22	Mitigation	Project vehicles, heavy equipment, machinery, and associated exhaust systems and mufflers (and/or other appropriate sound attenuation devices) will be regularly inspected and maintained so that they remain operating in accordance with manufacturer's recommendations.	X	-	-
23	Mitigation	Project vehicles, heavy equipment, and machinery will be shut down when stationary for long periods of time. The idling of vehicles and equipment will be avoided whenever practical.	X	-	-
32	Mitigation	An Explosives and Blasting Management Plan will be developed by the blasting contractor to provide direction for the safe storage, handling and use of explosives and explosive components at the Project site, to address the safety of the public and Project personnel, and protection of both the environment and Project components.	X	-	-
33	Mitigation	Areas to be cleared will have sediment and erosion control measures implemented per the site-specific Erosion & Sediment Control Plan prior to the initiation of clearing activities. The sediment and erosion control measures will be adapted to suit the field conditions associated with the specific construction activities as construction proceeds.	X	X	X
34	Mitigation	Construction areas will be routinely monitored to identify areas of potential erosion and to apply appropriate mitigation. Best practice erosion and sediment control measures will be implemented, as required.	X	X	X
35	Design	The drainage system for the site will be designed to appropriately manage stormflows considering impacts to on-site downstream watercourses, and coastlines, and infrastructure. Additionally, the site drainage system will consider the variable and seasonal up-stream drainage needs to provide adequate access to downstream watercourses without adverse impact on the plant site or other nearby infrastructure.	X	-	X
44	Mitigation	To avoid attracting wildlife, wastes will be securely stored, frequently removed from site, and properly disposed of in an environmentally acceptable manner at an approved site.	X	X	X
70	Mitigation	Waste generated on-site will be removed on a regular basis and disposed of appropriately at an approved facility.	X	X	X

Table 11.5 Mitigation Measures: Marine Environment and Use

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	**O**	**D**
77	Mitigation	Best practices for the proper handling, storage, and disposal of spilled hazardous chemicals and fuels will be included in the EPP and implemented by the Project personnel and contractors.	x	X	X
80	Mitigation	Emergency response plans will be developed, including spill prevention and response, emergency response measures, training, responsibilities, clean-up equipment and materials, and contact and reporting procedures.	x	x	x
83	Mitigation	Spill response kits will be available on-site. Project vehicles will be equipped with appropriately sized spill kits.	x	x	x
84	Mitigation	In the event of a spill, dry clean up and mopping techniques will be used, as appropriate. The area will not be "washed down" as this could cause the spills to spread to the surrounding environment and potentially enter drainage works or environmentally sensitive areas.	x	x	x
87	Mitigation	WEGH2 will regularly inspect and monitor Project infrastructure and equipment that may be impacted by the environment (in addition to its normal function) and take required action to maintain, repair, and upgrade infrastructure / equipment as needed.	x	x	x
88	Design	Work activities will include allowance / procedures for delays due to poor weather.	x	X	X
90	Mitigation	Weather forecasts (including marine forecasts) will be considered when planning construction and operation activities that may be affected by adverse conditions, such as receipt of materials and supplies, and product deliveries, particularly deliveries of products and diesel fuel. Where required, these activities will be scheduled for periods of favourable weather conditions.	x	x	x
91	Mitigation	Barge anchors will be moved only when necessary to reduce the resuspension of sediments.	X	X	X
92	Mitigation	Construction vessels and barges will use designated routes to and from the construction site.	X	-	-
93	Mitigation	WEGH2 will maintain up-to-date communication with fishers on Project activities and Project vessel operators, facilitated through a community liaison representative.	X	X	X
94	Mitigation	Navigational Warnings and Notices to Shipping will be issued.	-	X	-
95	Mitigation	Movement of vessels will be subject to the Practices and Procedures for Public Harbours under the *Marine Act.*	X	X	X
96	Mitigation	Vessels will use Pilots within compulsory pilotage area	-	X	-
97	Mitigation	All marine-based work undertaken by registered vessels will comply with the requirements of the *Canada Shipping Act*.	X	X	X

Table 11.5 Mitigation Measures: Marine Environment and Use

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
98	Mitigation	All marine-based work undertaken by foreign vessels must be undertaken pursuant to a Coasting Trade Permit issued under the *Coasting Trade Act*, and will comply with applicable regulations under the International Maritime Organization Conventions including the International Convention for the Prevention of Pollution from Ships (MARPOL).	X	X	X
99	Mitigation	All marine Project activities will be conducted in accordance with the requirements of the Canadian Coast Guard Marine Communication and Traffic Services (CCG-MCTS).	X	X	X
100	Mitigation	Consultation with local fish harvesters and other stakeholders will be undertaken regarding marine-related activities that may interact with fisheries.	X	-	-
101	Mitigation	Vessel maintenance, inspection and certifications will be required prior to mobilization. WEGH2 will require supportive evidence by a third-party vetting process.	X	X	X
102	Mitigation	Marine vessels operated by the Project or Contractors will be required to have trained and qualified personnel in accordance with Canadian Marine Personnel Regulations, the Marine Occupational Health and Safety Act, or an equivalent IMO-approved program.	X	X	X
103	Design	Project components will be designed to reduce the area of disturbance to the extent feasible.	X	X	X
104	Design	Subsea cables will be buried to reduce risk of species mortality and disturbance in the nearshore marine environment at both landfall sites.	X	-	-
105	Design	Fill material for the rock berms will be reasonably free of fines, debris and substances that would be deleterious to the marine environment.	X	-	-
106	Mitigation	All marine activities will comply with the conditions of Letter of Advice and authorization issued by DFO.	X	X	X
107	Mitigation	The use of ship's whistles will be reduced to the extent possible, and only used in compliance with the International Collision Regulations and standard operating procedures.	X	X	X
108	Mitigation	Project vessels will comply with applicable legislation, codes and standards of practice for shipping, including the Ballast Water Regulations under the *Canada Shipping Act* and the Guide to Canada's Ballast Water Regulations, to reduce risk of introduction of marine-invasive species.	X	X	X
109	Mitigation	Water quality monitoring will be conducted for total suspended solids (TSS) prior to, and during, dredging, as required by applicable permits and authorizations.	X	-	-

Table 11.5 Mitigation Measures: Marine Environment and Use

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
110	Mitigation	Vessels and equipment to be used during construction will be operated and maintained according to manufacturer's specifications with supervision and inspections being undertaken throughout the construction phase.	X	-	-
111	Mitigation	Routine effluents and operational discharges produced by marine vessels (e.g., grey and black water, bilge water, deck drainage, discharges from machinery, and non-hazardous waste material) will be managed in accordance with MARPOL and IMO guidelines, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act.*	X	X	X
112	Mitigation	Ammonium nitrate-fuel oil mixtures for blasting will not be used in, or near, water due to the potential for production of toxic by-products.	X	-	-
113	Mitigation	Prior to dredging, the Contractor will test the sediments in the dredge area for contaminants, and compare the results against relevant guidelines for the intended fate of the material (e.g., reuse for fill and/or land reclamation, and/or disposal at sea of surplus material) to determine if it is safe for industrial land use, commercial land use, parkland/residential land use, and/or for disposal at sea of surplus material (if required).	X	-	-
114	Mitigation	For disposal at sea of surplus dredge material that is coarse sediment (e.g., rubble and coral rock), the location for the creation of artificial reefs will be determined by regulators and in consultation with fishers.	X	-	-
115	Mitigation	Awareness training will be provided to Project-dedicated marine personnel to identify signs of marine mammals and sea turtles at the sea surface. Project-dedicated vessel masters will be instructed to avoid marine mammals and sea turtles while in transit, and reduce speed or deviate from course if safe to do so, in order to reduce probability of collisions/vessel strikes. For example, to comply with measures within the Cabot Strait voluntary slowdown zone.	X	X	X
118	Mitigation	Lighting on vessels will adhere to maritime safety regulations / standards.	X	X	X
120	Mitigation	Project vessels will be equipped with communication mechanisms to communicate with third-party mariners.	X	X	X
121	Mitigation	If construction activities must be scheduled during commercial fishing seasons and be conducted in the fishing grounds, WEGH2 will continue to manage and reduce adverse conflicts with affected fishers.	X	-	-

Table 11.5 Mitigation Measures: Marine Environment and Use

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
122	Mitigation	The cable installation contractor will issue regular "Security Messages" stating the vessel is restricted in ability to maneuver, course, speed and intentions. This will also be issued prior to the vessel arriving through the Notice to Mariners.	X	-	-
126	Mitigation	Routine effluents and operational discharges produced by cable-laying and support vessels (e.g., grey and black water, bilge water, deck drainage, discharges from machinery, and non-hazardous waste material) will be managed in accordance with MARPOL and IMO guidelines, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act*.	X	-	-
128	Mitigation	Ploughing or jetting will be employed as the primary method of cable burial during Project construction.	X	-	-
129	Mitigation	Following completion of cable deployment, the cable will only be extracted if necessary for cable repairs, thereby reducing potential effects on the marine environment related to cable removal and reburial.	-	X	-
130	Mitigation	Proper cable placement will mitigate potential underwater vibration caused by strumming. Cable pay-out tension will be regulated during construction to reduce suspensions between rocks. Post-lay inspection will be carried out to confirm that cable has been correctly deployed either on or into the seabed. In addition, modern cables have been designed to improve their protection against fish biting (Carter et al. 2009).	-	X	-
131	Mitigation	The cable will be de-activated and left in place indefinitely when no longer in use. This end-of-life option will avoid additional seabed disturbance and has, therefore, been selected rather than removal, which would require pulling up the cable along the entire route (including buried and unburied portions), and cause unwarranted disruption to the seabed, sediments, and benthic communities.	-	-	X
136	Mitigation	Site-specific erosion and sedimentation control plans will be developed during detailed design phase of the Project and will be implemented.	X	-	-
149	Mitigation	Blasting patterns and procedures will be used to reduce shock or instantaneous peak noise levels, in accordance with a Blast Management Plan that will be developed for the Project.	X	-	-

Table 11.5 Mitigation Measures: Marine Environment and Use

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
150	Mitigation	Explosives will be used in a manner that will reduce damage or defacement of landscape features, trees, ecologically sensitive areas such as wetlands, and other surrounding objects, by controlling through standard best practice (including precisely calculated explosive loads and adequate stemming), the scatter of blasted material beyond the limits of activity. Outside of cleared areas, inadvertently damaged trees will be cut, removed, and salvaged, if merchantable (refer to Section, "Clearing of Vegetation"). Fly rock, which inadvertently enters a waterbody, watercourse, or ecologically sensitive area and that can be recovered without further damage to the environment, will be removed. Instances where larger fly rocks (boulders) enter these areas or deep waterbodies, recovery of this will be discussed with the OSEM.	X	-	-
211	Mitigation	If feasible, anchors and mooring cables will be placed in areas of lower ecological importance.	X	X	X
212	Mitigation	Tenders will be used to lift anchors rather than dragging them across the seabed.	X	X	X
213	Mitigation	Designated or directional anchoring will be implemented.	X	X	X
214	Mitigation	The subsea cable route will be selected to avoid sensitive marine habitats, to the extent possible.	X	-	-
215	Mitigation	Route length of the subsea cable will be reduced to the extent possible.	X	-	-
216	Mitigation	Displaced material will be backfilled to reduce the potential for sediment remobilization.	X	-	-
219	Mitigation	Cable burial depth will be monitored for safety and damage prevention.	-	X	-
220	Mitigation	Obstructions will be removed before installation along the cable route.	X	-	-
221	Mitigation	If pile driving is required during construction, use of quieting technologies will be considered to reduce noise (e.g., bubble curtains, vibratory pile drivers, isolation casings, cofferdams, or hydro sound dampers).	X	-	-
223	Mitigation	Trained observers will be used to maintain an exclusion area around pile driving activities for certain species. Pile driving activities must be shut down and delayed if a marine mammal or sea turtle is observed entering or within the relevant exclusion zones.	X	-	-
224	Mitigation	A gradual ramp up of hammer energy for impact pile driving will be implemented. The initial set of strikes will be followed by a waiting period and this process will be repeated several times prior to the initiation of pile driving.	X	-	-

Table 11.5 Mitigation Measures: Marine Environment and Use

ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	**O**	**D**
226	Mitigation	Vessels will follow and maintain a mandatory distance from species at risk.	X	X	X
228	Mitigation	Safety exclusion zones will be established during construction, maintenance, and decommissioning activities.	X	X	X
229	Mitigation	Infrastructure and obstructions for each Project phase will be charted and shared with affected stakeholders and regulators.	X	X	X
230	Mitigation	Guard vessels will be used, and shipping will be monitored when exclusion zones are in place.	X	X	X
231	Engagement	Coordination with local municipalities will be implemented to reduce impacts on popular events in the area (e.g., recreational fishing tournaments).	X	X	X
232	Engagement	The timing and location of construction and vessel movements will be communicated with affected recreation / tourism parties.	X	X	X
233	Mitigation	Pre-installation surveys will be conducted to confirm modelled habitat maps and mapped areas where substrate biological communities are unknown.	X	-	-

Notes:
"ID #" denotes the master identification number for mitigation in Appendix 26-A.
"C" denotes the construction phase of the Project.
"O" denotes the operation and maintenance phase of the Project.
"D" denotes the decommissioning and rehabilitation phase of the Project.
"X" denotes the Project phase for the mitigation measure.

11.4.1 Application of the Precautionary Principle to Project Mitigation Measures

WEGH2 will avoid sensitive marine habitats such as eelgrass, where possible with respect to potential effects of the Project on the marine environment and use before construction begins. Early in the EA process, and based on engagement and consultation with regulators, Indigenous groups, and stakeholders, WEGH2 completed a review and update of the Project design and layout to address specific concerns and issues. The Project layout will continue to evolve during the EA process as various stages of conceptual and detail design are completed.

The main Project components that interact with the marine environment and users are the subsea cable, marine outfall, and port upgrades. The mitigation measures in Section 11.4 have been selected in consideration of the environmental effects pathways and include standard proven mitigation measures, incorporate DFO measures to protect marine habitat, standards and best management practices, and consider regulations and guidelines that govern marine habitats and ocean related activities. As such, the mitigation measures presented are more than adequate to reduce effects to acceptable levels and to thresholds at levels below what would be considered unacceptable effect.

11.5 Residual Environmental Effects

11.5.1 Marine Habitat Quantity and Quality

11.5.1.1 Construction

Pathways that affect marine habitat quantity during construction as outlined in Section 11.3.3 are related to the direct placement of marine infrastructure and upgrades outside of the Port of Stephenville (i.e., subsea cable, marine outfall pipeline and diffuser, and barge landing sites) and inside the Port of Stephenville (jettyless mooring system, port dredging and upgrades).

Port upgrades and construction / installation of marine infrastructure mentioned above have the potential to result in changes to marine habitats by the direct alteration of the seabed and the flora / fauna communities that inhabit those areas.

To reduce marine habitat loss during construction, careful planning of the placement of marine infrastructure will be implemented. Pre-construction surveys will be conducted in areas where construction will occur to identify sensitive / important marine habitats (e.g., eelgrass beds). Where avoidance is not feasible, standard mitigation measures (Table 11.5) will be employed in addition to any requirements dictated by applicable federal / provincial regulations.

Activities during site installation and commissioning of the submarine cable (e.g., excavation in the intertidal zone to prepare the cable landing sites and trenching of the cable bed) and dredging could result in temporary disruption of the benthic habitat in the footprint of the Project Area. The trench would then be backfilled and the habitat reinstated, with a certain amount of fine material (i.e., silt, clay and sand) dispersed via the water column, though the coarse material would remain. It is expected that benthic communities would recolonize the trench and dredge areas following the installation of the subsea cable. Benthic communities are not highly affected by physical anthropogenic disturbances, likely because these communities are continually subjected to natural disturbance such as surface wave impacts on the benthos (Constantino et al. 2009).

If the dredging operations require ocean disposal of excavated material, the activity will be conducted in accordance with a Disposal at Sea Permit (obtained from ECCC). The material will meet the *CEPA* Disposal at Sea guidelines and disposal activities will be approved and regulated by ECCC. Should it be determined that construction activities will result in serious harm to fish or supporting fish species as defined under the *Fisheries Act* and policies, an Authorization will be sought in accordance with the *Fisheries Act* and a habitat offsetting plan will be prepared for DFO approval.

While there will be residual environmental effects from cable trenching during construction, the effects will be short-term and confined to a relatively small area. The duration of total suspended solids (TSS) in suspension and the geographic distance over which the sediment is spread depends on several factors, including particle size, duration of disturbance, and local oceanographic (current) conditions. The effects of TSS are limited to cable installation and the dredging period and will not be focused on one single location. Based on past evidence, this environmental effect will be reversible within a matter of hours to days (Stantec 2016).

The existing marine outfall pipeline, with diffuser, is intended to be operated with minimal upgrades; therefore, no alteration of benthic habitat is expected. A feasibility study is being conducted on the existing pipeline to inform WEGH2 of its suitability. Should substantial alterations to the pipeline or diffuser be required the marine habitat in the vicinity of the pipeline will be assessed at that time as required for permitting.

The construction of the barge landing sites will result in the alteration of marine habitat within the footprint of the structure. The barge sites will require clean rock-fill to build a jetty for barge landing. The exact jetty sizes have not yet been determined, but are estimated to be approximately 50 m x 200 m. The sites will be located at Aguathuna and West Bay. The Aguathuna landing site is a brownfield historic mining / quarry site that remains heavily disturbed. The landing site would be located in an area that slopes to the water's edge, reducing the requirement for excavation and grading. Similarly, the landing site in West Bay is located at the end of an existing road that slopes to the water's edge. It is expected that the jetties will alter marine habitat within the footprint for the duration of the construction phase of the Project. The jetties are planned to be removed post-construction.

The Port of Stephenville has undergone upgrades and previous dredging prior to this Project and has a history of seabed disturbance. The method of dredging has not been determined; however, it may be a combinations Trailing Hopper Suction Dredger and clamshell bucket from a barge. The dredged material be pumped via discharge hose or to the hopper and stored for transport. When full, the Trailing Hopper Suction Dredger will sail to the discharge location, or discharge via hose. Depending on Project specifications, the discharge would take place by opening the hopper doors, pumping the material to shore or by ejecting it using a rainbow installation. A Disposal at Sea permit will be required for the discharge or dredged materials and will be obtained prior to dredging This permit will characterize the chemical composition of the dredged material and the benthic ecology within the dredge and disposal areas. Ecologically, fine substrates offer limited attachment points for macroalgae canopy habitat unless shell fragments or rocks are present (Jones and Stokes 2006). It is anticipated that the benthic substrate is predominantly fines such as clay silt and sand. Disturbance to benthic communities is therefore more likely to be limited to burrowing and sessile fauna. Although there can be an initial impact on benthic community composition immediately after dredging, there is typically no statistically significant ($p < 0.05$) variation in macrobenthic community mean abundance, diversity, number of taxa or species richness between control and dredged sandy sites one day after dredging (Constantino et al. 2009).

WEGH2 will mitigate effects to marine habitat quantity as described in Section 11.4 and be compliant with applicable approvals under the *Water Resources Act* and/or *Fisheries Act*. Where residual adverse effects remain, these will be counterbalanced by offsetting through an authorization pursuant to the *Fisheries Act,* if necessary. A cautionary approach will be taken in developing a Fish Habitat Offsetting Plan to account for uncertainty in predicting the loss of fish habitat; it will aim for a net gain of fish habitat. The Fish Habitat Offsetting Plan will take into account input from consultation and engagement, and will be developed and implemented in consultation with DFO and in consideration of the "Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act*" (DFO 2019b).

Pathways that affect marine habitat quality as outlined in Section 11.3.3 are related to the direct placement of marine infrastructure and upgrades outside of the Port of Stephenville (i.e., subsea cable, marine outfall pipeline and diffuser, and barge landing sites) and inside the Port of Stephenville (jettyless mooring system, port dredging, and upgrades). Those works will include the use of industrial equipment and an increase in vessel traffic that are involved in construction. These activities can increase the potential for changes in marine habitat quality as a result of underwater noise and introduction of AIS through transiting vessels.

The installation of the subsea cable will result in localized, elevated levels of TSS. While TSS concentrations can become elevated due to natural processes (e.g., heavy rainfall, storm events), or in certain areas (e.g., nearshore coastal environments), marine construction activities typically increase the concentration of TSS. There is a wide range of tolerance of fish species to levels of TSS, with some species being more sensitive than others (Au et al. 2004). Species within the nearshore project area are expected to be more tolerant. Elevated TSS concentrations have been associated with high levels of stress in benthic invertebrates (Norton et al. 2002) and high concentrations can also affect fish. Oxygen deprivation has been observed due to sediments coating the respiratory epithelia of fish and cutting off gas exchange with water (Au et al. 2004). Avoidance by swimming out of the affected area is the primary response of fish to locally high levels of TSS.

Marine fish, marine mammals, and sea turtles have distinct hearing capacities and can react differently to underwater noise. Underwater noise introduced to an area involved with Project construction activities can reduce the quality of marine habitats, resulting in potential avoidance of those areas by mobile marine species. Noise generated by the Project is anticipated to vary throughout each phase. Noise generated during the construction phase could be generated in the marine environment through pre-construction surveys that characterize the seafloor and site conditions (CSA Ocean Sciences Inc. 2021). Noise can also originate from vessels and industrial equipment involved with activities for port upgrades (e.g., pile driving) or infrastructure installations (e.g., cable-laying). The intensity and frequency of underwater noise would be dependent on the type of vessel and equipment being used (CSA Ocean Sciences Inc. 2021). The degree to which a marine animal responds to underwater noise depends on a large number of variables including: the nature, magnitude, and duration of the sound; distance from the sound source; species and individual involved; and context (i.e., activity at the time of exposure) (Richardson et al. 1995; Southall et al. 2007; Popper and Hawkins 2012). Marine fish may exhibit a temporary startle response or avoid the source area for the duration of the disturbance (Feist et al. 1996; Wardle et al. 2001; Hastings and Popper 2005; Thomsen et al. 2012). Marine mammals have been known to exhibit a range of responses (Nowacek et al. 2007), from overt avoidance behaviours (Southall et al. 2007) or disruption of foraging patterns (e.g., Sundermeyer et al. 2012; Tougaard et al. 2012), to less obvious responses such as changes to communication (e.g., Castellote 2012; Risch et al. 2012; Williams et al. 2013; Merchant et al. 2014) or increased stress (Rolland et al. 2012). The magnitude of underwater noise created during trenching is variable and depends on several factors including site-specific details (e.g., type of substrate, depth of trench, equipment) and the type of equipment or installation techniques employed. Noise levels during site preparation and cable installation may exceed behavioural response thresholds for marine mammals within the vicinity of the trenching activity but these are expected to dissipate quickly with distance from the source.

The increase in vessel traffic also has the potential to lead to AIS introductions, especially if vessels are arriving from international waters. AIS introductions are known to originate from international marine vessels through ballast water and attachment to boat hulls (DFO 2019a). If AIS are introduced and become established, they can reduce the quality of marine habitats by altering them and rendering them inhabitable for native species. Project vessels will comply with applicable legislation, codes and standards of practice for shipping, including the *Ballast Water Control and Management Regulations* under the *Canada Shipping Act* and the Canadian Ballast Water Management Guidelines, to reduce risk of introduction of marine invasive species.

Careful planning will be implemented during construction to avoid effects to the extent practicable through avoiding sensitive / important areas and periods. Where avoidance is not feasible, standard mitigation measures (Table 11.5) will be employed in addition to measures required by applicable federal / provincial regulations.

Effects of Project construction on marine habitat quality are expected to be moderate in magnitude, restricted to construction areas within the LAA, have moderate timing sensitivity, occur as a single event, and be reversible.

Effects of Project construction on marine habitat quantity are expected to be low in magnitude, restricted to construction areas within the LAA, have moderate timing sensitivity, occur as a single event, and be reversible. Based on the information above, a summary of effects on marine habitat quantity and quality during the construction phase is provided in Table 11.6.

Table 11.6 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• No effect anticipated
Port au Port Wind Farm and Associated Infrastructure	• Alteration of the seabed during construction of the barge landing sites • Underwater noise generated from the installation of barge landing sites • Potential AIS introductions through vessel activity
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations (including marine cable)	• Alteration of the seabed during subsea cable installation • Underwater noise generated from subsea cable installation • Potential AIS introductions through vessel activity
Hydrogen / Ammonia Plant	• Underwater noise generated through marine outfall installation, if required • Potential AIS introductions through vessel activity
Port Facilities	• Alteration of the seabed during dredging and port upgrades • Underwater noise generated from port upgrades • Potential AIS introductions through vessel activity

11.5.1.2 Operation and Maintenance

No residual effects on fish habitat quantity are anticipated during the operation and maintenance phase of the Project. It is anticipated there will be no in-water work associated with this phase of the Project since infrastructure will already be in place from construction.

The presence, operation and maintenance of marine infrastructure and vessel activity may result in changes to marine habitat quality. Operation and maintenance of the hydrogen / ammonia plant will involve the discharge of treated process water into the marine environment. The treated wastewater will travel along the pipeline and released through the diffuser into St. George's Bay, approximately 500 m from the Port of Stephenville. Trace elements are naturally found in marine environments and are normal chemical constituents of marine organisms. However, an exceedance of elements through the plant wastewater can lead to a reduction to both marine water and sediment quality, which could ultimately affect marine life (Bryan 1971).

WEGH2 is seeking regulatory approval to discharge to the marine environment. Site water discharges (e.g., stormwater runoff, reject process water, sanitary discharge) will comply with applicable regulatory approvals and discharge criteria, which will be protective of the marine environment, although there may be localized changes to water quality and marine habitat. The anticipated concentration of parameters in the reject process water, which is assumed to be three times the concentration of the raw water from Noels Pond, will be discharged from a marine outfall at approximately 13 m water depth outside of the Port of Stephenville. The results from the Assimilative Capacity Study (Appendix 11-A) conducted indicates that the mixing zone is less than 1 m for temperature and salinity in most scenarios. The worst-case scenario is winter with an average current speed when the mixing zone for temperature and salinity can extend up to 3 m from the outfall before meeting the respective CCME guidelines. Using the conservative modelling parameters, it can be concluded that no exceedances of marine water quality objectives are observed at the end of the 3 m mixing zone (Appendix 11-A). Mitigation measures will be in place to reduce the effects to marine habitat quality during the operation and maintenance phase. Specifically, all discharges will be tested in accordance with applicable federal / provincial guidelines and regulations.

