Appendix L

Ice Throw Analysis

Ice Throw Analysis

Argentia Renewables Project

Pattern Energy

22 March 2024

→ **The Power of Commitment**

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The Power of Commitment

Executive Summary

GHD Limited (GHD) was retained by Pattern Energy Group (Pattern Energy) to conduct an ice throw study as part of the environmental assessment (EA) registration for the wind power project being developed in Newfoundland and Labrador (NL), Canada, as part of the Argentia Renewables Project (Project). The Project is a green energy project using wind generated electricity by a 300 Mega Watt (MW) wind farm to power an electrolysis process that extracts hydrogen from water. The hydrogen will in turn be converted into ammonia for more efficient storage and transportation by marine vessels to international markets.

The Project will consist of 46 wind turbines located around the Port of Argentia, NL. The ice throw assessment was completed using the Vestas V172-7.2 wind turbine model, with a hub height of 166 meters (m), rotor diameter of 172 m, and rated power of 7.2 MW.

The risk of ice fall or throw is a notable hazard for wind turbine operations in cold climates. Although there have been limited ice throw events leading to public property damage globally, and no known recorded events to date of a person being struck by a falling or thrown ice fragment, the consequences associated can be significant – potentially leading to serious injury or fatality – and therefore should be mitigated as reasonably achievable. Each incident or accident caused by ice throw is an unnecessary event and will decrease the public acceptance of wind energy.

The ice throw study presented herein is based on the high-level, conservative approach recommended by the Canadian Renewable Energy Association (CanREA) in the 2020 *Best Practices for Wind Farm Icing and Cold Climate Health and Safety* document [1]. This methodology is widely accepted as being conservative, as ice throw risk outside of the determined zone is considered null.

Following the methodology described in section 3, with a rotor diameter of 172 m and hub height of 166 m, the **maximum ice throw distance for the planned wind turbines is 507 m**.

In Appendix A, this maximum ice throw distance is assessed at each of the 46 wind turbines using Google Earth to identify hazards within the ice throw zone. Risks identified and potential mitigation measures are detailed in section 5.2 of this report and summarized in section 6 with conclusions and recommendations.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1 and the assumptions and qualifications contained throughout the Report.

Contents

Table index

Figure index

Appendices

1. Introduction

GHD Limited (GHD) was retained by Pattern Energy Group (Pattern Energy) to conduct an ice throw study as part of the environmental assessment (EA) registration for the wind power project being developed in Newfoundland and Labrador (NL), Canada, as part of the Argentia Renewables Project (Project). The Project is a green energy project using wind generated electricity by a 300-megawatt (MW) wind farm to power an electrolysis process that extracts hydrogen from water. The hydrogen will in turn be converted into ammonia for more efficient storage and transportation by marine vessels to international markets.

The Project will consist of 46 wind turbines located around the Port of Argentia, NL. The ice throw assessment was completed using the Vestas V172-7.2 wind turbine model, with a hub height of 166 meters (m), rotor diameter of 172 m, and rated power of 7.2 MW.

This report is structured as follows:

- Section 2 – Wind Turbine Icing Background: Discussion of wind turbine icing context and risks, and methodology for ice throw and ice fall analysis.
- Section 3 – Methodology: Presents the methodology for the ice throw assessment.
- Section 4 – Project Details: Provides information on the wind turbine characteristics, planned locations, and site conditions.
- Section 5 – Ice Throw & Fall Zone Evaluation: Presents the evaluation results including risk identification within the ice throw zones of each wind turbine.
- Section 6 – Conclusions: Conclusions and discussion.
- Appendix A – Max Ice Throw Zone Figures: Provides figures showing the locations of the 46 wind turbines, max ice throw zones, and identification of risks within these zones.

1.1 Purpose of this report

The purpose of this report is to present the methodology, results, and recommendations of the ice throw and fall study for the Argentia Renewables Project.

1.2 Scope and limitations

This report: has been prepared by GHD for Pattern Energy and may only be used and relied on by Pattern Energy for the purpose agreed between GHD and Pattern Energy as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Pattern Energy arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

Disclaimers

GHD has prepared this report on the basis of information provided by Pattern Energy and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

The following key assumptions have been utilized for the ice throw study:

– Evaluation is based on the Vestas V172-7.2 wind turbine model, with a hub height of 166 m and rotor diameter of 172 m.

– The latest planned wind turbine locations were provided via shape file on Nov. 21, 2023. Should the planned locations be modified, it is recommended to perform and updated ice throw assessment on the additional locations.

– Climate data is sourced from Argentia meteorological station (AUT, Climate ID 8400104), which is the nearest station to the Project site, located at latitude 47°18'38.278" N, longitude 53°59'53.423" W.

2. Wind Turbine Icing Background

2.1 Ice Throw & Fall Context

Cold climates present unique challenges for wind turbine operation. Wind turbine blades and other components can be subject to in-fog icing and freezing rain events, causing the accumulation of ice mass that can affect the performance of data collection devices, increase vibrations from blade imbalance, and impact blade aerodynamic properties resulting in reduced power conversion efficiency. Accumulated ice can break or melt off the blades and structure, resulting in ice throw or ice fall that presents a hazard to people, animals, and property.

The Canadian Renewable Energy Association (CanREA) has published a series of *Best Practices for Wind Farm Icing and Cold Climate Health & Safety* guidelines, the latest of which was updated with a 2020 publication, which is utilized as the methodology basis for this wind farm ice throw assessment [1].

Accumulated ice may be shed from wind turbines via two mechanisms, defined as follows:

– **Ice Throw:** refers to ice fragments detaching from the rotating wind turbine blades during operations, where the ice fragments can be projected out a significant distance from the wind turbine. In the case of ice throw, the maximum potential throw distance has been determined empirically to depend primarily on the hub height and blade length of the wind turbine in question.

– **Ice Fall:** refers to ice fragments detaching from the wind turbine when the turbine rotor is paused/idle, resulting in ice falling within a smaller radius of the turbine. In the case of ice fall, the maximum potential fall distance has been determined empirically to depend on the wind turbine hub height, blade length, and wind speeds. The majority of ice will typically fall within the footprint of the wind turbine itself, although some fragments may be carried a greater distance from the turbine by strong gusts of wind.

In either case of ice fall or ice throw, the ice fragments can present a significant hazard to people and property that lie within the maximum ice fall or throw zone. A 0.2 kilogram (kg) ice fragment falling from a height of just 30-50 m carries enough force to potentially land a fatal blow to an unprotected human head [1]. The risks of ice fall or throw are most likely to occur when temperatures rise or are close to or above 0 degrees Celsius, or when the wind turbine begins operation in the case of a turbine that was paused during the icing event. General risk mitigation measures following icing events are discussed in section 2.3.

2.2 Ice Class & Risk of Icing Occurrence

Ice accretion occurs during periods of meteorological icing, which is defined as the periods during which atmospheric conditions are favorable for ice build-up on structures, including wind turbines. The total duration that ice is present on structures is defined as the instrumental icing period, as ice can remain on structures for hours or even days after a meteorological icing event has occurred.

The International Energy Association (IEA) and CanREA further define *rotor icing* as the period during which ice is present on the rotor blades of a wind turbine. Rotor icing is not equivalent to instrumental icing due to the geometry of the blades, rotational speed, and resultant relative velocity of the wind acting upon the blades. Rotor ice can accrete faster than on static structures if the rotor is operating, and the ablation[1] phase during which ice remains on the blades is generally shorter than the period of instrumental icing, particularly if blade heating or other ice mitigation technology is employed. According to publications from the IEA Task 19 workforce on wind turbine icing and commentary from DNV [2], [3], rotor blade icing periods may correspond to half the period of instrumental icing, depending on the operating conditions and any blade de-icing technologies employed.

There are different methods for determining the risk of icing occurrence at a site, from direct site measurement campaigns to meso-scale modelling. CanREA refers to the wind power icing atlas, called WIceAtlas, created and managed by the VTT Technical Research Centre of Finland, which provides probability levels of in-cloud icing risk worldwide based on meso-scale modelling [4], for assessing the risk of icing occurrence. The WIceAtlas follows the IEA's Ice Class Definitions, which define the risk of meteorological and instrumental icing by IEA Ice Class 1 through 5 as follows:

Table 1 IEA Ice Class Definitions [5]

IEA Ice Class	Meteorological Icing (% of the year)	Instrumental Icing Risk (% of the year)
1	0 – 0.5	0 – 1.5
2	0.5 – 3	1 – 9
3	3 – 5	6 – 15
4	5 – 10	10 – 30
5	>10	>20

2.3 Best Practices & Risk Mitigation

The general hazards presented by ice throw/fall include:

- Serious injury or fatality to an unprotected worker or member of the public within the vicinity of the ice throw zone during periods of rotor icing.
- Serious injury or fatality to cattle or wildlife within the vicinity of the ice throw zone during periods of rotor icing[2].
- Damage to property and infrastructure within the ice throw zone during periods of rotor icing, including damage to vehicles, equipment, electrical or other infrastructure, and buildings.

It is worth noting that while the consequence of ice throw impact to persons is at the highest consequence rating (serious injury or fatality), in the history of wind farm operations in cold climates to date, there has never been a single recorded incident of injury or fatality from a human being struck by falling or thrown ice. The risk occurrence is very low at the outer areas of the maximum ice throw zone and considered null outside of the maximum ice throw zone.

[1] Ablation is defined as the removal of ice from the structure, either via shedding (ice fragments fall or are thrown), melting, sublimation or otherwise.
[2] Note that there are no active farming / ranching operations within the study area, so this risk is not addressed. The risk of wildlife being struck by an ice fragment is always present for any wind farm in cold climates but cannot be effectively mitigated by signage or otherwise.

Directly under the wind turbine, or any iced structure, CanREA recommends the risk should be considered as medium [1], as this is the zone in which most ice will shed from the structure.

There are several mitigation measures that can be employed by wind farm operators in cold climates to mitigate the hazards presented by ice fall or throw. These include the following:

– **Shutdown the turbines during rotor icing periods:** Generally, the ice throw zone is notably larger than the ice fall zone. During periods of rotor icing, which can be detected through a variety of direct and indirect methods (IEA has a detailed report on the technologies/methods available [6]), wind turbine operators can pause the wind turbines to mitigate the risk of ice throw, effectively reducing the hazard zone to the ice fall zone, closer to the wind turbine base. Pausing the wind turbine also mitigates vibrational impacts from blade imbalance due to uneven ice accretion, and results in less ice accumulation due to the lowered relative velocity of wind to the blades.

– **Ice protection devices:** In the case that workers may be required to attend to wind turbines during potential periods of rotor icing (for example, for maintenance following an icing event, when some ice is still present on the structure), ice protection devices should be installed at the wind turbine base such that workers can step directly from their vehicle into a covered walkway that leads to the base access. An example permanent ice protection device is shown in the figure to the right.

Figure 1 Permanent Ice Protection Device for Worker Access [1]

– **Restrain site access:** Public access to wind farms can be restricted, for example with fences or private property signage. The maximum ice throw zone could be used to determine the limits of site access restrictions.

– **Public Danger Warning Signs:** Operators should add signage to warn the public of the risk of ice fall around the maximum ice throw zones to emphasize the importance of not trespassing during and following periods of icing events. Public danger warning signs should be visible and placed strategically, keeping in mind potential recreational activities in the area (such as hiking, snowmobiling trails). Educational signs can be added to any parking lots, trail heads, etc. to provide more detailed information. Additionally, danger warning signs can be equipped with flashing lights to indicate ongoing icing events, which should be tied to the operator’s ice detection method. On public recreational trails, signs can be located at the points where the trail intersects with the maximum ice throw boundary, warning the public to remain clear of the area during potential icing events.

– **Anti- and De-Icing Technologies:** Wind farm project developers can opt for ice prevention technologies as part of the wind turbine package, which can include blade heating technology that actively reduces the rotor icing period by speeding up the melting/ablation of ice from the blades and mitigating ice accretion.

– **Follow the best practices detailed by CanREA** [1]**:** These include employing occupational health and safety systems and requirements including adequate personal protection equipment (PPE) for all workers, education on the hazard and right to refuse unsafe work for workers, regular inspections of protective equipment such as ice protection devices, and more.

3. Ice Throw Study Methodology

The ice throw study presented herein is based on the high-level, conservative approach recommended by CanREA in the 2020 *Best Practices for Wind Farm Icing and Cold Climate Health and Safety* document [1]. This methodology is widely accepted as being conservative (as ice throw risk outside of the determined zone is considered zero), however it does not result in probability distribution of an ice throw impact within the maximum ice throw zone. Should a statistical ice throw risk assessment be required within the ice throw zone, a more detailed analysis based on statistical computer models will be needed, which can allow for resizing (shrinking) the ice fall risk zone with a more precise and less conservative methodology. This type of analysis can provide quantitative evaluation of the expected probability of an ice fragment hitting the ground, measured as the number of strikes anticipated per square metre per year. The IEA Wind TCP Task 19 has published detailed guidance on such statistical ice throw risk assessment [2].

The risk of icing occurrence is determined utilizing the WIceAtlas icing map for the wind turbine locations [4] and IEA Ice Class definitions [5].

The maximum ice throw zone is evaluated with the following equation, as recommended by CanREA [1] and determined empirically by Seifert *et al.* [7]*:*

$$d_t = 1.5 * (D + H)$$

Where:

- d_t is the maximum ice throw distance (m)
- D is the wind turbine rotor diameter (m)
- H is the wind turbine hub height (m)

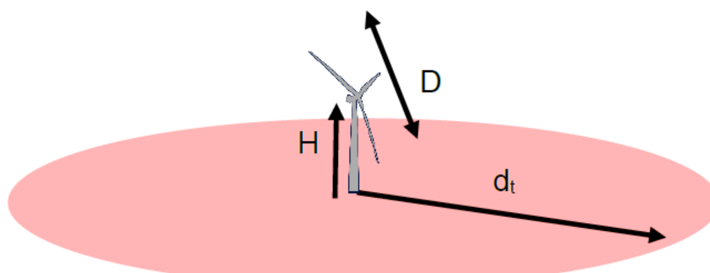


Figure 2 Maximum ice throw distance area

The maximum ice fall distance, on the other hand, is a result of the hub height, rotor diameter, and the wind speeds acting on the falling ice fragment. Ice fall should therefore be evaluated for a range of typical wind speeds, and actual wind speeds should be evaluated during rotor icing events to assess the safety of workers being near and around the wind turbines. Periods of higher wind speeds represent greater risk of ice falling beyond the direct footprint of the wind turbine.

The equation for maximum ice fall distance as recommended by CanREA and similarly determined empirically by Seifert *et al.* is as follows:

$$d_f = \frac{\frac{D}{2} + H}{15} * V$$

Where:

- d_f is the maximum ice fall distance (m)
- D is the wind turbine rotor diameter (m)
- H is the wind turbine hub height (m)
- V is the wind speed at hub height (m/s)

The maximum ice fall zones are determined for a range of wind speeds considering historical wind speed data from the region. Note that site-specific wind speed at hub height data was not available for this study. Such data can support more precise evaluation of potential ice fall zones.

The study assesses the maximum ice throw zone and ice fall zones (by wind speed) for the wind turbine model evaluated, and then identifies and assesses risks within the maximum ice throw zone for each wind turbine via geospatial data. Notable hazards are identified and potential mitigation measures are recommended.

4. Project Details

4.1 Wind Turbine Characteristics & Locations

The planned wind power project will consist of 46 wind turbines located around the Port of Argentia, NL. The expected installed capacity of the overall wind farm is over 300 MW, with exact capacity dependent on the final turbine selection.

The ice throw assessment was completed using the Vestas V172-7.2 wind turbine model, with a hub height of 166 m and rotor diameter of 172 m. The wind turbines have an installed rated power of 7.2 MW and come with pitch and variable speed control. Vestas offers anti- and de-icing technologies that can be considered for these units.

The figure below indicates the planned locations of the 46 wind turbines near the Argentia Port in Newfoundland and Labrador. Note that there were originally 47 wind turbines and in the updated plan wind turbine #3 has been removed. The wind turbines are still numbered 1 through 47 with the absence of number 3.

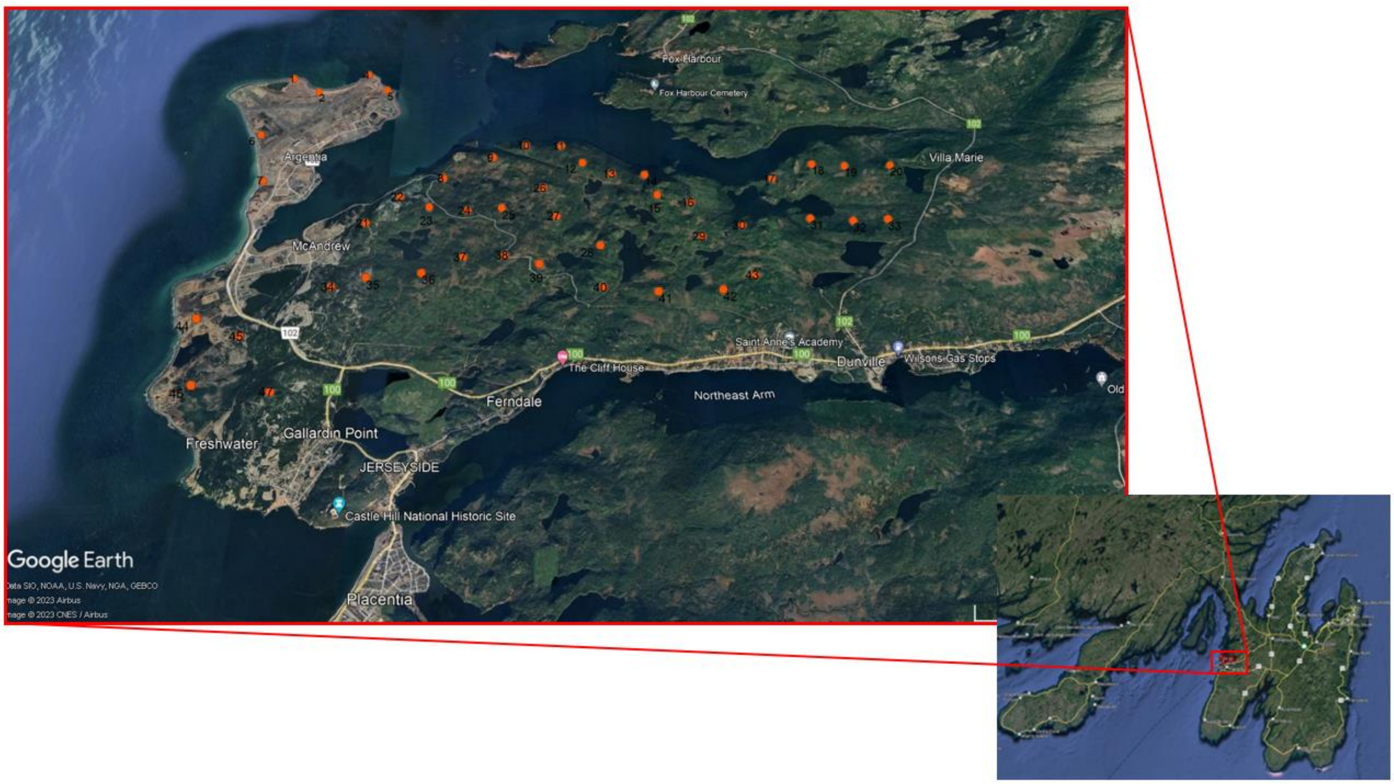
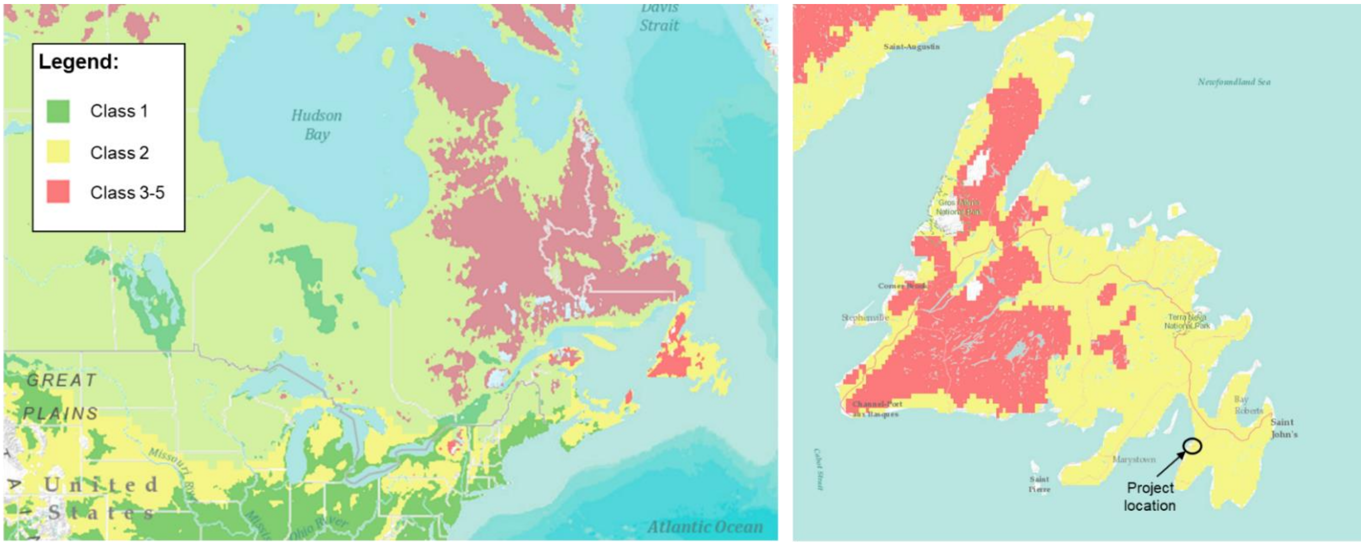


