Appendix H-4

Seeps, Springs, and Other Groundwater Attributes

SEEPS, SPRINGS, AND OTHER GROUNDWATER ATTRIBUTES SUPPORTING SIGNIFICANT WILDLIFE HABITAT

Groundwater seepage is a common phenomenon in the rolling Canadian Shield landscape of the Project Study Area. Shallow groundwater is stored in the thin layer of glacial till over impermeable granitic bedrock, which becomes rapidly saturated during rainfall events (Devito et al, 1996; Buttle et al, 2004). Analyses of regional groundwater flow in the Canadian Shield have demonstrated that groundwater movement is highly correlated with the complex surface topography (Sykes et al. 2009), and that the water table mimics the surface topography (Farvolden et al, 1987). Since groundwater movement is greatest when the hydraulic gradient is large, such as where the water table is steeply sloped (Smerden and Redding, 2007), over rolling terrain groundwater recharge and groundwater discharge can occur in close geographic proximity (Sykes et al, 2009).

In the Project Study Area, seeps are most frequently manifested as seepage from shallow groundwater where the sloping, impermeable bedrock meets thin, permeable surface deposits (Farvolden et al, 1987). The infiltration areas that support these seeps are generally diffuse and widespread across the glacial till, but there are small localized bedrock depressions where infiltration may be concentrated. These seepage areas and the small concentrated infiltration areas that contribute to them are often characterized by shallow organic soils and facultative plant species such as velvet-leaved blueberry, American fly honeysuckle, jewelweed, and interrupted fern. Individually these seeps and infiltration areas provide limited wildlife habitat function, especially in a landscape such as the Project Study Area with abundant surface water expressions. Collectively, these areas of the landscape contribute to the hydrologic balance of the landscape units.

Seeps may also occur where vertical fractures, which are ubiquitous in the crystalline bedrock of the Canadian Shield, provide a conduit for deeper groundwater to discharge to surface (Farvolden et al, 1987). This situation was observed less frequently in the Project Study Area.

Another form of seepage, albeit not groundwater-originating, occurs where rainwater permeates the thin soil layer and runs laterally on top of the bedrock, before discharging where bedrock meets the surface layer, in topographically-converging areas, or at the toe-slope of a hill (Walter et al, 2000). This process of lateral movement is called interflow, and is typically observable during wet periods (e.g. spring) relative to dry periods during summer and early fall (Walter et al, 2000). Interflow differs groundwater seepage, which contributes base flow to surface water features, and overland flow, which is the flow of water across the ground surface (USEPA 2010). Because interflow is not available to wildlife during dry periods or when the soil is frozen, it does not provide reliable habitat for seep-dependent wildlife.

Seepage areas and springs provide habitat for numerous uncommon species and may support a high diversity of plant species (MNR, 2000). In winter, these areas provide foraging opportunities for wildlife, including White-tailed Deer, Moose and Ruffed Grouse. Those that occur in headwater areas within forested habitats where the canopy maintains cool, shaded conditions are often at the source of coldwater streams and are considered most important.

SITE INVESTIGATION

Site investigations were conducted to determine whether this type of specialized habitat for wildlife was present in or within 120 m of the Project Location. Survey methods were consistent with REA guidelines for site investigation to identify seeps and springs. Searches for seeps and springs occurred within all woodlands in the ZOI during aerial surveys undertaken prior to leaf-out, vegetation surveys and general habitat assessments in the spring and summer of 2012. All watercourses identified during aquatic surveys, in support of the Water Assessment / Water Bodies Report, were followed to their source(s) to observe whether or not they originated from a seep. Areas with rust-coloured stains on the soil surface were noted, as this indicates iron hydroxide precipitating out of groundwater. Potential seeps were also identified through a review of aerial photographs and topographic maps of the ZOI.