Underwater noise during the operation and maintenance phase can also lead to changes in marine habitat quality. During this phase, underwater noise is generated by routine and non-routine maintenance activities and vessel traffic; however, noise levels may not be sufficient to have significant effects to marine habitat quality.

AIS introductions can also occur during operation and maintenance phase through vessels involved in the shipment of product from the hydrogen / ammonia plant and through maintenance activities. To prevent the introduction or spread of AIS, vessels entering Newfoundland ports will follow biosecurity protocols enforced through Transport Canada and ammonia carrying vessels will comply with ballast discharge guidelines and will not discharge ballast water in the Port of Stephenville. Therefore, no interaction of ballast waters with the Project area (e.g., introduction of invasive species) is anticipated.

Effects of Project operation and maintenance on marine habitat quality and quantity are expected to be moderate in magnitude, restricted to operational areas within the LAA, have moderate to high timing sensitivity (depending on the time of year), occur as a continuous event, and be reversible.

Based on the information above, a summary of effects on marine habitat quality during the operation and maintenance phase is provided in Table 11.7.

Table 11.7 Summary of Effects by Project Component During Operation and Maintenance

Project Site	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• No effect anticipated
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• No effect anticipated
Hydrogen / Ammonia Plant	• Localized change in temperature and salinity within the receiving environment adjacent to the marine outfall
Port Facilities	• AIS introductions through vessel activity • Noise generated through the loading of ammonia and vessel maneuvering within port and maintenance activities

11.5.1.3 Decommissioning and Rehabilitation

It is anticipated that after the life of the Project, the majority of marine infrastructure will be left in place or repurposed for future developments. However, a portion of the marine terminal facilities may be removed (e.g., barge landing sites, the jettyless mooring structures, and potentially the quay and associated mooring infrastructure).

The removal of these components could potentially impact the marine environment through underwater noise and benthic disturbance. The magnitude of effects would be similar to the construction of these components.

As a result, residual effects on marine habitat quantity and quality are expected to be low in magnitude, restricted to operational areas within the LAA, have low to moderate timing sensitivity (depending on the time of year), occur as a single event, and be reversible. Based on the information above, a summary of residual effects on marine habitat quantity during the decommissioning and rehabilitation phase is provided in Table 11.8.

Table 11.8 Summary of Effects on Marine Habitat Quantity and Quality During Decommissioning and Rehabilitation

Project Site	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• No effect anticipated
Port au Port Wind Farm and Associated Infrastructure	• No effect anticipated
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• No effect anticipated
Hydrogen / Ammonia Plant	• No effect anticipated
Port Facilities	• Alteration of the seabed during port decommissioning • Underwater noise generated during port decommissioning

11.5.2 Marine Species Health and Survival

11.5.2.1 Construction

Pathways that affect marine species health and survival as outlined in Section 11.3.3 are related to direct placement of marine infrastructure and upgrades outside of the Port of Stephenville (i.e., subsea cable, marine outfall pipeline and diffuser, and barge landing sites) and inside the Port of Stephenville (jettyless mooring system, port dredging, and upgrades). Those works will include the use of industrial equipment, seabed alterations, pile driving, and an increase in vessel activity. In general, effects to marine species health and survival are closely linked to effects to marine habitat quantity and quality. These activities can increase the potential for changes in marine species health and survival as a result of benthic disturbance and suspension of sediment, underwater noise, and vessel collisions.

Benthic disturbances can originate from seafloor preparation, dredging, cable burying, infrastructure installation, and vessel anchoring during construction. This can lead to localized increases in sediment suspension and turbidity within the water column, which can cause decreases in biological productivity and diversity. Increases in TSS can interfere with predator-prey interactions if foraging opportunities are disrupted. It can also lead to avoidance behaviour of mobile species within construction areas (Stantec 2022). Fish health can also be affected if TSS interferes with dissolved oxygen absorption via the gills, leading to respiratory stress (NYSERDA 2017a). Benthic disturbances involving the removal of sediment can lead to an increase in species mortality for benthic flora / fauna. Sessile species are particularly at risk. Negative effects due to turbidity and the removal of sediment would likely be temporary and minimal.

The potential for mortality of marine fish and benthos will be confined to the Project Area within highly localized areas affected by disturbance of the seabed (e.g., subsea cable route, dredge area, and barge landing footprint) and areas of sediment deposition (e.g., ocean disposal site). Harm to fish and mobile invertebrates because of physical disturbance is unlikely, as these species are typically able to avoid burial or crushing. There may be a loss of a limited number of sessile benthic species from benthic habitats during trenching for the subsea cables, dredging as part of the Port of Stephenville upgrades and placement of rock as part of the barge landing sites, but this would be limited to the Project Area. Studies have shown that one year after installation and burial of submarine cables, there is no visual evidence of the physical disturbance to the seafloor (Andrulewicz et al. 2003). In addition, there were no obvious changes in species composition, abundance or biomass of the macrobenthos fauna present in the area. For species that are able to avoid the construction area, the effect will be reversible; for sessile species that are injured during the trenching process the effect will be irreversible.

If the dredging operations require ocean disposal of excavated material, the activity will be conducted in accordance with a Disposal at Sea Permit to be obtained from ECCC. The dredge material will undergo analysis and will meet the *CEPA* Disposal at Sea guidelines. Dredging and disposal activities will be approved and regulated by ECCC. This will identify and limit the release of contaminants of potential concern from sediments.

Harm to fish from short-term elevations of TSS concentrations will be low because of a tolerance of species in coastal NL due to strong tidal currents, water turbulence, and naturally elevated concentrations of TSS in the coastal areas. There are few opportunities for effects on fish health due to relatively low levels of contaminants in the sediments. There is no designated critical habitat for marine species in the PDA or LAA for SAR or species important to marine fisheries. The mobility of species in the area will make it possible for them to avoid the area during temporary periods of decreased water quality.

To limit mortality of marine species or interfering with seasonal migration patterns, the timing of in-water work will be conducted, where practical, in consideration of sensitive biological periods (e.g., reproductive life stages) for marine species, as determined through discussions with DFO, fishers, and other regulators.

As mentioned in Section 11.5.1.2, underwater noise has the potential to causes changes to marine habitat quality through different pathways and can affect marine fish, marine mammals, and sea turtles. However, underwater noise can also lead to a change in marine species health and mortality. Underwater noise is known to cause physiological effects such as auditory masking or behavioural disturbance to more harmful effects of injury and hearing loss (NYSERDA 2017b; SEER 2022). Marine mammals and some fish species' communication can become masked by noise associated with vessel activity. Auditory masking can also cause physiological stress in fish and invertebrates and reduce their ability to respond to foraging and predators (CSA Ocean Sciences Inc. 2021). Auditory injury and hearing loss are associated with activities that generate a substantial amount of underwater noise if within close range (Kaldellis et al. 2016; Lüdeke et al. 2017). Project activities that involve pile driving have the greatest risk of causing noise-related injury as well as more subtle effects, including auditory masking and avoidance behaviours.

An increase to vessel traffic can also lead to changes in marine species and mortality through potential vessel collisions. Species such as marine mammals and sea turtles who spend a substantial amount of time near the surface or overlap with vessel routes are at greater risk of colliding with vessels associated with Project activities (NYSERDA 2017b; SEER 2022). The likelihood of collision and the severity of the potential injury depends on several factors, including the vessel, vessel speed, and species type and can result in less severe injuries such as sharp force trauma (e.g., propeller injury) to lethal injuries (SEER 2022). The potential for collisions with marine wildlife will be reduced by the slow speed of the cable ship and barges during Project construction. As Project activities are focused in nearshore habitats and the prevalence of marine mammals and sea turtles is low in these areas, the likelihood of vessel collisions occurring are anticipated to be low. Project supply vessels will also comply with Transport Canada vessel traffic management measures to help protect North Atlantic right whales in the Gulf (Transport Canada 2022).

With mitigation (as described in Table 11.5), the Project is anticipated to result in a reduction in marine species health and survival during construction activities. Effects of Project construction on marine species health and survival are expected to be moderate in magnitude, restricted to operational areas within the LAA, have moderate timing sensitivity, occur as a single event, and be reversible unless irreversible injury or mortality occurs. Based on the information above, a summary of residual effects on marine species health and survival during the construction phase is provided in Table 11.9.

Table 11.9 Summary of Effects on Marine Species Health and Survival During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• No effect anticipated
Port au Port Wind Farm and Associated Infrastructure	• Benthic disturbance, suspension of sediment, and underwater noise generated through the installation of barge landing sites • Potential vessel collisions through vessel activity
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations (including marine cable installation)	• Benthic disturbance, suspension of sediment, and underwater noise generated through subsea cable installation • Potential vessel collisions through vessel activity
Hydrogen / Ammonia Plant	• Benthic disturbance, suspension of sediment, and underwater noise generated through marine outfall installation • Potential vessel collisions through vessel activity
Port Facilities	• Benthic disturbance, suspension of sediment, and underwater noise generated through port upgrades • Potential vessel collisions through vessel activity

11.5.2.2 Operation and Maintenance

Presence, operation and maintenance of marine infrastructure and vessel activity may result in changes to marine species health and survival. Operation and maintenance of the hydrogen / ammonia plant will involve the discharge of treated wastewater into the marine environment. As mentioned, the treated wastewater will be released into St. George's Bay, which could affect the surrounding water and sediment quality. Marine species health and survival could be adversely affected if the wastewater reaches sufficiently high elemental concentrations to the point that it becomes toxic to marine organisms (Bryan 1971). Marine invertebrates and fish during early developmental stages are the most vulnerable to elemental exposure, which could affect fish and shellfish during spawning events in St. George's Bay. However, this is not expected if regulatory compliance is maintained.

The operation and maintenance of the subsea cable has the potential to cause changes to marine species health and survival through EMF emissions. Species including several species of fish (e.g., sturgeon, salmon), elasmobranch (e.g., sharks), sea turtles (e.g., loggerhead), cetaceans (e.g., whales), and invertebrates (e.g., lobsters and crabs), are capable of sensing EMFs and use these fields to support life processes like navigation and hunting for prey (SEER 2022). The interaction between EMF emissions from subsea cables and EMF sensitive marine species is not well understood but may affect their ability to use natural EMF cues (Taormina et al 2020). The generation and emission of induced electric and magnetic fields will be reduced through Project design that includes cable burial and the cable's insulation and sheathing. The strength of the EMF in the marine environment depends on the distance from the source and the amount of power being transferred through the cable. Generally, the magnetic and induced electric fields are strongest at the cable surface and decline rapidly with distance (CMACS 2003).

Natural sources of EMF are present in the marine environment and in Northumberland Strait, including the Earth's geomagnetic field. The predicted intensity of the natural geomagnetic field in the Project Area is 50 to 55 μT (Normandeau Associates Inc. 2011).

The subsea cables to be installed are high voltage (230 kV) alternating current (AC) cables capable of carrying up to 750 MW. In general, the magnetic field is proportional to the current, meaning if the current passing through the cable increases by three-fold, the magnetic field will increase by three times the original value. The magnetic field is also inversely proportional to the distance from the cable, which implies that if the magnetic field of 8 μT is measured at 0.5 m, then at a distance of 1.0 m the theoretical magnetic field would be 4 μT. The sediment type and cable burial depth does not alter the attenuation of the magnetic field; the burial depth of the cable only serves to increase the distance between the cable and the seafloor.

Using the modelled data from Normandeau Associates Inc. (2011), a 230 kV cable buried 1 m below the seafloor and operating at a theoretical current of 1,000 A (per phase) has a predicted magnetic field of approximately 24.5 μT at the seafloor and decreases to 0.7 μT at a distance of 5 m above the seafloor and to 0.01 μT at 15 m. Effects of magnetic fields on fish species specific to the Project are not yet well understood and Project-specific magnetic field thresholds have not been developed. Publications are available that identify potential biological effects (Normandeau Associates Inc. 2011); however, these effects are limited to localized attraction or repulsion and not necessarily related to fish health. The scale at which various physiological effects may occur is thought to extend approximately 15 m from the cables.

Direct electric fields are produced within the cable during the transmission of electricity. These direct electric fields are completely mitigated by cable design and insulation. Induced electric fields can be produced in the marine environment by alternating of AC magnetic fields or from water current flows or marine organisms swimming through the field. Studies in the North Sea around wind farm developments indicate that the induced electric fields may result in attraction or repulsion (EPRI 2013).

Vessel activity can also cause changes to marine species health and survival through vessel noise and vessel collisions during shipment of product from the hydrogen / ammonia plant and through maintenance activities. Marine species health and survival could also be affected if benthic disturbance and suspension of sediment occurred during maintenance activities. Effects during operation and maintenance for these pathways would be similar to those during construction, as discussed in Section 11.5.1.2.

With mitigation (as described in Table 11.5), the Project is anticipated to result in a change in marine species health and survival during operation and maintenance activities. Effects during this phase are expected to be moderate in magnitude, restricted to operational areas within the LAA, have moderate to high timing sensitivity (depending on the time of year), occur as a continuous event, and be reversible unless irreversible injury or mortality occurs. Based on the information above, a summary of residual effects on marine species health and survival during the operation and maintenance phase is provided in Table 11.10.

Table 11.10 Summary of Effects on Marine Species Health and Survival During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• No effect anticipated
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• EMF emissions from the subsea cable • Benthic disturbance and suspension of sediments through maintenance activities • Potential vessel collisions through vessel activity
Hydrogen / Ammonia Plant	• Discharge of wastewater from the marine outfall • Benthic disturbance and suspension of sediments through maintenance activities • Potential vessel collisions through vessel activity
Port Facilities	• Underwater noise generated through the loading of ammonia and vessel maneuvering within port and maintenance activities • Benthic disturbance and suspension of sediments through maintenance activities • Potential vessel collisions through vessel activity

11.5.2.3 Decommissioning and Rehabilitation

It is anticipated that after the life of the Project, the majority of marine infrastructure will be left in place or repurposed for future developments. However, a portion of the marine terminal facilities may be removed (e.g., barge landing sites, the jettyless mooring structures, and potentially the quay and associated mooring infrastructure).

The removal of these components could potentially impact the marine environment through underwater noise and vessel collisions. The magnitude of effects would be similar to the construction of these components.

As a result, residual effects on marine species health and survival are expected to be low in magnitude, restricted to operational areas within the LAA, have low to moderate timing sensitivity (depending on the time of year), occur as a single event, and be reversible. Based on the information above, a summary of residual effects on marine habitat quantity during the decommissioning and rehabilitation phase is provided in Table 11.11.

Table 11.11 Summary of Effects on Marine Species Health and Survival During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• No effect anticipated
Port au Port Wind Farm and Associated Infrastructure	• No effect anticipated
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• No effect anticipated
Hydrogen / Ammonia Plant	• No effect anticipated
Port Facilities	• Increased underwater noise and risk of vessel collisions

11.5.3 Fishing / Aquaculture Grounds and Productivity

11.5.3.1 Construction

Pathways that affect fishing / aquaculture grounds and productivity as outlined in Section 11.3.3 are related to the installation of marine infrastructure and upgrades outside of the Port of Stephenville (i.e., subsea cable, marine outfall pipeline and diffuser, and barge landing sites) and inside the Port of Stephenville (jettyless mooring system, port dredging, and upgrades). Those works will include the use of safety exclusion zones, industrial equipment, and an increase in vessel traffic during construction. These activities can increase the potential for changes in fishing / aquaculture grounds and productivity through the loss of access to fishing grounds, underwater noise, and introduction of AIS via transiting vessels.

Fishers may be affected by construction activities if safety exclusion zones are implemented, causing them to lose temporary access to their fishing grounds. This could cause an increase in competition if fishers decide to move outside of their normal fishing grounds (Van Hoey et al. 2021). Temporary displacement could also affect the success of a fishing operation. Fishers can also be displaced from their fishing grounds if Project vessels impede their navigation. An increase in vessel activity within fishing grounds may also increase the risk of collision / allision or damage fishing gear. For example, during subsea cable installation, an exclusion zone may extend hundreds of metres away from the cable installation vessel, which may not be considered by fishers (BIS 2008). A highly localized temporary displacement of fishing activity may result from the construction of the barge landing sites in Aguathuna and West Bay. However, fishing activity at the landing sites is anticipated to be low; therefore, displacement in these localized areas is expected to be minimal to negligible. Since the barge landing sites will also be removed prior to the operation and maintenance phase, this is not considered further.

As mentioned, effects to marine habitat quantity and quality are closely linked to fisheries, thus construction activities that have been previously discussed may cause changes to fishing / aquaculture grounds and productivity. Construction activities that result in habitat loss and a reduction in habitat quality are anticipated to interact with commercially important shellfish and fish species. Habitat loss, for example, could occur in areas where commercially important species may spawn (e.g., eelgrass beds) or in areas where species are known to congregate. A reduction in habitat quality for commercially important species could result from several pathways including AIS introductions, benthic disturbance and suspension of sediments, and an increase in underwater noise to the point that effects could also cause injury or mortality to species. These pathways can potentially affect catch rates for fishers. A loss in catch volume could also lead to an indirect effect on local fishing communities and/or seafood dealers, processors, and distributors (BOEM 2022).

The introduction of AIS through Project vessel activity could also disrupt local aquaculture operations. AIS species such as the golden star tunicate (*Botryllus schlosseri*), oyster thief (*Codium fragile ssp. fragile*), vase tunicate (*Ciona intestinalis*), and violet tunicate (*Botrylloides violaceus*) are known to cause issues with marine-based aquaculture operations. Three marine shellfish aquaculture farms and one of the proposed barge landing sites both reside in West Bay. Although it is unlikely that Project vessels will directly interact with aquaculture operations, shellfish farms could be adversely affected if AIS species, such as those mentioned, are introduced during the construction of the barge landing site.

Careful planning will be implemented during construction to avoid these pathways to the extent practicable. Where avoidance is not feasible, standard mitigation measures (Table 11.5) will be employed and WEGH2 will maintain ongoing consultation with fish harvesters and aquaculture operators during the Project phases to reduce conflicts and effects on resources. Effects of Project construction on fishing / aquaculture grounds and productivity are expected to be low to moderate in magnitude, restricted to operational areas within the LAA, have moderate timing sensitivity, occur as a single event, and be reversible unless irreversible income loss occurs. Based on the information above, a summary of residual effects on fishing grounds or productivity during the construction phase is provided in Table 11.12.

Table 11.12 Summary of Effects on Fishing / Aquaculture Grounds and Productivity During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• No effect anticipated
Port au Port Wind Farm and Associated Infrastructure	• Loss of access to fishing grounds and/or displacement during the installation of barge landing sites • Disruption to fisheries grounds / resources during the installation of barge landing sites • Disruption to aquaculture operations during the installation of the West Bay barge landing site
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• Loss of access to fishing grounds and/or displacement during the subsea cable installation • Disruption to fisheries grounds / resources during the subsea cable installation
Hydrogen / Ammonia Plant	• Loss of access to fishing grounds and/or displacement during the marine outfall installation • Disruption to fisheries grounds / resources during the marine outfall installation
Port Facilities	• Loss of access to fishing grounds and/or displacement during port upgrades • Disruption to fisheries grounds / resources during port upgrades

11.5.3.2 Operation and Maintenance

Presence, operation and maintenance of marine infrastructure and vessel activity may result in changes to fishing / aquaculture grounds and productivity where effects are similar to effects and pathways during the construction phase.

Fishers can lose temporary access to fishing grounds if maintenance is required on marine infrastructure. For example, if cable repair is required, it could lead to temporary local interference with fishing activity, especially if safety exclusion zones are implemented. The presence of marine infrastructure can also cause localized loss of access to fishing grounds. A highly localized displacement of fishing activity is anticipated to result from the construction the marine outfall diffuser in St. George's Bay; however, since the marine outfall has been present in this location for decades this is not considered further. The cables and pipeline are anticipated to be buried; therefore, loss of access to these localized areas are not expected.

Project infrastructure that is installed on the marine benthic floor could hinder fisheries operations through loss or damage to fishing gear. Fishing gear such as trawls, scallop dredges, gillnets, and demersal longlines can become snagged on the infrastructure such as the subsea cable if not properly installed or buried.

Changes in water quality during the operation and maintenance phase can also lead to changes in fishing / aquaculture grounds and productivity. Activities that reduce habitat quality are anticipated to interact with commercially important shellfish and fish species. Activities during this phase could result from several pathways including AIS introductions, EMF emissions from the subsea cable, discharge from the marine outfall, benthic disturbance and suspension of sediments if maintenance is required, and underwater noise from vessel traffic. Similar to the construction phase, these pathways can also potentially affect catch rates for fishers. AIS introductions near aquaculture sites would not be an issue since the barge landing site would no longer be in use.

With mitigation (as described in Table 11.5) and consultation with fishers, the Project is anticipated to result in a reduction to fishing / aquaculture grounds and productivity during operation and maintenance activities. Effects during this phase are expected to be low to moderate in magnitude, restricted to operational areas within the LAA, have moderate to high timing sensitivity (depending on the time of year), occur as a continuous event, and be reversible unless irreversible income loss occurs. Based on the information above, a summary of residual effects on fishing grounds or productivity during the operation and maintenance phase is provided in Table 11.13.

Table 11.13 Summary of Effects on Fishing / Aquaculture Grounds and Productivity During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• No effect anticipated
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• Loss of access to fishing grounds and/or displacement during maintenance activities for the subsea cable • Disruption to fisheries grounds / resources during maintenance activities for the subsea cable and EMF emissions
Hydrogen / Ammonia Plant	• Loss of access to fishing grounds and/or displacement during maintenance activities for the marine outfall • Disruption to fisheries grounds / resources during maintenance activities for the marine outfall and discharge from diffuser
Port Facilities	• Loss of access to fishing grounds and/or displacement during maintenance activities and vessel movement within the port • Disruption to fisheries grounds / resources during maintenance activities within the port

11.5.3.3 Decommissioning and Rehabilitation

It is anticipated that after the life of the Project, the majority of marine infrastructure will be left in place or repurposed for future developments. However, a portion of the marine terminal facilities may be removed (e.g., the jettyless mooring structures, and potentially the quay and associated mooring infrastructure).

The removal of these components could potentially impact the fishing and aquaculture from the temporary displacement within the Port during decommissioning activities. The magnitude of effects would be similar to the construction of these components.

As a result, residual effects on marine species health and survival are expected to be low in magnitude, restricted to operational areas within the LAA, have low to moderate timing sensitivity (depending on the time of year), occur as a single event, and be reversible. Based on the information above, a summary of residual effects on marine habitat quantity during the decommissioning and rehabilitation phase is provided in Table 11.14.

Table 11.14 Summary of Effects on Fishing / Aquaculture Grounds and Productivity During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• No effect anticipated
Port au Port Wind Farm and Associated Infrastructure	• No effect anticipated
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• No effect anticipated
Hydrogen / Ammonia Plant	• No effect anticipated
Port Facilities	• Temporary displacement of fishers

11.5.4 Other Ocean Users

11.5.4.1 Construction

Pathways that affect other ocean users as outlined in Section 11.3.3 are related to the installation of marine infrastructure and upgrades outside of the Port of Stephenville (i.e., subsea cable, marine outfall pipeline and diffuser, and barge landing sites) and inside the Port of Stephenville (jettyless mooring system, port dredging, and upgrades). Those works will include the use of safety exclusion zones, industrial equipment, and an increase in vessel traffic during construction. These activities can lead to potential changes for other ocean users through the loss of access to particular areas such as recreational fishing grounds and the Port of Stephenville and an increase of collision risk with Project vessels.

The installation of marine infrastructure and port upgrades could lead to a temporary loss of access in areas undergoing construction for ocean users, especially if safety exclusion zones are implemented. Loss of access to the Port of Stephenville is anticipated to cause the most disruptions during construction activities (e.g., dredging), affecting users who frequent the port, including coast guard vessels, vessels involved in shipping and transportation of materials, and pleasure craft operators. An increase in vessel activity from construction could also impede navigation of other ocean users and increase the risk of collision with vessels associated with the Project.

Mitigation measures will be implemented where effects are unavoidable to ocean users. WEGH2 will maintain ongoing consultation with affected ocean users during the Project phases to reduce conflicts. Effects of Project construction on other ocean users are expected to be low in magnitude, restricted to construction areas within the LAA, have moderate timing sensitivity, occur as a single event, and be reversible. Based on the information above, a summary of residual effects on other ocean users during the construction phase is provided in Table 11.15.

Table 11.15 Summary of Effects on Other Ocean Users During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• No effect anticipated
Port au Port Wind Farm and Associated Infrastructure	• Loss of access and/or displacement and increase in vessel collision during the barge landing sites installation
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• Loss of access and/or displacement and increase in vessel collision during the subsea cable installation
Hydrogen / Ammonia Plant	• Loss of access and/or displacement and increase in vessel collision during the marine outfall installation
Port Facilities	• Loss of access and/or displacement and increase in vessel collision during port upgrades

11.5.4.2 Operation and Maintenance

Presence, operation and maintenance of marine infrastructure and vessel activity changes to other ocean users where effects will be similar to those during the construction phase. Other ocean users can lose temporary access to areas within the LAA if maintenance is required on marine infrastructure, especially if safety exclusion zones are temporarily implemented. Interruptions to vessel navigation and collisions could also occur with Project vessels. Areas within the LAA will likely be more accessible during this phase and since Project vessel activity will be reduced to maintenance activities and routine shipment of ammonia, the risk of collisions with other ocean users will be lower.

With mitigation (as described in Table 11.5) and consultation with other ocean users, the Project is anticipated to minimally affect other ocean users. Effects during this phase are expected to be low in magnitude, restricted to operational areas within the LAA, have moderate timing sensitivity, occur in irregular events, and be reversible. Based on the information above, a summary of residual effects on other ocean users during the operation and maintenance phase is provided in Table 11.16.