Figure 3 Planned Locations of the Project Wind Turbines near Argentia Port, NL

4.2 Site Conditions

The potential for instrumental icing and for ice throw or fall is influenced by site specific meteorological conditions. The IEA Ice Classification for the region is utilized to assess the potential for instrumental and rotor icing. Publicly available historical wind records from the nearest meteorological station (AUT) are utilized for the ice fall assessment [8].

The figure below presents the WIceAtlas IEA Ice Classifications for Eastern Canada (a) and zoomed in on the Island of Newfoundland with the project location identified (b).



(a) WIceAtlas snapshot for Eastern Canada

(b) WIceAtlas snapshot for Newfoundland with Project location identified

Figure 4 WIceAtlas IEA Ice Classification for Project Location [4]

As indicated by WIceAtlas in the figure above, the IEA Ice Class for the Project location is Class 2. This corresponds to anticipated:

– Meteorological icing occurrence 0.5 – 3% of the year (average of 1.8 to 11.0 days per year)

– Instrumental icing occurrence 1 – 9% of the year (average of 3.7 to 32.9 days per year)

The rotor icing period, during which ice is present on the wind turbine blades, is not equivalent to instrumental icing and is typically distinctly shorter as ice sheds more readily from wind turbine blades than static structures due to movement, vibrations, and heating. The duration of rotor icing strongly differs for a wind turbine at stand-still versus in operation, and for wind turbines with ice mitigation technologies such as integrated blade heating compared to wind turbines without. DNV has employed a factor of 50% for rotor icing compared to instrumental icing in other studies, which would correspond to an expected rotor icing occurrence of between 2 and 17 days per year for this Project. A conservative evaluation of rotor icing likelihood would equate rotor icing duration with instrumental icing duration, for a maximum expected rotor icing occurrence of up to 33 days per year for this Project.

In general, wind farm owners can invest in anti- or de-icing technologies up front that are provided by the turbine manufacturer. These systems can significantly reduce the period of rotor icing by (a) mitigating the build-up of ice on blades and (b) accelerating the process of melting / detaching ice from the blades. Vestas, for example, offers blade heating technology with anti- and de-icing modes. Employing such technology would reduce the rotor icing occurrence likelihood, mitigating risks of ice throw and fall.

Wind speeds for the Project location were sourced from Environment and Climate Change Canada (ECCC) historical data from the Argentia meteorological station, which is the nearest station to the Project site [8]. Maximum daily recorded wind speed records from 20-year historical record (2003-2023) were utilized for the ice fall assessment. Utilizing maximum daily wind gusts provides for a conservative assessment of ice fall zone as the likelihood of an ice fragment breaking off at the exact moment that the daily maximum wind gust is realized is very low [7].

The frequency of maximum daily recorded wind speeds (2003-2023) is visualized below. On average, the maximum daily recorded wind speed is less than 15 metre per second (m/s), with 56% of days recording less than this value. On the vast majority of days (83%), maximum recorded wind speed is less than 20 m/s.

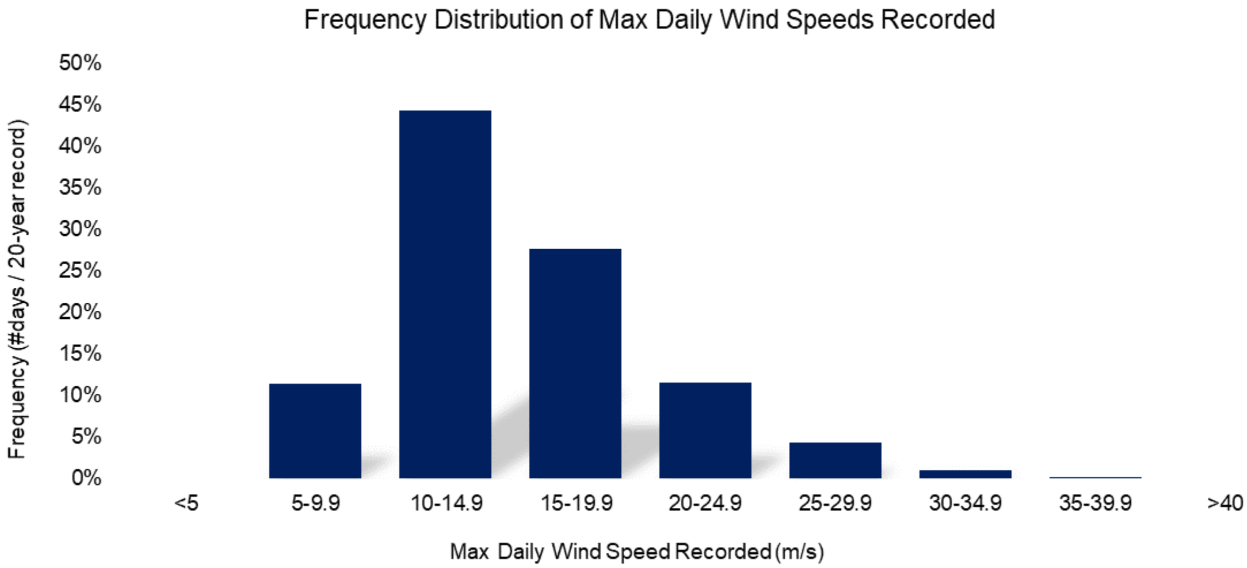


Figure 5 ***Frequency Distribution of Maximum Daily Wind Speeds Recorded at Argentia Station, 2003-2023 [8]***

Additionally, Pattern Energy provided met mast data collection on wind speeds for 2 measurement campaigns performed in the approximate area of the planned wind turbines, from July 2-8, 2008, and November 3-10, 2015. The recorded combined wind speeds (combined to single vector) at 60 m height from the November 2015 measurements is shown in Figure 6 below; July data is not shown as icing only occurs during winter season.

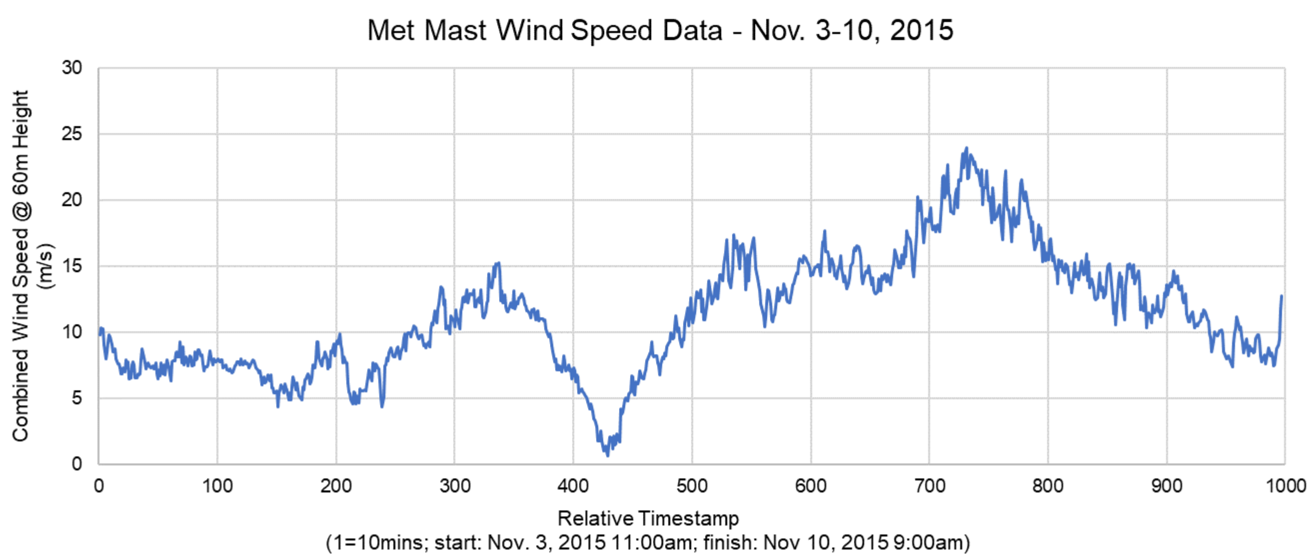


Figure 6 ***Recorded Wind Speed Data from Met Mast at 60 m height, November 3-10, 2015***

Although the time period of data collection is short, the data gives insight into fluctuations of wind speeds experienced. Over the seven-day period, wind speeds were recorded in excess of 20 m/s during 45 10-minute time periods, or about 4.5% of the recorded time.

5. Ice Throw & Fall Zone Evaluation

5.1 Results

5.1.1 Maximum Ice Throw

Following the methodology described in section 3, with a rotor diameter of 172 m and hub height of 166 m, the **maximum ice throw distance for the planned wind turbines is 507 m**.

In Appendix A, this maximum ice throw distance is assessed at each of the 46 wind turbines using Google Earth to identify hazards within the ice throw zone. Risks identified and recommended mitigation measures are summarized in section 5.2.

Maximum ice throw zone is reduced as wind turbine hub height or rotor diameter is reduced. For example, the Project was previously considering the Siemens SG 6.6-155 wind turbine with a hub height of 105 m and rotor diameter of 162 m, which would have a maximum ice throw zone of 400 m, considerably reduced from the current turbine model. Another model being considered by the Project is the Vestas V162-6.8MW wind turbine, with hub height of 119 m and rotor diameter of 162 m, which would have a maximum ice throw zone of 421 m.

5.1.2 Ice Fall

Maximum ice fall distance when the wind turbines are paused depends on both the turbine characteristics (hub height and rotor diameter) and wind speeds. Following the methodology described in section 3, the maximum ice fall distance from the turbines for various wind speeds is provided in the table below.

Table 2 Maximum Ice Fall Distance by Wind Speed

Wind speed (m/s)	Max ice fall distance (m)
0	0
5	84
10	168
15	252
20	336
25	420
30	504

The likelihood of ice falling a distance greater than 507 m (the maximum ice throw distance) when the wind turbines are paused is considered extremely low to null as the likelihood of an ice fragment detaching at the same time as a gust of wind in excess of 30 m/s is extremely low to null.

5.2 Risk Identification & Mitigations

5.2.1 General Risks & Mitigations for all Wind Turbines

General risks that apply for all the planned wind turbines include the following:

a. Workers accessing the wind turbines for maintenance / operations purposes during periods of rotor icing may be struck by a falling or thrown ice fragment, and

b. Damage to wind turbine structure or associated aboveground electrical or other infrastructure.

The risks associated with item (a) above include possible serious injury and/or death if workers are within the ice throw zone without ice protection. Ideally, this risk is best mitigated by avoiding maintenance activities within periods of rotor icing, such that workers do not enter the maximum ice throw zone when ice is detected to be present on the structure or blades. If workers must access the wind turbine during possible rotor icing periods, the following risk mitigation measures should be employed:

- **Use ice protection devices:** ice protection devices can be mobile units deployed as needed or permanent installations at each wind turbine. These devices should provide an entryway for workers to leave their vehicle and enter the wind turbine base while being completely covered and protected from any falling ice fragments, such as the structure shown previously in Figure 1.
- **PPE and training in accordance with CanREA Best Practices recommendations:** Workers should be aware of the risks, should be aware of active rotor icing events, and should have adequate PPE.

The risks associated with item (b) above include damage to property resulting in unexpected costs. Aboveground equipment sensitive to potential impacts from ice fragments can be protected with caging or housing. Following rotor icing events, operators should inspect equipment within the ice throw zones for any damage and plan repairs to ice protection devices as needed.

Across all the wind turbines and identified hazards, a driving factor for the risks presented is the likelihood of rotor icing occurrence. Rotor icing periods can be reduced with both active and passive ice mitigation techniques. These may include, for example, hydrophobic coatings on the blades that provide passive mitigation of ice accretion, or active blade heating technology that heats the sections of the blades most susceptible to icing to mitigate ice build up and accelerate the rate of ice ablation. Vestas offers anti- and de-icing technologies that can be considered for this project that would effectively reduce the expected periods of rotor icing.

Finally, a general risk mitigation measure across all the wind turbine sites can be to pause the wind turbines during active rotor icing events to reduce the likelihood of ice falling at greater distances.

5.2.2 Specific Risks Identified for the Planned Wind Turbine Locations

Appendix A provides a visual identification of features within the maximum ice throw zone for each of the 46 planned wind turbines that present risk from ice throw or fall. The features identified include the following. Risks and potential mitigation measures for each are discussed in the following subsections.

a. Abandoned Argentia Naval Base
b. Argentia Backland public hiking trails, roads, and destinations
c. Sunset RV Park
d. Ammonia Production Plant (planned)
e. Industrial activities and service/access roads
f. Public roads
g. Existing and planned transmission power lines
h. Potential planned connectors tie-in / substation

5.2.2.1 Abandoned Argentia Naval Base

The Argentia Port is home to the abandoned Argentia Naval Base, which was previously used as a U.S. strategic military base from 1941 to 1994. There are several historical sites remaining in the area, which are accessible to the public and of-interest to hobbyists and explorers. These include the abandoned airfield with historical sites featuring ammunition magazines, bunkers, and runways. While the area today is mostly used as an industrial park, public access is not restricted. Wind Turbine #45 also overlaps with Battery 282, a historical site part of the abandoned military operations just south of abandoned naval base.

Risk description: Public access within wind turbine maximum ice throw zones presents the risk that a person or vehicle may be struck by a falling or thrown ice fragment during periods of rotor icing. Although likelihood is low, the consequence of a person being struck may include serious injury and/or fatality, making this risk of very high importance. The consequence of a vehicle in motion or stopped being struck may include serious injury and/or fatality as well as property damage. The likelihood of this risk event occurring is above zero within the maximum ice throw zone during periods of rotor icing.

Relevant wind turbines: # 1, 2, 4, 5, 6, and 45.

Risk mitigations measures: Potential risk mitigation measures include the following:

- **Public danger warning signage:** Signs should be located at the outset of the ice throw zone where pathways or roads intersect with the zone. Signs should be clear and provide adequate understanding of the ice throw risk. As an added risk mitigation measure, signage with flashing lights can be tied to an ice detection system to warn the public of active rotor icing periods when the risk is present. The goal is to prevent members of the public from entering the maximum ice throw areas during periods of rotor icing through education and warning.
- **Restrain site access:** Where possible, particularly closer to the base of the wind turbines where the risk of ice fall or throw is highest, public access may be restricted with fencing or otherwise.

5.2.2.2 Argentia Backland Public Trails & Roads

The Argentia and Placentia Bay areas are home to the Backland Trail system, which includes approx. 16 kilometres of walking and vehicle trails to reach lookouts and historical sites. The trail is maintained by the Argentia Management Authority. The figure below presents an overview of the walking and driving trails that are part of this system.

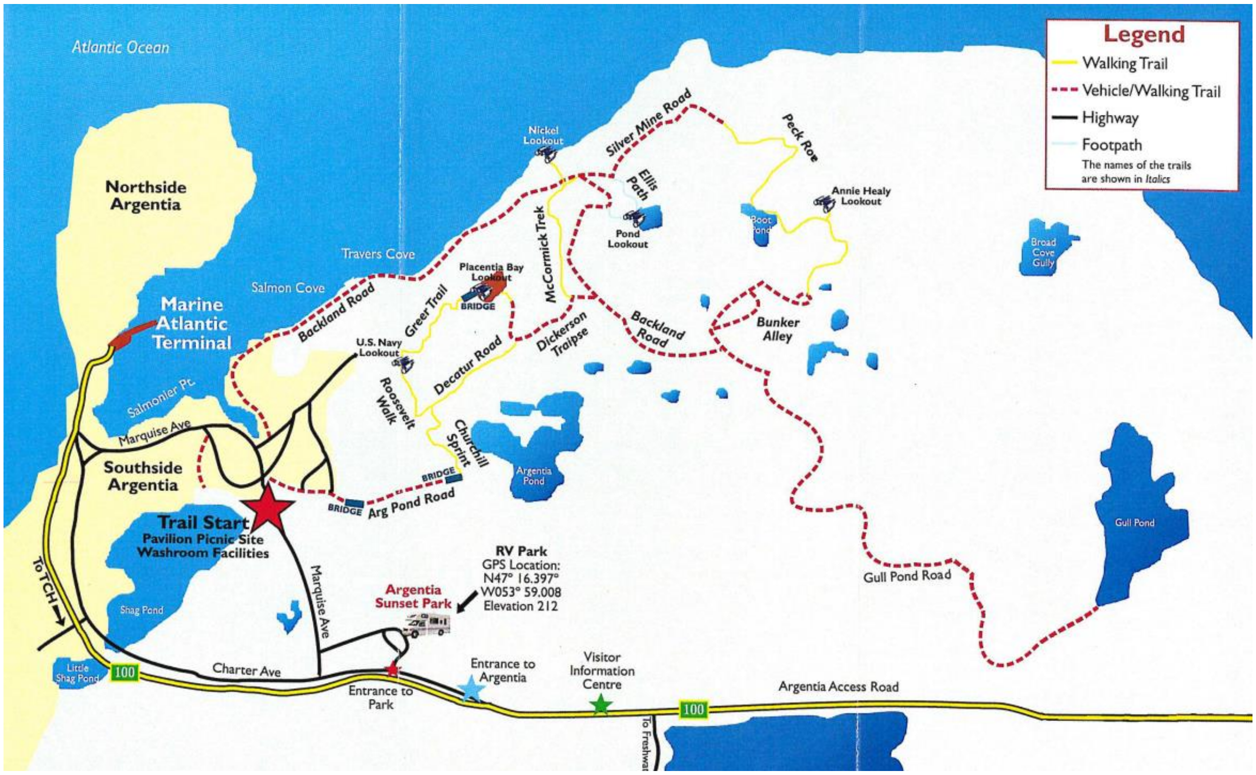


Figure 7 Argentia Backland Trails, from Port of Argentia [9]

Risk description: Public access within wind turbine maximum ice throw zones presents the risk that a person or vehicle may be struck by a falling or thrown ice fragment during periods of rotor icing. Although likelihood is low, the consequence of a person being struck may include serious injury and/or fatality, making this risk of very high importance. The consequence of a vehicle in motion or stopped being struck may include serious injury and/or fatality as well as property damage. The likelihood of this risk event occurring is above zero within the maximum ice throw zone during periods of rotor icing.

