WAASIGAN
TRANSMISSION LINE

FINAL ENVIRONMENTAL ASSESSMENT

Section 6.3 Groundwater

November 2023

Acknowledgements

We wish to acknowledge that the Waasigan Transmission Line Project is located within lands that represent the traditional territories and homelands of the Robinson-Superior Treaty (1850) and Treaty #3 (1873) First Nations, and traverse the Red Sky Métis Independent Nation, Northwestern Ontario Métis Community and Northern Lake Superior Métis Community.

Hydro One also wishes to acknowledge Indigenous artist, Storm Angeconeb, for developing the covering page and wildlife designs throughout the Final Environmental Assessment. Storm is a highly recognized visual artist from Lac Seul First Nation in Treaty #3 and currently resides in Red Lake. Many of her works include animals and birds as representations of herself or those close to her. The artist's description of the covering page is presented below.

Hydro One Environmental Study Art:

What stands out in this art piece is the symbolic representation of solar rays as "Bringing Power"; we can see the environment represented through the wildlife and Ojibwe floral visuals. This artwork is an excellent representation of Hope, Life, and Opportunity, visually portrayed through the Black Bear and her two cubs. The colour theme of this artwork comes from the Waasigan Transmission Line Project brand identity.

Artist: Storm Angeconeb

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6.3 Groundwater

Gondaawijiwan

This section describes and summarizes the groundwater baseline studies undertaken for the Project and presents an assessment of the effects of the Project on groundwater.

The assessment follows the general approach and concepts described in Section 5.0.

6.3.1 Input from Engagement

Comments pertaining to groundwater that were raised by Indigenous communities, government officials and agencies, and interested persons and organizations during engagement and how they are addressed in the environmental assessment (EA) are listed in Table 6.3-1. Comments and responses are provided in Section 4.0 – Engagement Summary. In addition, the Draft EA Report was provided to Indigenous communities, government officials and agencies, and interested persons and organizations for review and comment on May 17, 2023. A high-level summary of the key themes from the comments on the Draft EA Report and related engagement meetings are included in Table 6.3-1. The detailed responses to these comments are included in Appendix 4.0-A.

Table 6.3-1: Summary of Comment Themes Raised During Engagement Related to Groundwater

Comment Theme	How Addressed in the Environmental Assessment	Indigenous Community or Stakeholder
Water is very important and must be protected.	• Potential effects from the Project to groundwater are addressed in Section 6.3.7. The Project will have appropriate mitigation measures in place, mainly during construction, to reduce potential effects of the Project on groundwater (Section 6.3.7). With the implementation of these mitigation measures, no significant effects to groundwater are predicted.	Multiple Indigenous communities
Question if spring fed lakes and groundwater were included in the assessment.	• Potential effects to groundwater quality and quantity are assessed and appropriate mitigation measures are identified in this EA section.	Mitaanjigamiing First Nation
Concerns regarding potential contamination of surface water and groundwater.	• Potential effects to groundwater quality are assessed and appropriate mitigation measures are identified in this EA section.	Gwayakocchigewin Limited Partnership

Comment Theme	How Addressed in the Environmental Assessment	Indigenous Community or Stakeholder
		Members of the public
Concerns regarding potential damage to groundwater wells and the water table.	• Potential effects to water wells with respect to groundwater quality and quantity are assessed and appropriate mitigation measures are identified in this EA section.	Members of the public
Underground springs that feed wells in the area should be protected.	• Potential effects to water wells with respect to groundwater quality and quantity are assessed and appropriate mitigation measures are identified in this EA section.	Members of the public
Source Water Protection planning should be considered.	• Potential effects to groundwater quality and quantity are assessed and appropriate mitigation measures are identified in this EA section. The Lakehead Region Conservation Authority was consulted for comment on potential risks to source water.	Ministry of the Environment, Conservation and Parks
Activities such as dewatering and sewage disposal may be subject to permitting requirements.	• Proposed mitigation measures include obtaining and adhering to required permits.	Ministry of the Environment, Conservation and Parks
Concerns regarding how construction activities, such as excavations, poured concrete foundations, and blasting, may impact groundwater quality and flows.	• Potential effects to groundwater quality and quantity are assessed and appropriate mitigation measures for excavations, concrete foundations, and blasting are identified in this EA section.	Gwayakocchigewin Limited Partnership
Some properties near the Project may use water supply wells that are not recorded in the provincial well database such as shallow, dug wells.	• Hydro One will work with landowners to identify wells that may be potentially affected by the Project and determine ways that construction activities can be modified to avoid those effects.	Ministry of the Environment, Conservation and Parks
Construction dewatering may encounter flowing artesian conditions.	• Dewatering activities and dewatering well construction and decommissioning will comply with regulations to be protective of artesian aquifers.	Ministry of the Environment, Conservation and Parks

6.3.2 Information Sources

Information for the groundwater baseline was collected from review of the following sources:

- An Assessment of the Groundwater Resources of Northern Ontario (Singer and Cheng 2002);
- Thunder Bay Area Aquifer Characterization Groundwater Management and Protection Study (Burnside and AMEC 2005); and
- Ministry of the Environment, Conservation and Parks (MECP) Water Well Record and Permit to Take Water Databases (MECP 2022a,b).

The review of the MECP water well records was carried out to identify municipal water supply wells and private wells in the groundwater local study area (LSA). The water well record database also supported the characterization of groundwater levels. Some water wells, such as shallow, dug wells, may not be recorded in the MECP water well record database. Detailed information regarding water sources for Indigenous communities near the Project was not available at the time of writing.

For the purposes of the EA, sufficient information was deemed to be available from the references listed above to assess the potential effects of the Project on groundwater.

6.3.3 Criteria and Indicators

Criteria are components of the environment that are considered to have economic, social, biological, conservation, aesthetic, or ethical value, as described in Section 5.2. **Indicators** are an aspect or characteristic of a criterion that, if changed as a result of the Project, may demonstrate a physical, biological or socio-economic effect.

The criteria and indicators for groundwater were initially outlined in the Draft ToR. Feedback from Indigenous communities, government officials and agencies, and interested persons and organizations received during engagement was incorporated into the preliminary criteria and indicators approved in the Amended ToR.

No concerns have been raised during the EA process regarding the preliminary criteria and indicators proposed in the Amended ToR. The criteria and indicators selected for the assessment of Project effects on groundwater, and the rationale for their selection, are provided in Table 6.3-2.

Table 6.3-2: Groundwater Criteria and Indicators

Criteria	Indicators	Rationale	Measurement of Potential Effects
Groundwater Quality and Quantity	• Change in groundwater quality, levels and flow considering: ◦ numbers, depths, and proximity of water wells in the study area; and ◦ anticipated groundwater withdrawal and discharge during construction.	• IK and community feedback regarding the importance of water. • Commitment to avoid or minimize impacts to groundwater quality and quantity, which has social and cultural value and may: ◦ be a source of potable and non-potable water supply; and ◦ provide baseflow to surface water features.	• The amount or abundance and spatial configuration of groundwater and groundwater receptors. This is measured qualitatively and quantitatively as changes in abundance and distribution of the indicators in the assessment area. • Qualitative assessment of the physical and chemical characteristics of groundwater.

IK = Indigenous Knowledge

6.3.4 Assessment Boundaries

6.3.4.1 Temporal Boundaries

The Project is planned to occur in three stages:

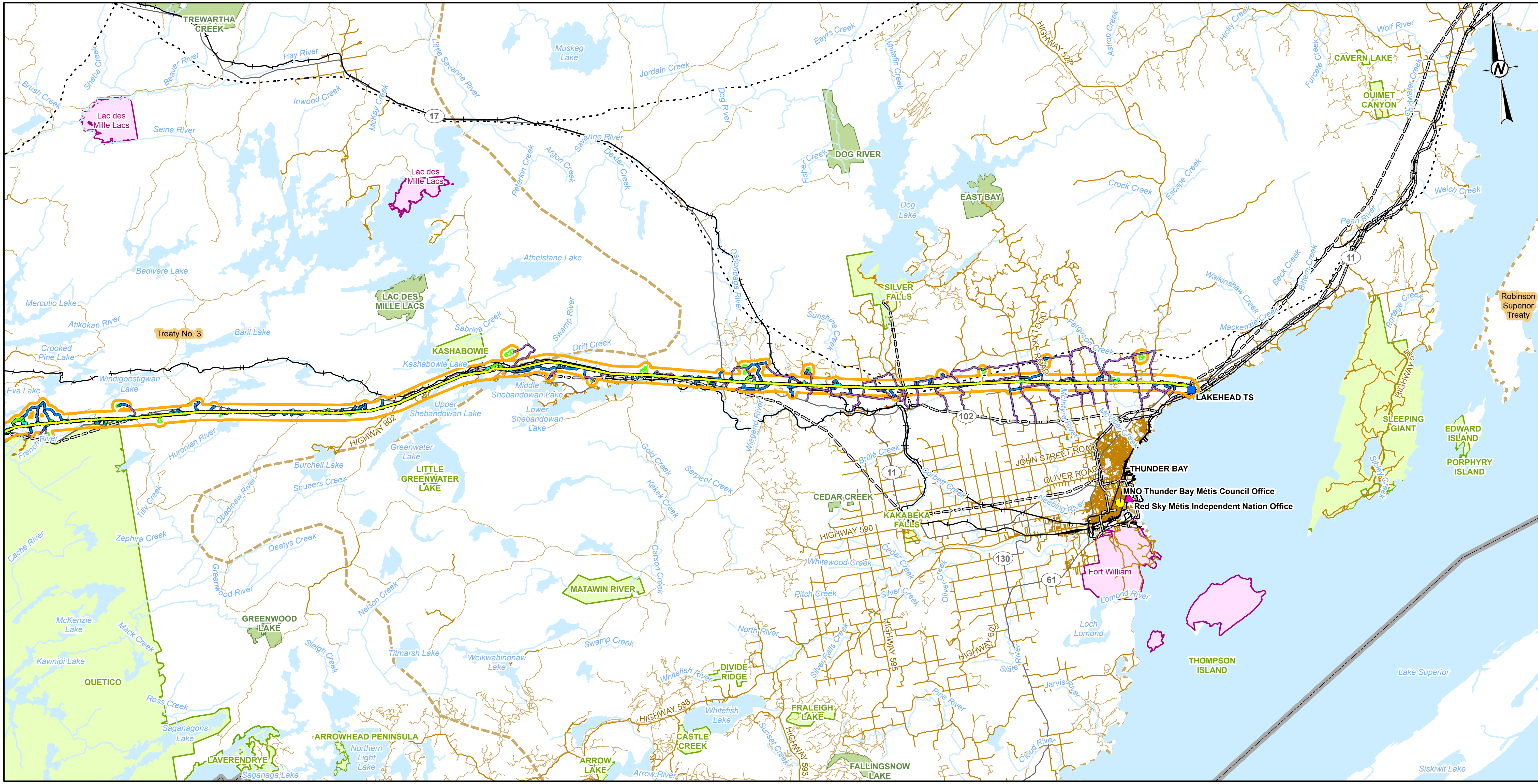
- **Construction stage**: the period from the start of construction to the start of operation (in-service date).
- **Operation and maintenance stage**: the period from the start of operation and maintenance activities through to the end of the Project life.
- **Retirement stage**: the period from the end of the Project life and start of retirement activities through to the end of final reclamation of the Project.