Table 11.16 Summary of Effects on Other Ocean Users During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• No effect anticipated
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• Loss of access and/or displacement and increase in vessel collision during the maintenance activities related to the subsea cable
Hydrogen / Ammonia Plant	• Loss of access and/or displacement and increase in vessel collision during the maintenance activities related to the marine outfall
Port Facilities	• Loss of access and/or displacement and increase in vessel collision during port maintenance activities and shipment of ammonia

11.5.4.3 Decommissioning and Rehabilitation

It is anticipated that after the life of the Project the jettyless mooring structures will be removed.).

The removal of these components could potentially impact the ocean users in the LAA from the temporary displacement within the Port during decommissioning activities. The magnitude of effects would be similar to the construction of these components.

As a result, residual effects on marine species health and survival are expected to be low in magnitude, restricted to operational areas within the LAA, have low to moderate timing sensitivity (depending on the time of year), occur as a single event, and be reversible. Based on the information above, a summary of residual effects on marine habitat quantity during the decommissioning and rehabilitation phase is provided in Table 11.17.

Table 11.17 Summary of Effects on Other Ocean Users During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• No effect anticipated
Port au Port Wind Farm and Associated Infrastructure	• No effect anticipated
Codroy Wind Farm and Associated Infrastructure	• No effect anticipated
230 kV Transmission Lines and Substations	• No effect anticipated
Hydrogen / Ammonia Plant	• No effect anticipated
Port Facilities	• Temporary displacement of other ocean users

11.5.5 Residual Environmental Effects Summary

11.5.5.1 Residual Environmental Effects Characterization

Table 11.18 summarizes the predicted environmental effects (residual effects) of the Project on Marine Environment and Use.

Table 11.18 Summary of Predicted Environmental Effects of the Project on Marine Environment and Use

Residual Effect	Residual Effects Characterization							
	Nature	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Construction								
Marine Habitat Quantity	A	L	LAA*	MS	ST	S	R	U/D
Marine Habitat Quality	A	L	LAA*	MS	ST	S	R	U/D
Marine Species Health and Survival	A	L	LAA*	MS	ST	S	R/I	U/D
Fishing / Aquaculture Grounds and Productivity	A	L/M	LAA*	MS	ST	S	R/I	U/D
Other Ocean Users	A	L	LAA*	MS	ST	S	R	U/D
Operation and Maintenance								
Marine Habitat Quantity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Marine Habitat Quality	A	L	LAA*	MS	MT	C	R	U/D
Marine Species Health and Survival	A	L	LAA*	MS	MT	C	R/I	U/D
Fishing / Aquaculture Grounds and Productivity	A	L	LAA*	MS	MT	C	R/I	U/D
Other Ocean Users	A	L	LAA*	MS	MT	IR	R	U/D
Decommissioning and Rehabilitation								
Marine Habitat Quantity	P	L	LAA*	MS	ST	S	R	D
Marine Habitat Quality	A	L	LAA*	MS	ST	S	R	D
Marine Species Health and Survival	A	L	LAA*	MS	ST	S	R	D
Fishing / Aquaculture Grounds and Productivity	A	L	LAA*	MS	ST	S	R	D
Other Ocean Users	A	L	LAA*	MS	ST	S	R	D

Note:
* No defined Project Area for Marine Environment and Use VEC. Geographic extent is limited to localized areas where Project activities occur within the LAA.

KEY:

Nature:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Timing:
NS: No Sensitivity
MS: Moderate Sensitivity
HS: High Sensitivity

Frequency:
S: Single Event
IR: Irregular Event
R: Regular Event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

11.5.5.2 Summary of Predicted Environmental Effects

In general, pathways for effects related to the marine environment are related to installed marine infrastructure and upgrades outside of the Port of Stephenville (i.e., subsea cable, marine outfall pipeline and diffuser, and barge landing sites) and inside the Port of Stephenville (jettyless mooring system, port dredging, and upgrades). Effects are expected to occur during the phases of the Project, with the removal of marine infrastructure in the decommissioning phase providing a benefit to the marine environment in terms of habitat quantity.

Changes to marine habitat quantity predominantly occurs during the construction phase. Habitat alteration is expected to result from the installation of marine infrastructure throughout the LAA and through port upgrades including dredging. Alterations to the habitat will likely directly affect the seabed and biological communities that occupy that space. Sensitive areas that are identified will be avoided where feasible. Residual effects to marine habitat quantity will be mitigated as described in Section 11.5 above and be compliant with applicable approvals under the *Water Resources Act* and/or *Fisheries Act*. Where residual adverse effects remain, these must be counterbalanced by offsetting through an authorization pursuant to the *Fisheries Act*.

Changes to marine habitat quality are anticipated to be a result of underwater noise and the introduction of AIS, and discharge from the marine outfall. Underwater noise can originate from different sources involved with construction and operation and maintenance activities. Mitigation measures will be placed to reduce the effects to habitat quality. Compliance monitoring of the marine outfall discharge will occur in accordance with regulatory requirements to maintain water and sediment quality.

Changes to marine species health and survival are closely associated with habitat quantity and quality and are related to benthic disturbance and suspension of sediment, underwater noise, vessel collisions, EMF emissions, and discharge from the marine outfall. Effects on species health and survival can range from auditory masking, behavioural changes, minor injuries, to mortality. Through mitigation, the effects on species health and survival will be reduced.

Changes to fishing grounds and productivity is influenced by marine habitat quantity and quality (and species health and survival). Fishers can be adversely affected through a loss of income due to a loss of access to fishing grounds and catch volume, damage to fishing gear, and through disruptions to fisheries resources. Changes to habitat quantity and quality have the potential to interact with commercially important shellfish and fish species. Changes to aquaculture operations can adversely be affected through the introduction of AIS through nearby vessel activity. Effects to both fisheries and aquaculture will be reduced by avoiding active fishing areas. Where avoidance is not feasible, mitigation and consultation with fishers and aquaculture operators will help reduce conflicts and disruptions to resources.

Changes to other ocean users may be affected through the temporary loss of access to areas within the LAA and an increase in vessel collisions with Project vessels. Activities occurring in the Port of Stephenville (e.g., dredging) are anticipated to affect several users, including shipping and transport vessels, coast guard vessels, and pleasure craft operators. Effects to other ocean users will be mitigated and consulted to reduce potential conflicts.

11.6 Determination of Significance

In consideration of the VEC-specific significance criteria defined in Section 11.3.2, the residual effect(s) of routine Project activities on Marine Environment and Use (i.e., changes to marine habitat quantity / quality, marine species health and survival, fishing / aquaculture grounds and productivity, and other ocean users) are predicted to be not significant.

The Project has been designed to avoid the net loss of marine habitat and conflicts with fisheries, aquaculture, and other ocean users through careful planning of the placement of infrastructure and through avoiding sensitive areas. Where avoidance was not feasible, the application of best practices in accordance with relevant regulatory requirements and other standard mitigation measures will be employed to help reduce the potential effects. WEGH2 will undergo consultations with affected users through each phase of the Project to reduce conflicts. The level of confidence in this prediction is discussed in Section 11.7.

11.7 Prediction Confidence

The overall determination of significance is made with a high level of confidence for each residual effect, given that the effects of these routine activities are well known and documented. In addition, information pertaining to the marine environment and ocean users relevant to the Project are also well studied with many online resources to avail of, which were used for this effects assessment.

11.8 Follow-Up and Monitoring

Follow-up and monitoring are intended to verify the accuracy of predictions made during the EA, to assess the implementation and effectiveness of mitigation, and to manage adaptively, if required. Compliance monitoring will be conducted to confirm that mitigation measures are properly implemented. Should an unexpected deterioration of the environment be observed as part of follow-up and/or monitoring, intervention mechanisms will include the adaptive management process. This may include identification of existing and/or new mitigation measures to be implemented to address it. Follow-up or monitoring required by applicable permits will be provided as appropriate to regulators. Follow-up and monitoring to be implemented include:

- Compliance monitoring of plant discharge
- Habitat characterization within the footprints of the subsea cable route, dredge area, and barge landing sites
- Physiochemical and biological assessment of the marine sediments within the dredge footprint and ocean disposal site

11.9 Capacity of Renewable Resources and Effects on Biological Diversity

The potential environmental effects of the Project on Marine Habitat and Use were thoroughly assessed. The assessment concluded that routine Project activities are not likely to result in significant residual adverse effects on Marine Habitat and Use. Therefore, adverse Project-related effects on the capacity of renewable resources to meet the needs of the present and those of the future are not anticipated with respect to Marine Habitat and Use. Similarly, adverse Project-related effects on biological diversity that exceed the limits of natural variability or affect the long-term viability of biological diversity in the RAA are not anticipated with respect to Marine Habitat and Use.

11.10 Predicted Future Environmental Conditions if the Project Does Not Proceed

If the project is not allowed to proceed, the existing conditions as described in the baseline section will continue to prevail, including current land use and natural conditions. It is possible that future development may occur in the area, including wind energy (given those Project areas are designated for wind farm development), but neither the likelihood nor extent of such development can be reasonably predicted at this time based on currently known information. Moreover, If the production of hydrogen / ammonia was included in future developments, Stephenville facilities and port infrastructure would be equipped to support both the production and shipping of products. Similar projects are anticipated to have comparable effects on the marine environment and use. Should the Project not go ahead, the predicted future condition of the marine environment and users would be relatively unchanged from that discussed in the existing environmental conditions of this assessment (Section 11.2). Future projects not related to wind energy could also be developed if this Project does not proceed, which could cause changes to the marine environment and use.

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12.0 Wetlands and Vegetation, Including Rare Plants

This chapter assesses the potential environmental effects of routine Project activities on Wetlands and Vegetation. Cumulative environmental effects are assessed separately in Chapter 24 and the environmental effects of potential Project-related accidents and malfunctions are assessed separately in Chapter 25.

12.1 Scope of Assessment

Wetlands and Vegetation were selected as a valued ecological component (VEC) because they have their own intrinsic value, are essential to maintaining natural ecosystems and provide important social, cultural, aesthetic, recreational, and economic value to the public, Indigenous groups, governments, and other affected parties and because of the potential interactions with Project activities and regulatory considerations.

Wetlands and vegetation have linkages to other VECs, such as:

- Surface Water Resources (Chapter 9) – wetlands and vegetation have the potential to be affected by Project-related changes to stream flows, which can affect wetland area and function, and change abiotic conditions for vegetation species
- Groundwater Resources (Chapter 8) - wetlands and vegetation have the potential to be affected by Project-related changes to groundwater resources through changes to the water table, which can affect wetland area and function, and change abiotic conditions for vegetation species
- Areas of Conservation Concern (Chapter 16) – many Areas of Conservation Concern have been established to protect specific vegetation communities, including wetlands
- Avifauna (Chapter 13) – changes to wetlands and vegetation communities may affect bird species, which use different vegetation communities including wetlands as habitat for nesting, feeding, and other important activities
- Bats (Chapter 14) – changes to wetlands and vegetation may affect bat species, which use different vegetation communities, including wetlands, as habitat for maternal roosting, feeding, and other important activities
- Other Wildlife (Chapter 15) – many wildlife species present on the Island of Newfoundland use different vegetation communities as habitat for various activities

12.1.1 Regulatory and Policy Setting

The effects assessment for wetlands and vegetation has been completed in accordance with the Newfoundland and Labrador *Environmental Protection Act* (NL EPA), and other wetland and vegetation related federal and provincial legislation, policies and guidance. This section identifies the primary regulatory requirements and policies which influence the scope of the assessment on wetlands and vegetation, including rare plants, and govern the management and protection of wetlands and vegetation in Canada and Newfoundland and Labrador (NL).

12.1.1.1 Federal

Federal Policy on Wetland Conservation

A federal mandate for wetland conservation is provided by the Federal Policy on Wetland Conservation (Government of Canada 1991). This policy has been adopted to help meet the objectives of wetland conservation as outlined in the Ramsar Convention Manual, 6th Edition (Ramsar Convention Secretariat 2013), and the Canadian Biodiversity Strategy (Government of Canada 1995). Policy goals are intended to apply on federal lands and waters or to federal programs where wetland loss has reached critical levels. They also apply to federally designated wetlands, such as Ramsar sites, or in association with other federal legislation such as the *Species at Risk Act* (SARA), the *Migratory Birds Convention Act* (MBCA), and the *Fisheries Act*.

Species at Risk Act

The *Species at Risk Act* (SARA) provides a framework across Canada to prevent the extinction of wildlife species, including vegetation, and to support actions for their recovery. General SARA prohibitions include Section 32(1), which states that "no person shall kill, harm, harass, capture, or take an individual of a wildlife species that is listed as an Extirpated species, an Endangered species or a Threatened species", and Section 33, which states that "no person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an Endangered species or a Threatened species, or that is listed as an Extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada." In addition, critical habitat, defined as the habitat that is necessary for the survival or recovery of a listed wildlife species, may be defined and protected under Section 58. Only those species currently listed in Schedule 1 of SARA (i.e., those listed as Extirpated, Endangered, or Threatened) are protected by the prohibitions of Sections 32 to 36 and 58 of SARA, and then only on federal lands, except for aquatic species and migratory birds which are protected throughout Canada by other acts and regulations.

12.1.1.2 Provincial

Newfoundland and Labrador *Water Resources Act* and Policy for Development in Wetlands

Under Section 30 of the Newfoundland and Labrador *Water Resources Act*, SNL 2002 cW-4.01 (NL *Water Resources Act*), the Minister for Environment and Climate Change may control alterations of wetlands where it is determined that such an alteration may affect the hydrological or other functions of that wetland.

NL's Policy for Development in Wetlands (NLDEC 2001) identifies developments that are not permitted within wetlands and defines activities that require permitting under Section 48 of the NL *Water Resources Act*. Those developments that are not permitted include:

- Infilling, drainage, dredging, channelization, removal of vegetation cover or removal of soil or organic cover of wetlands which could aggravate flooding problems, or have unmitigable adverse water quality, water quantity or hydrologic impacts.
- Development in wetlands which are located within the recharge zones of domestic, municipal or private groundwater wells.
- Placing, depositing or discharging any raw sewage, refuse, municipal or industrial wastes, fuel or fuel containers, pesticides, herbicides or other chemicals or their containers, or any other material which impairs or has the potential to impair the water quality of wetlands.

Developments which require permitting include disturbances to wetlands for the extraction of peat, for agricultural or forestry operations, construction of linear corridors, and infilling, dredging or other disturbance of wetlands for the construction of residential, commercial, industrial and institutional facilities, or extension and upgrading of existing buildings and facilities within wetland areas.

Under Section 64 of the NL *Water Resources Act* the Lieutenant-Governor in Council may make regulations related to the use of and modification of wetlands, including drainage for any purpose, though no specific regulations protecting wetlands currently exist.

Newfoundland and Labrador *Endangered Species Act*

In Newfoundland and Labrador, species at risk are protected under the Newfoundland and Labrador *Endangered Species Act* (NL ESA). Designation under the Act follows the recommendations of the Species Status Advisory Committee on the appropriate assessment of a species and referring concerns about the status of species to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), where the species is of national importance.

The purpose of NL ESA is to:

- Prevent listed species from being extirpated from Newfoundland and Labrador
- Provide for the recovery of species listed as Extirpated, Endangered, or Threatened as a result of human activity
- Conserve species listed as special concern to prevent them from becoming Endangered or Threatened

Prohibitions of NL ESA include Section 16, which states "a person shall not disturb, harass, injure, or kill an individual of a species designated as Threatened, Endangered or Extirpated". Species are listed under the *Endangered Species List Regulations*.

Under Section 19 of the NLESA, a permit can be obtained to engage in an economic activity that may affect "a designated species, the residence of a specimen of a designated species or critical or recovery habitat," if the minister is of the opinion that the activity is economically beneficial to the province, has no reasonable alternative, and will not prevent the recovery or survival of the designated species. Section 19 permits typically have conditions attached with could include fees to ensure compliance with the permit conditions and a commitment to restore individuals or habitat of a designated species affected by the permitted activity. The permit application is required to include a Species at Risk Impact Mitigation and Monitoring Plan (SARIMMP).

12.1.1.3 Species at Risk and Species of Conservation Concern

For this Project, Species at Risk (SAR) are defined as species that are:

- listed on Schedule 1 of SARA as Extirpated, Endangered, Threatened or Special Concern
- listed as Extirpated, Endangered, Threatened, or Vulnerable under the NL ESA

Species of Conservation Concern (SOCC) are defined for this assessment as those species that are not specified under federal or provincial legislation, but are considered rare in the province, or ones for which the long-term sustainability of their populations has been evaluated as tenuous. Following direction previously provided by the NL Department of Fisheries, Forestry and Agriculture– Wildlife Division (NLDFFA-WD), vascular plant SOCC are defined as those species that are:

- assessed as Extirpated, Endangered, Threatened, or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) but have not yet been added to Schedule 1 of SARA
- recommended for listing by the Species Status Advisory Committee (SSAC) as Endangered, Threatened or Vulnerable but are not yet listed under the NL ESA
- ranked as provincially rare by the Atlantic Canada Conservation Data Centre (AC CDC) including species with provincial status (S-ranks) of S1 (Critically Imperiled), S2 (Imperiled) or combinations thereof (e.g., S1S2) upon review by the AC CDC (AC CDC 2023a)

12.1.2 Boundaries

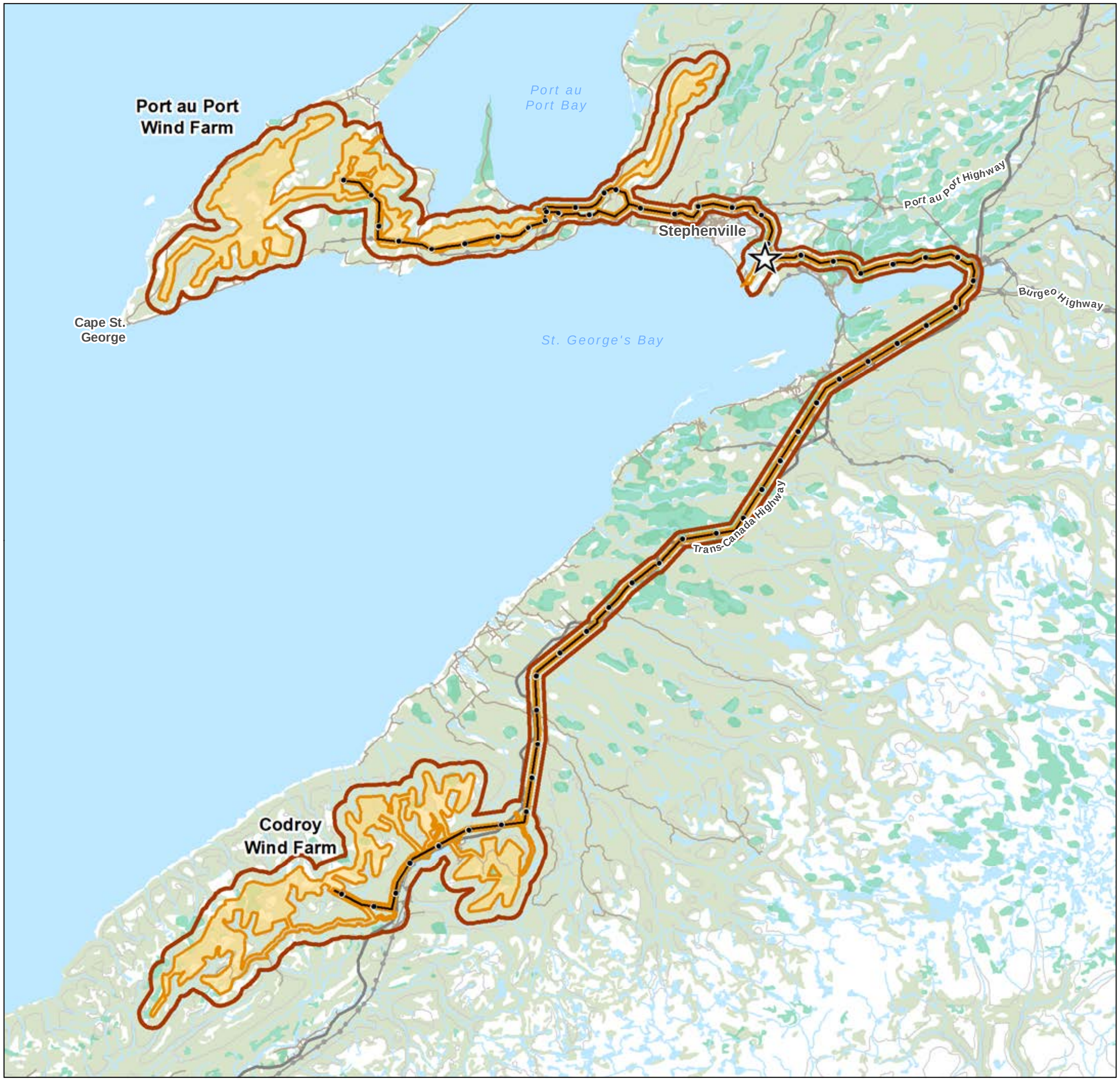
The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for wetlands and vegetation were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with wetlands and vegetation. The spatial and temporal boundaries associated with the effects assessment for wetlands and vegetation are described in the following sections.

12.1.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on wetlands and vegetation in areas surrounding the Project components (Figure 12.1, Figure 12.2):

- Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of following distinct areas: the Port au Port wind farm, the Codroy wind farm, the Hydrogen/Ammonia Production and Storage Facility (hydrogen / ammonia plant), Port Facilities, and the 230 kV Transmission Lines, as well as associated infrastructure including roads, substations, and water supply intake infrastructure. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project. In addition to encompassing the immediate area in which Project components and activities will occur, the Project Area also includes a buffer of up to 300 m for access roads and turbines and a 350 m corridor to accommodate the 70 to 75 m wide right of way (RoW) for the transmission line. These buffers allow flexibility for the micro-siting of Project components during detailed design, based on technical considerations as well as the avoidance of environmentally sensitive areas, where practicable.
- Local Assessment Area (LAA): The LAA for this VEC is 1 km around wind farms and hydrogen facility footprints, and 500 m around access roads and transmissions lines. The LAA has been selected to capture the area where the effects on wetlands and vegetation are likely to be most prevalent (e.g., effects to species/community diversity, wetland function).
- Regional Assessment Area (RAA): The RAA for this VEC is the full extent of the Port au Port, St. George's Bay, and Codroy Subregions, as well as a portion of the Corner Brook Subregion (the watershed surrounding Table Mountain), within the Western Newfoundland Forest Ecoregion. The RAA informs the assessment of cumulative effects (Chapter 23) and is the area within which accidental events (Chapter 24) are addressed.

Though not an official Project Boundary, the assessment references the "Project footprint", which is the anticipated area of direct physical disturbance associated with construction, operation and decommissioning, within the Project Area. The Project footprint is likely to change in some parts of the Project Area as a result of micro-siting, following biophysical surveys and detailed design. The Project footprint represents 5.29% of the LAA and 1.12% of the RAA. The Project Area, which is not expected to be completely directly disturbed but represents the extent where clearing is possible, represents 36.56% of the LAA and 7.71% of the RAA.



Stantec

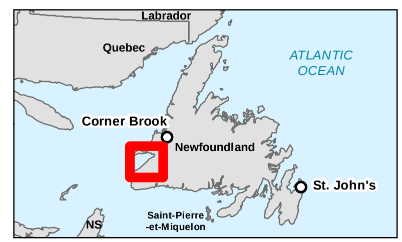
Proposed Project Features
- Hydrogen / Ammonia Plant Location
- Transmission Line 230 kV
- Project Area
- Local Assessment Area

Other Features
- Transmission Line, Existing
- Trans-Canada Highway
- Road
- Watercourse
- Contour (100 m)
- Wetland
- Waterbody
- Forested Area

N

0 10 Kilometres
(At original document size of 8.5x11)
1:520,227

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: World Energy GH2, NRCan CanVec, OpenStreetMap
3. Background: NRCan CanVec



Project Location
Stephenville
NL

Prepared by MB on 2023-06-30
QR by AW on 2023-07-06

Client/Project
World Energy GH2
Project Nujio'qonik

121417233_067b

Figure No.
12.1

Local Assessment Area of Wetlands and Vegetation

Stantec

Proposed Project Features

- Hydrogen / Ammonia Plant Location
- Transmission Line 230 kV
- Project Area
- Regional Assessment Area

Other Features

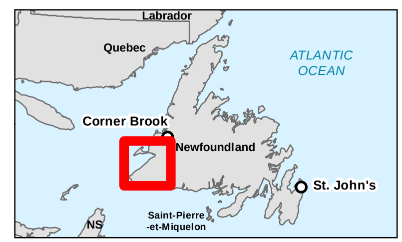
- Transmission Line, Existing
- Trans-Canada Highway
- Road
- Watercourse
- Contour (100 m)
- Waterbody
- Forested Area

N

0 10 Kilometres
(At original document size of 8.5x11)
1:730,000

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 21N
2. Data Sources: World Energy GH2, NRCan CanVec, OpenStreetMap
3. Background: NRCan CanVec



Project Location
Stephenville
NL

Prepared by MB on 2023-06-30
QR by AW on 2023-07-06

Client/Project
World Energy GH2
Project Nujio'qonik

121417233_067c

Figure No.
12.2

Regional Assessment Area of Wetlands and Vegetation

12.1.2.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on the Wetlands and Vegetation, Including Rare Plants VC include:

- Construction: Overall the construction phase of the Project will be from Q4 2023 through Q2 2027, pending EA approval and receipt of other required permits and approvals. Early civil works are planned to start Q4 2023 through Q3 2024. Construction of the Port au Port wind farm and associated infrastructure is expected to start in Q3 2024 with completion of the construction in Q4 2026. Construction of the Codroy wind farm and associated infrastructure is expected to start Q4 2025 with completion in Q1 2027. The hydrogen / ammonia plant will be constructed in phases from Q2 2024 to Q1 2026. Grid power sources are planned for hydrogen production in 2025 until March 2026, when the electrolyzer is commissioned.
- Operation and maintenance: Wind farm commissioning is anticipated to start Q1 2026 at the Port au Port wind farm and Q3 2027 at the Codroy wind farm. The 600 MW electrolyzer is expected to be commissioned in Q1 2026. The operational life of the Project is 30 years at each site.
- Decommissioning and rehabilitation: the decommissioning phase is anticipated to take two years, occurring between 2056 and 2058. Decommissioning is anticipated to begin Q1 2056 at the Port au Port wind farm, with completion in Q3 2058 at the Codroy wind farm.