Relevant wind turbines:

– Argentia Backland trail system: # 8, 9, 21, 22, 23, 24, 25, 26, 34, 35, 36, 37, 38, 39, 40, 45
– Unnamed trails and old railway line (used by ATVs and hikers) identified in geo-information system, not part of Backland system however similar risks and mitigation measures apply: #18, 19, 20, 31, 32, 33

Risk mitigations measures: Potential risk mitigation measures include the following:

– **Public danger warning signage:** Signs should be located at the outset of the ice throw zone where pathways or roads intersect with the zone. Signs should be clear and provide adequate understanding of the ice throw risk. As an added risk mitigation measure, signage with flashing lights can be tied to an ice detection system to warn the public of active rotor icing periods when the risk is present. The goal is to prevent members of the public from entering the maximum ice throw areas during periods of rotor icing through education and warning. In addition to being located at the points where trails intersect with the wind turbine maximum ice throw zones, it is recommended that descriptive signage be placed at the trail head at Pavilion Picnic Site, where tourists and explorers are most likely to park their vehicle to begin the trail, as well as at any lookout points that are within maximum ice throw zones.
– **Restrict site access:** Due to the extensive public trails through the area, restricting site access at the outset of the maximum ice throw zones is not likely a possibility. However, access closer to the wind turbines base where risk of ice fall is highest may be achievable at certain turbine locations and should be investigated.

5.2.2.3 Sunset RV Park

The Argentia Sunset RV Park features 40 serviced sites with amenities including water, sewer, electrical, washrooms, showers, and a picnic area. Notably, the RV Park is described as being seasonally operated, implying that the site may be closed during the winter season when camping and exploring is less popular, which would reduce the risk of active public activity during winter icing events.

Risk description: There is one wind turbine for which the maximum ice throw zone overlaps with the Sunset RV Park, where members of the public may be parked and camping. Public access within wind turbine maximum ice throw zones presents the risk that a person or vehicle may be struck by a falling or thrown ice fragment during periods of rotor icing. Although likelihood is low, the consequence of a person being struck may include serious injury and/or fatality, making this risk of very high importance. The consequence of a vehicle in motion or stopped being struck may include serious injury and/or fatality as well as property damage. The likelihood of this risk event occurring is above zero within the maximum ice throw zone during periods of rotor icing.

Relevant wind turbines: # 34

Risk mitigations measures: Potential risk mitigation measures include the following:

– **Reduce wind turbine size:** The maximum ice throw zone for wind turbine #34 currently overlaps significantly with the main parking area of the Sunset RV Park. The risk of ice throw from this turbine landing within the Sunset RV Park can be eliminated by reducing the size of this wind turbine, for example reducing either the hub height, rotor diameter, or both. For example, the original wind turbine model assessed (Siemens SG 6.6-155 wind turbine with a hub height of 105 m and rotor diameter of 162 m), would have a maximum ice throw zone of 400 m that does not overlap with the Sunset RV Park, as shown in Figure 8 (compare to Wind Turbine #34 image in Appendix A).

Figure 8 ***Wind Turbine #34 Maximum Ice Throw Distance if Hub Height and Rotor Diameter reduced to 105 m and 162 m, respectively***

– **Public danger warning signage:** Signs should be located at the outset of the ice throw zone where pathways or roads intersect with the zone. Signs should be clear and provide adequate understanding of the ice throw risk. As an added risk mitigation measure, signage with flashing lights can be tied to an ice detection system to warn the public of active rotor icing periods when the risk is present. The goal is to prevent members of the public from entering the maximum ice throw areas during periods of rotor icing through education and warning. In addition to being located at the points where trails intersect with the wind turbine maximum ice throw zones, it is recommended that descriptive signage be placed within the Sunset RV Park information area to educate and warn the public on the risks during periods of icing events and areas that the public should avoid during these times.

5.2.2.4 Ammonia Production Plant (Planned)

The planned ammonia production plant that will be supplied energy from the wind turbine project will be located within the Port of Argentia, in the area shown by the red outline below. There is one wind turbine (#2) that slightly overlaps with the Northernmost corner of the planned ammonia plant site, as shown in Appendix A. Given that the overlap is minimal, the risk may not be considered significant enough to warrant reducing the wind turbine size. That said, if the wind turbine size was reduced modestly, the risk of ice throw landing within the ammonia plant site would be eliminated.

Figure 9 Planned Ammonia Production Plant Site (Red Outline)

Risk description: There is one wind turbine for which the maximum ice throw zone overlaps slightly with the Northern corner of the planned ammonia plant site, presenting a risk for workers and property damage.

Relevant wind turbines: # 2

Risk mitigations measures: Potential risk mitigation measures include the following:

– **Reduce wind turbine size:** The maximum ice throw zone for wind turbine #2 currently overlaps only slightly with the Northernmost corner of the planned ammonia plant size. Reducing the wind turbine hub height and/or rotor diameter modestly will completely eliminate this risk.

5.2.2.5 Industrial, Coast Guard, & Research Activities & Service Roads

There are several industrial activities within maximum ice throw zones evaluated. These include:

– Coastal Exposure Marine Test Site (almost overlapped by max ice throw zone of Wind Turbine #6)

- Husky Graving Dock (overlapped by max ice throw zone of Wind Turbine #5)
- Argentia Freezers and Terminals Main Site and Marshalling Yard (overlapped by Wind Turbine #7)
- QSL Port Facility (overlapped by max ice throw zone of Wind Turbine #7)
- Canadian Coast Guard MCTS Centre (overlapped by max ice throw zone of Wind Turbine #7)
- Unidentified industrial / storage activities in Argentia area (overlapped by max ice throw zones of Wind Turbines #5, 6, 7, 44, 46, 47)
- Service / industrial access roads, not including the planned wind turbine access roads (Wind Turbines #1, 2, 4, 5, 6, 7, 8, 9, 21, 22, 23, 24, 34, 35, 44, 45, 46, 47

Risk description: Ice fall or throw may strike workers within industrial activity zones, potentially causing serious injury and/or fatality, or vehicle and property damage.

Relevant wind turbines: # 1, 2, 4, 5, 6, 7, 8, 9, 21, 22, 23, 24, 34, 35, 44, 45, 46, 47

Risk mitigations measures: Potential risk mitigation measures include the following:

- **Engage with and educate the industrial operations:** The industrial operations within the maximum ice throw zones should be included in stakeholder engagement and education for the Project. Operations should be educated on the risk of ice fall and throw and mitigation measures should be deployed, such as worker training and education, adequate PPE, signage indicating the hazardous area and potentially also indicating active rotor icing periods, and work stand down during periods of active rotor icing within ice throw zones. For added mitigation, the Project could consider an active notification system whereby the industrial and other stakeholders are notified of the start and finish of every rotor icing event.
- **Reduce wind turbine size:** The maximum ice throw zones can be reduced by reducing wind turbine size. Turbine locations can also be modified to mitigate ice throw zone overlap with industrial areas.
- **Warning / danger signs:** Signage can be placed at the points where industrial activities intersect with maximum ice throw zones to warn workers to avoid the areas during active icing events.

5.2.2.6 Public Roads

The maximum ice throw zones of several wind turbines overlap with public roads and a highway through the Argentia and Placentia areas. These include:

- Highway 102 / Charter Ave
- Backland Road
- Andrews Ave
- Fox Harbour Road
- Marquis Ave
- Argentia Pond Road
- Cooper Drive

There is also potentially a planned future Dunville Bypass road that will pass through the area.

Risk description: Ice fall or throw landing on roads may result in serious injury or fatality as well as property damage if ice fragments strike moving or parked vehicles. The likelihood of occurrence is reduced if vehicles do not stop within the ice throw zone and therefore are only within the ice throw zone for a short period of time.

Relevant wind turbines: # 7, 8, 21, 22, 23, 24, 25, 33, 34, 35, 38, 39, 40, 44, 45, 46

Risk mitigations measures: Potential risk mitigation measures include the following:

– **Public danger warning signage:** Similar to avalanche risk zones, public warning signage can be placed in visible locations along roadways to warn drivers of the danger and to not stop/park their vehicles within the ice throw zones during the winter season. Signage can also be tied to an ice detection system providing warning lights during periods of active rotor icing risk.

5.2.2.7 Transmission Power Line

There are existing and planned transmission power lines running from Argentia Port and through the Argentia Backland area.

Risk description: Ice throw may strike power lines or associated infrastructure and cause damages that could potentially lead to power outage resulting in economic losses.

Relevant wind turbines: # 7, 40, 41, 42, 44, 45

Risk mitigations measures: There are minimal potential mitigation measures unique to this risk. As with all other wind turbines, pausing the turbines during periods of active rotor icing will reduce the likelihood of ice fragments falling beyond the immediate area of the wind turbine itself, mitigating this risk.

5.2.2.8 Potential Planned Substation / Collectors Tie-In

Part of the Project will include electrical collectors bringing energy produced from the wind turbines to a collector substation. This is visualized in Figure 10 to the right showing the collectors from multiple wind turbines coalescing on the potential substation location.

Risk description: Aboveground electrical infrastructure may be struck by thrown/falling ice fragments leading to damages that could result in loss of power and economic losses.

Relevant wind turbines: # 16, 29

Risk mitigations measures: There are minimal potential mitigation measures unique to this risk. As with all other wind turbines, pausing the turbines during periods of active rotor icing will reduce the likelihood of ice fragments falling beyond the immediate area of the wind turbine itself, mitigating this risk.

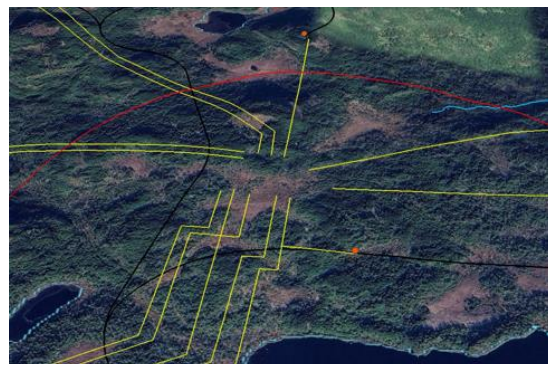


Figure 10 Planned Collectors Converging on Potential Electrical Substation Location

6. Conclusions & Recommendations

The risk of ice fall or throw is a notable hazard for wind turbine operations in cold climates. Although there have been limited ice throw events leading to public property damage globally, and no known recorded events to date of a person being struck by a falling or thrown ice fragment, the consequences associated can be significant – potentially leading to injury or fatality – and therefore should be mitigated as is reasonably achievable. Each incident or accident caused by ice throw is an unnecessary event and will decrease the public acceptance of wind energy.

The main risks identified in this ice throw analysis are summarized below along with recommended mitigation measures.

Note that across all risk items identified and wind turbines, potential mitigation measures that can be deployed include (a) pausing the wind turbines to reduce likelihood that ice fragments are thrown beyond the footprint of the wind turbine, and (b) investing in anti- and de-icing technologies from the wind turbine manufacturer to reduce rotor icing periods.

Table 3 Summary of Key Risks and Recommended Mitigation Measures

Risk Description	Relevant Wind Turbines	Recommended Mitigation Measures
Sunset RV Park – public parking and camping area within maximum ice throw and fall zones, where ice throw may strike a person or property resulting in serious injury or fatality or public property damage	34	• Reduce the size of wind turbine #34 to eliminate the overlap with the RV Park • Add public education and warning signage to the RV Park explaining the hazard and areas to avoid during potential icing events. For added mitigation, signage can be equipped with flashing lights tied to the rotor icing detection system to warn the public of active rotor icing events. The goal is to prevent members of the public from entering the maximum ice throw areas during periods of rotor icing through education and warning.
Wind farm operations and maintenance workers accessing wind turbines may be struck by thrown/falling ice resulting in serious injury and/or fatality	All wind turbines	• Invest in ice protection devices at all wind turbines to provide safe worker access. • Educate and train employees in the potential risks in accordance with the CanREA Best Practices.
Public access within the Backland Trails and Road system and abandoned Argentia Naval Base, and other trails in the area that are not within the Backland system, where a person or vehicle may be struck by falling or thrown ice resulting in serious injury or fatality and property damager	Backland trails: 8, 9, 21, 22, 23, 24, 25, 26, 34, 35, 36, 37, 38, 39, 40, 45 Abandoned Argentia Naval Base: 1, 2, 4, 5, 6, and 45 Other trails: 18, 19, 20, 31, 32, 33	• Add public education and warning signage to the trail head (Pavilion Picnic Site), lookouts, points of interest (such as Battery 282) and any point where a trail intersects with maximum ice throw zones. Signage should explain the hazard and areas to avoid during potential icing events. For added mitigation, signage can be equipped with flashing lights tied to the rotor icing detection system to warn the public of active rotor icing events. The goal is to prevent members of the public from entering the maximum ice throw areas during periods of rotor icing through education and warning.
Industrial, coast guard, and research activities and service roads within maximum ice throw zones, where industrial operations or workers may be struck by a thrown or falling ice fragment resulting in serious injury or death in addition to property damage	1, 2, 4, 5, 6, 7, 8, 9, 21, 22, 23, 24, 34, 35, 44, 45, 46, 47	• Engagement with the industrial and other activities as part of project stakeholder engagement, to educate the organizations on the risks of ice fall or throw and support development of risk mitigation plans. Risk mitigations that the industrial and other activities can employ will include adequate worker education and PPE, warning signage, and potentially work stand down during periods of active rotor icing. For added mitigation, the Project could consider an active notification system whereby the industrial and other stakeholders are notified of the start and finish of every rotor icing event. • Where risk is considered too significant for active industrial operations, wind turbine locations may be moved or wind turbine size reduced to remove the overlap with the maximum ice throw zone.
Public roadways that intersect within maximum ice throw zones present the risk of falling or thrown ice striking a vehicle, resulting in possible injury or fatality and property damage	7, 8, 21, 22, 23, 24, 25, 33, 34, 35, 38, 39, 40, 44, 45, 46	• Similar to avalanche risk zones, public warning signage can be placed in visible locations along roadways to warn drivers of the danger and to not stop/park their vehicles within the ice throw zones. Signage can also be tied to an ice detection system providing warning lights during periods of active rotor icing.
General risk of ice throw	All wind turbines	• Invest in anti- or de-icing technologies to reduce the anticipated rotor icing periods and thereby mitigate the likelihood of ice fall and throw. • Pause wind turbines during periods of detected active rotor icing events to mitigate the risk of ice throw.

7. References

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Appendices

Appendix A

Maximum Ice Throw Zones on Wind Turbine Locations

Ice Throw Assessment

Maximum Ice Throw Boundary

Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #2

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- NH3 PLANT SITE
- SERVICE ROAD
- ABANDONED ARGENTIA NAVAL BASE

Ice Throw Assessment

Maximum Ice Throw Boundary

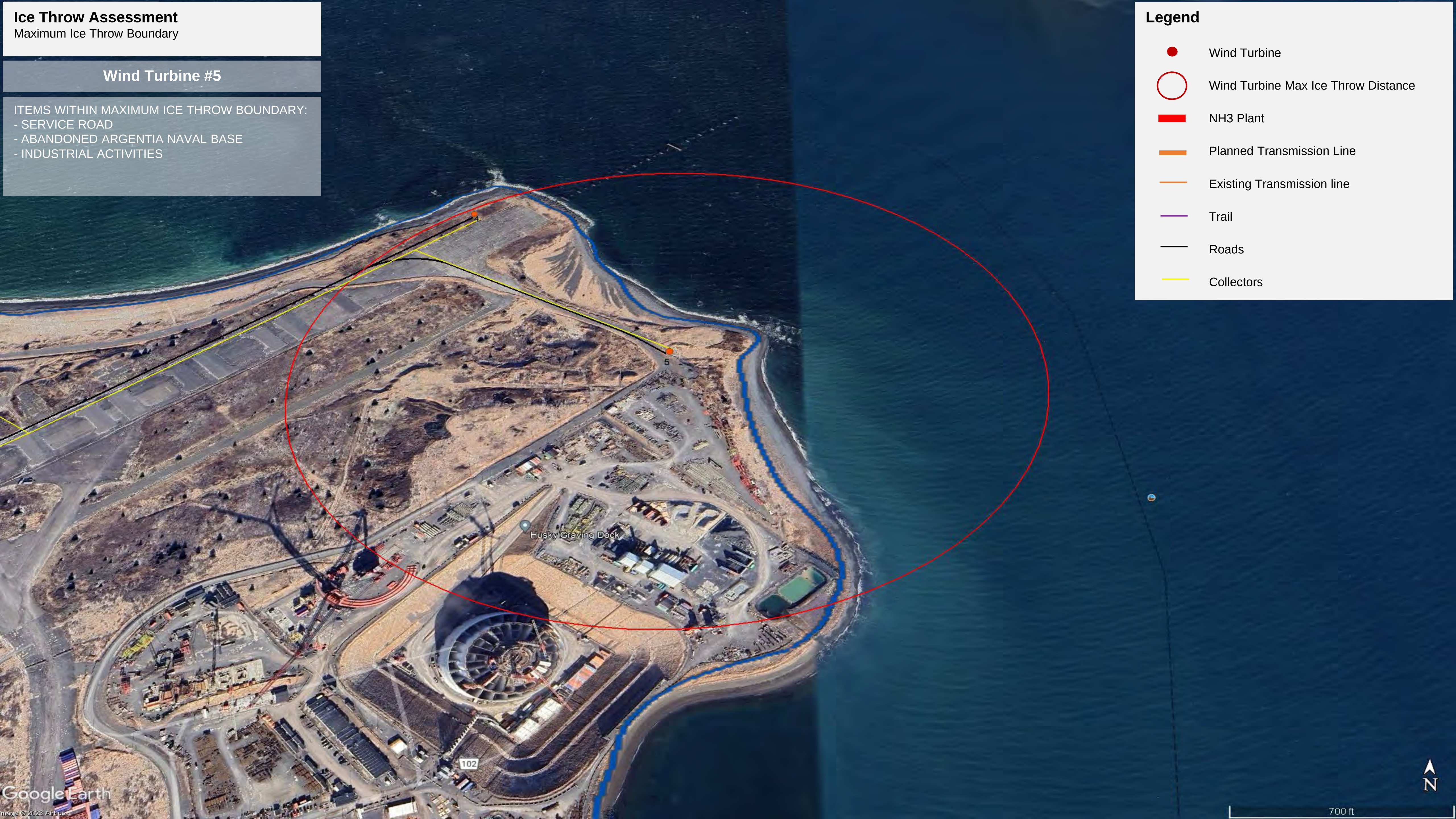
Wind Turbine #4

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROAD
- ABANDONED ARGENTIA NAVAL BASE