A YSI field dissolved oxygen meter was used to sample water in potential seeps or springs to confirm a groundwater origin. Where the use of the YSI meter was impractical, groundwater-originating seeps were determined based on topography, vegetation and evidence of persistent seepage in late summer. Candidate seeps identified by MKI and MNR were reviewed by Stantec to determine if these met REA criteria for seeps and springs, namely a groundwater origin.

The abundance of surface water in the Shield, and the characteristics of the bedrock knobs and shallow glacial overburden that dominate the Project Location will tend to mask groundwater features, such as seeps and springs. Thirty-four candidate locations for seeps and springs were identified by Stantec during site investigations. An additional nine candidate seeps and two confirmed seeps were identified by MNR.

Seepage resulting from interflow is short term in nature and varies with precipitation patterns over the preceding few days or weeks. These types of seeps are small in area, do not flow under frozen conditions, and result in minimal changes to vegetation patterns. As a result, interflow areas not been classified as candidate significant wildlife habitat in the Natural Heritage Assessment.

In the Project Study Area, infiltration areas tend to be concentrated on the tops and gently sloping shoulders of the bedrock knolls, while seepage and interflow tends to be concentrated on the mid to lower slope positions where gradient increases and the thickness of glacial drift is reduced. Due to the widespread and diffuse nature of infiltration areas, they are not mapped as attributes on Figures 6.1 to 6.9. However, the infiltration function has been considered in the impact analysis (Section 5.0) of the Natural Heritage Assessment.

EVALUATION OF SIGNIFICANCE

Per the Draft Significant Wildlife Habitat EcoRegion 5E Criterion Schedule, the presence of 2 or more seeps/springs within an ELC forest ecosite confirms significant wildlife habitat. By this measure, the entire forest landscape surrounding and including the Project Location is one large SWH feature due to the large number and widespread distribution of seeps and other

groundwater features within 120 m of the Project Location. Individual seeps are considered to be site-specific attributes supporting the SWH designation.

There are numerous areas in the landscape that may be wet in the spring and for short periods after high volume precipitation events. Such areas do not meet the definition for seeps and springs in O.Reg 359/09. These areas are better classified as shallow “interflow” features which do not have the seasonal longevity or altered water chemistry that deeper groundwater derived seeps and springs typically exhibit. However, these areas are still important components of the landscape ecology and are worthy of identification and management.

Individual areas of seepage and localized areas of recharge that support the seepage tend to be extremely small in this landscape; often less than 10 m by 10 m. At a 1:10 000 scale of mapping, the minimum area for mapping is generally accepted as 0,25 ha (50 m x 50 m). As a result, individual seeps have been mapped as points rather than polygons on Figures 6.1 to 6.9 and H-4.1 to H-4.9. Where linear concentrations of seepage areas were encountered, points were used to map the beginning and end of the seepage area. Very small and short term seepage areas that are not significant individually but that collectively contribute to the hydrology of the site have not been mapped, but are addressed generally in the Environmental Impact Statement.

Legend

- 120m Zone of Investigation

Project Components

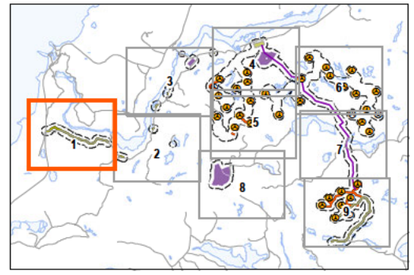
- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
- Access Road Corridor
- Collector Line Corridor
- Turbine Sweep Area
- Turbine Laydown Area
- Construction Compound
- Construction Compound & Welfare Building
- Construction Compound & Transformer Station/Operations & Maintenance Building

Existing Features

- Expressway / Highway
- Road
- Elevation Contour
- Existing Transmission Line
- Watercourse
- Waterbody
- Patent Land

Seep Observations

- Candidate Spring/Seep (MNR)
- Confirmed Spring/Seep (MNR)
- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation



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January 2013
160960771

Client/Project

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Nodin Kitagan Limited Partnership and Nodin Kitagan 2 Limited Partnership, through their General Partners Shongwish Nodin Kitagan GP Corp. and Shongwish Nodin Kitagan 2 GP Corp.