12.2 Existing Environmental Conditions

A characterization of the existing conditions within the spatial boundaries defined in Section 12.1.2 is provided in the following sections. This includes a high-level discussion of the influences of past and present physical activities on wetlands and vegetation, leading to the current conditions. An understanding of the existing conditions for the wetlands and vegetation within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 12.3.

For a more in-depth description of the existing environmental conditions, please refer to the Terrestrial Environment Baseline Study (Appendix BSA-3).

12.2.1 Methods

Information on existing wetland and vegetation conditions was obtained from desktop and field survey. Desktop information sources reviewed included: vegetation data recorded for the RAA provided by the AC CDC (AC CDC 2023b), and NLDFFA forest, non-forest, and wetland spatial data (NLDFFA 2018, herein referred to as land use data). Field data obtained during reconnaissance level surveys was also reviewed.

A summary of methods used to determine existing conditions is provided in the following sections. More detailed information on wetlands and vegetation, including rare plants, within the Project Area, LAA and/or the RAA is found in the Terrestrial Environmental Baseline Study (Appendix BSA-3).

12.2.1.1 Community Diversity

Vegetation communities, upland and wetland, within the Port Au Port area were mapped using an Object Based Image Analysis (OBIA) (Table 12.1). OBIA is a remote sensing exercise that differentiates habitat types by segmenting areas based on landscape and vegetation characteristics in imagery and Digital Elevation Model (DEM) data, such as colour/elevation, texture, size, and shape of naturally occurring features and is described in greater detail in the Terrestrial Environmental Baseline Study (Appendix BSA-3).

The land cover classification types used in the OBIA land cover classification exercise completed within the Port au Port and Corner Brook subregions are presented in Table 12.1.

Table 12.1 OBIA Land Cover Classification Results for the Port au Port Peninsula and Corner Brook Subregions

Land Cover Classification Type	Description
Anthropogenic Vegetated	Lawns and other landscaped vegetated areas
Bog	Sphagnum and ericaceous shrub-dominated peatland
Building	Anthropogenic structures
Coast	Beaches and coastlines
Coniferous Dense	Continuous forest dominated by coniferous trees, with limited openings between trees.
Coniferous Sparse	Forest dominated by coniferous trees with open spaces dominated by shrubs or herbaceous species present between scattered trees.
Dwarf Shrub Heath	Associated with barrens, a community of low and dwarf shrubs, such as bearberry (*Arctostaphylos uva-ursi*), alpine bearberry (*Arctous alpina*), and crowberry (*Empetrum nigrum*). Tree species such as balsam fir and black spruce are stunted and sparse. Herbaceous cover is also sparse and is dominated by entireleaf mountain avens (*Dryas integrifolia*) and running club moss (*Lycopodium clavatum*).
Fen	Sedge-dominated peatland
Flarks	Bogholes, or open water in the centre of bogs and fens, often supporting aquatic vegetation.
Low Tuckamore	Windswept and stunted coniferous trees, primarily balsam fir with black spruce. Beneath the stunted trees, the shrub layer is dominated by ericacous shrubs and other shrub species such as mountain holly (*Ilex mucronata*) and northern wild raisin (*Viburnum nudum*).
Mixedwood	Forest dominated by both coniferous and deciduous trees
Ocean	Atlantic Ocean
Open Water	Ponds
Regenerating Forest	Areas where trees have been removed within approximately the last 10 years, which are dominated by regenerating shrubs and herbaceous species.
Road	Paved and gravel roads
Rock Barrens	Open rock barrens with little vegetation

Table 12.1 OBIA Land Cover Classification Results for the Port au Port Peninsula and Corner Brook Subregions

Land Cover Classification Type	Description
Rock Barrens with Vegetation	Low vegetation associated with rock barrens, typically dominated by
Shrub Swamp	Swamps dominated by shrubs such as speckled alder (*Alnus incana*)
Snowbed Meadow	Sheltered areas protected from winds, typically with later snowmelt and dominated by herbaceous vegetation
Recently Harvested	Areas where trees have recently been removed and regenerating vegetation is not apparent
Watercourse	Flowing water

As the results of the OBIA are preliminary and not available for the entire Project Area, land use inventory data from the Department of Fisheries, Forestry and Agriculture (NLDFFA 2018) are also summarized for the Project footprint (i.e., the expected extent of vegetation clearing required for the construction of Project components and infrastructure), Project Area, LAA, and RAA. The NLDFFA land use classification types and descriptions are provided in Table 12.2.

Table 12.2 NLDFFA Land Use Classification Types and Descriptions

NLDFFA Land Use Category	NLDFFA Land Use Classification Type	Description
Barrens	Rock Barrens	Open rock barrens with little vegetation.
Barrens	Soil Barrens	Barrens with a thin soil layer that supports vegetation communities such as dwarf shrub heath.
Wooded	Coniferous Scrub	Windswept and stunted coniferous trees, primarily balsam fir with black spruce. Typically, less than 6.5 m in height.
Wooded	Deciduous Scrub	Thick, stunted deciduous trees and shrubs.
Wooded	Hardwood	Forest dominated by hardwood or deciduous tree species, typically white birch.
Wooded	Mixedwood	Forest dominated by hardwood or deciduous and softwood or coniferous tree species, primarily balsam fir and white birch.
Wooded	Softwood	Forest dominated by softwood or coniferous trees, primarily balsam fir with black spruce and some scattered tamarack.
Wooded	Unknown Forest	Treed land that has not been classified into one of the above-described forested classes.
Water	Freshwater Body	Lakes or ponds
Water	Ocean	Open ocean
Water	River	Watercourses
Wetland	Bog	Peatlands: bogs and fens
Wetland	Small Island	Islands within the open water in bogs and fens (aka flarks or bogholes); part of the larger bog or fen complex
Wetland	Treed bog	Peatlands (bogs and fens) supporting trees

12.2.1.2 Species at Risk and Species of Conservation Concern

A data request of vascular plant, lichen, and bryophyte species known from the LAA and surrounding areas was made to the AC CDC in early 2023 (AC CDC 2023b). These records were reviewed to determine which known locations are within the Project footprint, Project Area, LAA, or RAA. Because no federally-listed vegetation species were returned in the AC CDC data for the RAA, species ranges were reviewed for the vascular plant, lichen, and bryophyte species SAR occurring in Newfoundland and Labrador listed in Schedule 1 of the federal Species at Risk Act (SARA; GOC 2023).

This information was supplemented with observations from reconnaissance-level field surveys that have occurred in the area to date.

12.2.1.3 Culturally Important Species

Vegetation species of cultural importance (socio-economic and traditional importance) to Indigenous groups (e.g., trees, berries, medicines) that are likely to occur within the Port au Port Subregion, the St. Georges' Bay Subregion, and the Codroy Subregion were identified through a review of two documents provided by the Qalipu Mi'kmaq First Nation:

- Wild Edibles Walk of Blow Me Down Mountain Trail Led by Qalipu Mi'kmaq First Nation Band Elder, Kevin Barnes booklet (Barens et al. 2014)
- Medicine walk booklet (Barens et al. 2015)

12.2.1.4 Wetland Function

Functions of wetlands within the LAA were inferred from their assumed wetland classes, forms, and types, based on literature describing established functions wetlands are known to perform. These functions are qualitatively described.

12.2.2 Existing Conditions

12.2.2.1 Community Diversity

The Project Area occurs within the Western Newfoundland Forest Ecoregion (Damman 1983; Meades 1990; NLDECC 2008a), which is environmentally distinct in its geological diversity, humid climate, range in altitude, and relatively long, on average, growing season (Meades 1990). The ecoregion is primarily forested. Interspersed within the forested matrix are wetland and barren ecosystems. These areas are associated with edaphic (soil related), climatic, and topographic factors (Meades 1990).

Within the broader context of the Western Newfoundland Forest Ecoregion, the Project Area occurs largely within three provincial subregions, including the Port au Port Subregion, the St. Georges' Bay Subregion, and the Codroy Subregion (Meades 1990). The northern portion of Table Mountain (Stephenville) falls within the Corner Brook Subregion and a portion of this subregion is included in the wetlands and vegetation RAA.

Provincial forest, wetland, and non-forest inventory data for the Project footprint, Project Area, LAA, and RAA are presented in Table 12.3.

The Project footprint, Project Area, LAA, and RAA are all primarily forested; wooded categories account for between 70 and 77% of the various assessment areas (Table 12.3). Of these wooded habitats, softwood (coniferous) stands are the most common, accounting for between 37 and 40.5% of the assessment areas. Coniferous scrub is also common, comprising 17% of the RAA, and 28% of the Project Area. Hardwood (deciduous) stands are the least common wooded land cover type in the various assessment areas. These stands comprise between 0.6 and 1.6% of the various assessment areas, and are most abundant within the Codroy Subregion. Mapped wetlands, discussed in greater detail in Section 12.2.2.3, account for 6% of the Project footprint, 8% of the Project Area, 7% of the LAA, and 9.5% of the RAA. Wetlands represent a lower proportion of the Project footprint than other assessment areas because they were often avoided during the initial Project design.

Limestone barrens and associated plant communities are arguably the most ecologically notable vegetation communities in the Project Area (Limestone Barrens Species at Risk Recovery Team 2021). The limestone barrens are largely located in areas identified as rock barrens within the Port au Port subregion. Rock barrens represent 1-2% of the various assessment areas. Soil barrens, which support different plant communities, represent 6-11% of the assessment areas.

The limestone barrens support both vascular plant SAR and SOCC, including woolly arnica (*Arnica angustifolia* subsp. *Tomentosa*), low northern rockcress (*Braya humilis*), Lindley's aster (*Symphyotrichum ciliolatum*), MacKenzie's sweetvetch (*Hedysarum boreale* subsp. *Mackenziei*), rock dwelling sedge (*Carex petricosa* var. *misandroides*) (Section 12.2.2.2 Table 12.6; Terrestrial Environment Baseline Study (Appendix BSA-3)).

The limestone barrens are addressed in the Limestone Barrens Species at Risk Recovery Plan (Limestone Barrens Species at Risk Recovery Team 2021). Although the limestone barrens areas that are designated as critical habitat are restricted to the Great Northern Peninsula, which is located north of the Project Area, two "Sensitive Wildlife Areas" have been identified on the Port au Port Peninsula and a third "Sensitive Wildlife Area" exists on Table Mountain; each of these is associated with limestone barrens. One of these areas is the Cape St. George Transitional Reserve, located within the southwestern tip of the Port au Port Peninsula, outside of the Project Area. The other two "Sensitive Wildlife Areas" intersect with the Project Area on the top of Port au Port Peninsula and on Table Mountain. These "Sensitive Wildlife Areas" are much smaller than the areas identified as limestone barrens within the Limestone Barrens Species at Risk Recovery Plan (Limestone Barrens Species at Risk Recovery Team 2021), and include areas of limestone bedrock that support other vegetation communities like low tuckamore (mostly associated with the NLDFFA coniferous scrub land use), windswept areas dominated by stunted balsam fir and black spruce, and dwarf shrub heath (mostly associated with the NLDFFA soil barrens land use).

Table 12.3 NLDFFA Land Use Within the Project Footprint, Project Area, LAA, and RAA

NLDFFA Land Use Category	NLDFFA Land Use Classification Type	Project Footprint		Project Area		LAA		RAA	
		km²	%	km²	%	km²	%	km²	%
Barrens	Rock Barrens	0.42	1.04	3.42	1.21	12.28	1.59	42.82	1.17
Barrens	Soil Barrens	4.61	11.33	35.38	12.57	69.74	9.06	210.40	5.76
	Barrens Subtotal	*5.03*	*12.37*	*38.79*	*13.78*	*82.02*	*10.65*	*253.22*	*6.94*
Wooded	Coniferous Scrub	10.89	26.74	78.64	27.94	180.79	23.48	628.73	17.22
Wooded	Deciduous Scrub	0.84	2.06	3.91	1.39	11.52	1.50	59.21	1.62
Wooded	Hardwood	0.44	1.09	1.57	0.56	5.98	0.78	58.96	1.61
Wooded	Mixedwood	2.36	5.80	10.96	3.89	48.93	6.36	318.12	8.71
Wooded	Softwood	15.62	38.38	104.99	37.30	311.92	40.52	1363.37	37.34
Wooded	Unknown Forest	1.16	2.86	9.24	3.28	29.17	3.79	126.14	3.45
	Wooded Subtotal	*31.32*	*76.93*	*209.31*	*74.36*	*588.31*	*76.41*	*2,554.54*	*69.96*
Water	Lake/Pond	0.25	0.61	2.05	0.73	11.79	1.53	83.75	2.29
Water	Ocean	0.44	1.07	2.28	0.81	8.09	1.05	247.56	6.78
Water	River	0.08	0.19	0.45	0.16	2.29	0.30	39.34	1.08
	Water Subtotal	*0.76*	*1.87*	*4.79*	*1.70*	*22.17*	*2.88*	*370.65*	*10.15*
Wetland	Bog	2.16	5.31	18.83	6.69	46.21	6.00	307.10	8.41
Wetland	Small Island	0.0004	0.0009	0.02	0.01	0.07	0.009	0.49	0.01
Wetland	Treed bog	0.15	0.37	1.31	0.47	3.25	0.42	15.52	0.42
Wetland	Wet bog	0.25	0.61	2.29	0.81	5.33	0.69	22.51	0.62
	Wetland Subtotal	*2.56*	*6.29*	*22.44*	*7.97*	*54.86*	*7.13*	*345.62*	*9.47*
Anthropogenic/Other	Agriculture	0.10	0.24	0.52	0.18	5.01	0.65	42.25	1.16
Anthropogenic/Other	Cleared Land	0.78	1.91	1.69	0.60	4.66	0.61	21.99	0.60
Anthropogenic/Other	Residential	0.02	0.04	0.36	0.13	5.75	0.75	45.01	1.23
Anthropogenic/Other	Road RoWs	0.03	0.07	0.70	0.25	2.99	0.39	7.08	0.19

Table 12.3 NLDFFA Land Use Within the Project Footprint, Project Area, LAA, and RAA

NLDFFA Land Use Category	NLDFFA Land Use Classification Type	Project Footprint		Project Area		LAA		RAA	
		km²	%	km²	%	km²	%	km²	%
Anthropogenic/Other	TL RoWs	0.11	0.28	2.87	1.02	3.94	0.51	6.80	0.19
Anthropogenic/Other	Sand	0.002	0.005	0.02	0.01	0.17	0.02	4.04	0.11
Anthropogenic/Other Subtotal		*1.03*	*2.54*	*6.16*	*2.19*	*22.52*	*2.93*	*127.17*	*3.48*
Total		**40.72**	**100.00**	**281.49**	**100.00**	**769.88**	**100.00**	**3,651.19**	**100.00**

12.2.2.2 Species Diversity

Species at Risk

Seven federally listed SAR plants, six vascular plants and one bryophyte, and four lichens are known to occur in Newfoundland and Labrador (Table 12.4). Three of the vascular plants and one of the lichens are designated Endangered; two of the vascular plants, one lichen and the bryophyte are designated Threatened; and one of the vascular plants and two lichens are designated Special Concern.

Known occurrences of these six SARA-listed vascular plant species are not near the Project Area, but are in the far northwest end of the Island of Newfoundland (Strait of Belle Isle down to Barr'd Harbour), with a disjunct population of Fernald's braya extending south to Port au Choix, which is located over 200 km north of the Project Area (COSEWIC 2005; COSEWIC 2011; COSEWIC 2012; COSEWIC 2014a; EC 2011; ECCC 2018). These species are not discussed further.

Table 12.4 Plant and Lichen Species Listed in Schedule 1 of SARA Known to Occur in Newfoundland and Labrador

Scientific Name	Common Name	SARA Designation	NL ESA Designation
Vascular Plants			
Braya fernaldii	Fernald's braya	Endangered	Endangered
Braya longii	Long's braya	Endangered	Endangered
Salix jejuna	barrens willow	Endangered	Endangered
Arnica griscomii ssp. *Griscomii*	Griscom's arnica	Threatened	Endangered
Polystichum scopulinum	mountain holly fern	Threatened	-
Astragalus robbinsii var. *fernaldii*	Fernald's milk-vetch	Special Concern	Vulnerable
Bryophytes			
Haplodontium macrocarpum	Porsild's bryum	Threatened	Threatened
Lichens			
Erioderma mollissimum	vole ears lichen	Endangered	Endangered
Pannaria lurida	wrinkled shield lichen	Threatened	Threatened
Degelia plumbea	blue felt lichen	Special Concern	Vulnerable
Erioderma pedicellatum	boreal felt lichen	Special Concern	Vulnerable
Source: GOC (2023)			

Of the four lichen species, all but boreal felt lichen (*Erioderma pedicellatum)*, are likely to occur within the Project Area. Boreal felt lichen has not been documented near the Project. There are many documented populations on the Avalon Peninsula and other locations on the east coast and south-central areas of the Island of Newfoundland; the closest known records are along the Burgeo Highway, approximately 90 km east of the Project (COSEWIC 2014b). The only documented populations on the west coast are along the Great Northern Peninsula, north of the Project Area and RAA. Vole-ears lichen (*Erioderma mollissimum*), wrinkled shield lichen (*Pannaria lurida*), and blue felt lichen (*Degelia plumbea*) are all foliose, epiphytic cyanolichens with potential to be found on tree species known to occur within the Project Area. Of these three, only blue felt lichen is known to occur within the RAA (AC CDC 2023b). It has been found on yellow birch trunks, in hardwood and mixedwood forest stands in the Codroy Valley.

A single bryophyte SAR is known to occur on the Island of Newfoundland: Porsild's bryum (*Haplodontium macrocarpum*), with six known locations of this arctic/alpine species clustered at the northern tip of the Northern Peninsula (COSEWIC 2017). This species is not expected to occur in the Project Area because of the restricted nature of the known locations on the Island of Newfoundland and a lack of appropriate habitat within the Project Area. Known populations are primarily located on cliffs adjacent to open ocean and despite additional search effort in appropriate habitats, occurrences have not been documented in other coastal cliff locations in western Newfoundland or barren rock areas (COSEWIC 2017).

In addition to the three federally listed plant SAR that may occur in the Project Area, ten provincially listed vascular plant SAR, i.e., species listed under the NLESA (described in Section 12.1.1), have been documented within or near the Project Area (Table 12.5; Appendix BSA-3). The ten species include two tree species, seven forbs, and one sedge. The majority of these SAR have been observed on the Port au Port Peninsula and on Table Mountain. Several SAR have been observed east of Stephenville, one from the southern extent of St. George's Bay Subregion, and one from the Codroy Subregion. Recovery or management plans are available for one of the ten provincially listed plant SAR, low northern rock cress (*Braya humulis*) (NLDFFA 2021). These provincially listed vascular plant SAR species are described in the Terrestrial Environment Baseline Study (BSA-3).

Table 12.5 Vascular Plant Species at Risk Known to Occur Within the Vegetation and Wetlands RAA

Scientific Name	Common Name	NL ESA	Observed Location(s)	Observed Within Project Area	NL Land Use Inventory Where Observed (% of Known Occurrences)
Arnica angustifolia subsp. *Tomentosa*	woolly arnica	Endangered	One location in Cape St. George area and one historical record on Table Mountain (Stephenville).	N	Rock Barren (50%) Coniferous Scrub (50%)
Braya humilis	low northern rockcress	Endangered	Barrens in the southern portion of Table Mountain	Y	Soil Barren (98.3%) Rock Barren (0.8%) Softwood (0.8%)
Carex petricosa var. *misandroides*	rock dwelling sedge	Endangered	Barrens in the southern portion of Table Mountain	Y	Soil Barren (33.3%) Coniferous Scrub (66.7%)
Maianthemum racemosum subsp. *Racemosum*	feathery false Solomon's seal	Endangered	West bank of Grand Codroy River (single record)	N	Unknown Forest (100%)

Table 12.5 Vascular Plant Species at Risk Known to Occur Within the Vegetation and Wetlands RAA

Scientific Name	Common Name	NL ESA	Observed Location(s)	Observed Within Project Area	NL Land Use Inventory Where Observed (% of Known Occurrences)
Ranunculus gmelinii	small yellow water-crowfoot	Endangered	Historical record (single record from 1937) from pool on northern bank of Barachois Brook	N	Softwood (100%)
Symphyotrichum ciliolatum	Lindley's aster	Endangered	Western and central portions of Port au Port peninsula, southern portion of Table Mountain, and two historical records (1929) from Harry's Brook east of Stephenville	Y	Coniferous Scrub (51.4%) Rock Barren (15.4%) Soil Barren (13.1%) Deciduous Scrub (2.5%) Mixedwood (1.0%) Unknown Forest (0.4%) Sand (0.2%) Water (0.2%)
Fraxinus nigra	black ash	Threatened	On shore of First Pond, and historical observations (1962, 1963) from the shores of a tributary to Harry's Brook and near the shores of Southwest Brook	N	Bog (33.3%) Deciduous Scrub (33.3%) Water (33.3%)
Hedysarum boreale subsp. *Mackenziei*	MacKenzie's sweetvetch	Threatened	Barrens and associated dwarf heath habitats on Cape St. George and Garden Hill areas on the southwestern coast of Port au Port Peninsula	N	Rock Barren (93.2%) Coniferous Scrub (6.2%) Soil Barren (0.6%)
Pinus resinosa	red pine	Threatened	Northern bank of Little Barachois Brook (three records in same location)	N	Unknown Forest (100%)
Symphyotrichum tradescantii	tradescant aster	Threatened	Riparian and lacustrine habitats associated with First Pond, Bottom Brook, and Southwest Brook/St. George's River	Y	Mixedwood (45%) Water (30%) Anthropogenic (10%) Deciduous Scrub (5%) Softwood (5%) Unknown Forest (5%)

Species of Conservation Concern

A total of 37 vascular plant SOCC, not including SAR, have been documented in the Project Area, LAA or RAA (Table 12.6). The 37 species include three shrub species, 16 forbs, four ferns, five grasses, five sedges, three bulrushes, and one rush. The majority of these SOCC have been observed on the Port au Port Peninsula and on Table Mountain. Several SOCC have been observed east of Stephenville, and a scattering of SOCC have been observed near the TransCanada Highway 1 between Barachois Pond and Codroy Pond within the St. George's Bay and Codroy Subregions (Appendix BSA-3).

Further discussion on vascular plant SOCC is provided in the Terrestrial Environment Baseline Study (Appendix BSA-3).

Culturally Important Plants

The two booklets of culturally important plants provided by local Indigenous groups identified 11 genera and 14 species of plants that are considered culturally important (Table 12.7). Of these, 12 are trees and shrubs and 13 are herbaceous species. Island of Newfoundland S Ranks for these species range from S3 to S5 and SNA, with 10 of the species ranked S5. These species are expected to be common within appropriate habitats in the Project Area, with the exception of yellow birch, which is expected to be very uncommon in the Port au Port, Corner Brook, and St. George's Bay Subregions and uncommon in the Codroy Subregion. None of the culturally important plants are SAR or SOCC.