Ice Throw Assessment
Maximum Ice Throw Boundary

Wind Turbine #5

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROAD
- ABANDONED ARGENTIA NAVAL BASE
- INDUSTRIAL ACTIVITIES



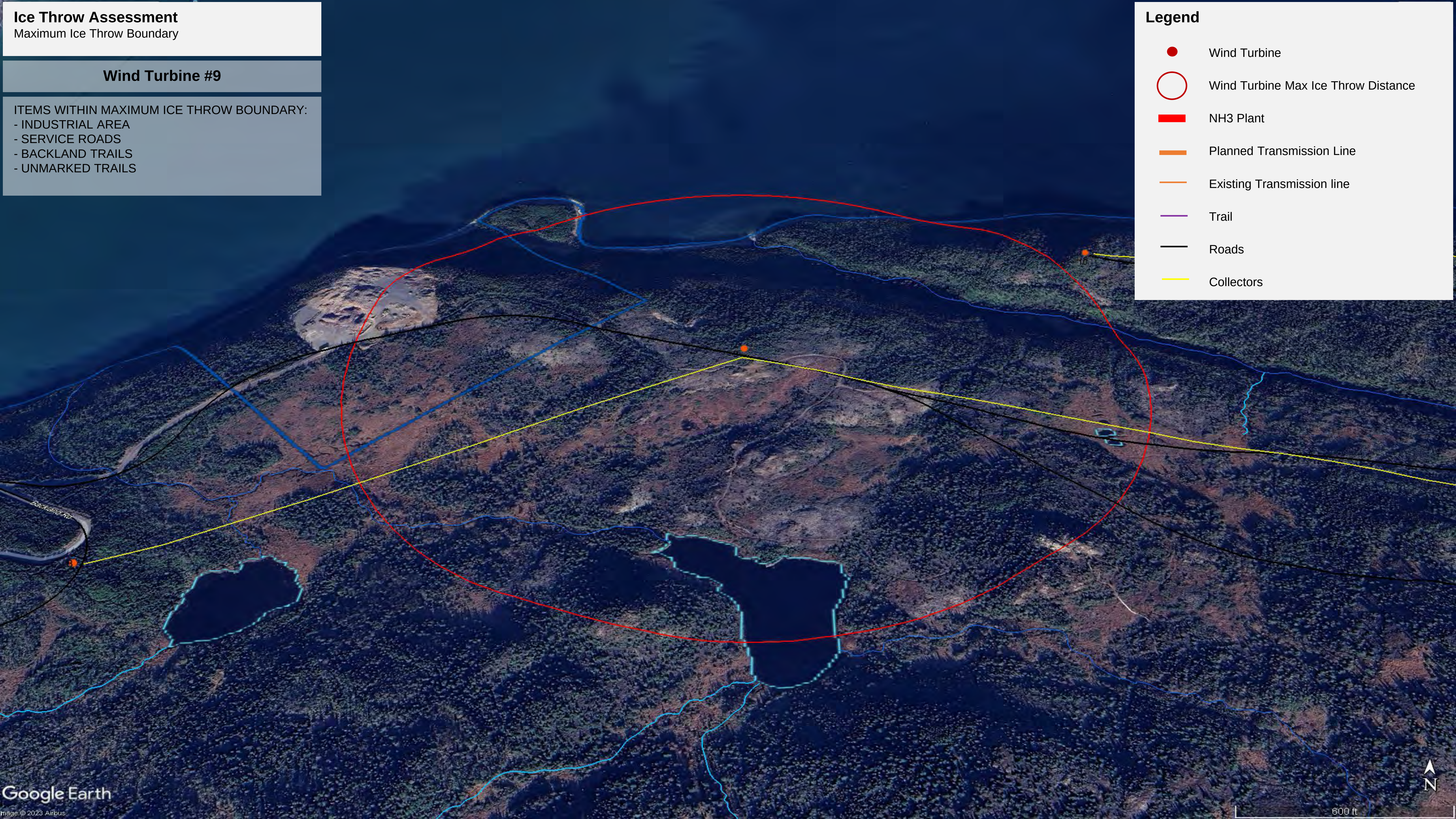

Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #6
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROAD
- ABANDONED ARGENTIA NAVAL BASE
- INDUSTRIAL ACTIVITIES
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Coastal Exposure Marine Test Site
6
102
Placentia Pike
N
700 ft
Google Earth
Image © 2023 Airbus

Ice Throw Assessment
Maximum Ice Throw Boundary

Wind Turbine #7

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- PLACENTIA PIKE
- HWY 102
- TRANSMISSION LINE
- INDUSTRIAL ACTIVITIES
- SERVICE ROADS

Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #8
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- BACKLAND ROAD & TRAILS
- SERVICE ROADS
- INDUSTRIAL AREA
- UNMARKED TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Backland Rd
Backland Rd
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
600 ft
N

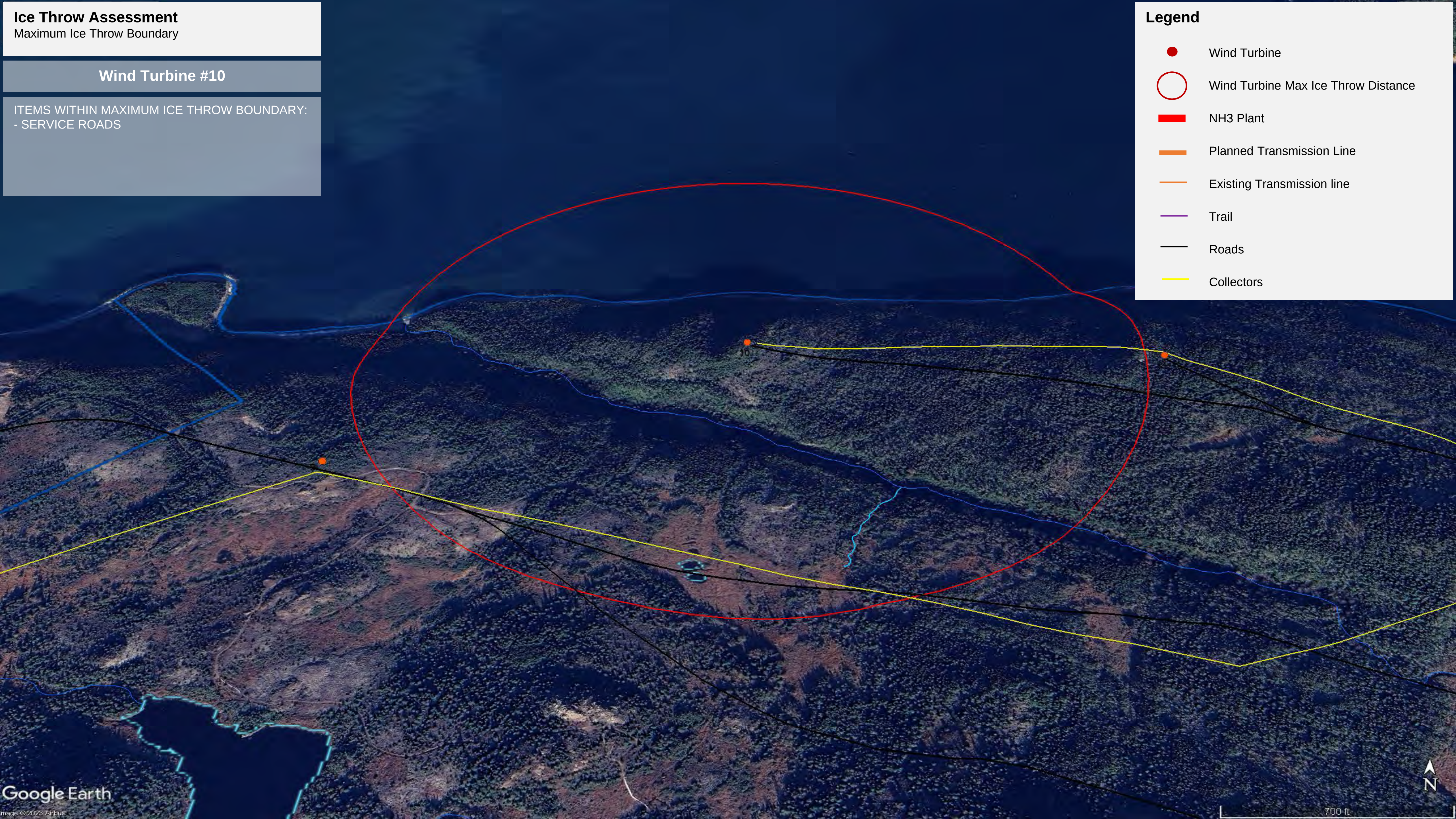

Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #9
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- INDUSTRIAL AREA
- SERVICE ROADS
- BACKLAND TRAILS
- UNMARKED TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Backland Rd
Google Earth
mage © 2023 Airbus
600 ft
N

Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #10

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS

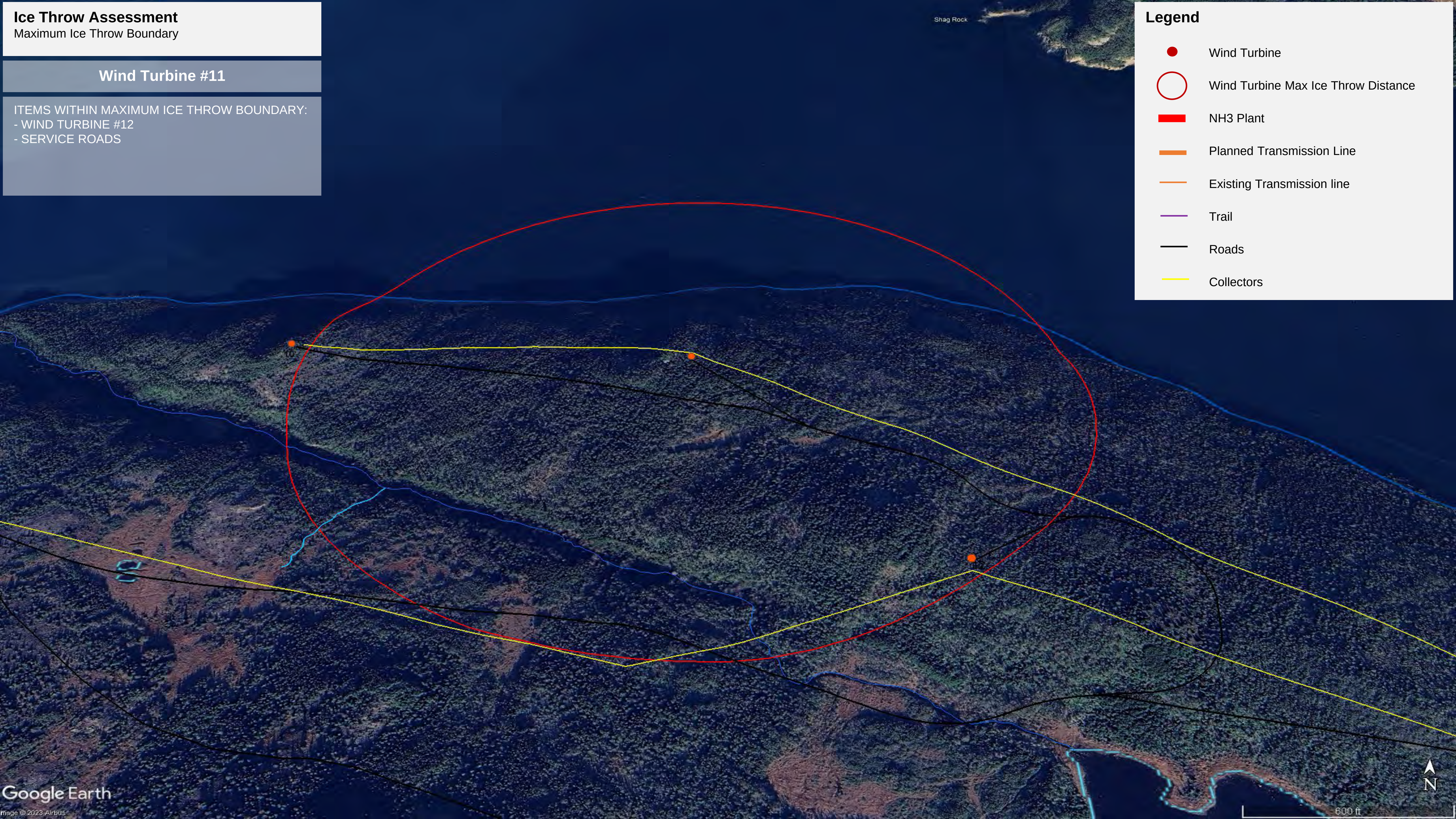


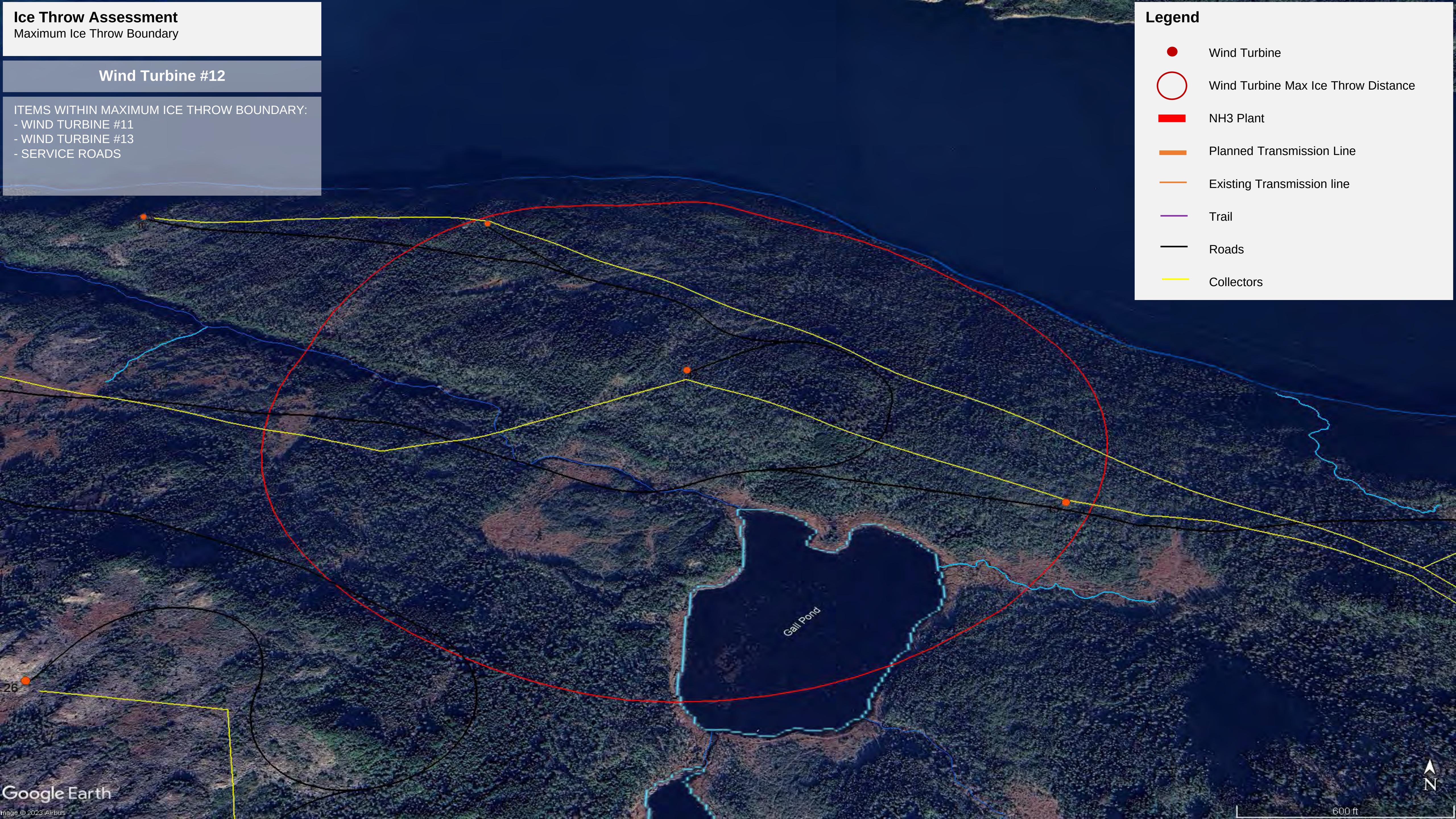
Ice Throw Assessment

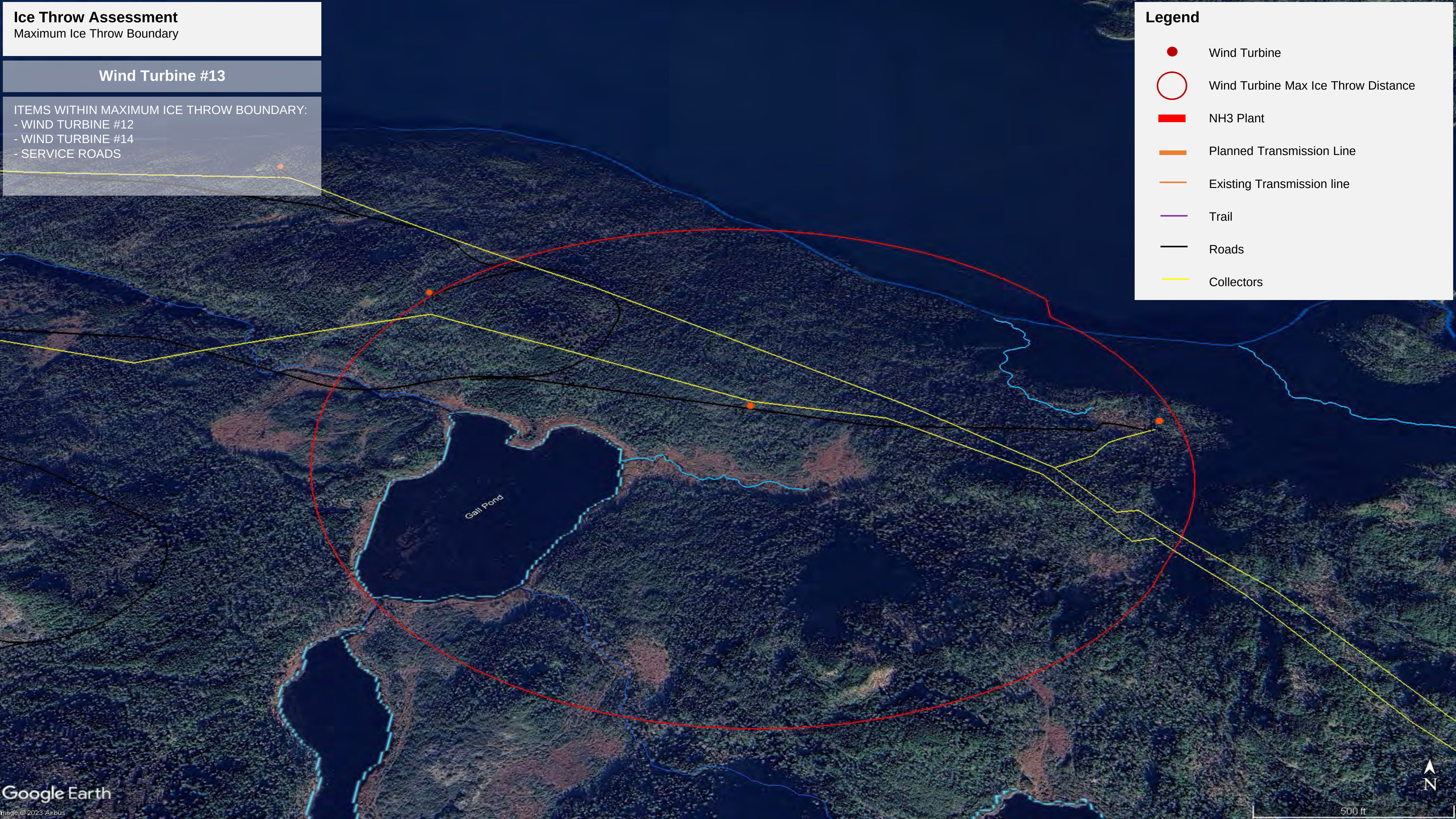
Maximum Ice Throw Boundary

Wind Turbine #11

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #12
- SERVICE ROADS




Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #12
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #11
- WIND TURBINE #13
- SERVICE ROADS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Gall Pond
26
N
600 ft
Google Earth
Image © 2023 Airbus


Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #13
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #12
- WIND TURBINE #14
- SERVICE ROADS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Gall Pond
Google Earth
Image © 2023 Airbus
N
500 ft

Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #14

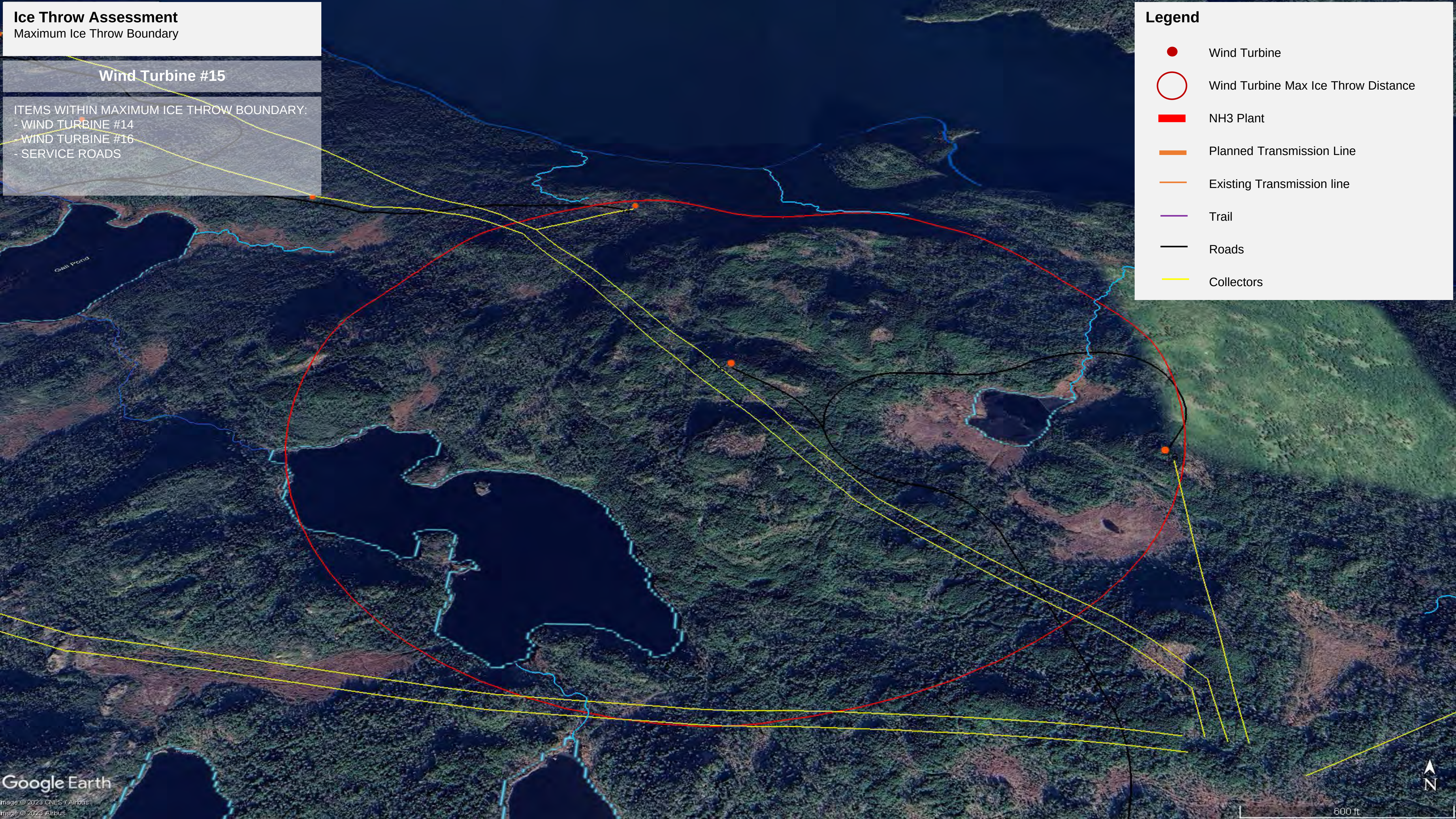
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #13
- WIND TURBINE #15
- SERVICE ROADS

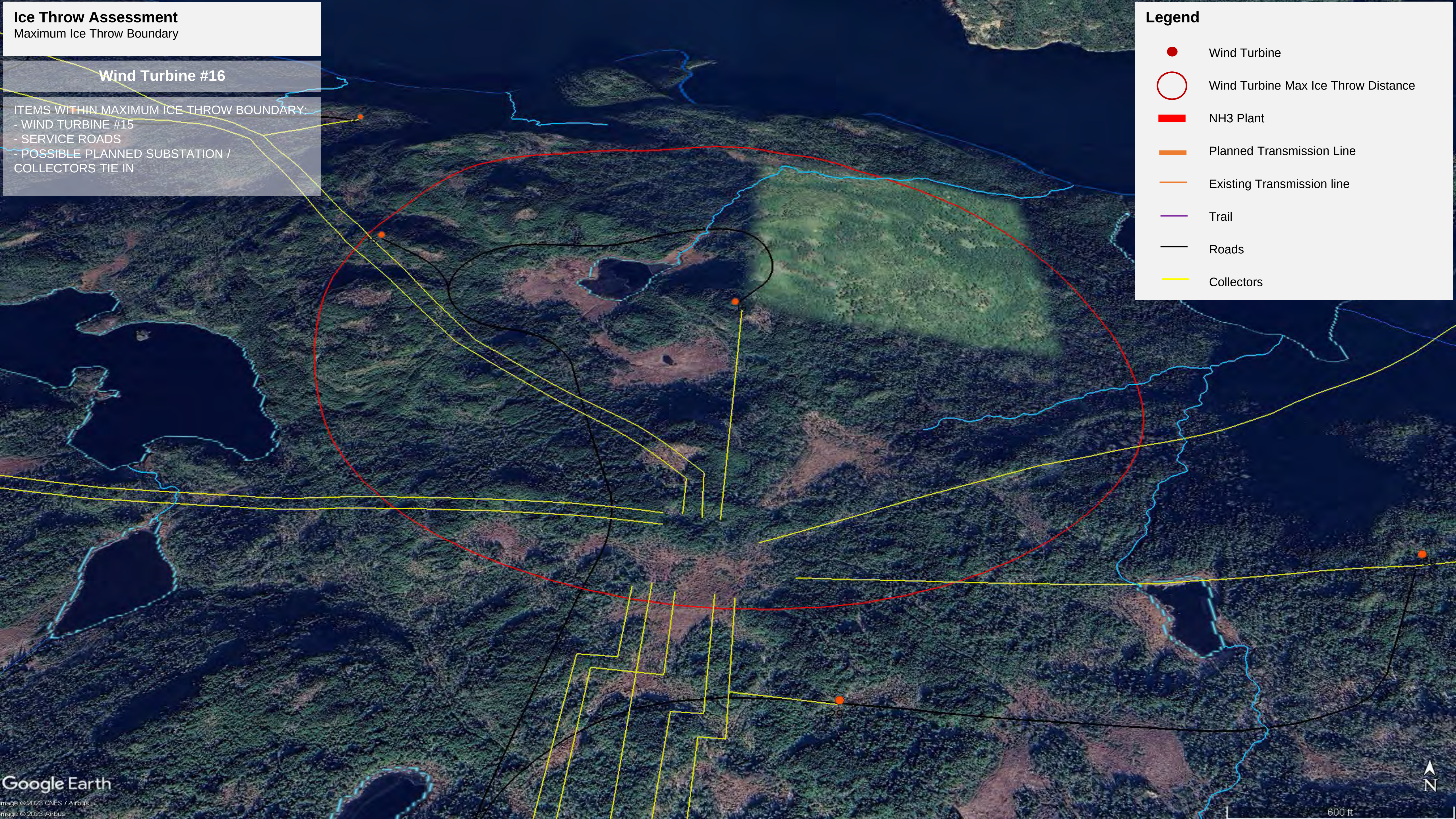
Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #15

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #14
- WIND TURBINE #16
- SERVICE ROADS

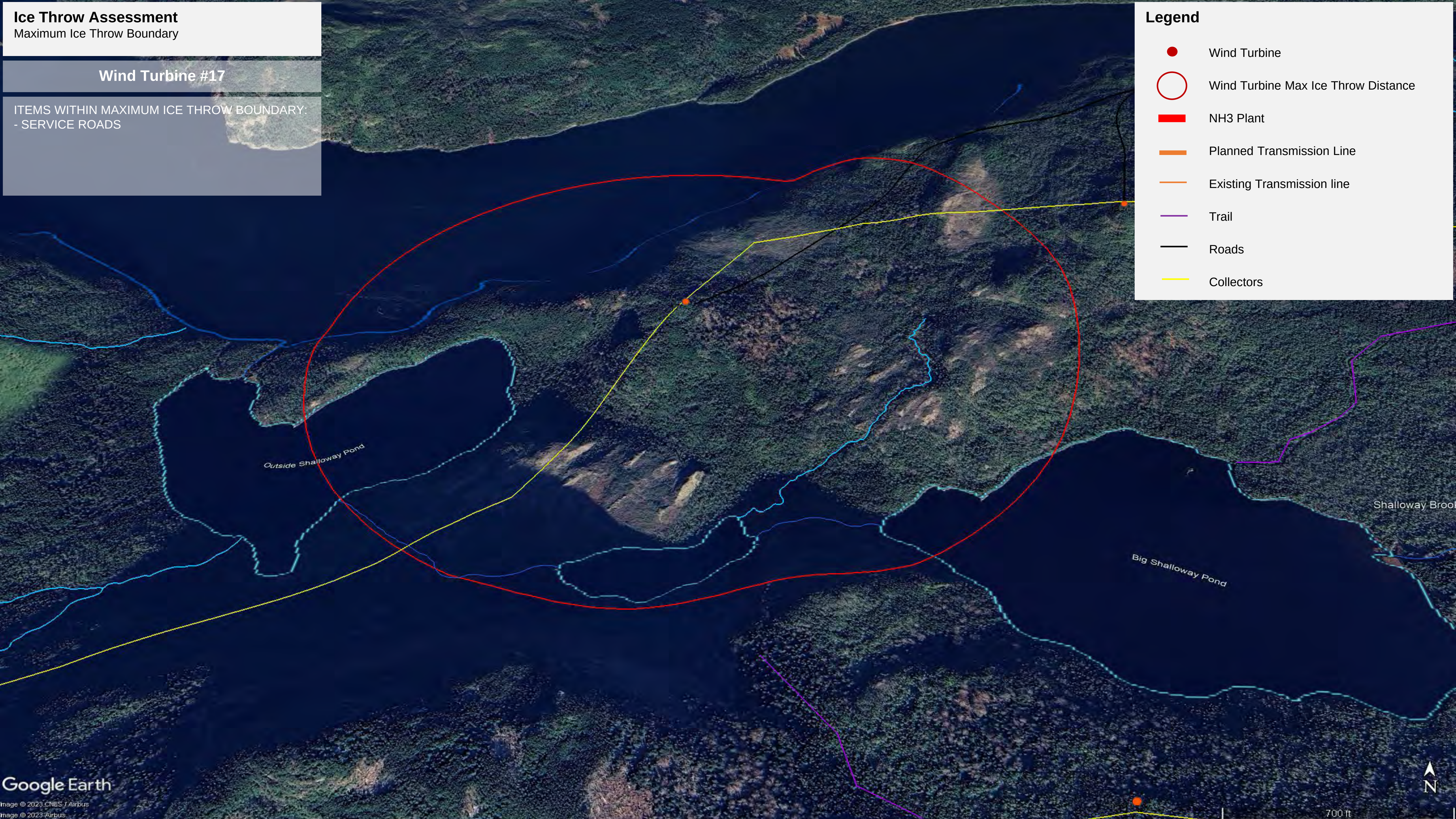


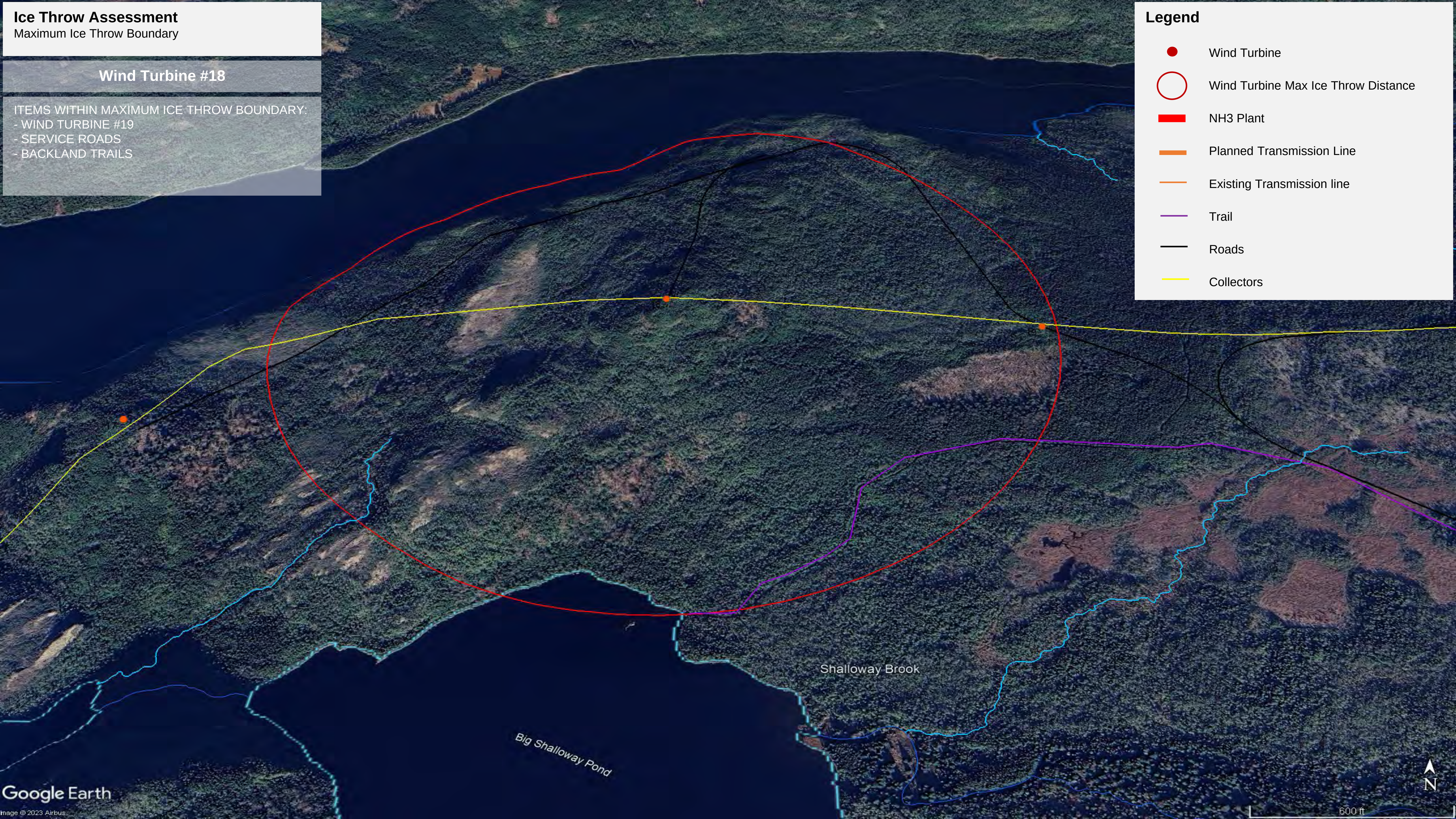

Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #16
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #15
- SERVICE ROADS
- POSSIBLE PLANNED SUBSTATION / COLLECTORS TIE IN
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
600 ft
N