Figure No.

H-4.1

Title

Seeps, Surface Water and Watercourses

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5232000 5231500 5231000 5230500 5230000

Hogg Dam Road

0 100 200 m
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Revised: 2013-01-24 By: pworsell

Legend

- 120m Zone of Investigation

Project Components

- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
- Access Road Corridor
- Collector Line Corridor
- Turbine Sweep Area
- Turbine Laydown Area
- Construction Compound
- Construction Compound & Welfare Building
- Construction Compound & Transformer Station/Operations & Maintenance Building

Existing Features

- Expressway / Highway
- Road
- Elevation Contour
- Existing Transmission Line
- Watercourse
- Waterbody
- Patent Land

Seep Observations

- Candidate Spring/Seep (MNR)
- Confirmed Spring/Seep (MNR)
- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation

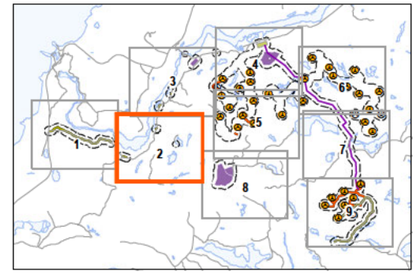

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Figure No.

H-4.2

Title

Seeps, Surface Water and Watercourses

Legend

- 120m Zone of Investigation

Project Components

- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
- Access Road Corridor
- Collector Line Corridor
- Turbine Sweep Area
- Turbine Laydown Area
- Construction Compound
- Construction Compound & Welfare Building
- Construction Compound & Transformer Station/Operations & Maintenance Building

Existing Features

- Expressway / Highway
- Road
- Elevation Contour
- Existing Transmission Line
- Watercourse
- Waterbody
- Patent Land

Seep Observations

- Candidate Spring/Seep (MNR)
- Confirmed Spring/Seep (MNR)
- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation

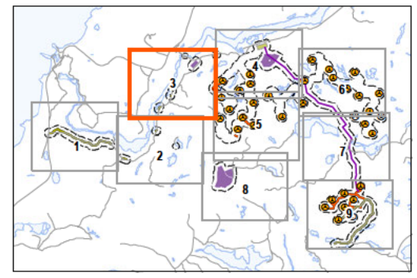

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Figure No.