Table 12.6 Known Vascular Plant SOCC in the Project Footprint, Project Area, LAA, and RAA

Scientific Name	Common name	Provincial S Rank [1]		Number of Known Occurrences[2]			Habitat Notes [3]
			Project Footprint	Project Area	LAA	RAA	
Port au Port Subregion (and Corner Brook Subregion)							
Amelanchier fernaldii	Fernald serviceberry	S1	0	0	0	1	Brooksides and damp bush ravines
Calypso bulbosa var. *americana*	fairy slipper	S1	0	0	4	4	Coastal limestone barren; low heath
Packera cymbalaria	dwarf arctic groundsel	S1	0	10	14	14	Limestone barrens
Scirpus pedicellatus	stalked bulrush	S1	0	1	1	1	Wet depression in fir forest
Sphenopholis intermedia	slender wedge grass	S1	0	0	0	1	Calcareous gravelly bank
Ranunculus recurvatus	hooked crowfoot	S1S2	0	1	0	1	Wooded calcareous gravelly bank
Oxytropis campestris var. *johannensis*	St. John's oxytrope	S1S3	0	0	1	1	Limestone barrens
Boechera stricta	Drummond's rockcress	S2	0	0	2	2	Limestone barren, disturbed ground
Bolboschoenus maritimus ssp. *Paludosus*	saltmarsh bulrush	S2	0	0	0	1	Tidal flats behind barachois (coastal lagoon)
Botrypus virginianus	rattlesnake fern	S2	0	0	0	1	Juniper dominated bowl at toe of slope
Carex concinna	beautiful sedge	S2	0	0	1	1	No information
Carex hostiana	Host's sedge	S2	2	3	6	6	Fen, marsh, alpine meadow, boggy spot in limestone barrens

Table 12.6 Known Vascular Plant SOCC in the Project Footprint, Project Area, LAA, and RAA

Scientific Name	Common name	Provincial S Rank [1]	Number of Known Occurrences[2]				Habitat Notes [3]
			Project Footprint	Project Area	LAA	RAA	
Carex umbellata	hidden sedge	S2	0	0	1	5	No information
Cystopteris laurentiana	Laurentian bladder fern	S2	0	0	0	3	Crack in limestone pavement
Drosera linearis	slender-leaved sundew	S2	1	4	5	5	Fen, and edge of fen pools
Festuca altaica	northern rough fescue	S2	0	0	0	1	Upper slope of baren limestone plateau, open heath
Festuca saximontana var. *saximontana*	rocky mountain fescue	S2	0	1	2	2	Limestone barrens
Juncus nodosus	knotted rush	S2	1	1	3	7	Wet habitats including fens, and beach around pond
Platanthera hookeri	Hooker's orchid	S2	0	0	22	48	Limestone barren, open to dense heath/ scattered tuckamore
Potamogeton friesii	Fries' pondweed	S2	0	0	1	1	Pond
Salix ballii	Ball's willow	S2	0	2	3	3	Brookside, limestone tableland bushy ravine or mossy knoll
Stuckenia filiformis ssp. *Occidentalis*	western threadleaf pondweed	S2	0	0	0	1	Brook within fen with mud over limestone substrate
Total			4	23	66	110	-

Table 12.6 Known Vascular Plant SOCC in the Project Footprint, Project Area, LAA, and RAA

Scientific Name	Common name	Provincial S Rank [1]		Number of Known Occurrences[2]			Habitat Notes [3]
			Project Footprint	Project Area	LAA	RAA	
St. George's Bay Subregion							
Amelanchier fernaldii	Fernald serviceberry	S1	0	0	0	1	Open muskeg
Anemone virginiana var. *alba*	Virginia anemone	S1	0	0	0	1	Alluvial island shore
Carex retrorsa	retrorse sedge	S1	0	0	0	1	Beaver cattail pool
Dennstaedtia punctilobula	hay-scented fern	S1	0	0	2	2	Dry peat, deciduous shrub
Dryopteris marginalis	marginal wood fern	S1	0	1	1	1	No information
Carex pseudocyperus	cyperus-like sedge	S2	0	3	4	7	Beaver and/or cattail marsh
Crataegus chrysocarpa var. *chrysocarpa*	fineberry hawthorne	S2	0	0	5	7	Shores, river banks, forest edge
Elatine minima	small water-wort	S2	0	0	1	1	Sandy lake shallows
Juncus nodosus	knotted rush	S2	0	0	0	1	Marsh, fen, meadow, wet spot in mossy woods, flood plain depression
Neottia auriculata	auricled twayblade	S2	0	0	0	2	Banks of brook above pond
Polygonum oxyspermum ssp. *Raii*	Ray's knotweed	S2	0	0	0	1	Beach
Schoenoplectus tabernaemontani	soft-stem bulrush	S2	0	0	0	1	No information
Sporobolus alterniflorus	saltwater cordgrass	S2	1	2	2	5	Pebble/cobble shoreline or open sand berm moist-mesic saline
Sporobolus pumilus	salt-meadow cordgrass	S2	0	0	0	4	No information

Table 12.6 Known Vascular Plant SOCC in the Project Footprint, Project Area, LAA, and RAA

Scientific Name	Common name	Provincial S Rank [1]	Number of Known Occurrences[2]				Habitat Notes [3]
			Project Footprint	Project Area	LAA	RAA	
Symphyotrichum lanceolatum var. *lanceolatum*	panicled aster	S2	0	0	0	2	River gravel, spruce and birch forest
Utricularia purpurea	greater purple bladderwort	S2	0	0	2	2	Lake shallows, sandy
Total			1	6	17	39	-
Codroy Subregion							
Dennstaedtia punctilobula	hay-scented fern	S1	0	1	1	1	Grassy area on transmission line
Equisetum hyemale	rough horsetail	S1	0	0	1	1	Grassy meadow, along shoreline
Total			0	1	2	2	-

Source:
AC CDC Data Request (2023b)
Notes:
[1] Provincial S Rank is S Rank 2015 for the Island of Newfoundland from AC CDC (2022)
[2] Records are cumulative (i.e., records in the Project Area are also in the LAA and the RAA).
[3] Habitat notes summarized from AC CDC provided data (AC CDC 2023)

Table 12.7 Culturally Important Plants

Common name[1]	Scientific Name	Traditional Mi'kmaq Name(s)	Provincial S Rank[2]	Source[3]	
				Wild Edibles Walk (Barens et al. 2014)	Medicine walk (Barens et al. 2015)
Trees and Shrubs					
alder	*Alnus* sp.	Tupsi (doop-see)	-	Y	Y
balsam fir	*Abies balsamea*	Stoqon (stoe-khon)	S5	Y	Y
birch (yellow)	*Betula alleghaniensis*		S3	Y	Y
blueberry	*Vaccinium* sp.	Pkwimann (bick-wee-mahn)	-	Y	Y
ground juniper	*Juniperus communis*	Apatamkiejit (ah-baht-ahm-gey-jhit)	S5	Y	Y
Labrador tea	*Rhododendron groenlandicum*		S5	Y	Y
pine	*Pinus* sp.		-	Y	-
spruce (black)	*Picea mariana*		S5	Y	Y
spruce (white)	*Picea glauca*	kjimuatkw/Kawatk (gah-wah-d-k)	S5	Y	Y
trembling aspen	*Populus tremuloides*	Miti (me-de)	S4S5	Y	Y
raspberry	*Rubus idaeus*	Klitaw (glee-daw)	S5	Y	Y
roses	*Rosa* sp.		-	Y	Y
Herbaceous Plants					
yarrow	*Achillea* sp.		-	-	Y
coltsfoot	*Petasites* sp.		-	Y	Y
bunchberry (cracker berry)	*Cornus canadensis*	Ka'qaju'manaqsi'l (gah-kay-jew-mahn-ack-seal)	S5	-	Y
dandelions	*Taraxacum* sp.		-	-	Y
cattail	*Typha latifolia*		SNA	Y	-
buttercup	*Ranunculus* sp.		-	-	Y
clover	*Trifolium* sp.		-	-	Y

Table 12.7 Culturally Important Plants

Common name[1]	Scientific Name	Traditional Mi'kmaq Name(s)	Provincial S Rank[2]	Source[3]	
				Wild Edibles Walk (Barens et al. 2014)	Medicine walk (Barens et al. 2015)
cow parsnip	*Heracleum maximum*	Bugosi	S5	-	Y
lambskill (sheep laurel)	*Kalmia angustifolia*		S5	-	Y
blue flag (wild iris, beaver root)	*Iris versicolor*		S5	-	Y
plantain	*Plantago major*		SNA	-	Y
lady slipper (moccasin flower)	*Cypripedium* sp.		-	-	Y
strawberry	*Fragaria* sp.	Atuomkkmink (ah-du-ohm-g-mink)	-	Y	Y

Notes:

[1] Common names were derived from Medicinal Plants – Newfoundland and the Seven Sorts (Miawpukek First Nations nd)

[2] Provincial S Rank is S Rank 2015 for the Island of Newfoundland from AC CDC (2022)

[3] Source Y = Yes, plant species listed in source material

12.2.2.3 Wetland Function

The wetland types and forms present in the LAA can provide important functions and ecosystem services including biogeochemical functions, hydrologic functions, and habitat for plants and wildlife (Beaulne et al. 2021; Kimmel and Mander 2010; Hanson et al. 2008; Price and Maloney 1994).

Bog wetlands are both common and occupy a large proportion of the Project Area on flat terrain and low depressions where rainwater accumulates. Large bog complexes are located between the barrens at the top of Port au Port Peninsula and the western coast of the peninsula and in the St. George's Bay subregion. One such bog is the Bras Mort Bog, a proposed ecological reserve located near Stephenville Crossing which is currently crossed by a transmission line which will be partially paralleled by the proposed transmission line connecting the Codroy wind farm to the hydrogen / ammonia plant. Many of these are Atlantic plateau bogs, with flat surfaces raised above the surrounding terrain. Basin bogs are also evident adjacent to the coast. Although bogs are generally acidic and nutrient-poor, underlying limestone bedrock lends a calcareous influence in the flora present within the Project Area. Both forested bog wetlands and open bogs occur. Bogs typically receive water from precipitation (Vitt 2013) and are dominated by vertical water movement. There are several water supply areas that intersect peatlands within the Port au Port Peninsula (Chapter 8). These are avoided by the Project Area and thus wetlands within the recharge zones of these water supply areas are not expected to be directly affected by the Project.

Slope fens, Atlantic ribbed fens, ladder fens, and stream fens occur in association with calcareous soils and stream margins on slopes and in valleys across the Port au Port Peninsula and in depressions on Table Mountain (Stephenville) (Meades 1990; Stantec 2017; AC CDC 2023). Atlantic ribbed fens consist of alternating ridges of peat (typically less than 1.5 m deep) and shallow pools of water. Ladder fens occur on the edges of the Atlantic plateau bogs and consist of a series of parallel peat ridges surrounding narrow polls of water. Ladder fens form drainageways for water from the adjacent bog and upland and peat is typically 1 m to 2 m deep. Water levels in stream fens vary in response to stream water levels and peat depth may exceed 3 m (National Wetlands Working Group 1997). Fen habitats within the Project Area are dominated by graminoids including a diversity of sedges, and sparse shrubs. Depending on their form, fens can store water and moderate water flows, protecting downstream environments from flooding, and protect stream shorelines from erosion (Hanson et al. 2008).

Bogs and fens both have potential to store carbon in peat and woody biomass; the rate of carbon sequestration is related to the height of the peat surface above the water table (Belyea and Malmer 2004). Bogs and fens can export nutrients and organics to downstream environments if they have outflows (Hanson et al. 2008).

Coastal wetlands, of which there are several in the Port au Port subregion, also mitigate storm surges (Wamsley et al. 2010).

Numerous streams and small lakes and ponds occur across the St. Georges Bay Subregion. Fringing riparian and lacustrine freshwater marsh wetlands and the cobble and sand beaches of lake and stream shorelines occupy a relatively small area within the subregion but provide habitat for several species of conservation concern. Tradescendant aster (*Symphyotrichum tradescantia*; provincially Threatened, Section 3.3.2.1) occurs along rivershores and cobble beaches exposed at low water levels, and cyperuslike sedge (*Carex pseudocyperus*) is found along river marshes (AC CDC 2023). Marshes can provide shoreline protection against storm surges, and both swamps and marshes can improve water quality through stabilization and retention of sediments, provide stream flow moderation and support, and often provide important habitat to wildlife species such as waterfowl (marshes) and forest songbirds and mammals (swamps) (Hanson et al. 2008; Johnston 1991).

Small tidal wetlands are present in sheltered inlets and fringing estuaries within the St. George's Bay and Codroy Subregions. Tidal marshes in general are not well-represented in either area or distribution across Newfoundland's exposed coastline (Roberts and Robertson 1986). These small wetlands are in themselves a provincially rare habitat and provide habitat for species of provincial conservation concern, including smooth cordgrass (*Sporobolus alterniflorus*) and saltmeadow cordgrass (*Sporobolus pumilus*) (AC CDC 2023).

Alder (*Alnus* spp.)-dominated shrub swamps are present in the throughout the RAA. In the Codroy subregion alder-dominated riparian swamps are found in association with alluvial plains and feature two plant communities not found elsewhere on Newfoundland: golden rod/ alder and bracken fern/alder shrub swamps (NLDECC 2008c) and support the provincially Endangered feathery false Solomon's seal (*Maianthemum stellatum* ssp. *stellatum)* (AC CDC 2023).

Within the Codroy subregion, the Grand Codroy Valley Estuary is located approximately 9 km south of the Project Area near the southern extent of the RAA, but headwaters occur farther inland and at higher elevations within the Project Area. The estuarine marsh wetlands associated with the Grand Codroy Valley Estuary were designated as a Ramsar site in 1987 by the Convention on Wetlands of International Importance; it is "the province's most important wetland" as a large coastal estuary that supports many waterfowl (CWS 2001). This area is also an Important Bird and Biodiversity Area (Chapter 13, Chapter 16).

12.3 Assessment Criteria and Methods

This section describes the criteria and methods used to assess environmental effects on wetlands and vegetation, including rare plants. Residual environmental effects (Section 12.5) are assessed and characterized using criteria defined in Section 12.3.1, including direction, magnitude, geographic extent, timing, duration, frequency, reversibility, and ecological or socio-economic context. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for wetlands and vegetation, including rare plants is provided in Section 12.3.2. Section 12.3.3 identifies the environmental effects to be assessed for wetlands and vegetation, including rare plants, and effect pathways and measurable parameters. This is followed by the identification of potential Project interactions with this VEC (Section 12.3.4). Analytical assessment techniques employed for the assessment of potential Project-related environmental effects on wetlands and vegetation are provided in Section 12.3.5. The assumptions that were made to support a conservative approach to the assessment of residual effects on wetlands and vegetation are described in Section 12.3.5.1.

12.3.1 Residual Effects Characterization

Table 12.8 presents definitions for the predicted environmental effects characterization of the undertaking on wetlands and vegetation. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 12.8 Characterization of Predicted Environmental Effects of the Undertaking on Wetlands and Vegetation, including Rare Plants

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Nature	The long-term trend of the residual effect	• **Neutral** – No net change in the measurable parameter(s) for wetlands and vegetation relative to baseline • **Positive** – A residual effect that moves the measurable parameter(s) in a direction beneficial to wetlands and vegetation relative to baseline • **Adverse** – A residual effect that moves the measurable parameter(s) in a direction detrimental to wetlands and vegetation relative to baseline
Magnitude	The amount of change in measurable parameter(s) of the VEC relative to existing conditions	• **Negligible** – No measurable change • **Low** – a measurable change of native vegetation communities, including wetlands, but unlikely to affect sustainability in the LAA, and no effect on SAR or SOCC, and no loss of wetland function. • **Moderate** – a measurable change affecting the sustainability of native vegetation communities, including wetlands, or vegetation SAR or SOCC in the LAA, but unlikely to affect sustainability in the RAA. Loss of wetland function limited to the LAA. • **High** – a measurable change affecting the sustainability of native vegetation communities, including wetlands or vegetation SAR or SOCC in the RAA. Loss of wetland function within the RAA.
Geographic Extent	The geographic area in which a residual effect of a defined magnitude occurs	• **Project Area** – Residual effect is restricted to the Project Area • **LAA** – Residual effect extends into the LAA • **RAA** – Residual effect extends into the RAA
Timing	Considers when the residual environmental effect is expected to occur, where applicable or relevant to the VEC.	• **Moderate Sensitivity** – Residual effect occurs during winter when plants are dormant and less sensitive to activity and wetlands are dry or frozen, including soils • **High Sensitivity** – Residual effect occurs during spring or summer when plants are actively growing or flowering, ground is thawed, and wetlands are flooded or soils are saturated

Table 12.8 Characterization of Predicted Environmental Effects of the Undertaking on Wetlands and Vegetation, including Rare Plants

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter(s) or the VEC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	• **Short-term** – Residual effect is restricted to the construction phase of the Project • **Medium-term** – Residual effect extends through to completion of post-construction reclamation • **Long-term** – Residual effect extends beyond the life of the Project
Frequency	Identifies how often the residual effect occurs during the Project, during a specific phase of the Project, or during another specified time period	• **Single event** • **Multiple irregular event** – Occurs at no set schedule • **Multiple regular event** – Occurs at regular intervals • **Continuous** – Occurs continuously
Reversibility	Describes whether a measurable parameter(s) or the VEC can return to its existing condition after the Project activity ceases, including through active management techniques	• **Reversible** – Residual effect is likely to be reversed after activity completion and rehabilitation • **Irreversible** – Residual effect is unlikely to be reversed
Ecological / Socio-economic Context	Existing conditions and trends in the area where the residual effect occurs	• **Undisturbed** – Area is relatively undisturbed or not adversely affected by human activity • **Disturbed** – Area has been substantially previously disturbed by human development or human development is still present

12.3.2 Significance Definition

A significant residual adverse effect on wetlands and vegetation, including rare plants is defined as a residual Project-related change to the environment that results in any of the following:

- Threatens the long-term persistence or viability of a vegetation species in the RAA, including effects that are contrary to or inconsistent with the goals, objectives, or activities of provincial or federal recovery strategies, action plans and management plans (i.e., change from a non-listed species to a Species at Risk)
- Threatens the long-term persistence or viability of a vegetation community in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of provincial or federal recovery strategies, action plans and management plans
- Results in a non-conformance with section 5.1 of the NL Policy for Development in Wetlands

12.3.3 Potential Environmental Effects, Project Pathways, and Measurable Parameters

Table 12.9 lists the potential Project effects on wetlands and vegetation and provides a summary of the Project effect pathways, measurable parameters, and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for large development projects in NL, renewable energy projects in other parts of Canada, comments provided during engagement, and professional judgment.

Table 12.9 Environmental Effects, Effect Pathways, and Measurable Parameters for Wetlands and Vegetation, including Rare Plants

Environmental Effect(s)	Effect Pathway(s)	Measurable Parameter(s) and Units of Measurement
Change in community diversity	• Direct disturbance – loss of the native vegetation communities through direct effects, primarily during clearing and grubbing • Indirect disturbance – change to vegetation communities through changes in abiotic factors and introduction and spread of non-native invasive plants	• Area (km^2) of vegetation communities • Spatial distribution of vegetation types • Qualitative assessment of change in community condition
Change in species diversity	• Direct disturbance – loss of known observations through direct effects, primarily during clearing and grubbing • Indirect disturbance – loss of individuals and populations through changes in habitat parameters	• Occurrences and population attributes of culturally important plant resources • Number of known occurrences of provincially or federally listed plant SAR • Number of known occurrences of vegetation SAR and SOCC • Area (km^2) of high suitability habitat for SAR
Change in wetland function	• Direct disturbance – loss of or change to wetland function through direct effects, primarily during clearing and grubbing • Indirect disturbance – change to wetland functions through changes in abiotic factors, primarily hydrology	• Area (km^2) of loss or disturbance to wetland types • Qualitative assessment of change in wetland hydrology and water chemistry

12.3.4 Project Interactions with Wetlands and Vegetation, including Rare Plants

Table 12.10 uses checkmarks to indicate the routine Project activities that could interact with the VEC and result in the identified environmental effect(s) to be assessed. Immediately following Table 12.11, environmental effects pathways are briefly described for potential routine Project-related environmental effects and justification is provided in cases where no Project interaction with the VEC (and therefore no potential environmental effect on the VEC) is predicted.

Table 12.10 Project Interactions with Wetlands and Vegetation, including Rare Plants, Environmental Effects, and Environmental Effect Pathways

Project Activities	Environmental Effect(s) to be Assessed		
	Change in community diversity	Change in species diversity	Change in wetland function
Construction			
Site Preparation and Civil Works (including turbine foundations, road construction, quarries, clearing, grubbing, blasting, cement production, and watercourse crossings)	✓	✓	✓
Transportation of Resources and Equipment (includes trucking, shipping, and barging of materials)	✓	✓	✓
Construction / Installation, Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	✓	✓	✓
Installation and Commissioning of Wind Turbines	-	-	-
Installation and Commissioning of Collector Systems	✓	✓	✓
Installation and Commissioning of Transmission Lines and Substations (including marine cable crossing)	✓	✓	✓
Installation and Commissioning of Hydrogen / Ammonia Production, and Storage Facilities and Associated Infrastructure (including Industrial water supply infrastructure)	✓	✓	✓
Restoration of Existing Port Facilities (including pile driving and dredging)	✓	✓	✓
Emissions, Discharges, and Wastes[1]	✓	✓	✓
Employment and Expenditures[2]	-	-	-
Operation and Maintenance			
Presence, Operation, and Maintenance of Wind Farms (including wind turbines, access roads, and collector systems)	✓	✓	✓
Presence, Operation, and Maintenance of Transmission Lines and Substations	✓	✓	✓
Presence, Operation, and Maintenance of Hydrogen / Ammonia Production and Storage Facilities and Associated Infrastructure (includes marine discharge from treatment plant)	-	-	✓

Table 12.10 Project Interactions with Wetlands and Vegetation, including Rare Plants, Environmental Effects, and Environmental Effect Pathways

	Environmental Effect(s) to be Assessed		
Project Activities	**Change in community diversity**	**Change in species diversity**	**Change in wetland function**
Presence, Operation, and Maintenance of Port Facilities (includes loading of ammonia and vessel maneuvering within Port)	-	-	-
Emissions, Discharges, and Wastes[1]	✓	✓	✓
Employment and Expenditures[2]	-	-	-
Decommissioning and Rehabilitation			
Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure	✓	-	-
Decommissioning and Rehabilitation of Wind Farms (including wind turbines, access roads, and collector systems)	✓	✓	✓
Decommissioning and Rehabilitation of Transmission Lines and Substations	✓	✓	✓
Decommissioning and Rehabilitation of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure	✓	-	✓
Decommissioning and Rehabilitation of Port Facilities	✓	-	
Emissions, Discharges, and Wastes[1]	✓	✓	✓
Employment and Expenditures[2]	-	-	-

Notes:

✓ = Potential interaction

– = No interaction

[1] Emissions (e.g., light, noise, vibration, air contaminants and GHGs), discharges (e.g., wastewater and other liquid effluents), and hazardous and non-hazardous wastes are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, "Emissions, Discharges, and Wastes" is listed as a separate item under each phase of the Project.

[2] Project employment and expenditures are generated by most Project activities and are the main drivers of many potential socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, "Employment and Expenditures" is listed as a separate item under each phase of the Project.

Micrositing of Project components to avoid sensitive vegetation and wetland features when practicable will reduce potential direct interactions between Project components or activities and wetlands and vegetation.

In the absence of micrositing and other mitigation, the Project may interact with wetlands and vegetation in the following ways:

- Site Preparation and Civil Works including clearing vegetation, stripping soils and grading for access road and turbine pad construction, and Construction / Installation, Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure, will result in the direct loss of vegetation, and potentially SAR and SOCC. Wetland function will also be altered where wetlands are intersected and may be altered where topography, soils or vegetation are altered near wetlands.
- Transportation of Resources and Equipment during construction could affect community diversity and species diversity indirectly due to potential effects of dust on vegetation adjacent access roads and potential introduction and spread of non-native invasive plants. Vehicle movement will generate dust and vehicles may act as a vector for exotic and invasive species to enter vegetation communities where they previously did not exist.
- Construction of Temporary Workforce Accommodations and Associated Infrastructure will result in the direct loss of vegetation, and potentially SAR and SOCC. Wetland function will also be altered where wetlands are intersected and may be altered where topography, soils, or vegetation are altered near wetlands.
- Installation and Commissioning of Collector Systems, Transmission Lines and Substations, and Hydrogen / Ammonia Production, and Storage Facilities and Associated Infrastructure could have indirect effects on wetlands and vegetation due to soil compaction from through heavy machinery being operated within wetlands and the potential to aid in the spread of exotic and invasive plant species.
- Presence, Operation, and Maintenance of Wind Farms (including wind turbines, access roads, and collector systems) could affect wetlands and vegetation, due to vegetation control, including herbicide application, and the generation of dust along access roads. Vehicle movement may also introduce or spread exotic and invasive plant species.
- Presence, Operation, and Maintenance of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure (includes marine discharge from treatment plant) could affect wetland function from ponds to be used as a source of industrial water for the facility.
- Emissions, Discharges, and Wastes during construction, operation and maintenance, and decommissioning and rehabilitation could affect wetlands and vegetation including rare plants by changing the water table in discharge areas.
- Decommissioning and Rehabilitation of Wind Farms (including wind turbines, access roads, and collector systems), Transmission Lines and Substations, and Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure could affect wetlands and vegetation from the operation of heavy machinery and the potential introduction of invasive plants.

The following Project activities are not expected to result in a change in species diversity, a change in community diversity, and/or a change in wetland function:

- Installation and Commissioning of Wind Turbines will occur in areas that will have been previously disturbed through site preparation and therefore the interactions with wetlands and vegetation will have been captured under that activity.
- Restoration of Existing Port Facilities during Construction, Presence, Operation, and Maintenance of Port Facilities, and Decommissioning and Rehabilitation of Port Facilities will occur in the marine environment, away from wetlands and vegetation.
- Employment and Expenditures during Construction, Presence, Operation, and Maintenance of Port Facilities, and Decommissioning and Rehabilitation will not have an effect on wetlands and vegetation, because employees will be restricted from recreational activities within the Project Area and will be operating within existing footprints and industrial sites.
- Presence, Operation, and Maintenance of Hydrogen / Ammonia Production, and Storage, Facilities and Associated Infrastructure (includes marine discharge from treatment plant) will occur in an industrial environment and will not result in a change in species diversity or a change in community diversity.
- Presence, Operation, and Maintenance of Port Facilities (includes loading of ammonia and vessel maneuvering within Port) will occur in an industrial and marine environment and not have an effect on wetlands and vegetation.
- Presence, Operation, and Maintenance of Temporary Workforce Accommodations and Associated Infrastructure during Decommissioning and Rehabilitation will occur in the same location as used during Construction, and therefore no further effects on wetlands and vegetation, including rare plants, is anticipated.

12.3.5 Analytical Assessment Techniques and Level of Knowledge

Potential effects of the Project on wetlands and vegetation were assessed quantitatively where information was available, and qualitatively where information or modelling results were not available. Quantitative assessments included:

- GIS analysis of the Project footprint intersection with AC CDC-identified locations of vegetation SAR and SOCC.
- GIS analysis of the Project footprint intersection with provincially-identified and delineated vegetation habitats, including wetlands.

Qualitative assessments were conducted using published literature of habitat preferences, biology and ecology of vegetation SAR, SOCC, and invasive plants, and known functions of wetland classes, forms, and types.

12.3.5.1 Assumptions and Conservative Approach

A conservative approach was used to address uncertainty in the environmental effects assessment, allowing for increased confidence in the final determination of significance. Several assumptions were employed in the assessment of Project effects on wetlands and vegetation, including rare plants, resulting in conservative predictions of residual effects:

- In the absence of comprehensive field survey results, vegetation SAR and SOCC are assumed to be present where they have been recorded within the AC CDC database, though some of these records are historical and the species may no longer be present at the recorded locations.
- The amount of high-quality habitat for Lindley's aster was estimated using broad habitat classes, which likely over-estimates the amount of suitable habitat within the Project footprint and Project Area. These broad habitats likely contain finer-scale habitats that would be less appropriate for Lindley's aster.
- In determining the size of the LAA, the distance from which indirect changes in habitat may extend from the Project footprint was assumed to occur at the maximum-identified distances of the LAA, whereas many indirect effects may not extend this far in practice.
- The assessment conservatively assumes all planned Project components will be developed. In practice, the proposed layout is preliminary, and some Project components may not be included in the final Project design.

12.4 Mitigation Measures

A series of environmental management plans will be developed by WEGH2 to mitigate the effects of Project development on the environment. A full list of mitigation measures to be applied throughout Project construction, operation and maintenance, and decommissioning and rehabilitation is provided in Chapter 26, Section 26.2. Key measures to mitigate the potential effects of the Project on wetlands and vegetation, including rare plants are listed in Table 12.11, by category and Project phase.