As described in Section 5.3.2, the Project will be operated for an indefinite period and the timing of retirement, or decommissioning, is not known at this time as it is anticipated that upgrades to reinforce or rebuild portions of the Project may occur over its lifetime to maintain its longevity. Further, potential effects and mitigation measures to be identified during the EA for the construction of the Project will likely equally apply to the potential removal of the Project at a future point in time, should it ever be required. Therefore, the construction scenario assessed as part of the EA is considered bounding and potential effects and mitigation measures for retirement are not identified separately in this EA.

The assessment of Project effects on groundwater considers changes that occur during the construction and the operation and maintenance stages. These boundaries are sufficient to capture the effects of the Project.

6.3.4.2 Spatial Boundaries

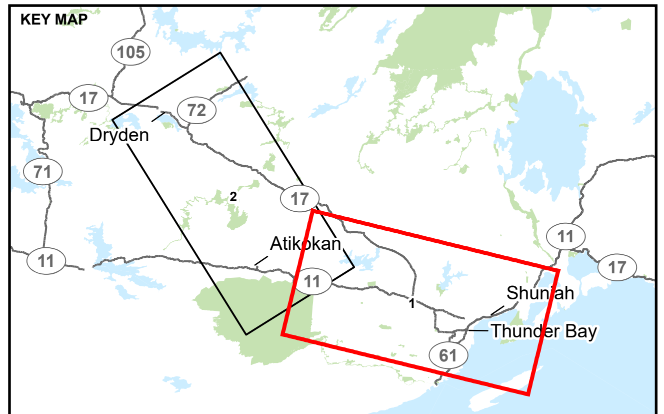
Spatial boundaries for the assessment are described in Table 6.3-3 and shown on Figure 6.3-1.



LEGEND

- RED SKY MÉTIS INDEPENDENT NATION OFFICE
- MNO COUNCIL OFFICE
- 230 kV TRANSFORMER STATION (TS)
- RAILWAY
- LOCAL ROAD
- SECONDARY HIGHWAY
- RESOURCE / RECREATION
- WATERCOURSE
- NATURAL GAS PIPELINE
- INTERNATIONAL BORDER
- EXISTING TRANSMISSION LINE
- EXISTING ACCESS ROAD - NO IMPROVEMENTS REQUIRED
- EXISTING ACCESS ROAD - POTENTIAL IMPROVEMENTS
- NEW ACCESS ROAD - PREFERRED
- NEW ACCESS ROAD - ALTERNATE
- PREFERRED ROUTE TRANSMISSION LINE RIGHT-OF-WAY
- AGGREGATE SITE
- FLY YARD
- GROUNDWATER STUDY AREA
- FIRST NATIONS RESERVE
- TREATY BOUNDARY
- CONSERVATION RESERVE
- PROVINCIAL PARK
- WATERBODY

KEY MAP



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PROJECTION: NAD 1983 CSRS UTM ZONE 15N

CLIENT
HYDRO ONE NETWORKS INC.

PROJECT
WAASIGAN TRANSMISSION LINE

CONSULTANT

wsp

YYYY-MM-DD	2023-09-28
DESIGNED	MB
PREPARED	DB
REVIEWED	HK
APPROVED	CS

TITLE
LOCAL STUDY AREA FOR GROUNDWATER

PROJECT NO.	CONTROL	REV.	FIGURE
20137728	0029	1	6.3-1.1

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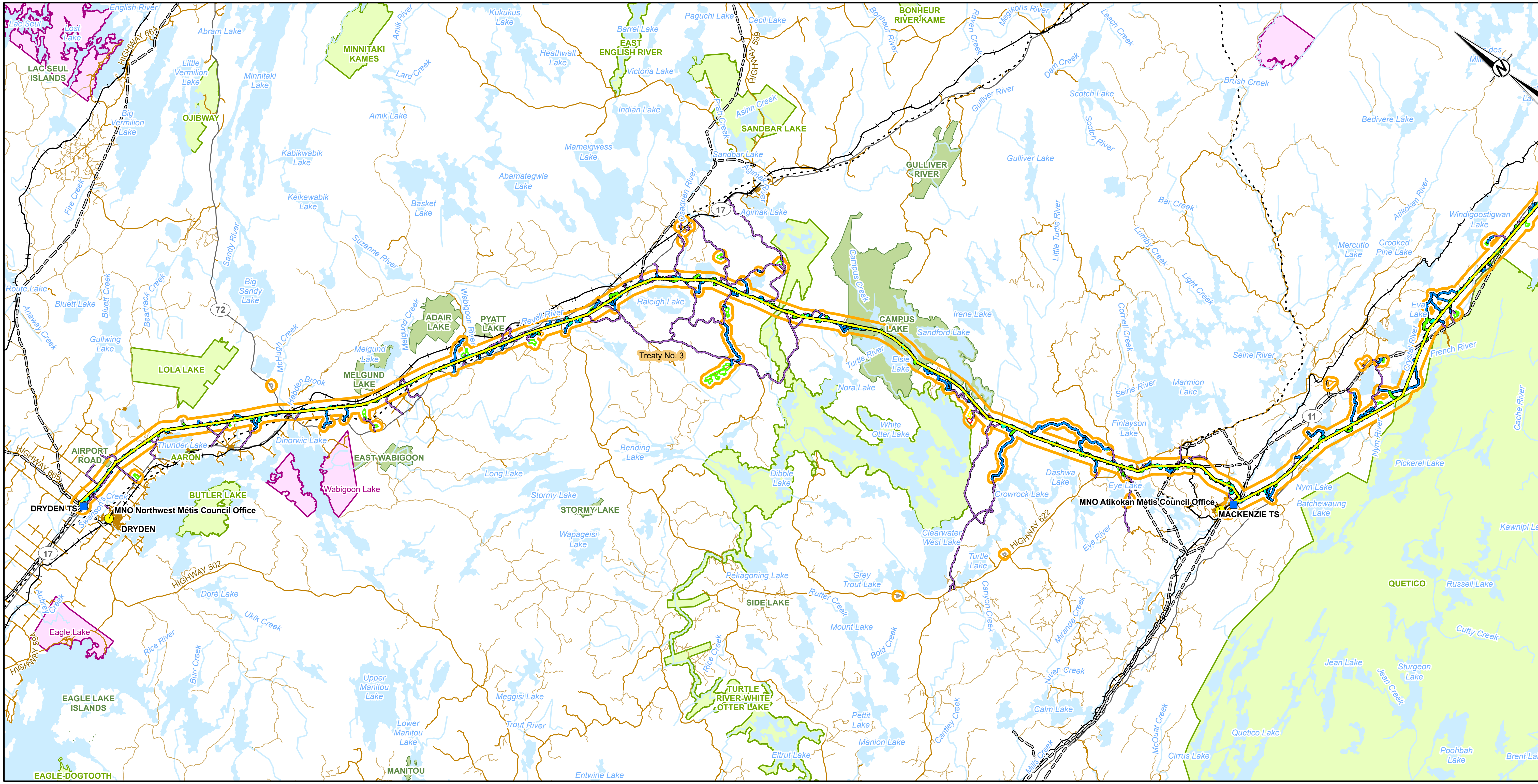