H-4.3

Title

Seeps, Surface Water and Watercourses

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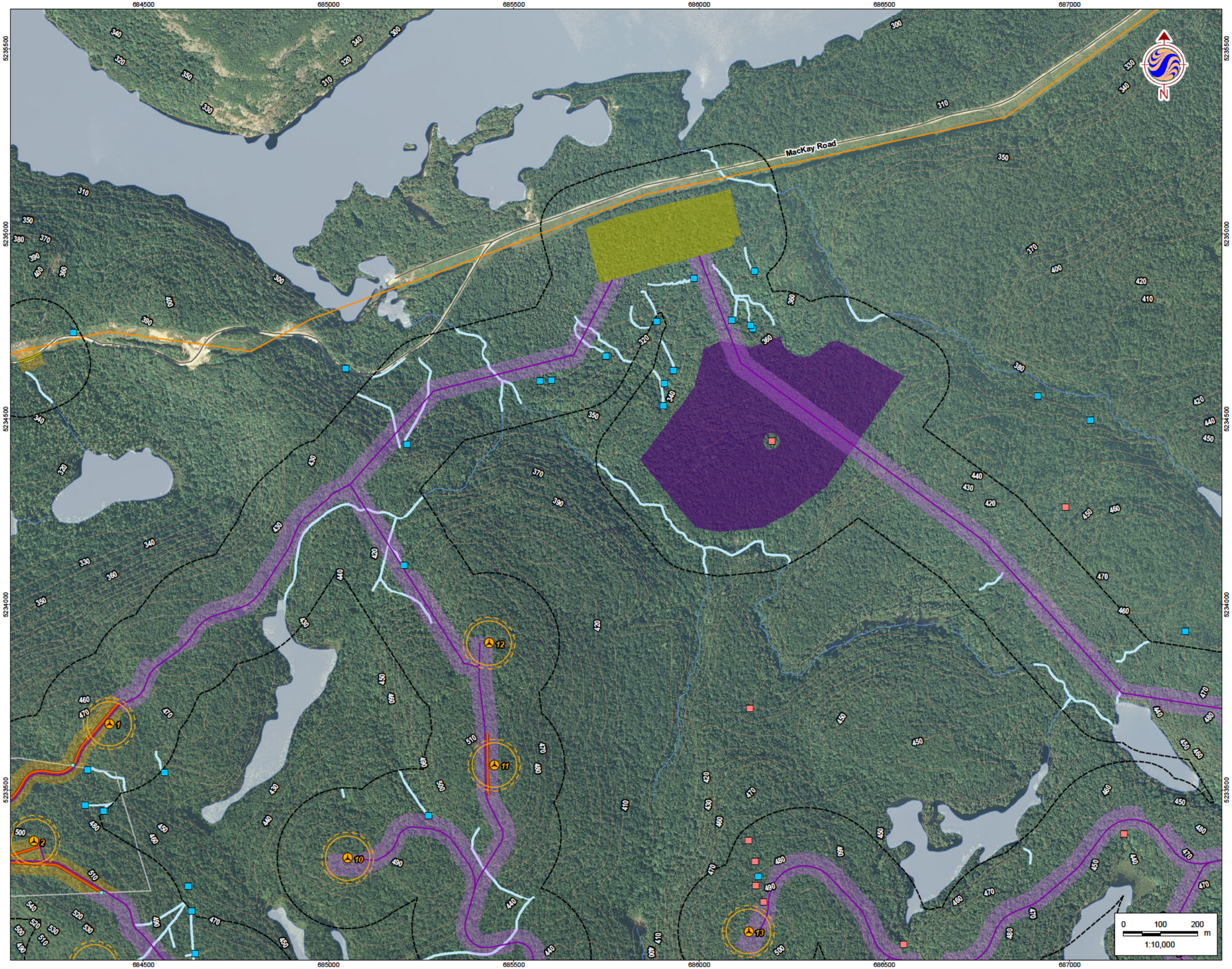

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Revised: 2013-01-24 By: pworsell

Legend

- 120m Zone of Investigation

Project Components

- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
- Access Road Corridor
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- Turbine Sweep Area
- Turbine Laydown Area
- Construction Compound
- Construction Compound & Welfare Building
- Construction Compound & Transformer Station/Operations & Maintenance Building

Existing Features

- Expressway / Highway
- Road
- Elevation Contour
- Existing Transmission Line
- Watercourse
- Waterbody
- Patent Land

Seep Observations

- Candidate Spring/Seep (MNR)
- Confirmed Spring/Seep (MNR)
- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation

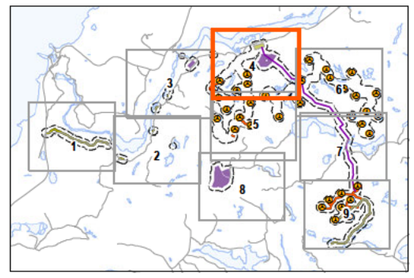

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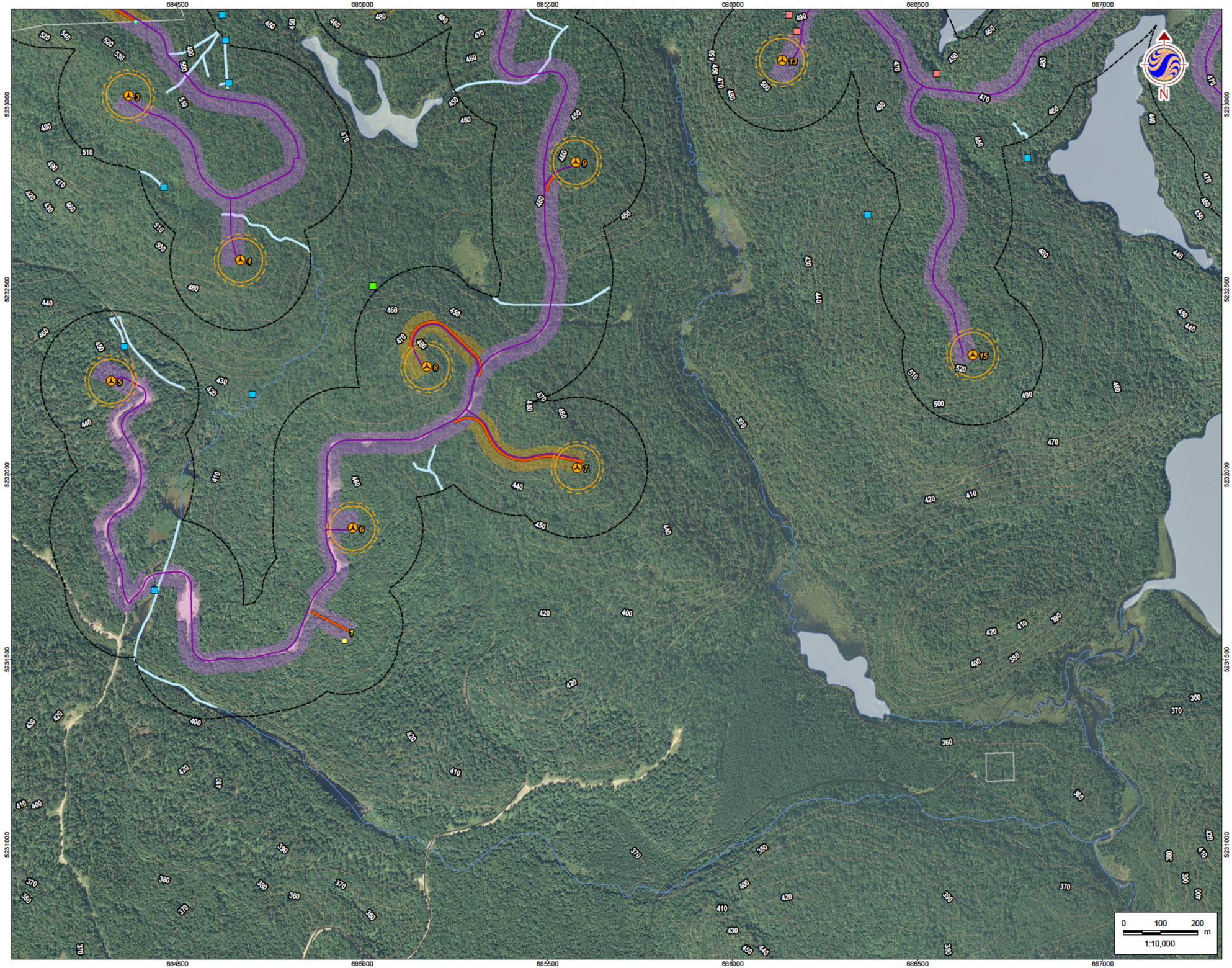
Figure No.
H-4.4

Title
Seeps, Surface Water and Watercourses



Legend

- 120m Zone of Investigation

Project Components

- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
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Seep Observations

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- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation

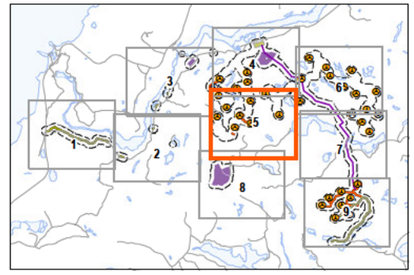

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Figure No.