Table 12.11 Mitigation Measures: Wetlands and Vegetation, including Rare Plants

Control ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
1	Mitigation	Existing riparian vegetation will be maintained according to buffer specifications in permits and regulations.	X	-	-
2	Mitigation	Work will be performed so that materials such as sediment, fuel or other hazardous materials do not enter watercourses and waterbodies through implementation of erosion and sediment control measures and hazardous materials management practices.	X	X	X
3	Mitigation	Work will be conducted in a manner to protect watercourses and wetlands from siltation and disturbance in accordance with Best Management Practices or as otherwise agreed upon with the regulator.	-	X	-

Table 12.11 Mitigation Measures: Wetlands and Vegetation, including Rare Plants

Control ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
4	Mitigation	Sensitive areas (e.g., wetlands, rare plant occurrences, hibernacula, mineral licks, roosts) identified prior to Project activities will be flagged and appropriate buffers maintained around these areas, where feasible.	X	-	-
5	Mitigation	Clearing for temporary road construction will be limited to the width required for road embankment, drainage requirements, and safe line of sight requirements. Trees will be cut close to ground level, and only large tree stumps will be removed, where practicable. Low ground shrubs will be left in place for soil stability and erosion protection purposes, where possible.	X	-	-
6	Mitigation	Where crossing of wetlands beyond the area to be cleared is unavoidable, protective layers such as matting or biodegradable geotextile and clay ramps, or other approved materials, will be used between wetland root / seed bed and construction equipment if ground conditions are encountered that create potential for rutting, admixing or compaction.	X	-	-
7	Mitigation	Grading will be directed away from wetlands, where possible, and will be reduced within wetland boundaries unless required for site specific purposes.	X	-	-
8	Mitigation	Project staff and contractors will adhere to the waste management procedures to be included in the EPP and the Waste Management Plan.	X	X	X
9	Mitigation	Construction areas will be kept clear of rubbish and debris. Rubbish and debris will be appropriately stored and managed.	X	-	-
10	Mitigation	Waste materials and debris will be collected and stored in acceptable containers on-site and disposed of off-site in an environmentally acceptable and approved site. Materials that can be recycled will be sorted and taken to an approved facility.	X	X	X
11	Mitigation	Volatile wastes and materials, such as fuel, mineral spirits, oil, or paint thinner will be stored appropriately and will not be permitted to enter into waterways or storm drains. They will be disposed of at an approved site.	X	X	X
12	Mitigation	Where portable toilets are required, waste will be removed from the site by the supplier in a timely manner for appropriate disposal. These toilets will be located more than 30 m from the boundaries of wetlands or watercourses.	X	X	X
13	Mitigation	Burning of rubbish and waste materials on-site will not be permitted. Rubbish and waste materials will not be buried on-site.	X	X	X

Table 12.11 Mitigation Measures: Wetlands and Vegetation, including Rare Plants

Control ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
14	Mitigation	Bulk fuel and lubricants will be stored in secure areas (i.e., with bund walls and impervious flooring) that have the capacity to trap more than the volume of petroleum hydrocarbons being stored; this will serve as a secondary containment should the primary containment fail. Other petroleum hydrocarbon products will not be stored in large quantities on-site, and secondary containment (e.g., drip trays) will be used in areas of storage and transfer.	X	X	X
15	Mitigation	Hazardous products will be stored according to industrial requirements and standards, and safely secured so that access is limited to authorized personnel.	X	X	X
16	Mitigation	Fuelling and servicing will be conducted using appropriate containment equipment, including spill kits.	X	X	X
17	Mitigation	Fuelling and servicing areas will be sited more than 100 m away from watercourses, coastlines, waterbodies, and wetlands.	X	X	X
18	Mitigation	The potential for spills will be reduced through the use of standard good practices, such as the use of appropriate containers, and avoiding overfilling.	X	X	X
19	Mitigation	Vehicles, heavy equipment, and machinery will be properly maintained to reduce the risk of leakage. Routine preventative maintenance and inspection of hydraulic equipment and machinery will be undertaken to avoid a hazardous material release.	X	X	X
20	Mitigation	Project footprint and disturbed areas will be limited to the extent practicable.	X	X	X
21	Mitigation	The limits for approved clearing, grubbing and topsoil overburden removal will be clearly identified (flagging/survey stakes) in the field prior to the commencement of work.	X	-	-
24	Mitigation	Dust from Project activities will be controlled where required by using applications of water or other approved agents. Waste oil will not be used for dust controls.	X	-	-
26	Mitigation	Re-seeding of areas will follow standard methods in compliance with permit conditions. These methods will be included the Project EPP.	-	-	X
27	Mitigation	Specific stockpiles of topsoil, overburden, and other potentially dust-generating materials will be kept covered, where practical, and used as soon as practical, or will be appropriately temporarily vegetated.	X	-	-
33	Mitigation	Areas to be cleared will have sediment and erosion control measures implemented per the site-specific Erosion & Sediment Control Plan prior to the initiation of clearing activities. The sediment and erosion control measures will be adapted to suit the field conditions associated with the specific construction activities as construction proceeds.	X	-	-

Table 12.11 Mitigation Measures: Wetlands and Vegetation, including Rare Plants

Control ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
34	Mitigation	Construction areas will be routinely monitored to identify areas of potential erosion and to apply appropriate mitigation. Best practice erosion and sediment control measures will be implemented, as required.	X	-	-
35	Design	The drainage system for the site will be designed to appropriately manage stormflows considering impacts to on-site downstream watercourses, and coastlines, and infrastructure. Additionally, the site drainage system will consider the variable and seasonal up-stream drainage needs to provide adequate access to downstream watercourses without adverse impact on the plant site or other nearby infrastructure.	X	-	-
42	Mitigation	Native plants will be used for landscaping, where practical.	X	X	X
43	Mitigation	To reduce the risk of introducing or spreading exotic and/or invasive vascular plant species, equipment will arrive at the construction site clean and free of soil and vegetative debris. Equipment will be inspected by Project personnel or designate and either approved for use or cleaned, re-inspected and approved for use.	X	-	-
45	Mitigation	Known occurrences of plant SAR / SOCC will be avoided through micro-siting of Project infrastructure, when practicable. If avoidance of plant SAR / SOCC is not possible, seed collection or transplant of the plant will be considered in consultation with the applicable regulators.	X	-	-
71	Mitigation	A hazardous waste inventory will be developed to support the management of general and hazardous operational waste streams.	X	X	X
77	Mitigation	Best practices for the proper handling, storage, and disposal of spilled hazardous chemicals and fuels will be included in the EPP and implemented by the Project personnel and contractors.	X	-	-
80	Mitigation	Emergency response plans will be developed, including spill prevention and response, emergency response measures, training, responsibilities, clean-up equipment and materials, and contact and reporting procedures.	X	X	X
81	Mitigation	Appropriate Project personnel will be trained in fuel handling, equipment maintenance, and fire prevention and response measures.	X	X	X
82	Design	Fire prevention and suppression systems will be maintained on site and will consider proper suppression systems for the various potential ignition sources.	X	X	X
83	Mitigation	Spill response kits will be available on-site. Project vehicles will be equipped with appropriately sized spill kits.	X	X	X

Table 12.11 Mitigation Measures: Wetlands and Vegetation, including Rare Plants

Control ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
84	Mitigation	In the event of a spill, dry clean up and mopping techniques will be used, as appropriate. The area will not be "washed down" as this could cause the spills to spread to the surrounding environment and potentially enter drainage works or environmentally sensitive areas.	X	X	X
85	Mitigation	Soil that may have become contaminated will be remediated. This may be done on-site or removed from site for disposal at an approved location.	X	X	X
136	Mitigation	Site-specific erosion and sedimentation control plans will be developed during detailed design phase of the Project and will be implemented.	X	-	-
137	Mitigation	To address the risk of slope instability, a detailed terrain mapping assessment, including ground-truthing, for the final Project Area will be completed to identify both construction constraints and geohazards that may impact the Project. Slope stability assessments will be completed as part of the design, particularly at locations where there is proposed re-grading and glacio-fluvial deposits that are susceptible to erosion and undermining as seen in Stephenville.	X	-	-
138	Mitigation	To address the risk of subsidence a detailed terrain mapping assessment using LiDAR from the Project Area to assess for karst formation that may be present will be completed.	X	-	-
139	Mitigation	To address the risk of landslide/rock fall a detailed terrain mapping assessment will be used to identify historical landslides and rock fall activity within the Project Area. Identification of naturally occurring past events may necessitate further investigation or avoidance. For human-made rock cuts, or largescale re-grading of rock slopes, geotechnical investigation and design will be conducted so that the final cuts / grading are stable and will not cause potential instability during construction or long term.	X	-	-
150	Mitigation	Explosives will be used in a manner that will reduce damage or defacement of landscape features, trees, ecologically sensitive areas such as wetlands, and other surrounding objects, by controlling through standard best practice (including precisely calculated explosive loads and adequate stemming), the scatter of blasted material beyond the limits of activity. Outside of cleared areas, inadvertently damaged trees will be cut, removed, and salvaged, if merchantable (refer to Section, "Clearing of Vegetation"). Fly rock, which inadvertently enters a waterbody, watercourse, or ecologically sensitive area and that can be recovered without further damage to the environment, will be removed. Instances where larger fly rocks (boulders) enter these areas or deep waterbodies, recovery of this will be discussed with the OSEM.	X	-	-

Table 12.11 Mitigation Measures: Wetlands and Vegetation, including Rare Plants

Control ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
151	Mitigation	Time delay blasting cycles or blasting mats will be used, if necessary, to control the scatter of blasted material.	X	-	-
158	Mitigation	Previous testing on selected samples of bedrock has shown the samples to be Non-Potentially Acid Generating (NPAG). As a precautionary measure, the OSEM will inspect all areas of blasted rock and rock stockpiles so no evidence of PAG material exists.	X	-	-
159	Design	Proposed ecological reserves on the Port au Port Peninsula and Codroy area will be avoided to the extent possible.	X	-	-
321	Mitigation	Travel through wetlands for inspection or maintenance activities will be limited, when possible. Non-invasive methods (e.g., drones) will be used when possible.	X	X	X
322	Mitigation	If field surveys identify concentrations of vegetation SAR that may be unavoidable with micro-siting and could result in a threat to the persistence of a vegetation SAR within the RAA, a plan will be developed in consultation with NLDFFA-WD with the intent of monitoring and mitigation potential adverse effects.	X	X	-
323	Mitigation	Clean aggregate material will be used for temporary road access near sensitive wetland and vegetation areas, including wetlands, to reduce the likelihood of introducing or spreading exotic and/or invasive plant species.	X	-	-
324	Mitigation	WEGH2 will develop, in consultation with NLDFFA-WD, a plan to reduce the potential spread of New York aster along roadways constructed or upgraded for the Project. This plan may incorporate multiple methods to reduce the spread of New York aster, including, but not limited to, lining road ditches with riprap, inspecting roadways and roadside ditches, and spot herbiciding observed locations of New York aster.	X	X	-
325	Mitigation	The locations of wetlands will be considered when designing water management plans and systems.	X	-	-
358	Mitigation	Vegetation and Land Cover field surveys will be completed prior to design completion to increase understanding of and confidence in the potential interactions between the Project and wetlands and vegetation, including rare plants, and aid in micrositing in consultation with NLDFFA-WD. The construction footprint will be adjusted to avoid sensitive wetland and vegetation features, including rare plants, where possible.	X	-	-

Table 12.11 Mitigation Measures: Wetlands and Vegetation, including Rare Plants

Control ID #*	Mitigation Type	Mitigation Measure	Project Phase*		
			C	O	D
359	Mitigation	When practicable, vegetation clearing in areas where grubbing is not required (e.g., in collector and transmission line RoWs) will be completed during frozen ground conditions, and if possible, when snow cover is present, to limit disturbance to soils, particularly in wetland areas. Localized grubbing will be required at electrical structure locations to support construction and maintenance. Collector lines will be routed adjacent to roads where possible.	X	-	-
360	Mitigation	Vegetation clearing will be limited within wetlands without tall vegetation (i.e. 4.15 m) that could interfere with electrical lines	X	X	-
361	Mitigation	Heavy machinery will be limited within the footprints of wetlands that will be cleared but not infilled (such as those within collector and transmission lines). Heavy equipment will be required at structure locations where wetland avoidance was not possible. Localized backfill with culverts may be required at electrical structure locations to provide sufficient structure support.	X	X	-
362	Mitigation	Herbicides for vegetation management will not be used within 300 m of wetlands or known instances of vegetation SAR or SOCC. Herbicides will only be used for control on non-native invasive plants.	-	X	-
363	Mitigation	Vegetation clearing in collector and transmission line RoWs will be limited to hand clearing of vegetation over 2.15 m in height within a buffer of known instances of vegetation SAR or SOCC. Vegetation control is expected to occur once every ten years.	X	X	-

* Note:
"Control ID #" denotes the master identification number for mitigation in Appendix 26-A
"C" denotes the construction phase of the Project.
"O" denotes the operation and maintenance phase of the Project.
"D" denotes the decommissioning and rehabilitation phase of the Project.
"X" denotes the Project phase for the mitigation measure

12.4.1 Application of the Precautionary Principle to Project Mitigation Measures

The mitigation measures in Section 14.4 have been selected in consideration of the environmental effects pathways and include standard proven mitigation measures for wetlands and vegetation. The precautionary principle was used in determining mitigation measures for the Project. For example, because supporting field surveys have not been completed at the time of EIS writing, it is assumed that the SAR Lindley's aster may be present in any high-quality habitat (here defined as habitat where the majority of known observations have been recorded) on the Port au Port Peninsula. Other SAR appear to have more well-defined range restrictions and have been assumed to be restricted to the general area where they have been recorded to date, though mitigation measures will be applied wherever these species are observed.

Because there is some uncertainty around the magnitude of effects on vegetation SAR and SOCC, an adaptive management framework will be used, which allows for mitigation to be changed or strengthened if unexpected, or higher magnitude than expected, effects are observed.

12.5 Residual Environmental Effects

12.5.1 Residual Change in Community Diversity

12.5.1.1 Construction

Construction of the Project has the potential to result in a change in community diversity through direct removal of vegetation and alteration of abiotic conditions in the Project footprint, and indirect change in abiotic factors of retained vegetation adjacent to the Project footprint. These changes will alter the areal extent of plant communities and the plant composition and structure of directly and indirectly affected areas. As with a change in species diversity, these interactions are expected to occur primarily through site preparation and civil works activities, where vegetation communities will be lost or changed through vegetation clearing and disturbances to soils, such as removal of organic materials and overburden. Clearing will remove trees and shrubs and damage understory vegetation. Grubbing and excavation will completely remove remaining vegetation and some soil layers and will likely remove the associated seedbank and compact residual soil layers, thereby influencing the plant communities that may later regenerate within the area. Construction equipment and vehicle traffic in partially disturbed areas (e.g., transmission line RoW) may also damage short shrubs and ground cover plants, including vascular and non-vascular plants and lichens, and compact soils altering growing conditions.

Emissions, discharges, and wastes from the Project will include stormwater and run-off from construction areas. Water that is diverted from one location to another can alter the hydrology of areas outside of the Project footprint or Project Area, potentially affecting plant species that cannot tolerate the changed hydrologic conditions. This could lead to a change in plant community structure, as raising or lowering water table levels can lead to a change from upland to wetland or vice versa, resulting in a change to the overall area of wetland or to wetland class or type (e.g., raising water levels can cause tree die off, changing swamps to marshes over time). These potential changes, which are also expected to occur during operation, are discussed further in Section 12.5.3.

In total, 281.49 km^2 of vegetation communities, 275.34 km^2 of native vegetation communities, are included in the Project Area and almost 41 km^2 of vegetation communities (39.7 km^2 excluding Anthropogenic/Other land types) are expected to be within the Project footprint (Table 12.14). Decreases in native vegetation community abundance due to the Project footprint range from 0.55% of wetland small island, to 6.61% of soil barrens, in the LAA, and 0.08% of wetland small island, to 2.19% soil barrens, in the RAA. Although the Project footprint is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project, the area of direct physical disturbance associated with construction will most likely be restricted to the cleared area. Native vegetation communities intersected by the cleared area will be lost (within the footprints of Project components) or changed (through vegetation removal, or damage from equipment and vehicle movement, such as within collector and transmission line RoWs).

Project micro-siting is largely intended to avoid vegetation SAR and SOCC but will also be used to further avoid or reduce interactions with sensitive vegetation community types such as barrens and wetlands, when possible. However, some loss of barrens habitats is likely unavoidable. As planned, the Project may result in the direct loss of 3.43% of the rock barrens and 6.61% of the soil barrens within the LAA, and 0.98% of the rock barrens and 2.19% of the soil barrens in the RAA (Table 12.12). Project micro-siting may further reduce the area of affect. Additionally, mitigation may include offset measures to further the goals identified in the Limestone Barrens SAR Recovery Plan (Limestone Barrens Species at Risk Recovery Team 2021). These offsets would be determined in consultation with appropriate regulators.

Table 12.12 Potential Changes in NLDFFA Land Use Types within the LAA and RAA

NLDFFA Land Use Category	NLDFFA Land Use Classification Type	Existing Conditions RAA		Existing Conditions LAA		Project Area[1]	Project Footprint	Post-Construction Area in RAA (Project Area)		Post-Construction Area in RAA (Project Footprint)		Post-Construction Area in LAA (Project Area)		Post-Construction Area in LAA (Project Footprint)	
		Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (km^2)	Area (km^2)	% Change	Area (km^2)	% Change	Area (km^2)	% Change	Area (km^2)	% Change
Barrens	Rock Barrens	42.82	1.17	12.28	1.59	3.42	0.42	39.40	-7.98	42.40	-0.98	8.86	-27.83	11.85	-3.43
Barrens	Soil Barrens	210.40	5.76	69.74	9.06	35.38	4.61	175.02	-16.81	205.79	-2.19	34.37	-50.72	65.13	-6.61
Barrens	**Subtotal**	**253.22**	**6.94**	**82.02**	**10.65**	**38.79**	**5.03**	**214.43**	**-15.32**	**248.18**	**-1.99**	**43.23**	**-47.30**	**76.98**	**-6.14**
Wooded	Coniferous Scrub	628.73	17.22	180.79	23.48	78.64	10.89	550.10	-12.51	617.85	-1.73	102.16	-43.50	169.90	-6.02
Wooded	Deciduous Scrub	59.21	1.62	11.52	1.50	3.91	0.84	55.30	-6.61	58.37	-1.42	7.60	-33.98	10.68	-7.29
Wooded	Hardwood	58.96	1.61	5.98	0.78	1.57	0.44	57.39	-2.67	58.52	-0.75	4.40	-26.34	5.53	-7.41
Wooded	Mixedwood	318.12	8.71	48.93	6.36	10.96	2.36	307.16	-3.45	315.76	-0.74	37.96	-22.40	46.57	-4.83
Wooded	Softwood	1,363.37	37.34	311.92	40.52	104.99	15.62	1,258.38	-7.70	1,347.75	-1.15	206.94	-33.66	296.30	-5.01
Wooded	Unknown Forest	126.14	3.45	29.17	3.79	9.24	1.16	1,16.91	-7.32	124.98	-0.92	19.93	-31.66	28.00	-3.99
Wooded	**Subtotal**	**2,554.54**	**69.96**	**588.31**	**76.42**	**209.31**	**31.32**	**2,345.23**	**-8.19**	**2,523.22**	**-1.23**	**379.00**	**-35.58**	**556.98**	**-5.32**
Water	Lake/Pond	83.75	2.29	11.79	1.53	2.05	0.25	81.70	-2.45	83.50	-0.30	9.74	-17.41	11.54	-2.11
Water	Ocean	247.56	6.78	8.09	1.05	2.28	0.44	245.28	-0.92	247.12	-0.18	5.81	-28.23	7.66	-5.40
Water	River	39.34	1.08	2.29	0.30	0.45	0.08	38.88	-1.16	39.26	-0.20	1.83	-19.86	2.21	-3.40
Water	**Subtotal**	**370.65**	**10.15**	**22.17**	**2.88**	**4.79**	**0.76**	**365.86**	**-1.29**	**369.89**	**-0.21**	**17.38**	**-21.62**	**21.41**	**-3.44**
Wetland	Bog	307.10	8.41	46.21	6.00	18.83	2.16	288.27	-6.13	304.94	-0.70	27.38	-40.74	44.05	-4.68
Wetland	Small Island	0.49	0.01	0.07	0.01	0.02	0.0004	0.47	-3.62	0.49	-0.08	0.05	-25.48	0.07	-0.55
Wetland	Treed bog	15.52	0.42	3.25	0.42	1.31	0.15	14.21	-8.45	15.37	-0.98	1.94	-40.32	3.10	-4.66
Wetland	Wet bog	22.51	0.62	5.33	0.69	2.29	0.25	20.23	-10.15	22.27	-1.10	3.04	-42.88	5.08	-4.63
Wetland	**Subtotal**	**345.62**	**9.47**	**54.86**	**7.13**	**22.44**	**2.56**	**323.18**	**-6.49**	**343.06**	**-0.74**	**32.42**	**-40.90**	**52.30**	**-4.67**
Anthropogenic/ Other	Agriculture	42.25	1.16	5.01	0.65	0.52	0.10	41.73	-1.23	42.16	-0.23	4.49	-10.38	4.91	-1.92
Anthropogenic/ Other	Cleared Land	21.99	0.60	4.66	0.61	1.69	0.78	301.79	1,272.62	61.93	181.65	284.47	6,004.47	44.60	857.06
Anthropogenic/ Other	Residential	45.01	1.23	5.75	0.75	0.36	0.02	44.65	-0.80	44.99	-0.04	5.39	-6.25	5.73	-0.27
Anthropogenic/ Other	Road RoWs	7.08	0.19	2.99	0.39	0.70	0.03	6.38	-9.87	7.05	-0.42	2.29	-23.40	2.96	-1.00
Anthropogenic/ Other	TL RoWs	6.80	0.19	3.94	0.51	2.87	0.11	3.92	-42.27	6.69	-1.68	1.07	-72.86	3.83	-2.89
Anthropogenic/ Other	Sand	4.04	0.11	0.17	0.02	0.02	0.002	4.02	-0.43	4.04	-0.06	0.15	-10.02	0.17	-1.30
Anthropogenic/ Other	**Subtotal**	**127.17**	**3.48**	**22.52**	**2.93**	**6.16**	**1.03**	**402.50**	**216.51**	**166.85**	**31.20**	**297.86**	**1,222.52**	**62.20**	**176.19**
	Total	**3,651.19**	**100.00**	**769.88**	**100.00**	**281.49**	**40.72**	**3,651.19**	**-**	**3,651.19**	**-**	**769.88**	**-**	**769.88**	**-**

Edge effects that will occur in areas adjacent to cleared areas will have some effects on community composition, although are unlikely to result in major changes to community diversity. Edge effects can include changes in abiotic factors such as light availability, humidity, wind, and temperature, which can change which plants are able to grow and thrive in an area. The distance that edge effects can penetrate a vegetation community relates to structural characteristics such as vegetation height and density; in forested areas, edge effects have been measured to decline beyond approximately 20 m from an edge (Harper et al. 2005; Zheng et al. 2008; Harper et al. 2015). An exception can be the introduction of an extremely invasive plant species, which could occur through edge effects and through Project-related transportation along access roads potentially as far as 1 km into undisturbed habitat (Henderson 2011; Vakhlamova et al. 2016). Invasive species can outcompete and displace native species, which could lead to a change in community diversity by altering plant community types (Sieg et al. 2003). Although there is no comprehensive list of invasive species on the Island of Newfoundland, some exotic species that are known to be invasive in other jurisdictions are likely present within the Project Area. Planned mitigation measures will reduce but are unlikely to eliminate the spread of invasive plant species through the Project Area; however, changes to community types as a result of the introduction of invasive plant species are not expected as the majority of non-native plants are likely to become established in disturbed areas and roadside ditches.

Transportation of resources and equipment during construction will generate dust. Dust generated from vehicles can be deposited onto vegetation, which can cover leaves and block stomata, reducing photosynthesis and causing other physiological effects (Farmer 1993), as well as altering soil chemistry (Brown 2009). Components of dust can also be absorbed by plants through the soil, and can lead to a host of reactions, including reduction of plant productivity or overall fitness, and can ultimately lead to the loss of more sensitive plant species, potentially resulting in changes to community diversity (Hosker and Lindberg 1982). Dust suppression mitigation is planned to reduce the potential effects of dust generated as a result of the Project that are described in preceding sentences. Although many factors influence the distance to which road dust penetrates adjacent vegetation communities (e.g., climate, vehicle speed, vehicle weight, gravel properties, density and structure of adjacent vegetation), most dust deposition and resultant effects on vegetation occur within 125 m of unpaved roads (Walker and Everett 1987). Although the distance which edge effects and dust deposition may affect vegetation cannot be known without a study conducted in this region, conservatively it is assumed that edge effects could occur within 200 m of access roads within the Project Area and thus the effects of dust will be restricted to the LAA.

With the expected reduction in native vegetation communities, and potential alteration in conditions of native communities adjacent to the cleared area, effects of Project construction on community diversity are adverse. No native community will be lost from the LAA or become locally or regionally uncommon within the LAA or RAA (i.e., occupy less than 1% of the area). Barrens, a regionally ecologically important native community, will be affected, but will remain abundant in the LAA and RAA. As such, the Project is unlikely to affect sustainability of native vegetation communities in the RAA and effect magnitude is considered moderate. Indirect effects of Project construction on community diversity from dust, edge effects, and non-native invasive plants will occur beyond the Project footprint but are expected to be restricted to the Local Assessment Area. The duration of the residual effect is considered long-term as some changes will persist beyond the life of the Project. Construction will occur as a single event, potentially during the spring or summer, a high sensitivity period. Indirect effects will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects) and during moderate and high sensitivity periods. Effects are considered reversible following Project decommissioning and rehabilitation; however, plant composition of re-established communities will likely differ from existing native communities. A summary of residual effects on change in community diversity during the construction phase by Project site is provided in Table 12.13.