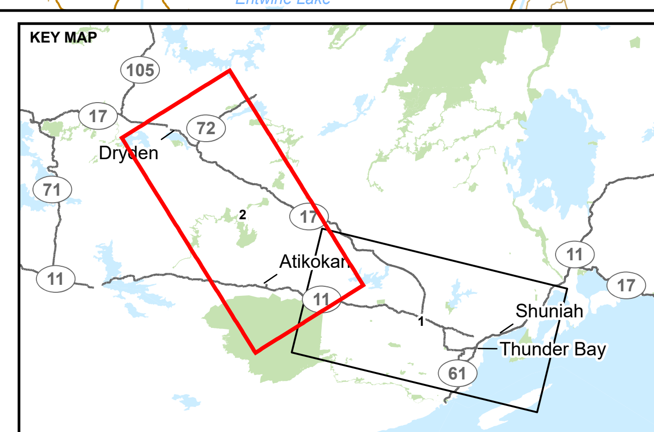

LEGEND

- MNO COUNCIL OFFICE
- 230 kV TRANSFORMER STATION (TS)
- RAILWAY
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- RESOURCE / RECREATION
- WATERCOURSE
- NATURAL GAS PIPELINE
- EXISTING TRANSMISSION LINE
- EXISTING ACCESS ROAD - NO IMPROVEMENTS REQUIRED
- EXISTING ACCESS ROAD - POTENTIAL IMPROVEMENTS
- NEW ACCESS ROAD - PREFERRED
- NEW ACCESS ROAD - ALTERNATE
- PREFERRED ROUTE TRANSMISSION LINE RIGHT-OF-WAY
- D26A / F25A CIRCUIT SEPARATION
- AGGREGATE SITE
- FLY YARD
- CAMP / LAYDOWN
- CONSTRUCTION CAMP (NO LONGER TO BE USED)
- FLY YARD / CAMP / LAYDOWN
- GROUNDWATER STUDY AREA
- FIRST NATIONS RESERVE
- TREATY BOUNDARY
- CONSERVATION RESERVE
- PROVINCIAL PARK
- WATERBODY

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PROJECTION: NAD 1983 CSRS UTM ZONE 15N

CLIENT
HYDRO ONE NETWORKS INC.

PROJECT
WAASIGAN TRANSMISSION LINE

CONSULTANT

YYYY-MM-DD	2023-10-25
DESIGNED	MB
PREPARED	DB
REVIEWED	HK
APPROVED	CS

TITLE
LOCAL STUDY AREA FOR GROUNDWATER

PROJECT NO.	CONTROL	REV.	FIGURE
20137728	0029	1	6.3-1.2

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Table 6.3-3: Overview of Spatial Boundaries

Spatial Boundaries	Area (ha)	Description	Rationale
Project footprint	4,073	The Project footprint includes: • Typical 46 m wide transmission line ROW; • Widened ROW for the separation of circuits F25A and D26A for 1 km; • Modification of the Lakehead TS, Mackenzie TS, and Dryden TS; • Access roads (improved existing roads and new); • Temporary supportive infrastructure associated with construction including fly yards, construction/stringing pads, laydown areas, construction camps, and helicopter pads; and • Aggregate pits.	• Designed to capture the potential direct effects of the physical footprint of the Project.

LSA	89,098	Includes the Project footprint and:
		• A 1 km buffer on the transmission line ROW (including the ROW for circuits F25A and D26A)
		• A 500 m buffer on the ancillary components including:
		  ◦ TS expansion areas;
		  ◦ Access roads (improved existing roads and new);
		  ◦ Temporary supportive infrastructure; and
		  ◦ Aggregate pits.
			• The predicted radius of influence from groundwater pumping or changes to groundwater recharge from construction activities is not anticipated to extend beyond 500 m. The LSA is therefore considered to be large enough to encompass any measurable effects on groundwater.
			• The LSA also provides an area for regional context and assessment of cumulative impacts.
			• A separate groundwater regional study area (RSA) is not necessary because the predicted zone of influence from the Project on groundwater is anticipated to be within the LSA and the groundwater LSA is appropriate for assessing potential cumulative impacts from other groundwater use in the LSA.

ha = hectares; km = kilometre; m = metre; ROW = right-of-way; LSA = local study area; RSA = regional study area, TS = transformer station.

6.3.5 Description of the Existing Environment

This section provides a summary of the existing environment for groundwater based on review of desktop information.

6.3.5.1 Baseline Data Collection Methods

A desktop study was completed to identify the groundwater baseline conditions in the LSA. Available data sources were reviewed, and relevant information assembled to provide overview descriptions of groundwater distribution, flow, and quality within the LSA. Information was collected from existing published literature and provincial mapping data and incorporated into a geographic information system (GIS) platform. Baseline conditions are summarized below.

6.3.5.2 Baseline Conditions

6.3.5.2.1 Groundwater Quantity

Groundwater aquifers in the northwest Ontario region and the LSA can be divided into two main groups based on geology. Overburden aquifers are localized and occur where there is sufficient extent and depth of overburden deposits to accumulate significant quantities of groundwater. These aquifers can be highly productive sources of groundwater where there are large areas of coarse-grained (sand and gravel) deposits. Bedrock aquifers are widespread throughout the area, but their groundwater productivity is variable, and dependent on the local fracture networks in the rock (Singer and Cheng 2002).

Regional groundwater flow generally follows the surface watersheds with flows towards the east and Lake Superior in the eastern parts of the LSA. West of the Kashabowie area, the regional flow direction is towards the northwest and Hudson Bay via the Nelson River system. Local groundwater flow typically parallels the surface topography, particularly adjacent to major river valleys. Groundwater discharge may provide baseflow to streams and rivers (Burnside and AMEC 2005).

Recharge of the overburden and bedrock aquifers in the LSA occurs through direct infiltration of precipitation and from surface watercourses and waterbodies. Recharge rates would be highest in areas of coarse-grained overburden and exposed, fractured bedrock. Groundwater discharge may occur in low-lying areas such as watercourse valleys and wetlands.

A review of MECP water well records within the LSA indicates that overburden (where present) ranged in thickness from 0.3 to 55 metres (m). Groundwater levels measured at the time of installation of these wells reportedly ranged from 7.6 metres above ground surface to 64 metres below ground surface (mbgs).

Within the LSA there were 608 MECP water well records identified. These wells were drilled between 1954 and 2021. The reported MECP water well record well usage in the LSA is summarized in Table 6.3-4 and the well record details are summarized in Appendix 6.3-A, Table 1; the well locations are shown on Figures 1 to 30 in Appendix 6.3-B.

Table 6.3-4: Summary of Water Well Use in the Local Study Area

Primary Well Use	Number of well records
Water supply	489
Test, observation, monitoring, or dewatering	42
Abandoned	27
No/other use specified	50

In the LSA, 489 wells were recorded as used for water supply; of these, 60% (or 293 wells) were drilled deep enough to reach bedrock at depths of 0.3 mbgs to 54.9 mbgs (median depth to bedrock 5.2 mbgs). The depths of the water supply wells ranged from 1.8 mbgs to 252 mbgs (median well depth 39.0 mbgs). The static water level in these wells upon completion of drilling ranged from 7.6 metres above ground surface to 64 mbgs (median static water level 5.2 mbgs).

Five wells in the LSA reported flowing artesian conditions (i.e., static groundwater levels above the ground surface). Two of these wells are located south of the Lakehead TS, at a lower elevation. Another is located north of Thunder Bay and also likely at a lower elevation than the Project footprint. The remaining two flowing wells are located north of Dryden, in the area of the Dryden TS, and appear to be at a similar elevation as the Project footprint in the area. Other water well records are also located in these areas, with similar depths, that do not report flowing conditions.

It is estimated that dewatering of excavations for foundation installations on the Project may have a potential 115 m radius of influence on groundwater levels (see Section 6.3.7.2). According to the MECP water well records (MECP 2022b), there are 72 water supply wells within the 115 m potential radius of influence of the Project footprint. These wells are summarized in Table 2, in Appendix 6.3-A.

6.3.5.2.1.1 Ministry of the Environment, Conservation and Parks Permit to Take Water Database

The MECP Permit to Take Water (PTTW) database (MECP 2022a) was queried to identify active PTTWs in the LSA. The PTTW are classified into general categories by use and subdivided into specific purposes. The following items are noted with respect to the PTTW:

- Maximum daily takings represent the maximum allowable volume of water that can be taken under the associated permits and do not necessarily represent actual sustained takings; and
- The reported locations of the water takings are based on the applicant's information and accuracy may vary.

Five active PTTW were identified within the LSA. Two of the PTTW were for takings from multiple sources. A summary of the information for these PTTW is presented in Table 6.3-5, below. The locations of the active PTTW in the LSA are shown on Figures 1 to 30 in Appendix 6.3-B.