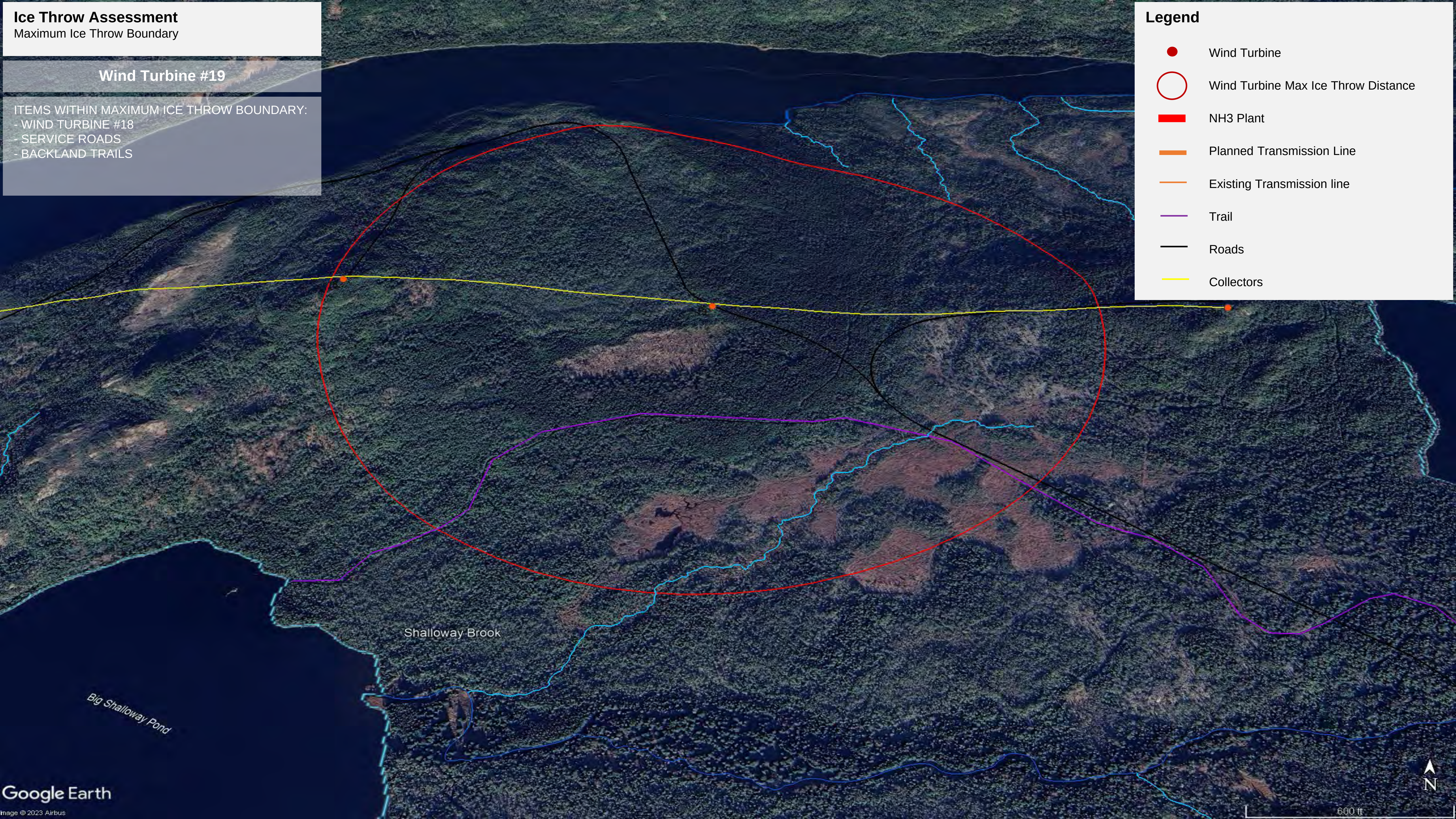
Ice Throw Assessment
Maximum Ice Throw Boundary

Wind Turbine #17

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS



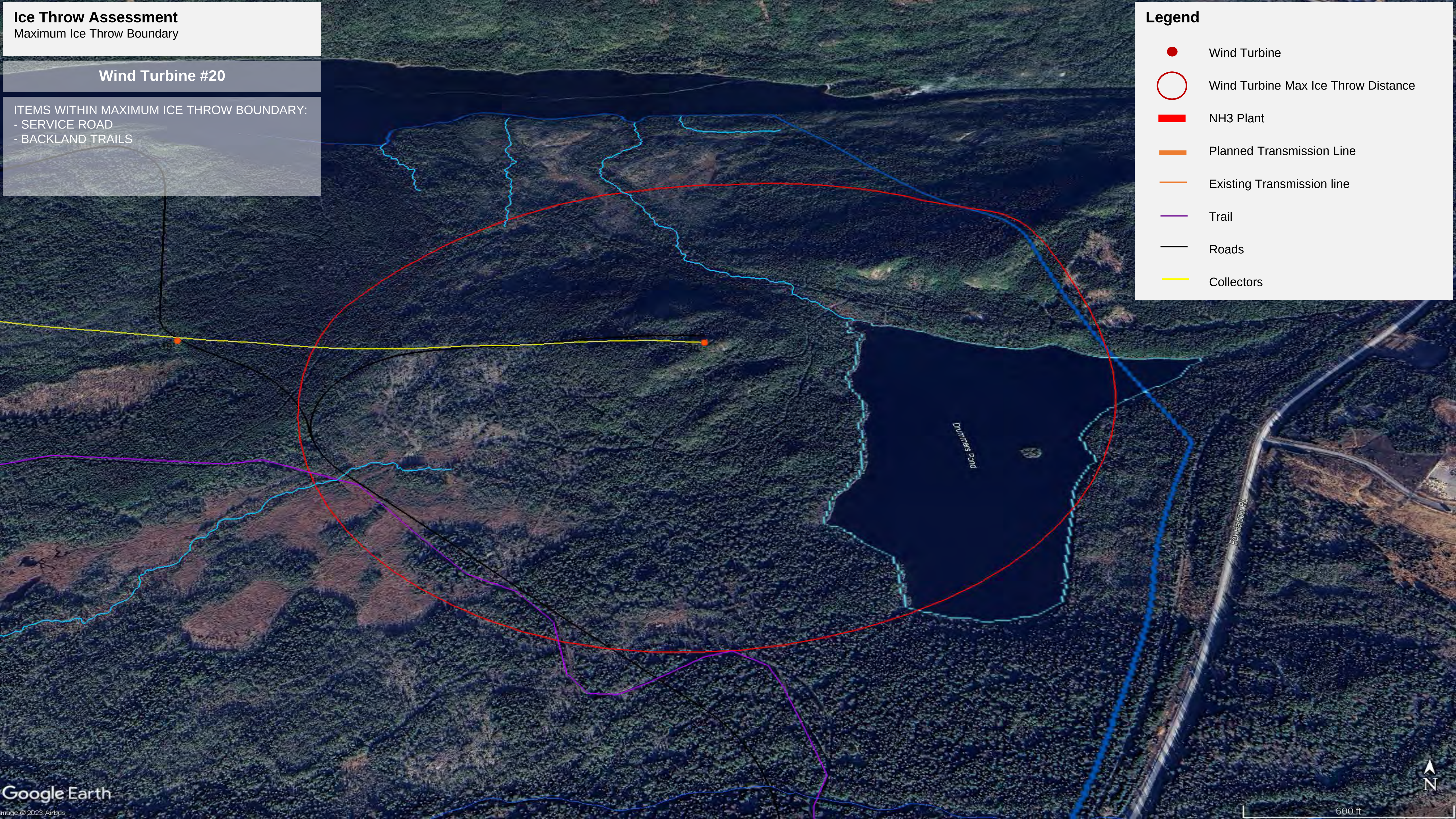

Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #18
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #19
- SERVICE ROADS
- BACKLAND TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Shalloway Brook
Big Shalloway Pond
Google Earth
Image © 2023 Airbus
600 ft
N


Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #19
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #18
- SERVICE ROADS
- BACKLAND TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Shalloway Brook
Big Shalloway Pond
Google Earth
Image © 2023 Airbus
600 ft
N