Table 12.13 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• Residual effects to community diversity during construction of temporary workforce accommodations will be mitigated through Project design and siting of components. Although the location of the temporary workforce accommodations is unknown and resulting changes to vegetation community diversity cannot be fully understood, native land cover types are expected to be lost or changed as a result of its construction and additional adjacent native land cover types may be changed through edge effects and hydrological changes.
Port au Port Wind Farm and Associated Infrastructure	• Residual effects to community diversity such as to limestone barrens during construction of the Port au Port wind farm and associated infrastructure will be mitigated through Project design and siting of components. Varying amounts of different native land cover types are expected to be lost or changed as a result of Project construction and adjacent native landcover types may be changed through edge effects and hydrological changes.
Codroy Wind Farm and Associated Infrastructure	• Residual effects to community diversity, including untouched tolerant hardwood stands, during construction of the Codroy wind farm and associated infrastructure will be mitigated through Project design and siting of components. Varying amounts of different native landcover types are expected to be lost or changed as a result of Project construction and adjacent native landcover types may be changed through edge effects and hydrological changes.
230 kV Transmission Lines and Substations	• Residual effects to community diversity, including the Bras Mort Bog and riparian systems during construction of the 230 kV transmission lines and substations will be mitigated through Project design and siting of components, as well as by limiting clearing within sensitive community types such as wetlands.
Hydrogen / Ammonia Production and Storage Facilities	• Residual effects to community diversity during construction of the hydrogen/ammonia production and storage facilities will be limited as the footprint is largely within a brownfield site. The residual loss of some native landcover types is possible as some land cover types fall within the footprint of the facilities.
Port Facilities	• Residual effects to community diversity during restoration of existing port facilities will be limited as the footprint is largely within a marine environment. The residual loss of some vegetation communities is anticipated through dredging of some salt marsh habitat within the cleared area associated with the port.

12.5.1.2 Operation and Maintenance

Though most effects on community diversity will occur during the construction phase, operation and maintenance of the Project has the potential to result in adverse environmental effects resulting in further change to native community diversity. Although the threat of invasive species will have started during construction (Section 12.5.2.1), roads and transmission lines can act as pathways for invasive species throughout their use, and vehicle traffic on access roads associated with the operation and maintenance of wind farms and on collector and transmission lines associated with vegetation maintenance could lead to the further introduction or spread of invasive plant species. Although the frequency of vegetation maintenance has not been established, other transmission lines on the Island of Newfoundland are typically maintained every 5-10 years, though the requirement for maintenance will vary according to community type and the rate of woody vegetation growth (Emera 2013). Emissions, discharges and wastes during operation and maintenance of the Project, in particular stormwater and run-off, could also continue to affect community diversity similarly as during construction (Section 12.5.2.1), and dust could be deposited on native vegetation adjacent to access roads. Edge effects will also persist as the Project footprint will be maintained with taller trees and shrubs controlled along the collector and transmission line RoWs and other areas maintained in an unvegetated condition.

As indirect effects from Project operations and maintenance will occur to native vegetation communities, effects are considered adverse. Effects magnitude is considered low and restricted to the LAA as no additional clearing will occur during operations and maintenance and the sustainability of native communities will not likely be threatened in the RAA due to infrequent Project activities during this period. The duration of the residual effect is considered long-term as some changes will persist beyond the life of the Project. Effects will have high timing sensitivity as activities will likely occur during the spring and summer and as a continuous event, likely weekly (traffic) to once per decade (vegetation maintenance), depending on activity. Indirect effects will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects). Effects are considered reversible following Project decommissioning and rehabilitation, although changes in plant composition may persist and differ from existing conditions in established communities. Based on the information above, a summary of residual effects on change in community diversity by Project component during the operation and maintenance phase is provided in Table 12.14.

Table 12.14 Summary of Effects by Project Component During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• Residual effects to community diversity resulting from emissions, discharges, and wastes will be managed by applying best practices and standard erosion and sedimentation control mitigation measures described in Section 12.4
Codroy Wind Farm and Associated Infrastructure	
230 kV Transmission Lines and Substations	• Residual effects to community diversity are anticipated to be limited within the operation phase of the 230 kV transmission lines and substations
Hydrogen / Ammonia Production and Storage Facilities	• There are no interactions anticipated between the hydrogen/ammonia production and storage facilities and community diversity during operations and maintenance as this will occur in an industrial environment (Table 12.11); therefore, no residual effects are anticipated.
Port Facilities	• There are no interactions anticipated between the port facilities and community diversity during operations and maintenance as this will occur within a marine environment (Table 12.11); therefore, no residual effects are anticipated.

12.5.1.3 Decommissioning and Rehabilitation

During the decommissioning and rehabilitation phase it is anticipated that a re-vegetation plan will be implemented. The plan will include active revegetation using native species in some areas and natural recovery in other areas. In both cases, natural vegetation communities will be targeted for re-establishment following the removal of Project components and the rehabilitation of cleared areas. However, woody species are slow growing, particularly in much of the Project Area where growing conditions are harsh, and many communities also establish under specific conditions which are unlikely to be replicated following decommissioning and rehabilitation. Therefore, most vegetation communities are not expected to return to pre-Project conditions for many decades, following rehabilitation and plant composition may differ from existing conditions. Traffic on access roads and throughout the Project Area during decommissioning and rehabilitation will continue to potentially aid in the spread of invasive vegetation species, though effects to vegetation communities from invasive species are not expected with proposed mitigation.

Effects of Project decommissioning and rehabilitation on community diversity are expected to be neutral to positive relative to construction and operation phases, and low in magnitude as work will largely be restricted to areas altered within the construction phase. Indirect effects from dust, edge effects, and non-native invasive plants may occur beyond the Project footprint but are expected to be restricted to the LAA. The duration of the residual effect is considered long-term as some changes will persist beyond the life of the Project. Decommissioning and rehabilitation activities may occur in the spring and summer which would have high timing sensitivity; however, activities will occur within the Project footprint. Indirect effects will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects), and are considered reversible. Based on the information above, a summary of residual effects on change in community diversity during the decommissioning and rehabilitation phase is provided in Table 12.15.

Table 12.15 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• Natural vegetation dominated communities are expected to re-establish following the removal of Project components and the rehabilitation of cleared areas. However, some vegetation communities, such as tuckamore and mature forest will take many decades to establish.
Port au Port Wind Farm and Associated Infrastructure	
Codroy Wind Farm and Associated Infrastructure	
230 kV Transmission Lines and Substations	
Hydrogen / Ammonia Production and Storage Facilities	
Port Facilities	

12.5.2 Residual Change in Species Diversity

12.5.2.1 Construction

Construction of the Project has the potential to result in adverse environmental effects resulting in a change to or the loss of species diversity, including rare and culturally important plants. Most disturbance will occur during site preparation and civil works activities. Vegetated areas will be cleared for roads, transmission lines, turbine pads, the hydrogen/ammonia plant, and other Project infrastructure. Clearing will remove trees and shrubs and damage other plants and is expected to be required within the footprint of all Project infrastructure, including collector and transmission lines. Additional site preparation activities will be required for most Project components including turbine pads, access roads, substations, and the Hydrogen / Ammonia production and storage facilities, such as grubbing, which will completely remove vegetation, where it occurs. Depending on the extensiveness of the activities, site preparation could remove topsoil and the associated seedbank, and heavy machinery can compact the remaining soil layers. Removing soil and associated seed banks can change the habitat quality for plants that later regenerate in disturbed areas.

Species at Risk and Species of Conservation Concern

Vascular plant SAR and SOCC that have been recorded within the Project Area are included in Table 12.16. Four provincially listed plant SAR and 13 plant SOCC have been documented in the RAA and occurrences of these species are intersected by the Project Area. Two plant SAR and five plant SOCC are intersected by the Project footprint, with 2% to 15% of the known plant SAR occurrences and 13% to 33% of known plant SOCC occurrences in the RAA affected.

Table 12.16 Vascular Plant Species at Risk and Species of Conservation Concern Known to Occur Within the Vegetation and Wetlands Project Area, and their Known Number of Occurrences in the Project Footprint and Regional Assessment Area

Scientific Name	Common Name	NL ESA/ Provincial S Rank	Number of Observations in Project Footprint[1]	Number of Observations in Project Area	Number of Observations in RAA
SAR					
Braya humilis	low northern rockcress	Endangered/S1	0	54	121
Carex petricosa var. *misandroides*	rock dwelling sedge	Endangered/S1	0	1	3
Symphyotrichum ciliolatum	Lindley's aster	Endangered/S2	9	68	480
Symphyotrichum tradescantii	tradescant aster	Threatened/S1	3	5	20
SOCC					
Dennstaedtia punctilobula	hay-scented fern	S1	1	1	3
Dryopteris marginalis	marginal wood fern	S1	0	1	5
Packera cymbalaria	dwarf arctic groundsel	S1	0	10	14
Scirpus pedicellatus	stalked bulrush	S1	0	1	1
Sphenopholis intermedia	slender wedge grass	S1	0	1	1
Ranunculus recurvatus	hooked crowfoot	S1S2	0	1	1
Carex hostiana	Host's sedge	S2	2	3	6
Carex pseudocyperus	Cyperus-like sedge	S2	0	3	7
Drosera linearis	slender-leaved sundew	S2	1	4	5
Festuca saximontana var. *saximontana*	rocky mountain fescue	S2	0	1	2
Juncus nodosus	knotted rush	S2	1	1	8
Salix ballii	Ball's willow	S2	0	2	3
Sporobolus alterniflorus	saltwater cordgrass	S2	1	2	5

Note:
[1] Data presented are from AC CDC 2023b.

The previously recorded low northern rockcress observations within the RAA are located at the southern end of Table Mountain, and approximately 45% of these known observations are within the Project Area (AC CDC 2023b). Although within the Project Area, none of the previously recorded observations of this species are within the Project footprint. Direct disturbance to these plants is not expected. Because these plants occur within barrens habitat, no vegetation clearing outside of permanent Project infrastructure footprints is expected to be required and thus potential edge effects are expected to be limited, relative to edge effects in forested areas and other habitats with more vegetation structure. The road and transmission line footprints are within provincially-identified critical habitat for this species (Tilley et al. 2005).

Some observations of low northern rockcress made during Project field surveys conducted in 2023 are within the footprint of the Project footprint for the access road to Table Mountain. It therefore may not be possible to avoid all instances of this plant during construction, but with careful micro-siting, a very small proportion of the known instances of this plant are expected to be affected by the Project.

The three known records of rock dwelling sedge within the RAA are historical; the most recent record from within the RAA is from 1967. Of the three records, only one is within the Project Area and it is outside of the Project footprint. This species is not expected to be affected by the Project.

Of the 480 known records of Lindley's aster, 9, approximately 2%, are within the Project footprint that may be directly affected (Table 12.16). Although there are inevitably more Lindley's aster within the Project Area and Project footprint than has been observed through surveys conducted to date, it is also expected that there are additional Lindley's aster occurrences outside of the Project Area that will not be directly affected by the Project.

The known observations of this species have mostly been recorded within coniferous scrub, with lesser amounts in rock barren and soil barren land use types (AC CDC 2023). Together, these three land use types represent 79.9% of the recorded observations of Lindley's aster and are considered to represent "high-quality habitat" for this species, despite the fact that these habitat classes are coarse and contain other habitats that may not be used by Lindley's aster. The amount of coniferous scrub within the Project footprint that will be lost or altered represents a change of 6.0% of coniferous scrub within the LAA and 1.7% of the coniferous scrub within the RAA. The amount of rock barrens within the Project footprint represents 3.4% of the LAA and 1.0% of the RAA, while the amount of soil barrens within the Project footprint represents 6.6% of the LAA and 2.2% of the RAA. Although the areas of supporting land use types intersected by the Project footprint are small, all areas are likely not occupied by the plant SAR and smaller scale conditions (e.g., site microtopography) not identifiable from desktop may not be consistently present in all land use type locations.

Project micro-siting is also expected to reduce the number of Lindley's aster directly affected by the Project. Because this species often occurs in open and edge habitats such as edges of coniferous and mixedwood forests, in Tuckamore, and sheltered microsites associated with limestone barrens (SSAC 2009), edge effects to Lindley's aster occurring outside of the Project footprint are expected to be somewhat limited, i.e., changes in abiotic factors associated with adjacent tree canopy removal may not affect Lindley's aster that are not directly disturbed. However, indirect interactions with the Project are possible due to the likelihood of the Project to aid in the potential introduction and/or spread of New York aster, which could then hybridize with Lindley's aster, diluting populations of the Endangered plant (SSAC 2009). Mitigation measures described in Section 12.4 are planned to reduce the potential introduction and spread of New York aster, but monitoring is recommended to evaluate the effectiveness of these measures. The "purest" populations of Lindley's aster (i.e., those with the fewest *Symphyotrichum x subgeminatum* present) occur in microhabitats associated with the top of Port au Port barrens (SSAC 2009), which are largely avoided by the Project.

Of the 20 known records of tradescant aster, three are within the Project footprint with potential to be directly affected by the Project. These observations are all in the same location, within the planned transmission line between the hydrogen/ammonia plant and the Codroy wind farm. With the planned mitigation of limiting vegetation clearing to hand clearing of only tree and shrub species over a minimum height threshold within a buffer around known vegetation SAR and SOCC that occur within the planned footprint of collection and transmission lines, interactions between the Project and tradescant aster are expected to be limited.

There are currently no known observations of lichen SAR within the Project Area or LAA, but there is potential for them to exist within the LAA, particularly within the Codroy subregion. Blue felt lichen has been observed on yellow birch trunks in hardwood and mixedwood stands within the RAA. Project micrositing is planned to avoid instances of lichen SAR that may be found during surveys planned for the Project Area.

Of the 151 records of vegetation SOCC that are known to occur within the RAA, five records are within the Project footprint: two records of Host's sedge, one record of slender-leaved sundew, one record of knotted rush, and two records of saltwater cordgrass (Table 12.6). The two records of Host's sedge and one record of knotted rush are within the Project footprint associated with the access road to turbines located on Table Mountain. These may be avoided through micrositing. The slender-leaved sundew is located within the footprint of a turbine and may not be avoidable through micrositing. However, this species is likely more common than the AC CDC data suggest. Saltwater cordgrass is located within the footprint of the land to be cleared associated with the restoration of existing port facilities and will not be avoidable. Two other records of this species are located nearby, and more may exist within the LAA and RAA.

Although rare plant species will be avoided when possible, it will not be possible to avoid all known instances of rare plant species, particularly Lindley's aster, which occupies a range of habitats and is locally common within appropriate habitats in the Port au Port area. In addition, there will inevitably be more instances of vegetation SAR and SOCC within the Project Area that will be discovered during rare plant surveys conducted in support of the Project. Although these species will be avoided through micro-siting to the extent possible, some individuals will be directly disturbed and lost. An adaptive management framework will be developed, including applying for an NLESA Section 19 permit and creating a SARIMMP, and new mitigation measures will be identified for unavoidable effects to plant SAR.

Plant SAR and SOCC may also be indirectly affected through site preparation activities, including from edge effects, the introduction of invasive or exotic plants, and dust. Some plant species are more susceptible to edge effects than others, as plant species have ideal ranges of abiotic conditions which they can tolerate. Some can tolerate a wide range of conditions, while others have narrow and specific needs. Edge effects can also result in changes in species diversity by direct mortality though herbivory (i.e., through increasing access for larger herbivores). Although changes resulting from edge effects will not be as great as those resulting from direct disturbance within the Project footprint, they represent a change from pre-Project conditions. Edge effects are expected to occur in areas adjacent to the Project footprint, within the Project Area and extending into the LAA. Edge effects are not expected to extend beyond the LAA.

Vegetation species in the Project Area and adjacent areas can also change as a result of the introduction of invasive or exotic plants, which can be facilitated through transportation of resources and equipment during construction. Many invasive and exotic plants are strong competitors that thrive in disturbed habitats and could out-compete native species in the area. Although there is no comprehensive list of invasive species on the Island of Newfoundland, some exotic species that are known to be invasive in other jurisdictions are likely present within the Project Area. Planned mitigation measures will reduce but are unlikely to eliminate the spread of invasive plant species in the Project Area.

In a similar manner, the Project may facilitate the spread of New York aster within the Project Area. Though not invasive, this species is a conservation issue due to its ability to hybridize with Lindley's aster, diluting the population of that Endangered species (SSAC 2009). New York aster is typically found in wet areas near the coast, often in salt marshes (Gleason and Cronquist 1991) but is also known from roadside ditches (Hinds 2000) and has been observed in ditches and other habitats within the Project Area. Seeds of New York aster are wind dispersed and may travel further into the Project Area. As such, indirect effects from the Project on Lindley's aster are expected to continue to occur.

The spread of New York aster and invasive plant species is an existing issue within the Project Area, as habitat containing Lindley's aster is subject to firewood harvesting and the Project Area contains numerous all-terrain vehicle (ATV) and snowmobile trails, which facilitates the spread of these species. Specific mitigation to reduce the potential spread of Lindley's aster is planned; however, some introduction and spread is likely. Project monitoring design mitigation, including but not limited to lining road ditches with riprap, inspecting roadways and roadside ditches, and spot herbicide application on observed locations of New York aster, should help reduce potential introduction and spread.

Transportation of resources and equipment during construction will generate dust, which will affect species diversity through mechanisms described in Section 12.5.1.1. Conservatively it is assumed that edge effects could occur within 200 m of access roads within the Project Area and thus effects of dust on species diversity will be restricted to the LAA.

Emissions, discharges and wastes from the Project will include stormwater and run-off from construction areas. Water that is diverted from one location to another can alter the hydrology of areas within and outside of the Project Area. In some areas, these changes may be extensive enough to affect plant species that cannot tolerate the changed hydrologic conditions, potentially leading to changes in species diversity in these areas. Known locations of vegetation SAR and SOCC will be considered when planning stormwater discharge and run-off locations.

Culturally Important Plants

Culturally important plants that have been identified within the region (Table 12.8) are expected to be relatively common throughout the LAA and RAA. The plants identified to species are provincially ranked S4S5, meaning the plants have an extensive range and/or many populations or occurrences, to S5, meaning the plants have very extensive range or abundant populations or occurrences (NatureServe 2023). Removal of these species within the Project footprint or Project Area is not expected to affect the persistence and availability of these species within undisturbed areas of the LAA and RAA. Some culturally important plants could be removed from portions of the Project Area and edge effects and dust could affect culturally important plants adjacent to the Project footprint; however, the spatial distribution of culturally important plants within the Project Area is not currently known.

Summary

As planned, the Project is expected to affect plant SAR and SOCC and culturally important plants within the Project footprint and adjacent areas and potentially beyond the Project Area. As planned and with existing information, the Project will affect three provincially-listed plant SAR and five plant SOCC. Additional interactions with federally-listed lichen SAR are possible. Though mitigation and micro-siting is planned and should reduce interactions with plant SAR and SOCC, it is likely not possible to avoid all plant SAR and SOCC.

As planned and with the current knowledge of species occurrences, the Project is expected to result in the loss of plant SAR and SOCC such that those species may no longer be sustainable within the RAA. As such, effects of Project construction on vegetation species diversity are expected to be adverse and high in magnitude. Direct effects on species diversity will occur within the Project footprint, and indirect effects resulting from dust, edge effects, and non-native invasive plants will be restricted to the Local Assessment Area. The duration of the residual effect is considered long-term as some changes will persist beyond the life of the Project. Construction activities will occur as a single event, and are likely to occur during spring or summer, a high sensitivity period. Indirect effects will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects) and during moderate and high sensitivity periods. Because the specific requirements for rehabilitation of many of the plant SAR and SOCC are not well understood, the effects are considered irreversible. Based on the information above, a summary of residual effects on species diversity during the construction phase is provided in Table 12.17.

Table 12.17 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• The location of the temporary workforce accommodations is unknown for the Codroy site, so residual effects to plant species diversity cannot be fully understood. However, there is potential for this activity to result in the residual loss of plant SAR or SOCC and culturally important plants, or the introduction of invasive plant species. These changes will be mitigated to the extent practicable through Project design and siting of components.
Port au Port Wind Farm and Associated Infrastructure	• Residual effects to vegetation species diversity during construction of the Port au Port wind farm and associated infrastructure are expected due to the relatively large number of plant SAR and SOCC known to occur on the Port au Port peninsula. These residual effects will be mitigated through Project design and siting of components. However, the residual loss of some plant SAR and SOCC and culturally important plants is expected. The spread of invasive plant species will be managed through mitigation and best practices.
Codroy Wind Farm and Associated Infrastructure	• Residual effects to vegetation species diversity during construction of the Codroy wind farm and associated infrastructure may occur, but the distribution of plant SAR and SOCC is not well understood in this area. Any residual effects will be mitigated through Project design and siting of components. However, the residual loss of some plant SAR and SOCC and culturally important plants is expected. The spread of invasive plant species will be managed through mitigation and best practices.
230 kV Transmission Lines and Substations	• Residual effects to vegetation species diversity during construction of the 230 kV transmission lines and substations will be mitigated through Project design and siting of components, as well as by limiting clearing within a buffer around known location of vegetation SAR and SOCC. However, the residual loss of some plant SAR and SOCC and culturally important plants is expected. The spread of invasive plant species will be managed through mitigation and best practices.
Hydrogen / Ammonia Production and Storage Facilities	• Residual effects to vegetation species diversity during construction of the hydrogen/ammonia production and storage facilities will be limited as the footprint is largely within a brownfield site. The residual loss of some plant SAR and SOCC is possible within the natural habitats that fall within the footprint of the facilities.
Port Facilities	• Residual effects to vegetation species diversity during restoration of existing port facilities will be limited as the footprint is largely within a marine environment. The residual loss of some plant SOCC is anticipated through dredging of some salt marsh habitat within the Project footprint associated with the port.

12.5.2.2 Operation and Maintenance

Though most effects on vegetation species diversity will occur during the construction phase, operation and maintenance of the Project has the potential to result in adverse environmental effects resulting in a further change to or the loss of species diversity. Vegetation management will occur within transmission and collector lines, and within the footprint of Project components associated with the wind farms; however, these activities will largely occur within previously disturbed areas. Those plant SAR and SOCC within transmission and collector lines not lost to due to construction could be affected by vegetation control occurring during Project operation and maintenance. With the planned mitigation of limiting vegetation control to hand clearing of only tree and shrub species over a minimum height threshold within a buffer around known vegetation SAR and SOCC that occur within the planned footprint of collection and transmission lines, interactions between the Project and vegetation SAR and SOCC are expected to be limited.

Vehicle traffic on access roads associated with the operation and maintenance of wind farms can lead to the introduction or spread of invasive plant species, and New York aster, which can threaten Lindley's aster populations. Although the threat of invasive species will have started during construction (Section 12.5.1.1), roads and transmission lines can continue to act as pathways for invasive species throughout their use.

The presence, operation, and maintenance of wind farms will involve vehicle traffic on access roads, which can generate dust, which can affect vegetation species in several ways, as described in the construction phase (Section 12.5.1.1).

Emissions, discharges and wastes during operation and maintenance of the Project could continue to affect vegetation species diversity similarly as during construction (Section 12.5.1.1).

Indirect effects from Project operation and maintenance may affect vegetation species diversity through dust, edge effects, and the introduction or spread of non-native invasive plants; therefore, the effects are expected to be adverse, but low in magnitude as mitigation should be effective at limiting loss of plant SAR and SOCC. Effects are expected to be restricted to the Local Assessment Area, and as no additional clearing will occur during operations and maintenance, the sustainability of remaining species will not likely be threatened. The duration of the residual effect is considered long-term as some changes will persist beyond the life of the Project. Effects will have high timing sensitivity as activities will likely occur during the spring and summer and as a continuous event, likely weekly (traffic) to once per decade (vegetation maintenance), depending on activity. Indirect effects from Project operations and maintenance will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects). Effects during operation and maintenance are considered reversible following Project decommissioning and rehabilitation; however, effects from the introduction and spread of non-native invasive plants and New York aster, if they occur, may be irreversible. Based on the information above, a summary of residual effects on change in species diversity during the operation and maintenance phase is provided in Table 12.18.

Table 12.18 Summary of Effects by Project Component During Operation and Maintenance

Project Site	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• Residual effects to vegetation species diversity will be mitigated through establishing buffers around known instances of plant SAR and SOCC occurrences during vegetation maintenance within the collector lines.
Codroy Wind Farm and Associated Infrastructure	
230 kV Transmission Lines and Substations	• Residual effects to vegetation species diversity will be mitigated through establishing buffers around known instances of plant SAR and SOCC occurrences during vegetation maintenance within the 230 kV transmission lines.
Hydrogen / Ammonia Production and Storage Facilities	• There are no interactions anticipated between the hydrogen/ammonia production and storage facilities and vegetation species diversity during operations and maintenance as this will occur in an industrial environment (Table 12.11); therefore, no residual effects are anticipated.
Port Facilities	• There are no interactions anticipated between the port facilities and vegetation species diversity during operations and maintenance as this will occur within a marine environment (Table 12.11); therefore, no residual effects are anticipated.

12.5.2.3 Decommissioning and Rehabilitation

During the decommissioning and rehabilitation phase, removal of infrastructure from the collector and transmission lines has potential to affect vegetation SAR and SOCC. With the planned mitigation of avoiding vegetation within a buffer around known vegetation SAR and SOCC that occur within the planned footprint of collector and transmission lines, interactions between the Project and vegetation species diversity will be limited to indirect effects. Traffic on access roads and elsewhere in the Project Area during decommissioning and rehabilitation will continue to potentially aid in the spread of invasive vegetation species and New York aster, and generate dust.

Effects of Project decommissioning and rehabilitation on vegetation species diversity are expected to be neutral or possibly positive relative to construction and operation phases and low in magnitude as work will be largely restricted to areas altered within the Construction phase. Indirect effects from dust, edge effects and non-native invasive plants will occur beyond the Project footprint but are expected to be restricted to the LAA. The duration of the residual effect is considered long-term as some changes may persist beyond the life of the Project, such as crossbreeding with New York aster. Decommissioning and rehabilitation activities may occur in the spring and summer which would have high timing sensitivity. Indirect effects will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects), and are considered reversible. Effects from the introduction or spread of non-native invasive plants and New York aster may be irreversible. Based on the information above, a summary of residual effects on change in species diversity during the decommissioning and rehabilitation phase is provided in Table 12.19.