Table 6.3-5: Ministry of the Environment, Conservation and Parks Permits to Take Water Within the Local Study Area

Permit Number	Permit Holder Name	Purpose	Specific Purpose	Maximum Litres per Day	Source Type
2017-9LDKKS	Walter F Marchese (Silver Springs Estates)	Water Supply	Communal	25,000	groundwater
2017-9LDKKS	Walter F Marchese (Silver Springs Estates)	Water Supply	Communal	25,000	groundwater
2017-9LDKKS	Walter F Marchese (Silver Springs Estates)	Water Supply	Communal	25,000	groundwater
2017-9LDKKS	Walter F Marchese (Silver Springs Estates)	Water Supply	Communal	25,000	groundwater
P-300-5166020505	Lempiala Sand & Gravel Limited	Industrial	Aggregate Washing	2,618,000	surface water
P-300-5166020505	Lempiala Sand & Gravel Limited	Industrial	Aggregate Washing	1,745,000	surface water
4237-9XJRG3	The Corporation of the Town of Atikokan	Water Supply	Municipal	6,048,000	surface water
5818-B9MKZE	Atikokan Sportsmen's Conservation Club	Commercial	Aquaculture	72,000	surface water
5746-AVQMFN	The Corporation of the City of Dryden	Water Supply	Other - Water Supply	741,600	groundwater

6.3.5.2.1.2 *Source Water Protection and Water Supply*

The eastern part of the LSA is located within the Lakehead Source Protection Area (LSPA). Within the LSPA the water sources for municipal water supply systems are identified and studied to protect the source water quality and quantity through risk management. The only municipal groundwater source in the LSPA is in Rosslyn Village, about 18 km south of the LSA. The City of Thunder Bay sources its municipal drinking water from Lake Superior (Burnside and AMEC 2005). The Lakehead Region Conservation Authority was consulted and confirmed that the Rosslyn Village Wellhead Protection Area and the City of Thunder Bay Intake Protection Zone are both located outside of the Project footprint and they had no concerns with the Project relating to source water protection. Studies within the LSPA have also characterized the hydrologic systems of the region including assessments of Significant Groundwater Recharge Areas (SGRA) and Highly Vulnerable Aquifers (HVA). The LSA crosses several limited areas designated as SGRA that are associated with coarse-grained overburden deposits. SGRA are areas where the groundwater recharge rate is above the average recharge rate for the region. The majority of the LSPA is designated as HVA area and this is also true of the LSA. HVA are areas that are judged to have an elevated risk of contamination at surface reaching the underlying aquifers. The shallow and coarse-grained overburden found across much of the LSPA leads to the widespread presence of HVA areas. Areas where SGRA and HVA are mapped are shown on Figures 1 to 6 in Appendix 6.3-C.

Municipal water supplies for Atikokan (Atikokan River) and Dryden (Wabigoon Lake) are also sourced from local surface water bodies (City of Dryden 2022, Northern Waterworks Inc. 2022).

Private water supplies outside of the municipal systems can be expected to rely on wells for their water source.

6.3.5.2.2 Groundwater Quality

A review of the reported water quality from the MECP water well record database indicated that fresh water was produced by 449 wells, one well was salty, and the remaining wells did not have water quality recorded.

An assessment was made of general groundwater quality in the Thunder Bay area based on public water quality results from several hundred wells (Burnside and AMEC 2005). The assessment looked at the concentrations of six common water quality parameters: nitrate, sodium, chloride, iron, manganese, and hardness. The assessment found that there was wide variation in concentrations across the studied area with no clear spatial trends. Groundwater quality in general was typical of results in other parts of the province with hard water being common and variable concentrations of the other parameters that likely resulted from natural groundwater conditions. One possible association between elevated chloride concentrations and proximity to major roads in the area was attributed to salt application to roads for de-icing.

6.3.6 Potential Project-Environment Interactions

Potential Project-environment interactions were identified through a review of the Project Description and existing environmental conditions. The linkages between Project components and activities and potential effects to groundwater are identified in Table 6.3-6.

Table 6.3-6: Project-Environment Interactions for Groundwater

Criteria	Indicator	Project Phase Construction[(a)]	Project Phase Operation and Maintenance	Description of Potential Project-Environment Interaction
Groundwater Quality and Quantity	Change in groundwater quality, levels and flow	✓	✓	Changes to groundwater quality from spills
Groundwater Quality and Quantity	Change in groundwater quality, levels and flow	✓	–	Changes to groundwater levels and flows from excavations and dewatering activities
Groundwater Quality and Quantity	Change in groundwater quality, levels and flow	✓	–	Changes to groundwater quality from excavations and dewatering activities
Groundwater Quality and Quantity	Change in groundwater quality, levels and flow	✓	✓	Changes to groundwater levels and flows from altered recharge rates due to vegetation clearing, and road and structure construction
Groundwater Quality and Quantity	Change in groundwater quality, levels and flow	✓	–	Changes to groundwater quality and flow from blasting for road, quarry, and foundation construction
Groundwater Quality and Quantity	Change in groundwater quality, levels and flow	✓	–	Changes to groundwater levels and flow associated with operation of construction camp water supply wells
Groundwater Quality and Quantity	Change in groundwater quality, levels and flow	✓	–	Changes to groundwater quality, levels and flow due to water discharges from construction activities and camps

✓ = A potential Project-environment interaction could result in an environmental or socio-economic effect;
_ = No plausible interaction was identified.

a) As described in Section 6.3.4.1, the construction scenario assessed as part of the EA is considered bounding and potential effects and mitigation measures for retirement are not identified separately in this EA.

6.3.7 Potential Effects, Mitigation Measures, and Net Effects

This section presents the potential effects, appropriate mitigation measures, and predicted net Project effects for groundwater. A summary of the potential effects, mitigation measures, and net effects are presented in Table 6.3-7.

6.3.7.1 Changes to Groundwater Quality from Spills

Potential Effects

Activities such as materials haulage, solid and liquid waste handling, fuel storage and use, and hazardous materials handling have the potential to affect groundwater quality if accidental spills occur.

Mitigation Measures

Hydro One Networks Inc. (Hydro One) and their contractor(s) will prepare and implement an Environmental Protection Plan (EPP) and Spill and Emergency Preparedness and Response Plan that will include procedures to decrease the risk of an accidental spill occurrence and timely clean-up if a spill were to occur. A Waste Management and Disposal Plan will also be developed to effectively manage non-hazardous and hazardous wastes. Specific mitigation measures will include: limiting work to within the ROW as much as possible; prohibiting refuelling of equipment near sensitive receptors; equip work areas and vehicles with spill kits for spill response; limit soil stripping wherever possible; maintain access roads and establish safe driving rules for Project vehicles; transportation and storage of hazardous materials will follow all applicable regulatory requirements; conducting and documenting regular inspections of material storage and equipment; avoiding work within designated HVA where practicable; providing secondary containment for all bulk fuel storage; developing waste management plans for all Project waste streams that comply with regulations and include spill prevention; and ensure that employees are trained in material handling, spill prevention, and spill response and clean-up.

Net Effects

With the implementation of an EPP, Spill and Emergency Preparedness and Response Plan, and Waste Management and Disposal Plan, accidental spills or discharges of wastes of sufficient magnitude to alter groundwater quality are not expected to occur. Therefore, this potential effect is classified as having no net effect and this effect was not carried forward to the net effects characterization.

6.3.7.2 Changes to Groundwater Levels and Flows from Excavations and Dewatering Activities

Potential Effects

Installation of transmission structures, connection facilities and TSs will likely require excavations for foundations. Dewatering of these excavations could result in short-term changes to groundwater levels and flow. Foundation types and specific locations will be determined in detailed planning. For the effects assessment it is assumed that dewatering would be required for foundations in order to consider all potential effects of the Project; however, all these effects may not be realized.

Grouted soil and rock anchors may be used for the guy wires to resist the tension force applied by each guy wire. Typically, for grouted soil and rock anchors, holes will be drilled into the subsurface material, a steel anchor bar inserted into the drillhole to the required depth and the bar grouted into the soil or rock. It is expected that no dewatering will be required for the installation of the soil and rock anchors for the guy wires as this method of construction does not require dewatering.

Micropiles may be used for the transmission structures or if deep foundations are required in cases where bedrock is relatively shallow. Where soft soils or deep rock are anticipated, helical piles are expected to be the primary foundation option. Micropile foundations are small diameter pile type foundations (typically less than 300 millimetres) that are drilled in place and capped. A capped micropile would be used for each leg of the transmission structure. Micropiles may be installed by various methods such as drilling, impact driving or jacking. Helical piles are installed with rotary hydraulic equipment. It is unlikely that installation of the small diameter micropiles or helical piles will result in a measurable change in groundwater volume or flow direction. No dewatering is expected to be required for the installation of micropiles or helical piles.

Shallow concrete foundations may also be required for light duty steel poles as well as for the legs of self-supporting steel lattice towers. Typical dimensions of shallow concrete foundations are approximately 1.5 m by 1.5 m with a depth ranging up to 3.5 m, depending on subsurface conditions. For the purposes of this assessment, a maximum foundation depth of 3.5 m has been assumed. It is estimated that the radius of influence (for groundwater drawdown of 0.3 m or greater) of dewatering for such an excavation could extend up to 115 m from the excavation based on an estimated hydraulic conductivity of 1×10^{-3} m/s for sandy till soils (Freeze and Cherry 1979), and conservatively assuming that the water table is at ground surface. If the dewatering rates are greater than 50,000 litres per day (L/day), a Permit to Take Water or registration with the Environmental Activity and Sector Registry (EASR) will be required.

Shallow concrete foundations will also be required for the TSs. Typical dimensions of these foundations are approximately 4.5 m by 4.5 m with a depth of 2 m. It is estimated that the radius of influence (for groundwater drawdown of 0.3 m or greater) of dewatering of each of these shallow excavations could extend up to 95 m from the excavation based on an estimated hydraulic conductivity of the sandy till soils of 1×10^{-3} m/s (Freeze and Cherry 1979), and conservatively assuming that the water table is at ground surface. A more detailed assessment of the dewatering requirements can be made once the geotechnical investigation is completed during the design stage. If the dewatering rates are greater than 50,000 L/day, a Permit to Take Water or registration with the EASR will be required.

If dewatering is required for foundation construction, it could temporarily result in a lowering of the local groundwater table, and a temporary alteration in the direction of groundwater flow adjacent to the excavations during construction. In certain cases where artesian groundwater pressures exist, dewatering may be required to lower potential groundwater levels below excavations. Depressurization pumping could also potentially cause temporary alteration to the direction of local groundwater flows and dewatering wells could potentially create pathways for groundwater discharge from the artesian aquifer.