H-4.5

Title

Seeps, Surface Water and Watercourses

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Revised: 2013-01-24 By: pworsell

Legend

- 120m Zone of Investigation

Project Components

- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
- Access Road Corridor
- Collector Line Corridor
- Turbine Sweep Area
- Turbine Laydown Area
- Construction Compound
- Construction Compound & Welfare Building
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Existing Features

- Expressway / Highway
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- Elevation Contour
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- Watercourse
- Waterbody
- Patent Land

Seep Observations

- Candidate Spring/Seep (MNR)
- Confirmed Spring/Seep (MNR)
- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation

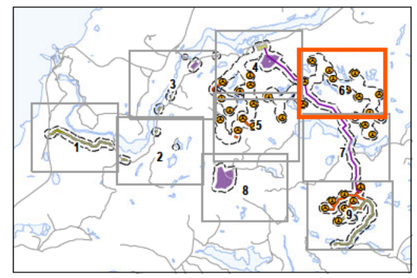

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Figure No.
H-4.6

Title
Seeps, Surface Water and Watercourses

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5232000 5231500 5231000 5230500 5230000

Mile 67 Road

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Legend

- 120m Zone of Investigation

Project Components

- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
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Existing Features

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- Road
- Elevation Contour
- Existing Transmission Line
- Watercourse
- Waterbody
- Patent Land

Seep Observations

- Candidate Spring/Seep (MNR)
- Confirmed Spring/Seep (MNR)
- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation

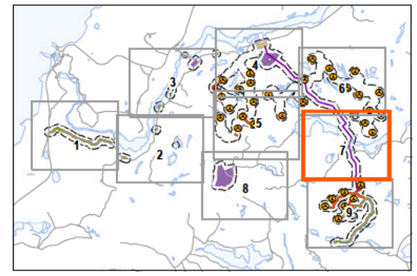

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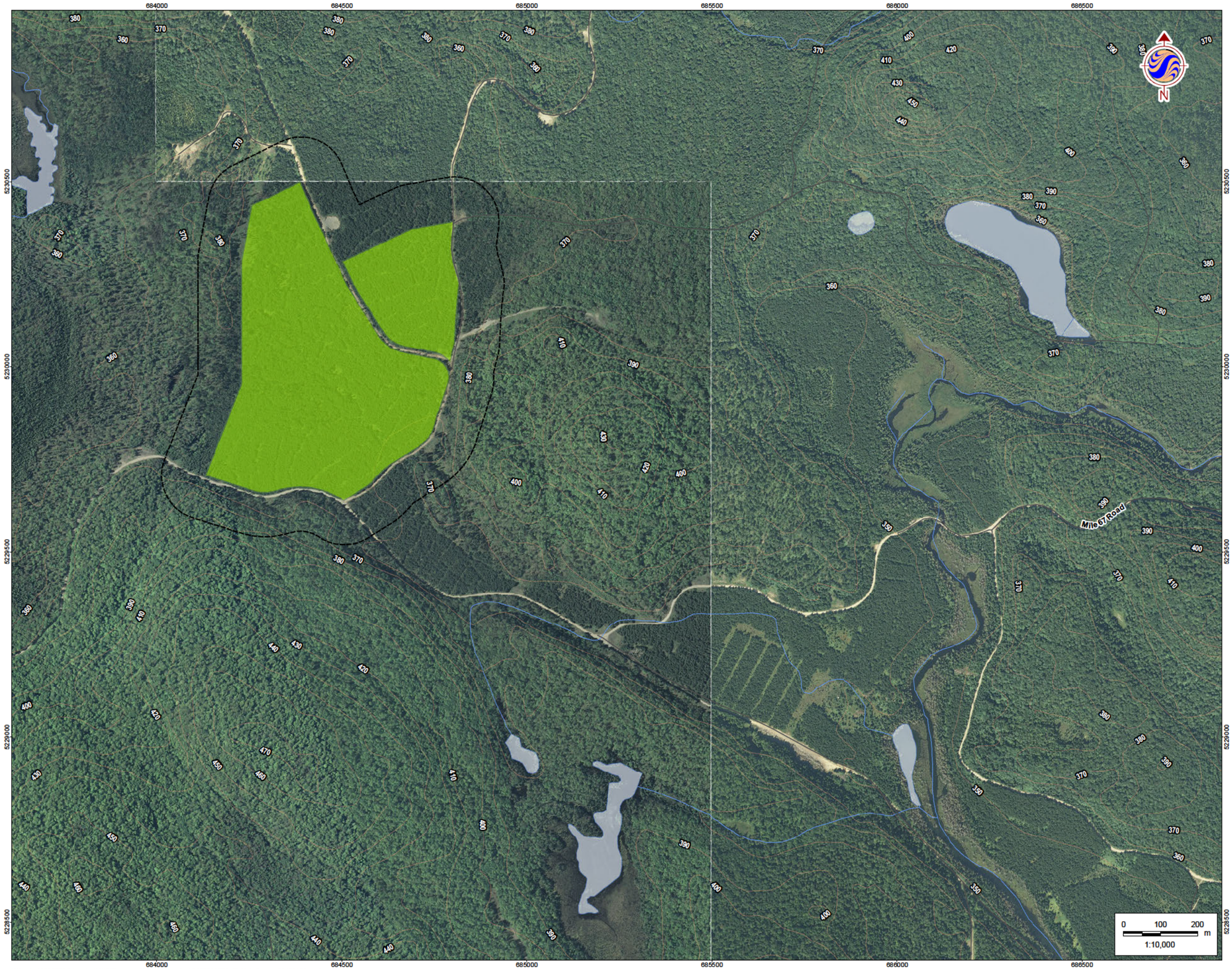
Figure No.