Table 12.19 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Site	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations	• There are no interactions anticipated between the temporary workforce accommodations and vegetation species diversity during decommissioning and rehabilitation as this will occur in a developed area (Table 12.11); therefore, no residual effects are anticipated.
Port au Port Wind Farm and Associated Infrastructure	• Residual effects to vegetation species diversity during decommissioning and rehabilitation of the Port au Port wind farm and associated infrastructure will be managed through mitigation and best practices.
Codroy Wind Farm and Associated Infrastructure	• Residual effects to vegetation species diversity during decommissioning and rehabilitation of the Codroy wind farm and associated infrastructure will be managed through mitigation and best practices.
230 kV Transmission Lines and Substations	• Residual effects to vegetation species diversity during decommissioning and rehabilitation of the 230 kV transmission lines and substations will be managed through mitigation and best practices.
Hydrogen / Ammonia Production and Storage Facilities	• There are no interactions anticipated between the hydrogen/ammonia production and storage facilities and vegetation species diversity during decommissioning and rehabilitation as this will occur in an industrial environment (Table 12.11); therefore, no residual effects are anticipated.
Port Facilities	• There are no interactions anticipated between the port facilities and vegetation species diversity during decommissioning and rehabilitation as this will occur within a marine environment (Table 12.11); therefore, no residual effects are anticipated.

12.5.3 Residual Change in Wetland Function

12.5.3.1 Construction

Construction of the Project could result in a change in wetland function through direct disturbance or through changes in hydrology. These interactions are expected to occur primarily through site preparation and civil works activities, where wetlands or portions of wetlands will be disturbed during construction for roads, collector and transmission lines, turbine pads, the hydrogen/ammonia plant, and other Project infrastructure.

During construction, wetlands will be lost or changed by vegetation clearing and disturbances to soils, such as removal of organic materials and overburden, and infilling. Clearing will remove trees and shrubs and potentially damage understory vegetation, changing plant composition and structure. Infilling, which will be necessary within the footprints of Project infrastructure intersecting wetlands such as turbines, roads, substations, collector and transmission line structures, and the hydrogen/ammonia production and storage facility, will remove some wetland areas and their associated functions. Although not identified as wetland within the provincial land use data, wetlands appear to be present within the area that will be dredged during restoration of the existing port facilities. Wetland plant structure along the collector and transmission lines will be altered where trees and tall shrubs are managed to maintain safe line operation.

Wetland soils and lower growing vegetation (e.g., forbs, low shrubs, moss) may also be damaged by equipment and vehicle traffic.

The Bras Mort Bog, a proposed reserve mapped at just over 26 km^2, is a wetland that occurs within the 230 kV transmission line route. Just over 1 km of the 230 kV transmission line passes through the Bras Mort Bog, near its western edge, and will likely be intersected by three or more structures, and will be partially parallel to an existing transmission line that passes through the Bog. The Project Area interacts with approximately 90 ha within the Bras Mort Bog, the Project footprint, which equals 7.5 ha, represents approximately 0.2% of the Bras Mort Bog. Vegetation clearing along the transmission line RoW in the Bras Mort Bog be limited as tall vegetation likely capable of interfering with safe electrical line operation is not abundant.

Loss of wetlands will result in a decrease in available habitat within the Project Area for plants, and wildlife that use wetland habitats, including waterfowl (Chapter 13) and large mammals (Chapter 15). Loss of wetland habitats will also reduce other wetland functions within the Project Area, such as carbon sequestration. Organic carbon sequestration is an important wetland function (Government of Canada 1991), particularly in Sphagnum-dominated peatlands (Glenn et al. 2006), which are common in and near the Project Area. Hydrologic functions of bogs that are partially affected by Project clearing and infilling are unlikely to be affected as bogs are ombotrophic and receive little in the way of surface or groundwater inputs (National Wetlands Working Group 1997). Hydrologic and water quality functions of wetlands such as fens, including stream flow support, water cooling, and functions related to water chemistry, may be reduced in wetland areas adjacent to the Project footprint. Water supply areas that intersect peatlands within the Port au Port Peninsula (Chapter 8) are, however, avoided by the Project Area and thus wetlands within the recharge zones of these water supply areas are not expected to be directly affected by the Project. Changes in wetland abundance due to the Project are also not expected to contribute to flooding problems as the Project footprint will reduce wetland abundance by less than 0.74% in the RAA and the majority of the Project footprint is not located near urban areas.

Conversion of wetland habitat (i.e., a change from one type of wetland to another) will result in a change in the extent to which individual wetland functions are performed, as wetland classes, forms and types perform different functions to varying degrees. For example, if a forested wetland is cleared of trees while the wetland area remains unchanged, the wetland may have a reduced carbon sequestration function or altered wildlife habitat functions. Heavy machinery will be limited within the footprints of wetlands that will not be infilled, to reduce rutting and potential damage to wetland soils. Vegetation clearing within collector and transmission lines will be limited within wetlands without tall vegetation that could interfere with electrical lines. Other mitigation measures, such as the use of swamp mats to protect wetland soils, will be employed to reduce temporary effects to wetlands.

Invasive plant species could become introduced to or spread within wetlands through edge effects and through Project-related transportation along access roads. Invasive species can cause a change in native plant community support functions within wetlands by outcompeting and displacing native species (Sieg et al. 2003; Zelder and Kercher 2004). Planned mitigation measures will reduce but are unlikely to eliminate the spread of invasive plant species throughout the Project Area; however, mitigation is expected to be sufficient to limit the potential reduction in wetland function as result of invasive plant species.

During the construction phase, water management and erosion control structures (e.g., ditches and sedimentation ponds) will be constructed or installed. In these areas, emissions discharges, and wastes, may also alter hydrological outputs to wetlands outside the Project Area in the LAA. Changes to hydrological outputs, such as the amount or timing of water released to wetlands outside the Project Area could result in raising or lowering of the water table, which could result in a change in wetland area or wetland class or type, and a change in or reduction to associated wetland function. Wetland locations and extents will be considered when designing water management plans and systems.

Using the provincial NL land use data, at least 2.56 km^2 of wetland is within the footprint of the Project (Table 12.17), which represents approximately 4.7% of the wetland within the LAA and 0.7% of the wetland within the RAA. Of the 2.56 km^2 of wetlands within the Project footprint, 1.55 km^2 of wetland is only within the footprint of collector lines or transmission lines and is not within the footprint of other Project components. With the exception of the footprint of structures, these wetlands and their associated functions may be changed but are not expected to be lost. The actual amount of wetland within the Project footprint is likely higher than this, as treed and shrub swamps are known to be present but are not represented within the provincial data; these wetlands are likely encompassed by various wooded classes; however, these values cannot be known with currently available data. Much of the Project infrastructure has been designed to avoid or reduce interactions with known large wetland complexes, such as the peatlands on the western side of the Port au Port Peninsula; peatlands around St. George's River, including the Bras Mort Bog; and the Grand Codroy Valley Estuary. Project micrositing is largely intended to avoid vegetation SAR and SOCC but will also be used to further avoid or reduce interactions with sensitive vegetation community types such as wetlands, when possible.

Indirect effects will occur within wetlands in the Project Area and extending into the LAA. The amount of mapped wetland within the LAA but outside of the Project footprint is estimated to be 52.30 km^2 and a portion of this could potentially be indirectly affected by the Project. It is not expected that indirect effects of the Project on wetlands will extend to the boundary of the LAA in most areas. Many wetlands within the LAA but outside of the Project footprint are not contiguous with the Project footprint. Project effects in these areas will be reduced if present at all.

The hydrogen/ammonia production and storage facilities will be supported by water intake from local waterbodies, including Muddy Pond, Noels Pond, and Gull (Mine) Pond. During construction, short berms are planned to be added to Gull (Mine) Pond, which will raise the water level by approximately 1.5 m. This increase in water level could result in a combination of changes including increasing the amount of contiguous wetland associated with Gull (Mine) Pond, converting upland habitat to wetland by raising the water table or converting existing wetland to deep water habitat (2 m or greater depth of water).

With the expected reduction in wetland function resulting from direct and indirect effects of Project construction on wetland function are adverse. Effects of Project construction on wetland function are expected to be moderate in magnitude, as they will be measurable within the LAA. Indirect effects of Project construction on wetland function from hydrological changes, dust, edge effects, and non-native invasive plants will occur beyond the Project footprint but are expected to be restricted to the LAA. The duration of the residual effect is considered long-term as some changes will persist beyond the life of the Project. Construction will occur as a single event, potentially during the spring or summer, a high sensitivity period. Indirect effects will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects). Because some of the wetlands have developed over millennia, loss of their functions is considered irreversible. Based on the information above, a summary of residual effects on change in wetland function during the construction phase is provided in Table 12.20.

Table 12.20 Summary of Effects by Project Component During Construction

Project Site	Summary of Effect during Construction
Temporary Workforce Accommodations	• The location of the temporary workforce accommodations is unknown so residual effects to wetland function cannot be fully understood. However, there is potential for this activity to result in the residual loss of wetland function. Residual effects to wetland function during construction of temporary workforce accommodations will be mitigated through Project design and siting of components to the extent practicable.
Port au Port Wind Farm and Associated Infrastructure	• Residual effects to wetland function during construction of the Port au Port wind farm and associated infrastructure will be mitigated through Project design and siting of components. Some wetlands, including portions of large peatland complexes, are expected to be lost or changed as a result of Project construction and some wetland habitat adjacent to the Project footprint may also be changed through edge effects and hydrological changes.
Codroy Wind Farm and Associated Infrastructure	• Residual effects to wetland function during construction of the Codroy wind farm and associated infrastructure will be mitigated through Project design and siting of components. Some wetlands, including rich riparian wetlands, are expected to be lost or changed as a result of Project construction and some wetland habitat adjacent to the Project footprint may also be changed through edge effects and hydrological changes.
230 kV Transmission Lines and Substations	• With the exception of the footprint of structures, wetlands within the 230 kV transmission lines, including the Bras Mort Bog, will experience vegetation clearing potentially resulting in a change to wetland type or class, and wetland functions.
Hydrogen / Ammonia Production and Storage Facilities	• Some wetland area within the footprint of the hydrogen/ammonia production and storage facilities will be permanently lost. Clearing within the wetland will be limited to the necessary footprint for construction purposes.
Port Facilities	• Although not identified as such within the Provincial land use data, some wetland area will likely be lost as a result of dredging associated with restoration of the existing port facilities.

12.5.3.2 Operation and Maintenance

Although most of the changes to wetlands, particularly within the Project Area, are expected to occur during the construction phase, some additional changes are expected during the operation and maintenance phase. As described above for construction, Project-related transportation during operation could introduce or aid in the spread of invasive plant species to wetlands and can spread dust in areas adjacent to the access road, although the rate of traffic is expected to be lower than during construction. Plants may also be temporarily damaged by equipment and vehicle use along the collector and transmission line RoW. Emissions, discharges, and wastes during operation are predicted to continue to interact with wetland function through water management and erosion control structures that were established during construction, and these may continue to affect the hydrology of wetlands within and adjacent to the Project Area.

Access road maintenance will include dust control activities, which can increase sedimentation and siltation into wetlands adjacent to the access roads. Sand applied for road maintenance during winter months can enter the surrounding environment, resulting in siltation and changes to soil fertility and soil structure, particularly in wetlands.

The operation of the hydrogen/ammonia production and storage facilities will be supported by water intake from local waterbodies, including Muddy Pond, Noels Pond, and Gull (Mine) Pond. During operation, the industrial water supply withdrawals are anticipated to reduce mean annual outflow of Noels Pond by 19% and 25% for Gull (Mine) Pond (described in greater detail in Chapter 7). These reductions in flow could result in reductions to area of wetlands downgradient of these waterbodies and their outflows. There are very few mapped wetlands adjacent to the outflows of either Noels Pond or Gull (Mine) Pond; thus, little wetland area is expected to be affected by potential water drawdown; however, there could be measurable changes in plant communities in these wetlands resulting from changes in water table depth.

Effects of Project operation and maintenance on wetland function are expected to be adverse, low in magnitude, and restricted to the LAA, as wetland communities may change but a loss of wetland function is not expected to be measurable within the LAA. The duration of the residual effect is considered long-term as some changes will persist beyond the life of the Project. Effects will have high timing sensitivity as activities will likely occur during the spring and summer and as a continuous event, likely weekly (traffic) to once per decade (vegetation maintenance), depending on activity. Indirect effects will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects). Effects are considered reversible following Project decommissioning and rehabilitation, although changes in wetland community composition may persist and differ from existing conditions within the LAA. Based on the information above, a summary of residual effects on change in wetland function during the operation and maintenance phase is provided in Table 12.21.

Table 12.21 Summary of Effects by Project Component During Operation and Maintenance

Project Component	Summary of Effect during Operation and Maintenance
Port au Port Wind Farm and Associated Infrastructure	• Residual effects to wetland function resulting from emissions, discharges, and wastes will be managed by applying best practices and standard erosion and sedimentation control mitigation measures described in Section 12.4.
Codroy Wind Farm and Associated Infrastructure	
230 kV Transmission Lines and Substations	• Residual effects to wetland function are anticipated to be limited within the operation phase of the 230 kV transmission lines and substations and will be managed through mitigation measures described in Section 12.4.
Hydrogen / Ammonia Production and Storage Facilities	• Residual effects to wetland function are anticipated to result from industrial water supply withdrawals from nearby waterbodies and watercourses. As there are few mapped wetlands adjacent to these areas, loss of wetland function is expected to be limited.
Port Facilities	• There are no interactions anticipated between the port facilities and wetland function during operations (Table 12.11); therefore, no residual effects are anticipated.

12.5.3.3 Decommissioning and Rehabilitation

During the decommissioning and rehabilitation phase it is anticipated that some wetlands will re-establish following the removal of Project components and the rehabilitation of the Project footprint. Most wetlands are not expected to return to pre-Project conditions and functions may not return for many decades, if at all, following rehabilitation as woody species are slow growing, particularly in much of the Project Area where growing conditions are harsh. Surrounding topography may also be permanently altered, changing water inputs to adjacent wetlands. In particular, undisturbed peatlands within the Project Area have developed over millennia (Davis 1984), and areas of tuckamore could be hundreds of years old (Payette et al. 2008). Traffic on access roads and throughout the Project Area during decommissioning and rehabilitation will continue to potentially aid in the spread of invasive vegetation species; though effects to wetland function from invasive species are not expected, invasive species that establish within wetlands are likely to persist.

Effects of Project decommissioning and rehabilitation on wetland function are expected to be neutral or possibly positive relative to construction and operation phases, and low in magnitude as work will be largely restricted to areas altered during the Construction phase. Indirect effects from dust, edge effects and non-native invasive plants will occur beyond the Project footprint but are expected to be restricted to the LAA. The duration of the residual effect is considered long-term as some changes will persist beyond the life of the Project. Decommissioning and rehabilitation activities may occur in the spring and summer which would have high timing sensitivity. Indirect effects will occur as multiple irregular events (i.e., introduction of non-native invasive plants and dust) to continuous (i.e., edge effects), and be reversible. Based on the information above, a summary of residual effects on change in wetland function during the decommissioning and rehabilitation phase is provided in Table 12.22.

Table 12.22 Summary of Effects by Project Component During Decommissioning and Rehabilitation

Project Component	Summary of Effect during Decommissioning and Rehabilitation
Temporary Workforce Accommodations Port au Port Wind Farm and Associated Infrastructure Codroy Wind Farm and Associated Infrastructure 230 kV Transmission Lines and Substations	• Some wetlands are expected reestablish following the removal of Project components and the rehabilitation of the Project footprint. However, wetlands will take many decades to re-establish, if they do so at all, and may re-establish with different functions than pre-Project. In particular, the peatlands within the Port au Port wind farm may take millennia to re-establish.
Hydrogen / Ammonia Production and Storage Facilities	• Topography of the area within the hydrogen / ammonia production and storage facilities that was wetland prior to construction will be re-established to encourage the reformation of wetland in this area.
Port Facilities	• There are no interactions anticipated between the port facilities and wetland function during decommissioning and rehabilitation as this will occur within a marine environment (Table 12.11); therefore, no residual effects are anticipated.

12.5.4 Residual Environmental Effects Summary

12.5.4.1 Residual Environmental Effects Characterization

Table 12.23 summarizes the predicted environmental effects (residual effects) of the undertaking on wetlands and vegetation, including rare plants.

Table12.23 Summary of Predicted Environmental Effects of the Undertaking on Wetlands and Vegetation, including Rare Plants

Residual Effect	Residual Effects Characterization							
	Nature	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Construction								
Change in Community Diversity	A	M	LAA	HS	LT	S/IR	R	U/D
Change in Species Diversity	A	H	LAA	HS	LT	S/IR	I	U/D
Change in Wetland Function	A	M	LAA	HS	LT	S/IR	I	U/D
Operation and Maintenance								
Change in Community Diversity	A	L	LAA	HS	LT	IR/C	R	U/D
Change in Species Diversity	A	L	LAA	HS	LT	IR/C	R/I	U/D
Change in Wetland Function	A	L	LAA	HS	LT	IR/C	R/I	U/D
Decommissioning and Rehabilitation								
Change in Community Diversity	N	L	LAA	HS	LT	IR/C	R	U/D
Change in Species Diversity	N	L	LAA	HS	LT	IR/C	R/I	U/D
Change in Wetland Function	N	L	LAA	HS	LT	IR/C	R/I	U/D

KEY:

Nature:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Timing:
NS: No Sensitivity
MS: Moderate Sensitivity
HS: High Sensitivity

Frequency:
S: Single Event
IR: Irregular Event
R: Regular Event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

12.5.4.2 Summary of Predicted Environmental Effects

With mitigation, the Project is anticipated to result in adverse residual effects to community diversity, species diversity and wetland function during construction and operation and maintenance. Residual effects are expected to be neutral during decommissioning and rehabilitation. Vegetation clearing and other aspects of site preparation and civil works will result in direct disturbance to vegetation communities, SAR, SOCC and wetland function, and indirect disturbance will result from edge effects and the potential introduction of invasive plants. The magnitude of these changes will be moderate to high, plant SAR and SOCC, during construction, and low during operation and maintenance and decommissioning and rehabilitation. The indirect disturbance will extend into the LAA for all Project phases and may occur during high sensitivity windows for plants, as the phases are expected to occur year-round. The residual effects will be long-term during all phases, as vegetation communities will not immediately recover once a phase is over. The frequency of the residual effects will be continuous due to potential on-going effects from invasive plants, dust, and edge effects. The frequency of effects from clearing will be a single event. Residual effects occurring during the construction phase are considered reversible for community diversity, although plant composition in established communities may differ from existing communities, and irreversible for species diversity and wetland function because non-native invasive plants may persist and topography adjacent to wetlands may not returned to existing condition. The residual effects occurring during the operation and maintenance phases and the decommissioning and rehabilitation phases are largely indirect and are considered reversible to irreversible. Effects from dust and edge effects are likely reversible following Project decommissioning and rehabilitation and effects from non-native invasive plants and New York aster will likely persist. Prior to the Project, the ecological and socio-economic context of most of the Port au Port Peninsula and the Stephenville area is disturbed, but the majority of the Project falls within the Port au Port and Codroy wind farms which are relatively undisturbed.

12.6 Determination of Significance

A significant residual adverse effect on wetlands and vegetation, including rare plants is defined as a residual Project-related change to the environment that results in any of the following:

- Threatens the long-term persistence or viability of a vegetation species in the RAA, including effects that are contrary to or inconsistent with the goals, objectives, or activities of provincial or federal recovery strategies, action plans and management plans (i.e., change from a non-listed species to a species of management concern)
- Threatens the long-term persistence or viability of a vegetation community in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of provincial or federal recovery strategies, action plans and management plans
- Results in a non-conformance with section 5.1 of the NL Policy for Development in Wetlands

In consideration of the VEC-specific significance criteria defined above, with application of avoidance (through Project design and micro-siting) and other currently planned mitigation, the residual effects of routine Project activities on wetlands and vegetation are predicted to be significant due to the anticipated loss of plant SAR and SOCC. Two plant SAR, Lindley's aster and tradescant aster, and five plant SOCC, hay-scented fern, Host's sedge, slender-leaved sundew, knotted rush, and saltwater cordgrass, are currently within the Project footprint. Fifteen percent of the known SAR records for tradescant aster in the RAA, and a third of all known records in the RAA of two plant SOCC, hay-scented fern and host sedge, are intersected by the Project footprint. Additionally, the viability of other plant SAR and SOCC potentially affected by the Project may be threatened due to the limited number of known occurrences in the RAA and their provincial status (e.g., Endangered). Approximately 2% of the known occurrences of Lindley's aster in the RAA are directly intersected by the Project footprint, but occurrences will likely be indirectly affected by further spread of New York aster, which could hybridize with Lindley's aster, diluting populations of the Endangered plant. Recovery or management plans have not been released for the plant SAR affected.

To help manage the potential significant effects to plant SAR and SOCC, a rare plant mitigation plan and SARIMMP will be prepared as part of an NLESA Section 19 permit application, and submitted to NLDFFA-WD. In consultation with NLDFFA-WD the Plan will be developed on the basis of estimates of SAR and/or SOCC lost, and the extent of their remaining habitat in the Project Area, LAA and RAA, with the intent of monitoring and mitigating potential adverse effects to SAR and SOCC. The Plan will present general and species-specific mitigation and habitat restoration measures (where applicable) to be implemented, including: relevant commitments; new mitigation measures, if applicable, resulting from supplementary botanical surveys; criteria that describes the circumstances under which each measure will be applied; and measurable goals for evaluating mitigation success.

The area of some native vegetation communities will be reduced due to the Project, but no native community type will be lost from the RAA and no native community type not currently uncommon in the RAA (i.e., occupying 1% or less of the RAA) will become uncommon based on available information. The greatest direct loss will be to soil barrens, coniferous scrub and wet bog (greater than 10% reduction in existing area in the RAA). Wet bog is currently uncommon in the RAA, occupying 0.62% of the RAA, and abundance will be reduced to 0.55%. Though wetland area will be lost and corresponding functions reduced as a result of the Project, the residual effects to wetland function are not expected to result in non-conformance with section 5.1 of the NL Policy for Development in Wetlands. The level of confidence in this prediction is discussed in Section 12.7.

12.7 Prediction Confidence

The prediction confidence in the determination of significance for wetlands and vegetation, including rare plants, is considered low. The predictions are based largely on publicly available information collected as part of digital data compilation, and uncertainty in the final Project footprint.

The distribution and relative abundance of vegetation species (including SAR and SOCC), vegetation communities, and wetlands in the Project Area and the suitability of the coarse habitat types to support specific vegetation species, including SAR are not fully understood. Available data of the distribution and abundance of plant SAR and SOCC does not cover the entire Project Area; it is expected that some records (particularly those which are considered historical) may no longer represent current occurrences, additional occurrences of many of the SAR and SOCC recorded within the RAA exist within the Project Area, and that new, previously unrecorded plant SOCC may also be present within the Project Area and Project footprint. A conservative approach was used to identify high-quality habitat for Lindley's aster and predict loss of vegetation communities, including wetlands, which compensates for some uncertainty. Habitat occurrence and loss was mapped using available GIS data, but habitat data was coarse and was not suitable for detailed quantitative analyses. Additional community types are also likely present, and wetlands are likely underrepresented in the available data. Mitigation measures identified in Section 12.4 are based on industry standards.

Prediction confidence is expected to increase following the completion of pre-construction surveys and proposed monitoring programs discussed in Section 12.8.

12.8 Follow-Up and Monitoring

Vegetation species and land cover classification surveys are currently being conducted within the Port au Port and portions of the St. George's Bay Subregions of the Project Area, to gain a better understanding of and quantify:

- distribution and abundance of vegetation SAR and SOCC
- vegetation SAR and SOCC habitats
- potential Project effects on vegetation SAR and SOCC
- extents and descriptions of land cover classes, including vegetation communities and wetlands, present in the RAA
- Project effects to vegetation communities, including wetlands, such as any that may occur within the Port facilities footprint

These surveys will continue in the St. George's Bay and Codroy Subregions in 2024. The results of these surveys will be reported to regulators following their completion.

Should it be determined that the Project will directly affect SAR or sensitive habitats, additional mitigation and monitoring programs will be developed in consultation with NLDFFA-WD.

12.9 Capacity of Renewable Resources and Effects on Biological Diversity

The potential environmental effects of the Project on wetlands and vegetation, including rare plants, were assessed using the best available public data. The assessment concluded that routine Project activities are not likely to result in significant residual adverse effects on wetlands and vegetation communities. Although some of the vegetation communities within the LAA are used by local persons for firewood harvesting, wooded areas (i.e., hardwood, mixedwood and softwood) will remain abundant with 376.40 km^2 remaining in the LAA and 1,847.00 km^2 in the RAA, following Project construction. Similarly, the abundance of plants of cultural importance to Indigenous groups will be altered but are expected to remain common within the LAA and RAA. Areas of higher importance for traditional use are not known and may be affected by the Project. Potential effects to firewood users and the capacity of renewable timber resources to meet present and future needs are further addressed under Land and Resource Use (Chapter 20). Adverse Project-related effects on biological diversity that affect the long-term viability of biological diversity in the RAA are not anticipated with respect to wetlands and vegetation communities. Adverse Project-related effects on the long-term biological diversity in the RAA are anticipated for plant SAR and SOCC, including rare plants, provided additional mitigation measures are incorporated for SAR and SOCC. WEGH2 will work with NLDFFA-WD to apply for an NLESA Section 19 permit and develop a rare plant mitigation plan and SARIMMP to reduce effects from the Project to acceptable levels.

12.10 Predicted Future Environmental Conditions if the Project Does Not Proceed

If the Project is not allowed to proceed, the existing conditions as described in the baseline section will continue to prevail, including current land use and natural conditions. It is possible that future development may occur in the area, including wind energy (given those Project areas are designated for wind farm development), but neither the likelihood nor extent of such development can be reasonably predicted at this time based on currently known information. Future projects are anticipated to have similar effects on wetlands and vegetation, including rare plants. Should the Project Area remain undeveloped, the predicted future condition of wetlands and vegetation, including rare plants would be relatively unchanged from what was documented during the existing environment assessment presented in Section 12.2.

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