Groundwater baseflow is seasonally important to some local waterbodies and natural environment features (e.g., vegetation, fish and fish habitat, and wetlands). Construction activities have the potential to temporarily locally influence groundwater discharge as baseflow to these features. The surface water effects assessment, indicates that approximately 16% of waterbody crossings were located on waterbodies identified as seasonal flow or relatively low flows, thereby not receiving groundwater throughout the year.

There are 72 wells located within 115 m of the Project footprint that are listed as water supply wells and 55 of these well records reported static water levels for the well. Based on the distances of each of the wells from the Project footprint, estimated groundwater level drawdown at each well location due to construction dewatering for foundation construction was estimated using the Theis equation (Theis 1935) and summarized in Table 2 in Appendix 6.3-A. The available depth of water (water column) in these wells is estimated to be temporarily reduced by 1% to 29% due to dewatering activities, based on static water levels provided in the MECP water well records.

In general, wells located at distances greater than 10 m from the Project footprint showed less than 10% change in the available water column. All wells had less than 20% estimated change in available water column with the exception of well ID 5400614, which is located within the Project footprint and has an estimated 29% reduction in available water column. Well 5400614 is reported to be drilled into bedrock to a depth of almost 18 m, so dewatering of shallower foundation excavations would not be expected to significantly affect the water supply to this well.

The effect of dewatering activities on groundwater quantity in the water supply wells within the potential radius of influence is considered temporary, with water levels anticipated to recover following the end of construction activities. The rate of rebound will depend upon well construction, proximity to dewatering activities and precipitation but is, in most cases, anticipated to recover during construction or extending into the early stage of operation and maintenance.

Mitigation Measures

Hydro One and their contractor(s) will develop and implement an EPP and Groundwater Dewatering and Discharge Plan that will include practices and procedures to reduce the impacts from dewatering foundation excavations. These practices and procedures will comply with O.Reg. 387/04 and will include recording all water taking amounts, times and locations. Dewatering wells will be constructed and decommissioned in compliance with O.Reg. 903.

Hydro One will also work with private landowners to identify nearby wells with the potential to be affected by the Project, including shallow dug wells, and ways in which construction activities and locations can be modified to reduce those effects, including avoiding excavation near private wells. In the event of well interference as a result of the Project, Hydro One will work with the landowner to provide alternative water supply.

Net Effects

A temporary measurable change relative to baseline groundwater levels and flow is expected where dewatering is conducted for foundation excavations and installation. Based on the potential effects assessment above, there may be water supply wells within the estimated radius of influence that could experience a temporary, measurable reduction in water levels due to the Project dewatering. Therefore, there is a net effect of changes to groundwater levels and flow from excavations and dewatering activities and this interaction is carried forward to the net effects characterization.

6.3.7.3 Changes to Groundwater Quality from Excavations and Dewatering Activities

Potential Effects

Changes to groundwater quality in the LSA may occur due to Project activities, such as concrete foundation construction or dewatering of excavations, that changes groundwater flow patterns and moves pre-existing contaminants to new areas.

Poured concrete used for foundations for the transmission towers, TSs and connection facilities has the potential to affect groundwater quality. Lime (i.e., calcium oxide or calcium hydroxide) used in concrete is alkaline in nature and imparts a relatively high pH to uncured concrete. The use of concrete for foundation construction may increase the pH of groundwater in the immediate vicinity of the foundation during the curing process.

Water supply wells are located within the anticipated 115 m radius of influence of foundation excavation dewatering. Groundwater fed springs may also be located within the radius of influence. Dewatering of excavations during Project construction may result in changes to groundwater flow that mobilize pre-existing groundwater contamination.

Mitigation Measures

Hydro One and their contractor(s) will develop and implement an EPP, Spill and Emergency Preparedness and Response Plan, and Groundwater Dewatering and Discharge Plan that will include practices and procedures to reduce the impacts of dewatering foundation excavations. These practices and procedures will include: avoiding construction below the groundwater table where practicable; conduct dewatering according to regulatory and permit requirements; daily monitoring of environmentally sensitive features such as water bodies and springs; training for spill response, clean-up and disposal; monitoring of dewatering according to permit requirements; and contain dewatering discharge that does not meet regulatory or permit requirements and treat or dispose at a licensed disposal facility.

Hydro One will also work with private landowners to identify nearby wells with the potential to be affected by the Project, including shallow dug wells, and ways in which construction activities and locations can be modified to reduce those effects, including avoiding excavation near private wells. In the event of well interference as a result of the Project, Hydro One will work with the landowner to provide alternative water supply.

Net Effects

Where dewatering is carried out for foundation excavations and installation of foundations, a temporary measurable change in groundwater quality relative to baseline groundwater quality may occur due to contact with uncured concrete or mobilization of pre-existing contamination. Therefore, there is a net effect of changes to groundwater quality from excavations and dewatering activities and this interaction is carried forward to the net effects characterization.

6.3.7.4 Changes to Groundwater Levels and Flows from Altered Recharge Rates due to Vegetation Clearing, and Road and Structure Construction

Potential Effects

Clearing of vegetation will take place along the ROW, where new or improved existing access roads are constructed, where temporary supportive infrastructure is located (e.g., construction camps and laydown areas) and where TSs are expanded. Clearing of vegetation may increase recharge to shallow groundwater areas, thereby potentially increasing local groundwater levels. Conversely, the construction of access roads and Project structures will increase the areas of hardened surfaces and may increase runoff/reduce local groundwater recharge in those areas. These effects are expected to be localized and limited in magnitude as the Project footprint area represents only about 3% of the LSA, vegetation will be re-established in the ROW and temporary roads and workspaces will be removed and restored following construction.

Mitigation Measures

Hydro One and their contractor(s) will develop and implement an EPP that will include practices and procedures to reduce the impacts of altered recharge rates. These practices and procedures will include: using existing access roads as much as possible; locating laydown and fly yards, construction camps and aggregate pits in previously disturbed areas wherever practicable and locating Project facilities involving large areas of hardened surfaces, such as construction camps and laydown yards, outside of designated SGRA to the extent practicable; limiting clearing and grading to only where necessary; retaining low vegetation along the ROW where feasible; restricting stumping and grading to work areas and avoid on slopes; maintaining soil cover on the ROW as much as practicable; replacing and regrading any removed soil in workspaces; revegetating cleared areas following construction; and removing temporary access roads and workspaces following construction.

Net Effects

A temporary change in the local groundwater table is possible due to changes to recharge rates caused by removal of vegetation (increasing recharge) or construction of roads and structures (decreasing recharge). This change is limited by the small area that the changes would occur in of about 3%, or less, of the LSA. Any changes to groundwater levels are expected to not be measurable and, therefore, there is no net effect of changes to groundwater levels and flow from altered recharge rates due to vegetation clearing, and road and structure construction and this interaction is not carried forward to the net effects characterization.

6.3.7.5 Changes to Groundwater Quality and Flow from Blasting for Road, Quarry, and Foundation Construction

Potential Effects

Use of explosives during Project construction has the potential to affect groundwater quality and flow patterns. Specifically, ammonium nitrate-based explosives may be used to remove bedrock for the placement of foundations and roads and the extraction of rock from quarries. This type of explosive has the potential to leave nitrogen residual substances (e.g., ammonia, nitrate) that can leach into groundwater. The vibrations associated with blasting can also loosen or dislodge and then suspend fine particles (rock flour) from the well bore of water wells, causing a temporary condition of turbid water quality in the well. Blasting of bedrock can induce fracture formation in the bedrock around the blasting site due to the forces involved. This has the potential to increase the bulk hydraulic conductivity of the bedrock, which could change groundwater flow patterns.

Mitigation Measures

Hydro One and their contractor(s) will develop and implement an EPP and Blasting and Communication Management Plan that will include practices and procedures to reduce the impacts of blasting for road and foundation construction. These practices and procedures will include: employing rock ripping, hammering or drilling instead of blasting wherever possible; using existing access roads where possible; establishing quarries above the water table only; following all applicable regulatory and permit requirements for explosives storage, use, and disposal; and using blast patterns designed to minimize ground disturbance outside of the target area.

Hydro One will work with private landowners to identify nearby wells with the potential to be affected by the Project, including shallow dug wells, and ways in which construction activities and locations can be modified to reduce those effects, including avoiding excavation and blasting near private wells. In the event of well interference as a result of the Project, Hydro One will work with the landowner to provide alternative water supply.

Net Effects

Blasting may be used during Project construction to remove bedrock for building roads, structure foundations or quarries. This blasting may leave residual substances that can change groundwater quality, it can cause fracturing of bedrock around the blast area that can change groundwater flow and may change water quality in the well. These effects are expected to be localized but potentially measurable and therefore, there is a net effect of changes to groundwater quality and flow from blasting for road, quarry and foundation construction and this interaction is carried forward to the net effects characterization.

6.3.7.6 Changes to Groundwater Levels and Flow Associated with Operation of Construction Camp Water Supply Wells

Potential Effects

Eleven potential construction camp locations are included in the Project footprint; however, it is anticipated that only three will be required once detailed planning is completed. The other sites may still be used as laydown areas. It is anticipated that the three temporary construction camps may source their potable water supply from wells if municipal water is not readily available. The average water consumption per person is estimated at 300 L/day. A daily rate of 105,000 L/day is therefore anticipated to be required for a camp supply well based on an anticipated peak occupancy of each camp of up to approximately 350 workers. This water taking rate would require a Permit to Take Water from the MECP as it is greater than 50,000 L/day.