H-4.7

Title

Seeps, Surface Water and Watercourses



Legend

- 120m Zone of Investigation

Project Components

- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
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- Elevation Contour
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- Watercourse
- Waterbody
- Patent Land

Seep Observations

- Candidate Spring/Seep (MNR)
- Confirmed Spring/Seep (MNR)
- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation

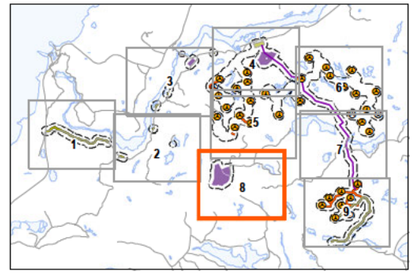

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Figure No.

H-4.8

Title

Seeps, Surface Water and Watercourses

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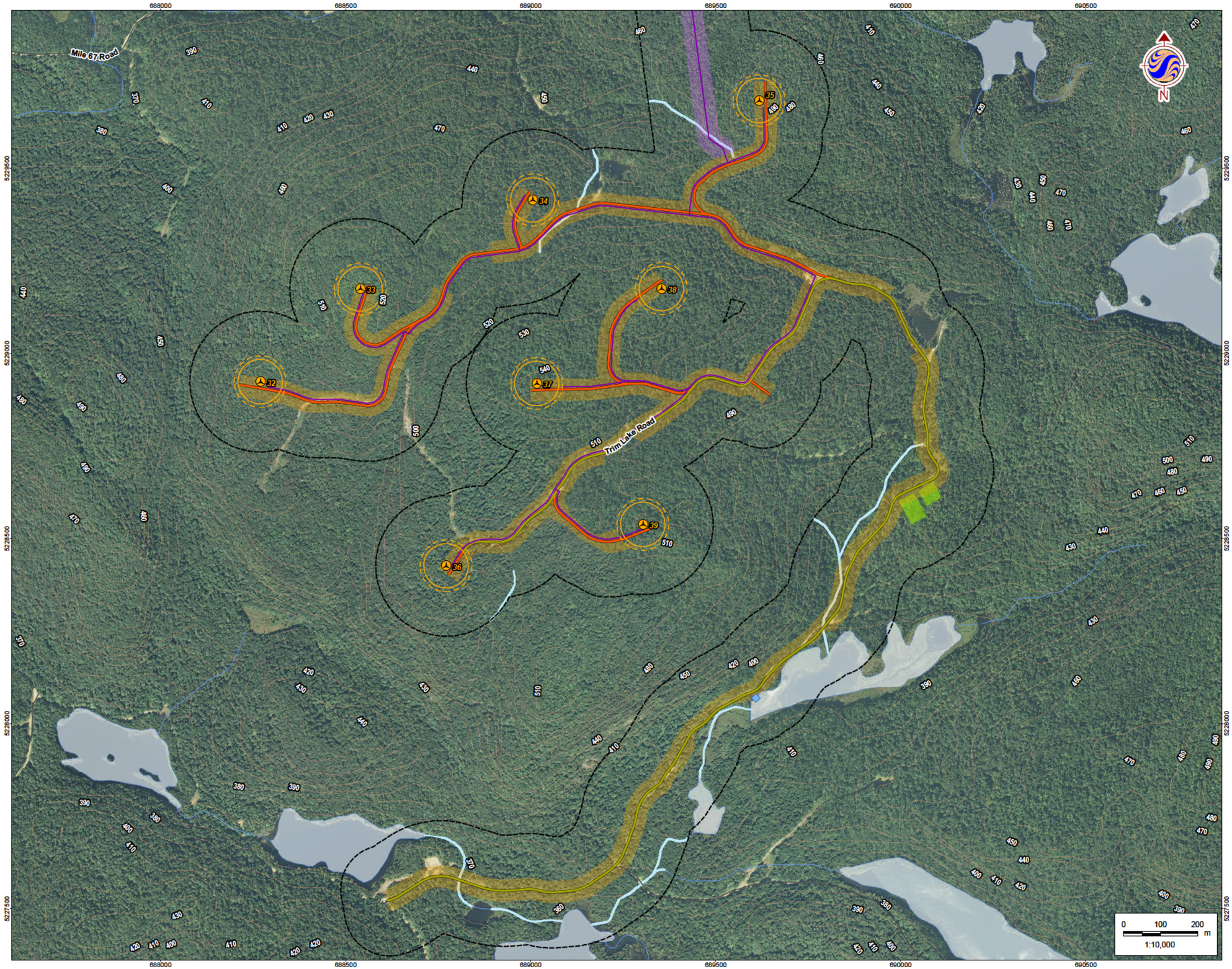

Legend

- 120m Zone of Investigation

Project Components

- Turbine Location
- Gate Location
- Meteorological Tower
- Proposed Water Extraction Location
- Access Road (New)
- Access Road (Upgrade)
- Overhead/Underground Collector Line
- Access Road Corridor
- Collector Line Corridor
- Turbine Sweep Area
- Turbine Laydown Area
- Construction Compound
- Construction Compound & Welfare Building
- Construction Compound & Transformer Station/Operations & Maintenance Building

Existing Features

- Expressway / Highway
- Road
- Elevation Contour
- Existing Transmission Line
- Watercourse
- Waterbody
- Patent Land

Seep Observations

- Candidate Spring/Seep (MNR)
- Confirmed Spring/Seep (MNR)
- Confirmed Spring/Seep (Stantec)
- Confirmed Watercourse in the Zone of Investigation

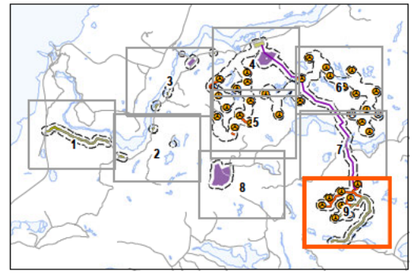

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Figure No.

H-4.9

Title

Seeps, Surface Water and Watercourses

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