Details of camp water requirements and well needs will be determined during detailed planning. The potential construction camp locations, as shown on Figures 1 to 30 in Appendix 6.3-B, are located far (more than 500 m) away from MECP water well record locations. All of the potential camp locations are located near wetland areas, which may be affected by changes to groundwater levels and flow.

Mitigation Measures

Hydro One and their contractor(s) will develop and implement an EPP and Groundwater Dewatering and Discharge Plan that will include practices and procedures to reduce the impacts of camp water supply wells. These practices and procedures will include: locating construction camps outside of the required buffer zone for water bodies and wetlands; and constructing, permitting, and decommissioning water supply wells according to applicable regulations. If required, permitting of water taking for new water supply wells will include site-specific technical studies to assess the potential impacts of the water taking on nearby water users and natural environmental features.

Net Effects

Temporary construction camps may require new water supply wells. Taking water from these wells will lower local groundwater levels and change groundwater flow directions. These effects are expected to be limited in extent but potentially measurable and, therefore, there is a net effect of changes to groundwater levels and flow associated with operation of construction camp water supply wells and this interaction is carried forward to the net effects characterization.

6.3.7.7 Changes to Groundwater Quality Due to Water Discharges from Construction Activities and Camps

Potential Effects

Construction activities, such as equipment cleaning, and temporary camp operations, will generate water that may be discharged back to the environment where it could infiltrate the ground and interact with the groundwater. If the discharged water contains contaminants or has different properties than the groundwater, the quality of groundwater could be affected.

Mitigation Measures

Hydro One and their contractor(s) will develop and implement an EPP, Waste Management and Disposal Plan, and Groundwater Dewatering and Discharge Plan that will include practices and procedures to reduce the impacts of water discharges. These practices and procedures will include: avoiding work within designated HVAs where practicable; designating concrete and equipment wash areas; temporary camp sewage and grey water will be contained and treated prior to on-site discharge via an approved and permitted sewage system or removed by a licenced contractor for off-site disposal at an approved disposal facility; if contaminated groundwater is encountered it will not be discharged on-site, but contained and disposed off-site at a licensed facility; and inspecting wastewater systems regularly and maintaining records of discharge volumes, locations and times.

Permitting of sewage systems for temporary camps (e.g., Environmental Compliance Approval) will include site-specific technical studies to assess the impacts of the discharge on nearby waters and natural environmental features.

Net Effects

Discharge of water from construction activities and temporary camp operations may infiltrate the ground surface and contact groundwater. Infiltration of discharged water close to where the water was sourced is desirable to maintain local water balances, but the properties of groundwater may be changed. These effects are expected to be limited in extent but potentially measurable and, therefore, there is a net effect of changes to groundwater quality due to water discharges from construction activities and camps and this interaction is carried forward to the net effects characterization.

6.3.7.8 Summary

Table 6.3-7 provides a summary of the effects assessment, which is based on the previous assessment discussion and the implementation of mitigation measures identified above and summarized in the table below.

Table 6.3-7: Potential Effects, Mitigation Measures, and Predicted Net Effects to Groundwater

Project Component or Activity	Potential Effect	Mitigation Measures	Net Effect
Project activities during the construction stage: • Transportation of personnel, materials and equipment; and • Hazardous materials, solid and liquid waste handling. **Project activities during the operations stage:** • Transportation of personnel, materials and equipment; and • Hazardous materials, solid and liquid waste handling.	Changes to groundwater quality from spills.	• Hydro One with their contractor(s) will prepare and implement an EPP and Spill and Emergency Preparedness and Response Plan. • Limiting all work to within the ROW as much as possible. • Prohibiting refuelling of equipment near sensitive receptors. • Equipping work areas and equipment with spill kits for spill response. • Limiting soil stripping wherever possible, maintaining access roads and establishing safe driving rules for Project vehicles. • Transportation and storage of hazardous materials will follow all applicable regulatory requirements, conducting and documenting regular inspections of material storage and equipment. • Avoiding work within designated HVA where practicable. • Providing secondary containment for all bulk fuel storage. • Developing waste management plans for all Project waste streams that comply with regulations and include spill prevention, and ensuring that employees are trained in material handling, spill prevention, and spill response and clean-up.	No net effect
Project activities during the construction stage: • Foundation excavation and installation including dewatering activities.	Changes to groundwater levels and flows from excavations and dewatering activities.	• Hydro One with their contractor(s) will prepare and implement an EPP and Groundwater Dewatering and Discharge Plan. • Avoiding foundation construction requiring dewatering where groundwater will be encountered if feasible. • Recording water taking amounts, times and locations. • Conducting all water takings according to regulatory requirements. • Constructing and decommissioning dewatering wells according to regulatory requirements. • Working with private landowners to identify wells with the potential to be affected by the Project, and ways in which construction can be modified to reduce those effects. • Working with private landowners to provide alternative water supply if required.	Net changes to groundwater levels and flows from excavations and dewatering activities.

Project Component or Activity	Potential Effect	Mitigation Measures	Net Effect
Project activities during the construction stage: • Foundation excavation and installation including dewatering activities.	Changes to groundwater quality from excavations and dewatering activities.	• Hydro One with their contractor(s) will prepare and implement an EPP, Spill and Emergency Preparedness and Response Plan, and Groundwater Dewatering and Discharge Plan. • Avoiding construction below the groundwater table where practicable. • Conducting dewatering according to regulatory and permit requirements. • Daily monitoring of environmentally sensitive features, such as water bodies and springs. • Training for spill response, clean-up and disposal. • Monitoring of dewatering according to permit requirements. • Containing dewatering discharge that does not meet regulatory or permit requirements and treating or disposing of the discharge at a licensed disposal facility. • Working with private landowners to identify wells with the potential to be affected by the Project, and ways in which construction can be modified to reduce those effects. • Working with private landowners to provide alternative water supply if required.	Net changes to groundwater quality from excavations and dewatering activities.
Project activities during the construction stage: • Clearing, grubbing, stumping, grading and removal of vegetation from the ROW and access roads; and • Construction of access roads, work areas, temporary camps and structure foundations. **Project activities during the operations stage:** • Vegetation management along the ROW and access roads; and • Maintenance and construction of new access roads if required.	Changes to groundwater levels and flows from altered recharge rates due to vegetation clearing, and road and structure construction.	• Using existing access roads as much as possible. • Locating laydown and fly yards, construction camps and aggregate pits and quarries in previously disturbed areas wherever practicable. • Locating Project facilities involving large areas of hardened surfaces, such as construction camps and laydown yards, outside of designated SGRA to the extent practicable. • Limiting clearing and grading to only where necessary. • Retaining low vegetation along the ROW where feasible. • Restricting stumping and grading to work areas and avoid on slopes. • Maintaining soil cover on the ROW as much as practicable. • Replacing and regrading any removed soil in workspaces. • Revegetating cleared areas following construction where necessary. • Removing temporary access roads and workspaces following construction.	Net changes to groundwater levels and flows from altered recharge rates due to vegetation clearing, and road and structure construction.

Project Component or Activity	Potential Effect	Mitigation Measures	Net Effect
Project activities during the construction stage: • Potential use of explosives and blasting to create level areas for transmission structures, roads, and for foundation and quarry excavations.	Changes to groundwater quality and flow from blasting for road, quarry, and foundation construction.	• Hydro One with their contractor(s) will prepare and implement an EPP and Blasting and Communication Management Plan. • Employing rock ripping, hammering or drilling instead of blasting wherever reasonably possible. • Using existing access roads where reasonably possible. • Establishing quarries above the water table only. • Following all applicable regulatory and permit requirements for explosives storage, use, and disposal. • Using blast patterns designed to minimize ground disturbance outside of the target area. • Working with private landowners to identify wells with the potential to be affected by the Project, and ways in which construction can be modified to reduce those effects. • Working with private landowners to provide alternative water supply if required.	Net changes to groundwater quality and flow from blasting for road, quarry, and foundation construction.
Project activities during the construction stage: • Pumping of wells for supply of potable water to temporary construction camps.	Changes to groundwater levels and flow associated with operation of construction camp water supply wells.	• Hydro One with their contractor(s) will prepare and implement a EPP and Groundwater Dewatering and Discharge Plan. • Locating construction camps outside of the required buffer zone for water bodies and wetlands. • Constructing, permitting, and decommissioning water supply wells according to applicable regulations.	Net changes to groundwater levels and flow associated with operation of construction camp water supply wells.

Project Component or Activity	Potential Effect	Mitigation Measures	Net Effect
Project activities during the construction stage: • Discharge of water from construction activities and temporary construction camp operations.	Changes to groundwater quality due to water discharges from construction activities and camps.	• Hydro One with their contractor(s) will prepare and implement an EPP, Waste Management and Disposal Plan, and Groundwater Dewatering and Discharge Plan. • Avoiding work within designated HVAs where practicable. • Designating concrete and equipment wash areas. • Containing and treating temporary camp sewage and grey water prior to on-site discharge via an approved and permitted sewage system or removal by a licenced contractor for off-site disposal at an approved disposal facility. • Discharging groundwater from excavations to designated areas on site, more than 30 m away from surface waterbodies where it can infiltrate the ground surface. • Contaminated groundwater, if encountered, will be contained and disposed of at an off-site licensed facility. • Inspecting water system regularly and maintaining records of discharge volumes, locations and times.	Net changes to groundwater quality due to water discharges from construction activities and camps.

m = metres; ROW = right-of-way, HVA = Highly Vulnerable Aquifers, EPP = Environmental Protection Plan

6.3.8 Net Effects Characterization

6.3.8.1 Net Effects Characterization Approach

The effects assessment approach followed the general process described in Section 5.6 (Assess Net Effects).

Potential effects with no predicted net effect after implementation of mitigation measures identified in Table 6.3-7 are not carried forward to the net effects assessment.

Net effects are described using the significance factors identified in Table 5.6-1. Effects levels are defined for the magnitude of effects characteristics for groundwater as described in Table 6.3-8.

Table 6.3-8: Magnitude Effect Levels for Groundwater

Indicator / Net Effect	Negligible	Low	Moderate	High
Change in groundwater quality, levels and flow	A small measurable change that is expected to be within the range of baseline or guideline values, or within the range of natural variability	A measurable change (discernable) that is expected to be at or slightly exceed the limits of baseline or guideline values	A discernable effect that is potentially detrimental but manageable – does not represent a management concern[(a)]	A discernable effect the is substantially detrimental – the effect can pose a serious risk and represents a management concern[(a)]

a) An effect that poses a management concern may require actions such as research, monitoring or recovery initiatives.

6.3.8.2 Net Effects Characterization

A summary of the characterization of net effects of the Project on groundwater is provided in Table 6.3-9. Net effects are described after the implementation of effective mitigation measures, and summarized according to direction, magnitude, geographic extent, duration/reversibility, frequency, and likelihood of the effect occurring following the methods described in Section 5.6. Effective implementation of mitigation measures summarized in Table 6.3-7 is expected to reduce the magnitude and duration of net effects on groundwater.

6.3.8.3 Net Changes to Groundwater Levels and Flow from Excavations and Dewatering Activities

Where dewatering is required for foundation excavation and installation, groundwater levels within the LSA are expected to change to a local extent. These changes are expected to be negative and short-term in duration as changes in groundwater levels may persist following completion of the dewatering but are reversible. The occurrence of the effect is expected to be infrequent since most of the Project foundations are not anticipated to require dewatering and the effect is probable since the Project crosses a large area with many areas where foundations will be installed.

The effect of the Project on groundwater levels and flow is predicted to be low magnitude due to the expected measurable lowering of groundwater levels near the dewatered excavation that are not likely to be detrimental.

6.3.8.4 Net Changes to Groundwater Quality from Excavations and Dewatering Activities

Changes to groundwater quality in the Project footprint may occur due to Project activities, such as concrete foundation construction or dewatering of excavations, that change groundwater flow patterns and moves pre-existing contaminants to new areas. The groundwater quality may change in the localized area of construction as a result of contact with uncured concrete for foundations or as a result of mobilizing pre-existing contaminants during dewatering of excavations. These possible effects on groundwater quality are expected to be negative, local in extent (limited to within the Project footprint) and occur infrequently as one-time events at each dewatering location with a medium-term duration where the effect may persist following the activity but is reversible.

The effect of the Project on groundwater quality is predicted to be low magnitude due to the expected potential for measurable changes to groundwater quality to occur that are not likely to be detrimental.

6.3.8.5 Net Changes to Groundwater Levels and Flows from Altered Recharge Rates due to Vegetation Clearing, and Road and Structure Construction

Clearing of vegetation may increase recharge to shallow groundwater areas, thereby potentially increasing local groundwater levels. Conversely, the construction of access roads and Project structures will increase the areas of hardened surfaces and may increase runoff/reduce local groundwater recharge in those areas. These possible effects on groundwater levels and flows can range from positive to negative, and are expected to remain local in extent within the LSA, and to occur infrequently, have long-term duration but are reversible.

The effect of the Project on groundwater levels and flows is predicted to be of negligible magnitude due to the limited area of the Project footprint relative to the wider LSA and the relatively small but incremental changes to recharge rates expected from vegetation clearing and Project construction.

6.3.8.6 Net Changes to Groundwater Quality and Flow from Blasting for Road, Quarry, and Foundation Construction

Blasting may be used during Project construction to remove bedrock for building roads, structure foundations or quarries. This blasting may leave residual substances that can change groundwater quality and it can cause fracturing of bedrock around the blast area that can change groundwater flow. These probable effects on groundwater quality and flow are expected to be negative, remain within the Project footprint and occur frequently with medium-term duration for groundwater quality effects that are reversible, and permanent duration for bedrock fracturing effects.

The effect of the Project on groundwater quality and flow is predicted to be of moderate magnitude due to the potential for detrimental effects to groundwater quality and bedrock fracturing that will be limited in extent and not represent management concerns.

6.3.8.7 Net Changes to Groundwater Levels and Flow Associated with Operation of Construction Camp Water Supply Wells

Temporary construction camps may require new water supply wells. Taking water from these wells will lower local groundwater levels and change groundwater flow directions. These effects on groundwater levels and flow are negative, probable, and expected to remain within the LSA, be continual and medium-term in duration and reversible.

The effect of the Project on groundwater levels and flow is predicted to be low magnitude due to the expectation that groundwater level lowering would be measurable but not detrimental and not a management concern.

6.3.8.8 Net Changes to Groundwater Quality Due to Water Discharges from Construction Activities and Operation of Camps

Discharge of water from construction activities and temporary camp operations may infiltrate the ground surface and contact groundwater. Infiltration of discharged water close to where the water was sourced is desirable to maintain local water balances, but the properties of groundwater may be changed. These effects on groundwater quality are negative, possible, and expected to occur within the LSA, be frequent and medium-term duration.

The effect of the Project on groundwater quality is predicted to be low magnitude due to the expectation that the changes to groundwater quality would be beyond baseline values but not detrimental or a management concern.

Table 6.3-9: Characterization of Predicted Net Effects for Groundwater

Criteria	Indicators	Net Effect	Direct/ Indirect	Direction	Magnitude	Geographic Extent	Duration/ Irreversibility	Frequency	Likelihood of Occurrence	Significance
Groundwater	Groundwater levels and flow	Changes to groundwater levels and flows from excavations and dewatering activities	Direct	Negative	Low	LSA	Short-term	Infrequent	Probable	Not Significant
Groundwater	Groundwater quality	Changes to groundwater quality from excavations and dewatering activities	Direct	Negative	Low	Project Footprint	Medium-term	Infrequent	Possible	Not Significant
Groundwater	Groundwater levels and flow	Changes to groundwater levels and flows from altered recharge rates due to vegetation clearing, and road and structure construction	Indirect	Positive to Negative	Negligible	LSA	Long-term	Infrequent	Possible	Not Significant
Groundwater	Groundwater levels, flow, and quality	Changes to groundwater quality and flow from blasting for road, quarry, and foundation construction	Direct	Negative	Moderate	Project Footprint	Medium-term to Permanent	Frequent	Probable	Not Significant
Groundwater	Groundwater levels and flow	Changes to groundwater levels and flow associated with operation of construction camp water supply wells	Direct	Negative	Low	LSA	Medium-term	Continual	Probable	Not Significant
Groundwater	Groundwater quality	Changes to groundwater quality due to water discharges from construction activities and camps	Direct	Negative	Low	LSA	Medium-term	Frequent	Possible	Not Significant

LSA = Local Study Area

6.3.8.9 Characterization of Net Effects

A summary of the characterization of incremental adverse net effects of the Project on groundwater quality, levels and flow in the net effects assessment is provided in Table 6.3-9. Net effects were described after the implementation of effective mitigation measures, and summarized according to direction, magnitude, geographic extent, duration/reversibility, frequency, and likelihood of the effect occurring following the methods described in Section 5.6. Effective implementation of mitigation measures is summarized in Table 6.3-7 and the mitigation measures described are expected to reduce the magnitude and duration of net effects on groundwater quality, levels, and flow.

6.3.9 Assessment of Significance

The assessment of significance of net effects of the Project is informed by the interaction between the significance factors, with magnitude, duration and geographic extent being the most important factors. Consideration is also given to concerns of Indigenous communities, government officials and agencies, and interested persons and organizations raised during consultation and engagement and through review comments on the EA reports. Implementation of proven mitigation measures is expected to avoid or reduce the duration and magnitude of net effects on groundwater.

Net effects to the groundwater quality and quantity criterion would be considered significant if they are assessed as moderate to high magnitude, long-term or permanent duration, at any geographic extent and represent a management concern. The predicted net effects on groundwater are not anticipated to result in a change that will alter the sustainability of the criterion beyond a manageable level or result in changes that are not in accordance with provincial and federal guidelines. Therefore, the predicted net effects on groundwater quality and quantity are assessed as not significant.

6.3.10 Cumulative Effects Assessment

In addition to assessing the net environmental effects of the Project, which considered past and present developments, this assessment also evaluates and assesses the significance of net effects from the Project that overlap temporally and spatially with effects from other reasonably foreseeable future developments (RFD) and activities (i.e., cumulative effects).

For a criterion that has identified net effects, it is necessary to determine if the effects from the Project interact both temporally and spatially with the effects from one or more past, present, or RFD or activities, since the combined effects may differ in nature or extent from the effects of individual Project activities. Where information is available, the cumulative effects assessment estimates or predicts the contribution of effects from the Project and other developments on the criteria, in the context of natural changes in the environment.

For this assessment, the net effects characterized in Table 6.3-9 are carried forward to a cumulative effects assessment if they have a likelihood of occurrence of ‘probable’ or ‘certain’ and a non-negligible magnitude. Net effects with this characterization are most likely to interact with other RFD.

Based on this assessment, the following net effects to groundwater quality, levels and flow listed in Table 6.3-9 are carried forward to the cumulative effects assessment:

- Net changes to groundwater levels and flows from excavations and dewatering activities;
- Net changes to groundwater quality and flow from blasting for road, quarry, and foundation construction, and;
- Net changes to groundwater levels and flow associated with operation of construction camp water supply wells.

A list of the RFDs that were considered for this EA are presented in Section 9.0, Table 9.0-1. Of these projects, the RFDs listed in Table 6.3-10 were identified as being probable to occur within the LSA and, therefore, have potential to have net effects within the LSA.

Table 6.3-10: Reasonably Foreseeable Developments that Overlap with the Local Study Area

ID	Project	Spatial Overlap of Net Effects	Temporal Overlap of Net Effects	Included in Cumulative Effects Analysis
17	Highway 11, 11B resurfacing, paved shoulders	• No	• Yes	• No
18	Highway 11 resurfacing, paved shoulders	• No	• Yes	• No
21	Seine River Bridge, rehabilitation	• No	• Yes	• No
23	Revell River No. 3 Bridge, rehabilitation	• No	• Yes	• No
24	Treasury Metals Inc. Goliath Gold Project	• Yes	• Yes	• Yes
25	Rehabilitation of Steep Rock Mine	• Yes	• No	• No

The RFD IDs 17, 18, 21, and 23 involve the rehabilitation and resurfacing of existing highway and bridge infrastructure and are unlikely to involve excavations and dewatering activities, blasting, or operation of water supply wells. Therefore, there are no overlapping net effects between these RFD and the Project that could result in cumulative effects and these RFD are not further assessed.

The RFD ID 25 (Rehabilitation of Steep Rock Mine) involves the stabilization and remediation of the former Steep Rock Mine site including the raising of water levels in the flooded mine pit areas. It is expected that the former mine pit water levels will take several decades to reach their modelled static elevation, so the cumulative effects assessment would only consider net effects identified to occur during Project operations. None of the Project net effects on groundwater carried forward for cumulative effects assessment are expected to occur during Project operations. Therefore, there are no overlapping net effects between this RFD and the Project that could result in cumulative effects and this RFD is not further assessed.

The RFD ID 24 (Goliath Gold Project) involves the construction, operation and decommissioning of an open pit and underground gold mine. Expected activities and features related to this mining project that may impact groundwater quality, levels, and flow include pit and mine excavations, blasting, mine dewatering, and mine water supply. These activities could cause cumulative effects to groundwater quality, levels, and flow when combined with the following potential net effects from the Project:

- Changes to groundwater levels and flows from excavations and dewatering activities, and
- Changes to groundwater quality and flow from blasting for road, quarry, and foundation construction.

No temporary construction camps for the Project are planned to be located near the Goliath Gold Project so no cumulative effects assessment is carried forward for changes to groundwater levels and flow associated with operation of construction camp water supply wells.

A summary of the potential cumulative effects on groundwater are provided in Table 6.3-11.

Table 6.3-11: Summary of Cumulative Effects Interactions for Groundwater

Other Projects/Activities	Potential Incremental Effect	Rationale for Potential Cumulative Effect	Corresponding Number
Treasury Metals Inc. Goliath Gold Project	• Changes to groundwater levels and flows from excavations and dewatering activities; and • Changes to groundwater quality and flow from blasting for road, quarry, and foundation construction.	• Project-related excavations and dewatering may result in changes to groundwater levels, and flow with potential to interact with this RFD. • Project-related blasting may result in changes to groundwater quality and flow with potential to interact with this RFD.	24

The following section briefly describes the Goliath Gold Project RFD activities considered likely to have a cumulative interaction with the net effects of the Project on groundwater and the likely cumulative effects on groundwater.

Potential activities associated with the Goliath Gold Project RFD that could cause net effects on groundwater include: mine excavation and dewatering; construction of mine facilities and infrastructure; construction of waste rock and tailings storage facilities; groundwater takings for water supply; and blasting. Cumulative effects to groundwater levels and flow may occur due to dewatering of Project excavations in combination with dewatering of RFD excavations and mine workings. Cumulative effects to groundwater quality may occur due to blasting for construction of Project foundations in combination with blasting for construction of mine facilities, infrastructure, or pits and mine workings in bedrock.

The proposed Goliath Gold Project RFD would overlap the Project footprint and, therefore, the net effects of both projects could overlap. Cumulative effects to groundwater quality, levels, and flow are expected due to the potential interactions of the Project and this RFD. However, due to the scale of the RFD relative to the Project, the cumulative effects are not expected to be significantly greater than the net effects of the RFD itself.

Some examples illustrating the difference in scale and net effects between the RFD and the Project are as follows:

- Predicted groundwater level drawdowns due to dewatering of foundation excavations for the Project are a maximum of 4.5 m of drawdown and a horizontal radius of drawdown influence of up to 115 m. Predicted groundwater level drawdowns due to the dewatering of the RFD mine workings are over 100 m with a maximum radius of influence of about 3.5 km (AMEC 2018).
- The Project transmission line ROW crosses through the predicted RFD radius of influence for groundwater over a distance of approximately 5.5 km. Approximately 15 transmission towers would be constructed along this length with a combined foundation excavation area of less than 150 m^2 and expected foundation depths of up to 3.5 m. The RFD has a predicted mine pit footprint of approximately 320,000 m^2 with a pit depth of up to 180 m.

Based on these examples, the Project net effects are estimated to be on the order of 5% or less of the relative magnitude of the Goliath Gold Project net effects.

6.3.10.1 Cumulative Effects Characterization

Cumulative effects may occur where the Project and other RFD both cause similar net effects within Project boundaries. As discussed in the previous section, net effects to groundwater quality, levels, and flow may occur due to Project and RFD activities that overlap spatially and temporally.

The cumulative effects are characterized based on the incremental effects that result from the combination of the standalone net effects of the Project and the RFD.

The summary of cumulative effects on groundwater quality in the LSA is presented in Table 6.3-12.

Table 6.3-12: Characterization of Cumulative Effects for Groundwater Quality

Indicators	Cumulative Net Effect	Direction	Magnitude	Geographic Extent	Duration/ Irreversibility	Frequency	Likelihood of Occurrence	Significance
Groundwater levels and flow	Changes to groundwater levels and flows from excavations and dewatering activities	Negative	Low	LSA	Short-term	Frequent	Probable	Not Significant
Groundwater quality	Changes to groundwater quality from excavations and dewatering activities	Negative	Negligible	LSA	Medium-term	Infrequent	Unlikely	Not Significant

LSA = Local Study Area

6.3.10.2 Assessment of Significance

The contribution of the Project and other RFD to cumulative effects on groundwater quality, levels, and flow in the groundwater LSA is not anticipated to have a cumulative effect on the overall functionality of groundwater resources as they currently exist based on the predicted characterization of the cumulative effects. Consequently, the cumulative effects on groundwater are predicted to be not significant (Table 6.3-12).

6.3.11 Monitoring

This section identifies any recommended effects monitoring to verify the prediction of the effects assessment and to verify the effectiveness of the mitigation measures and compliance monitoring to evaluate whether the Project has been constructed, implemented, and operated in accordance with the commitments made in the EA Report.

6.3.11.1 Monitoring of Water Takings

All water takings should be monitored, and the amounts, rates, times, and locations of water taken should be recorded. Monitoring requirements of any water taking permits issued should be carried out in addition to the above.

6.3.11.2 Monitoring of Water Discharge

Water discharges will adhere to the conditions of the applicable permits. Discharge locations should be approved by the Project environmental inspector and records of the amounts, times, and locations of discharges should be recorded. Monitoring requirements of any water discharge permits issued should be carried out in addition to the above.

6.3.11.3 Monitoring of Rock Blasting

Following blasting of rock, the blasted area should be inspected by qualified personnel. If excessive fracturing of rock or blasting residues are identified, the designs of future blasts should be adjusted for better performance. Monitoring requirements of any blasting permits issued should be carried out in addition to the above.

6.3.12 Prediction Confidence in the Assessment

The confidence in the effects assessment for groundwater is moderate to high.

For the purposes of the EA, sufficient information was available from the resources available for the desktop study to understand the existing conditions and assess the potential effects of the Project on groundwater.

The mitigation measures described in Section 6.3.7.1 are based on accepted and proven best management practices that are well understood and have been applied to transmission line projects throughout North America. There is a high degree of certainty that Project construction activities will result in minor and localized changes to groundwater quality, levels, and flow.

Construction of Project components has high certainty of encountering groundwater over the large area traversed by the Project footprint.

Uncertainty in the assessment has been further reduced by making conservative assumptions regarding potential disturbances, areas, and magnitudes of effects. The implementation of monitoring programs will be used to provide feedback on the effectiveness of mitigation and success of reclamation activities. Using monitoring and adaptive management, mitigation may be modified and/or additional mitigation may be implemented to reduce predicted or unexpected effects.

6.3.13 Information Passed on to Other Components

Results of the groundwater assessment were reviewed and incorporated into the following components of the EA:

- Physiography, geology, surficial geology, and soils (Section 6.1)
- Surface water (Section 6.2);
- Vegetation and wetlands (Section 6.4);
- Fish and fish habitat (Section 6.6);
- Land and Resource Use (Section 7.1);
- First Nations rights, interests, and use of land and resources (Section 7.7); and
- Métis rights, interests, and use of land and resources (Section 7.8).

6.3.14 Criteria Summary

Table 6.3-13 presents a summary of the assessment results for groundwater by criteria.

Table 6.3-13: Groundwater Assessment Summary

Criteria	Assessment Summary
Groundwater Quality and Quantity	• Net effects are assessed to be not significant. • Cumulative effects are assessed to be not significant.

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