Ice Throw Assessment
Maximum Ice Throw Boundary

Wind Turbine #20

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROAD
- BACKLAND TRAILS

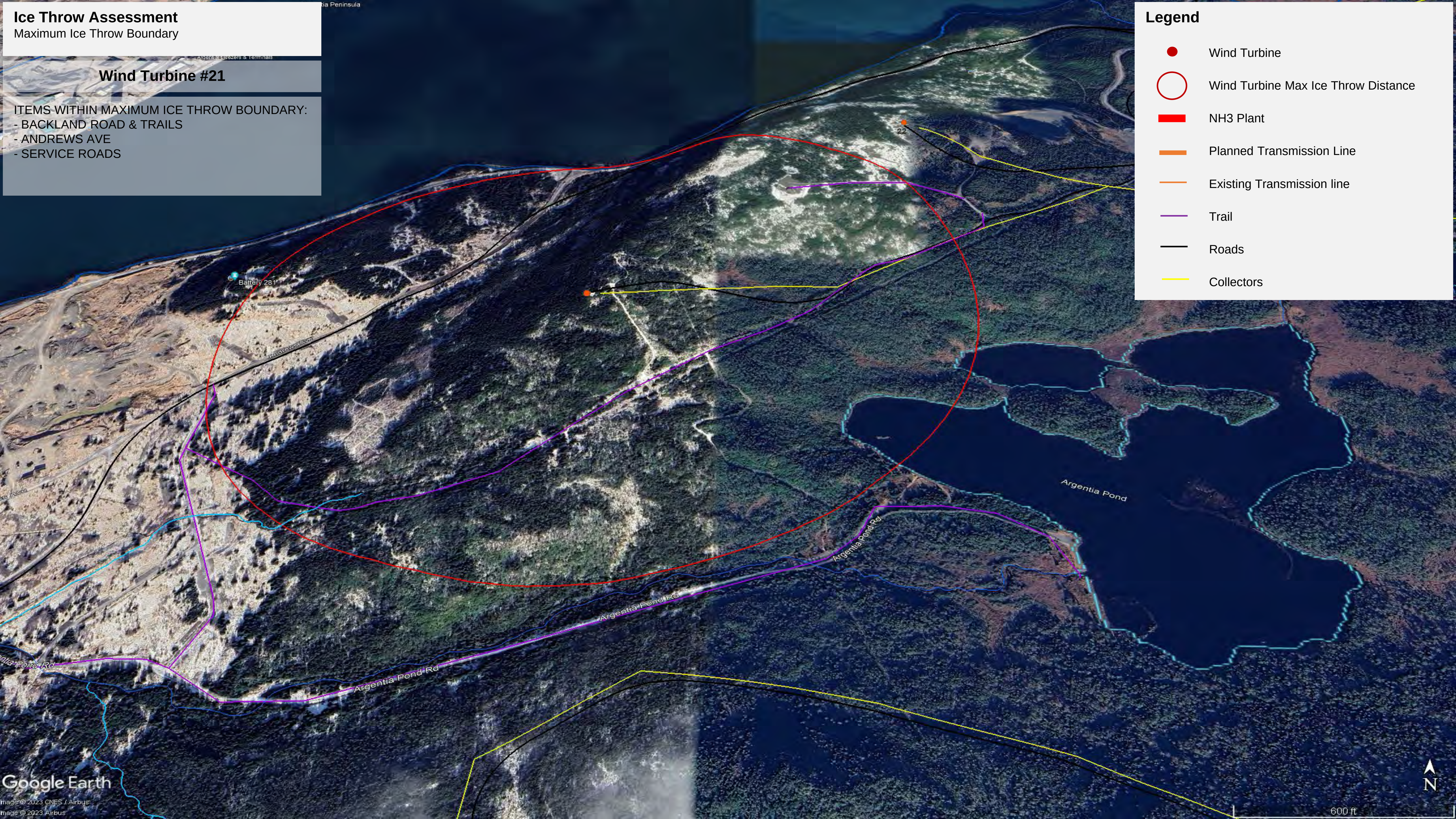


Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #21

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- BACKLAND ROAD & TRAILS
- ANDREWS AVE
- SERVICE ROADS

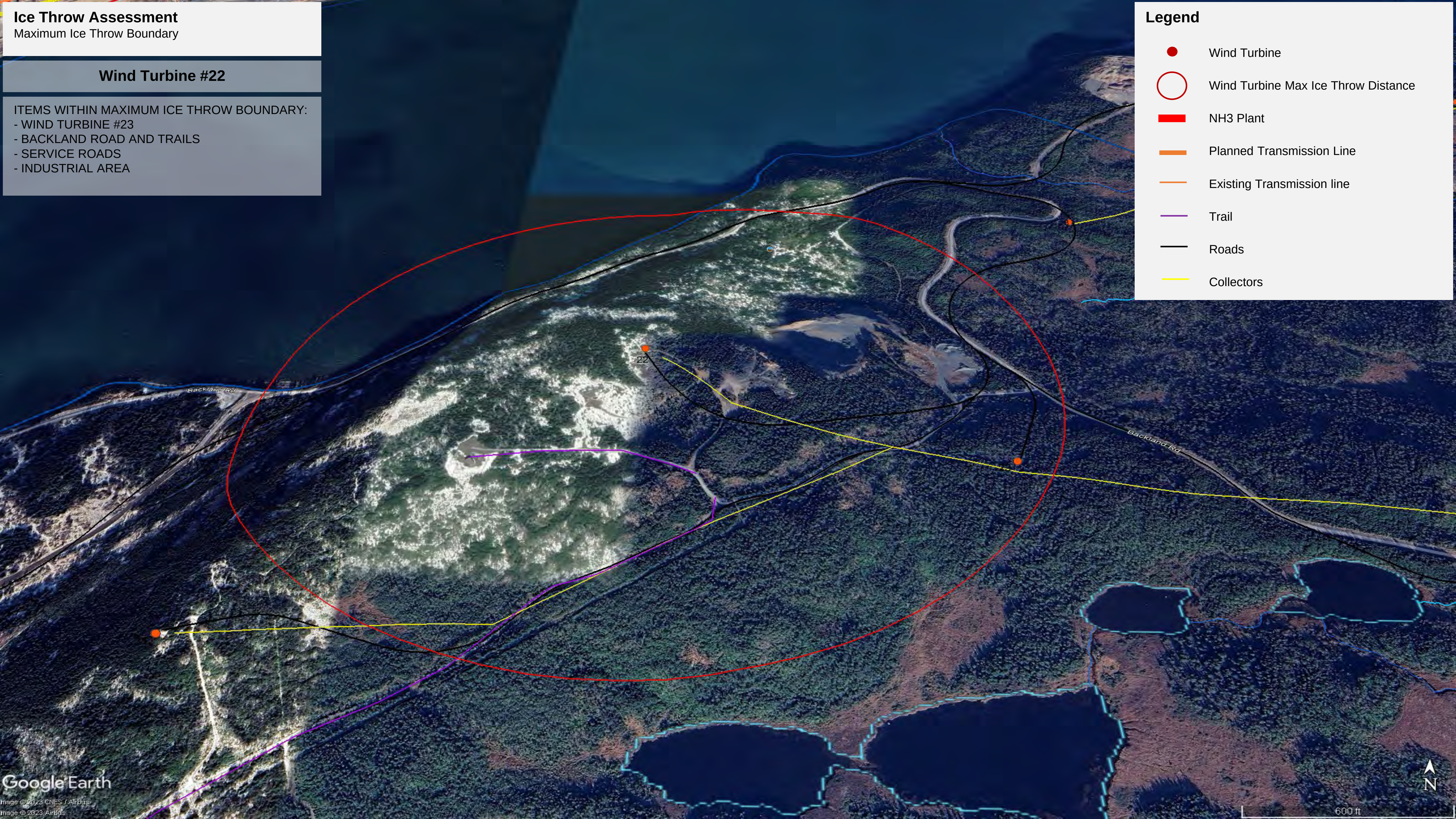


Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #22

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #23
- BACKLAND ROAD AND TRAILS
- SERVICE ROADS
- INDUSTRIAL AREA

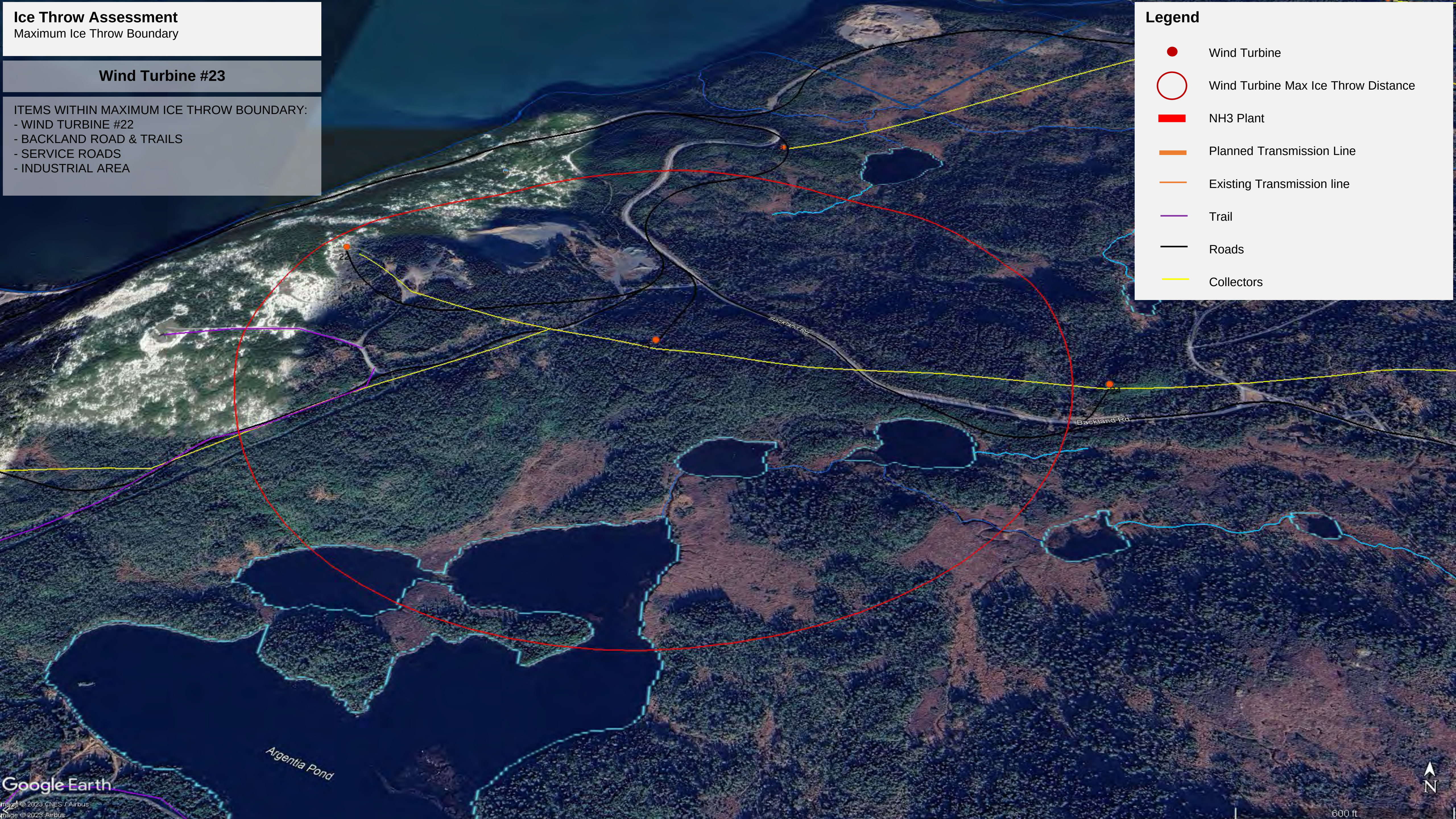


Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #23

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #22
- BACKLAND ROAD & TRAILS
- SERVICE ROADS
- INDUSTRIAL AREA

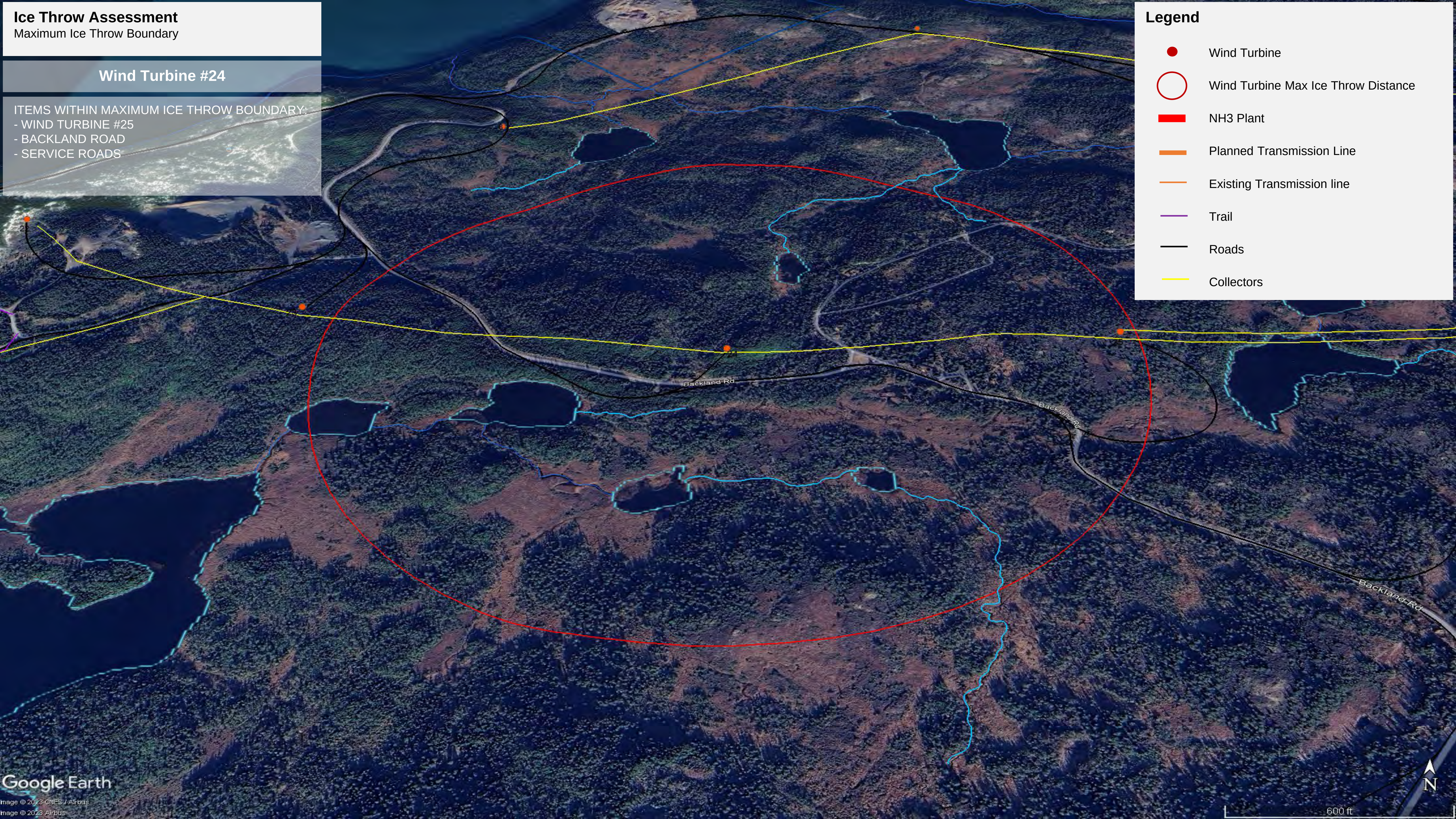


Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #24

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #25
- BACKLAND ROAD
- SERVICE ROADS



Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #25

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #24
- BACKLAND ROAD
- SERVICE ROADS

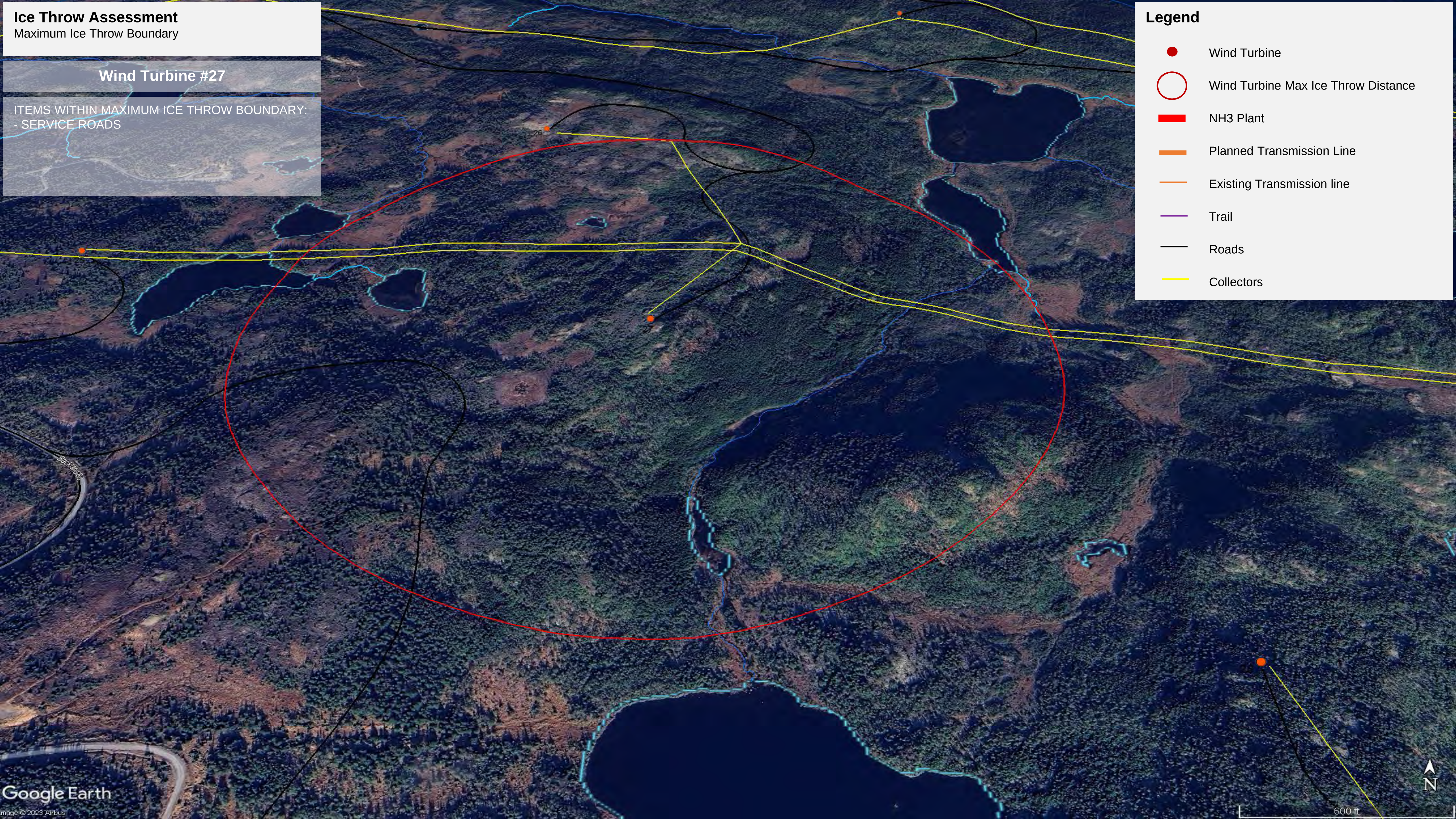

Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #26
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
26
Google Earth
Image © 2023 Airbus
N
600 ft

Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #27

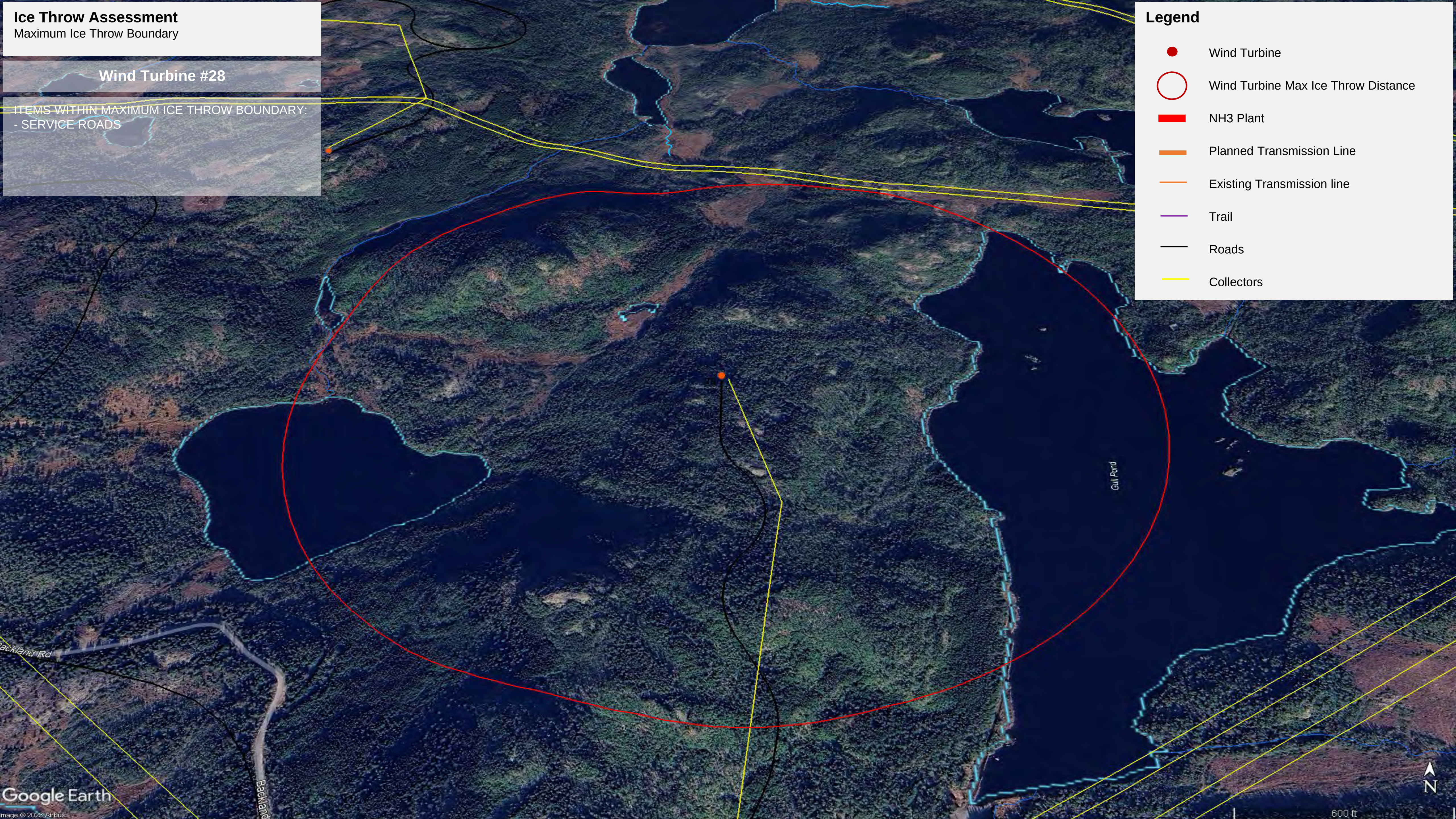
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS

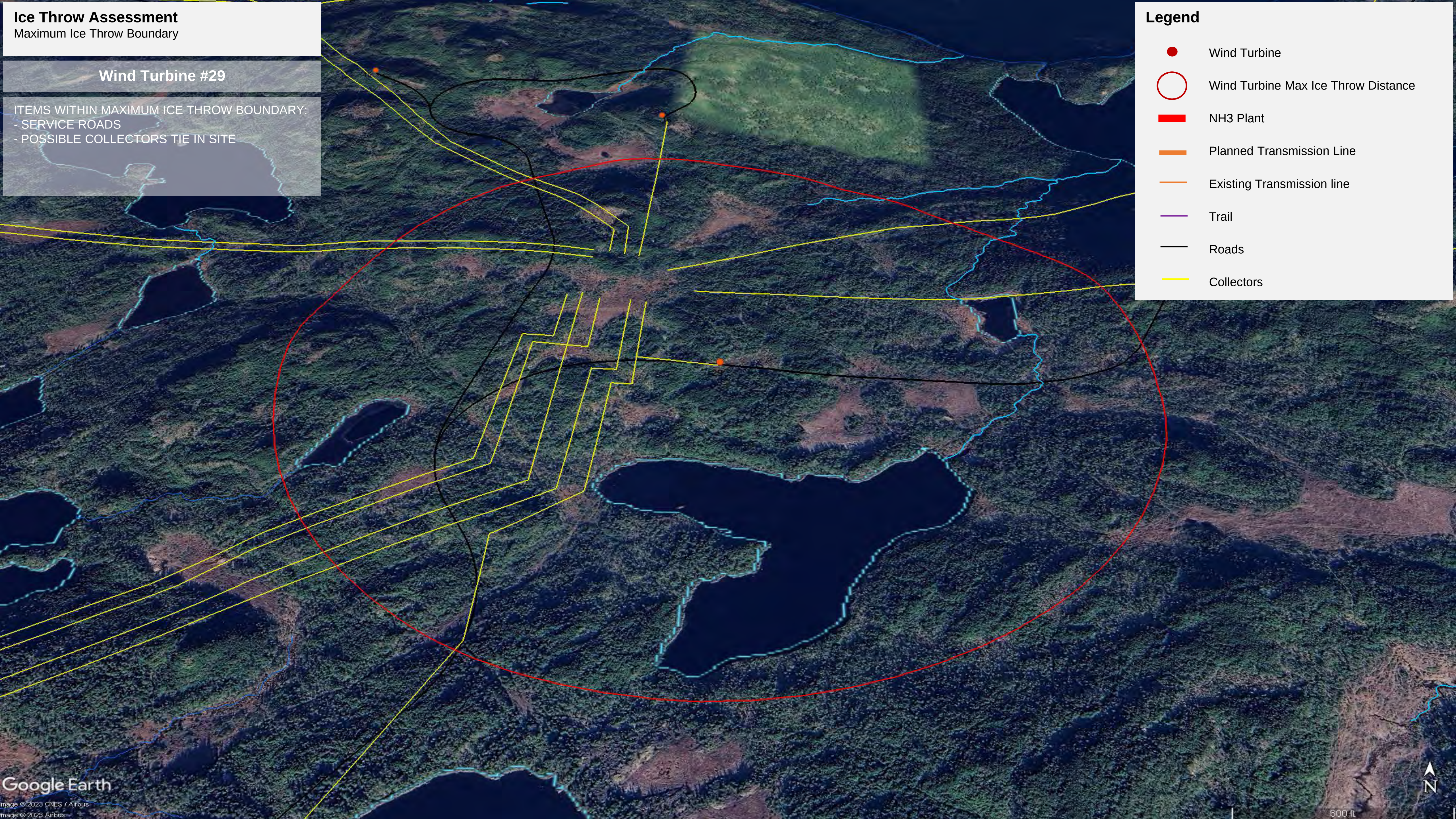


Ice Throw Assessment
Maximum Ice Throw Boundary

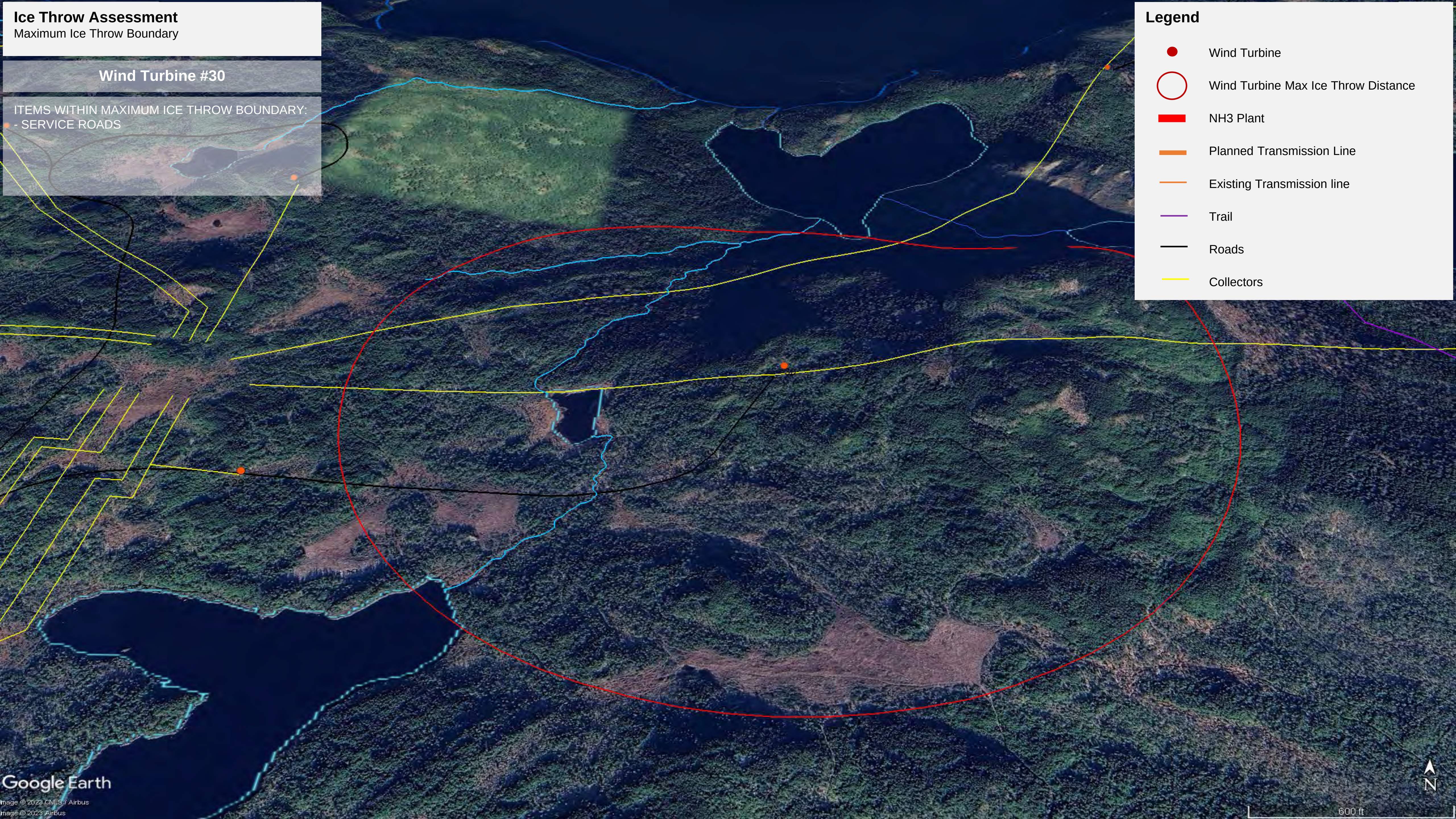
Wind Turbine #28

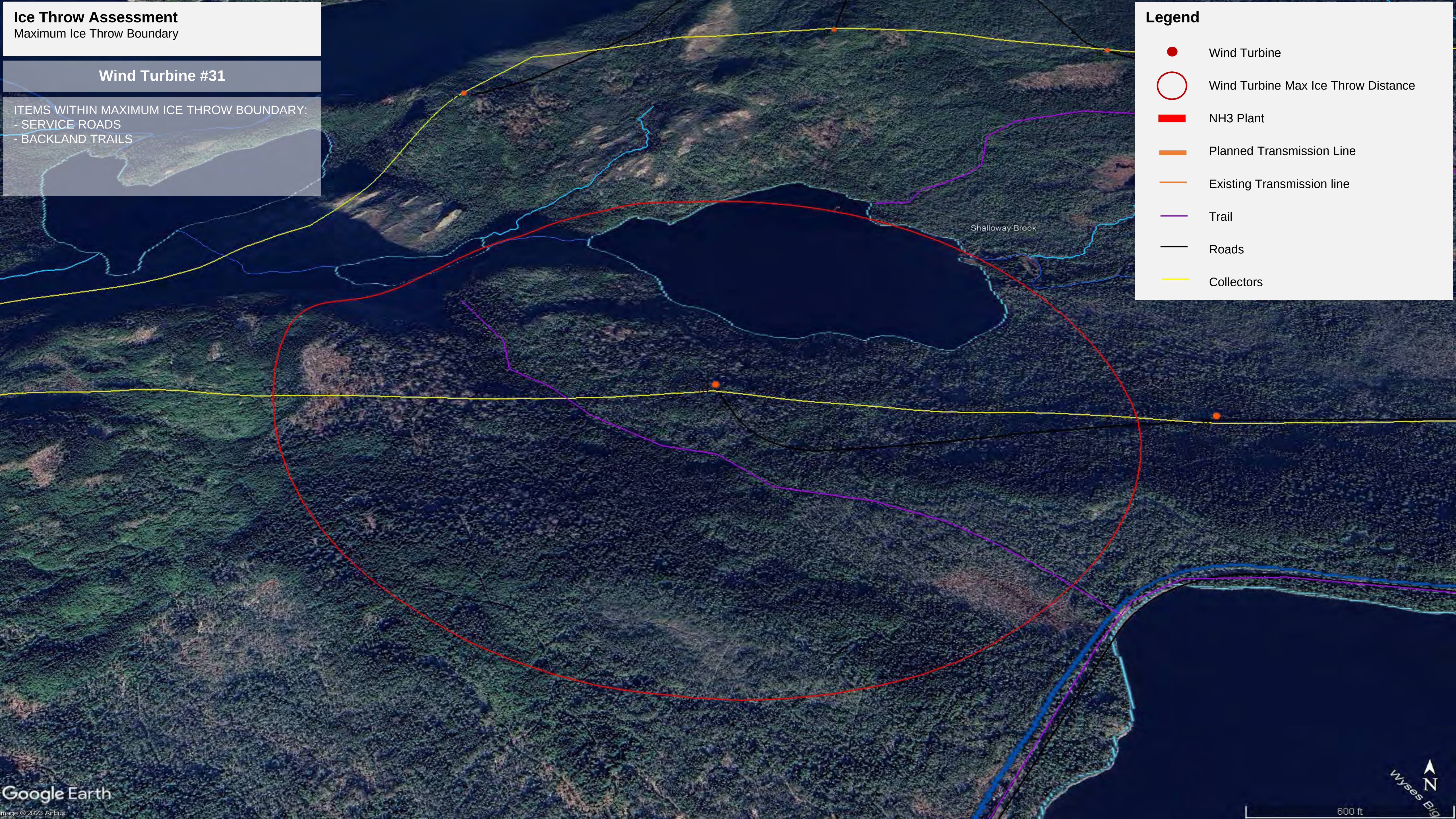
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS

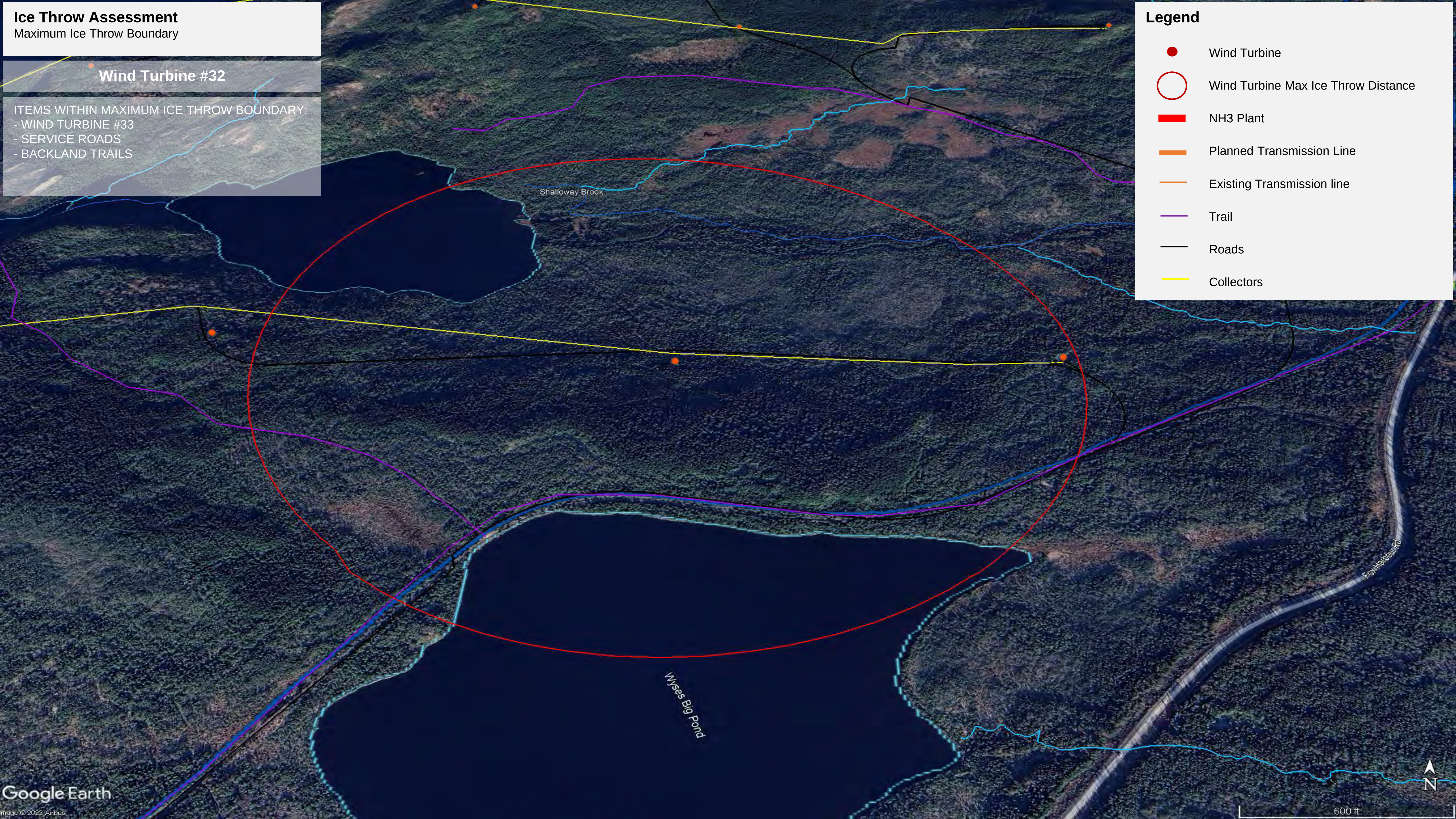




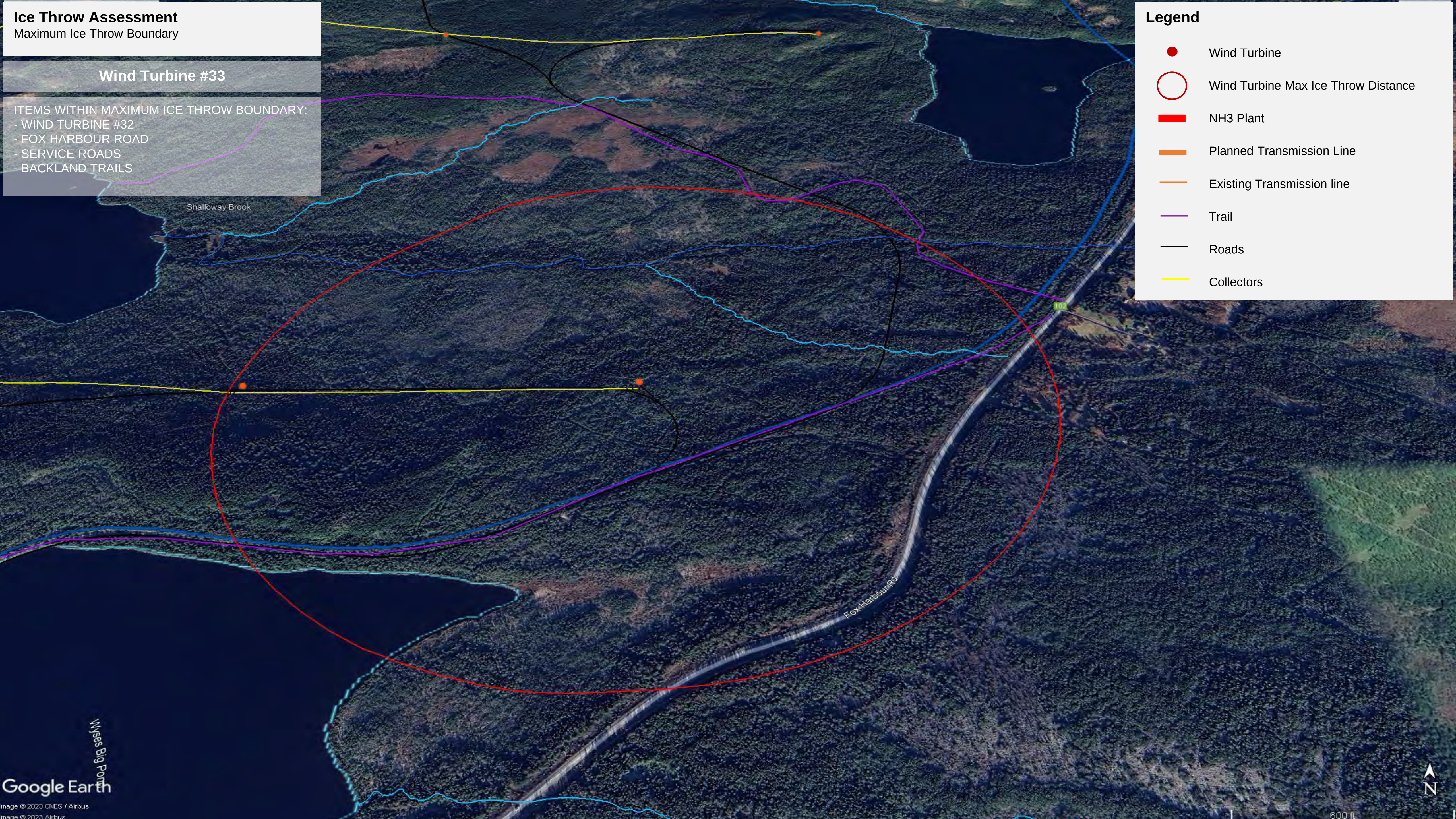
Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #29
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
- POSSIBLE COLLECTORS TIE IN SITE
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
600 ft
N

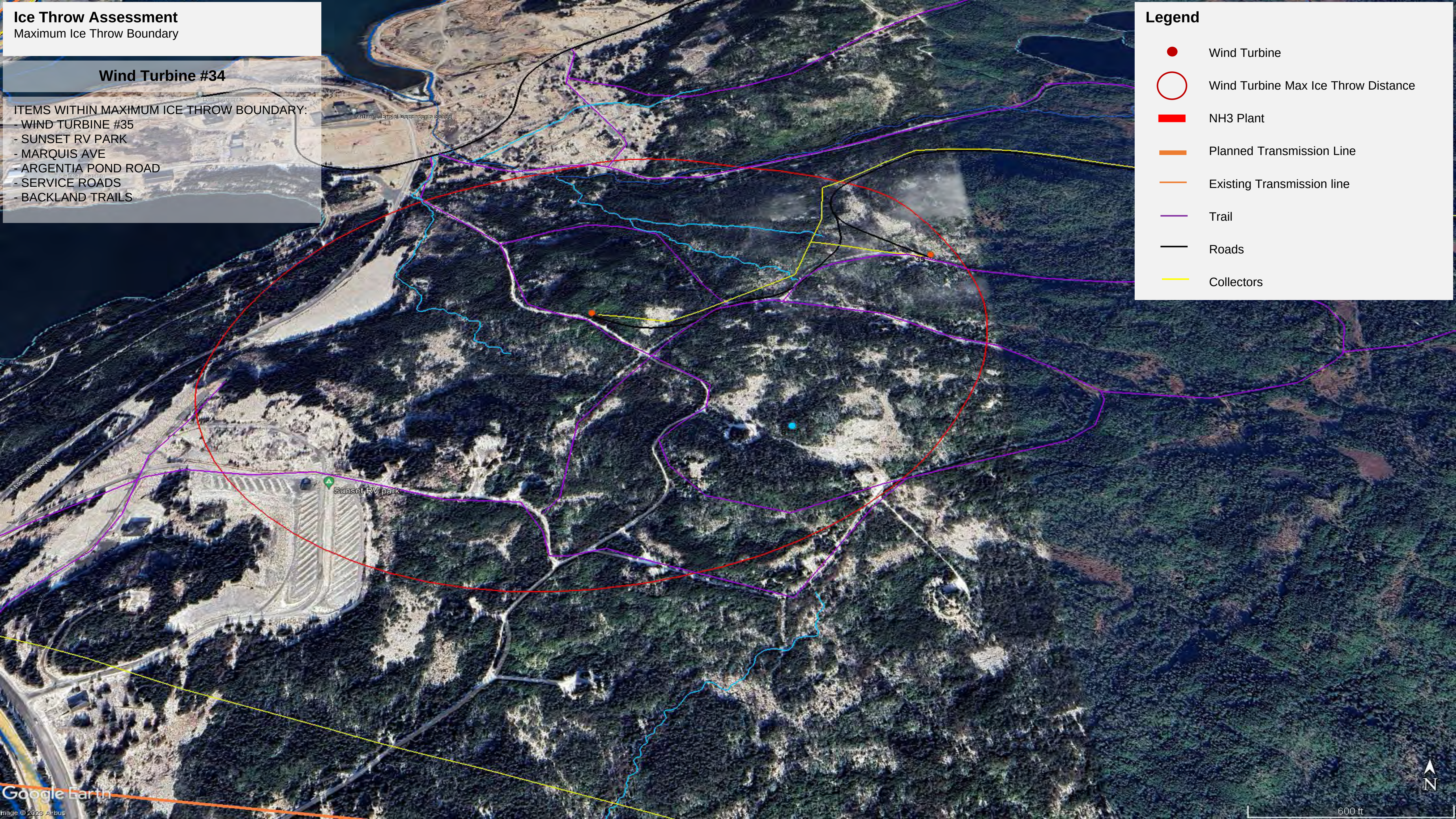

Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #30
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
N
600 ft

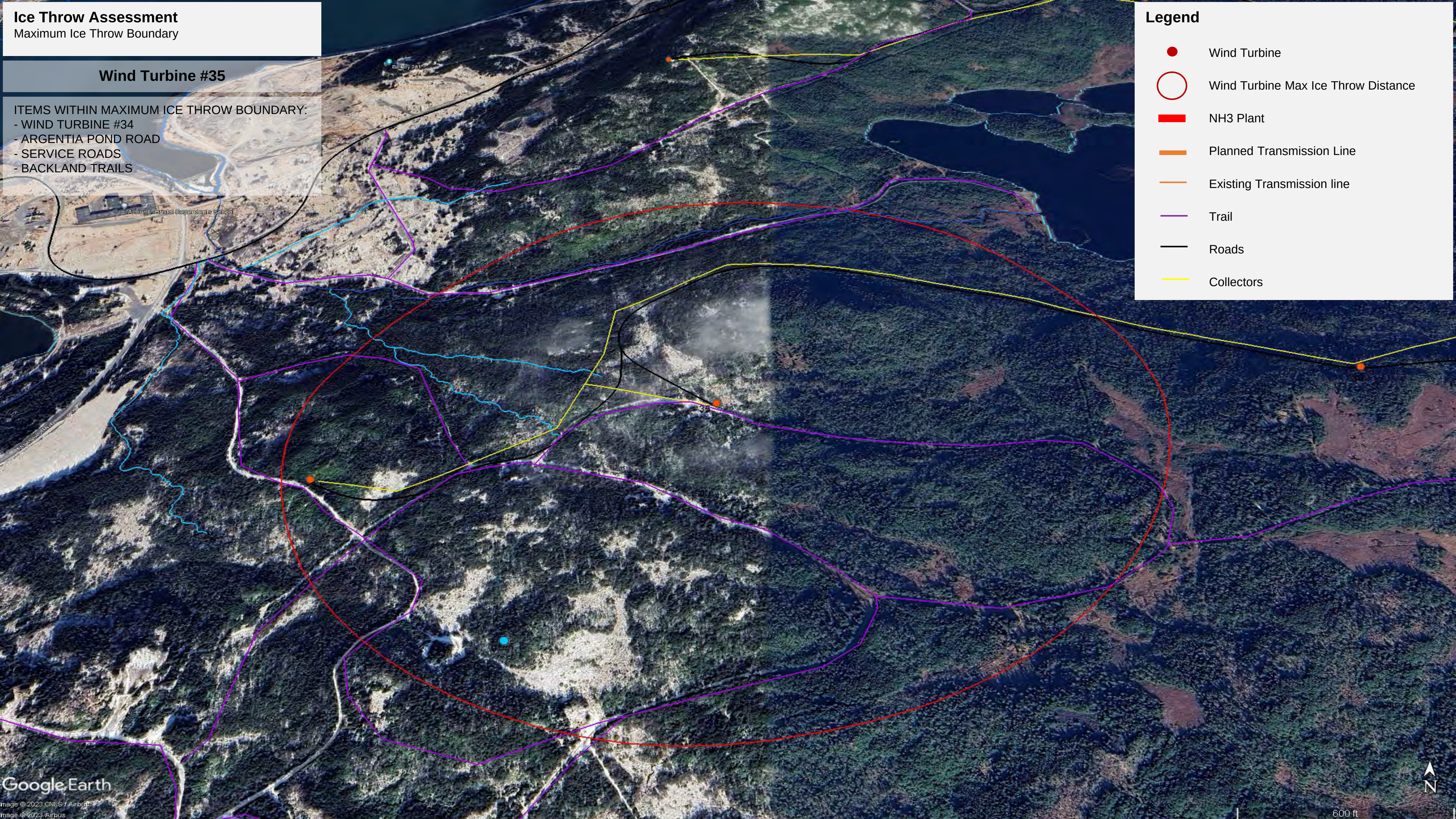

Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #31
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
- BACKLAND TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Shalloway Brook
Google Earth
Image © 2023 Airbus
600 ft
N



Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #32
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #33
- SERVICE ROADS
- BACKLAND TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Shalloway Brook
Wyses Big Pond
Fox Harbour Rd
600 ft
N
Google Earth
Image © 2023 Airbus


Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #33
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #32
- FOX HARBOUR ROAD
- SERVICE ROADS
- BACKLAND TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Shalloway Brook
Fox Harbour Rd
Wyses Big Pond
Google Earth
Image © 2023 CNES / Airbus
N
600 ft


Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #34
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #35
- SUNSET RV PARK
- MARQUIS AVE
- ARGENTIA POND ROAD
- SERVICE ROADS
- BACKLAND TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Sunset RV park
Google Earth
Image © 2023 Airbus
600 ft
N



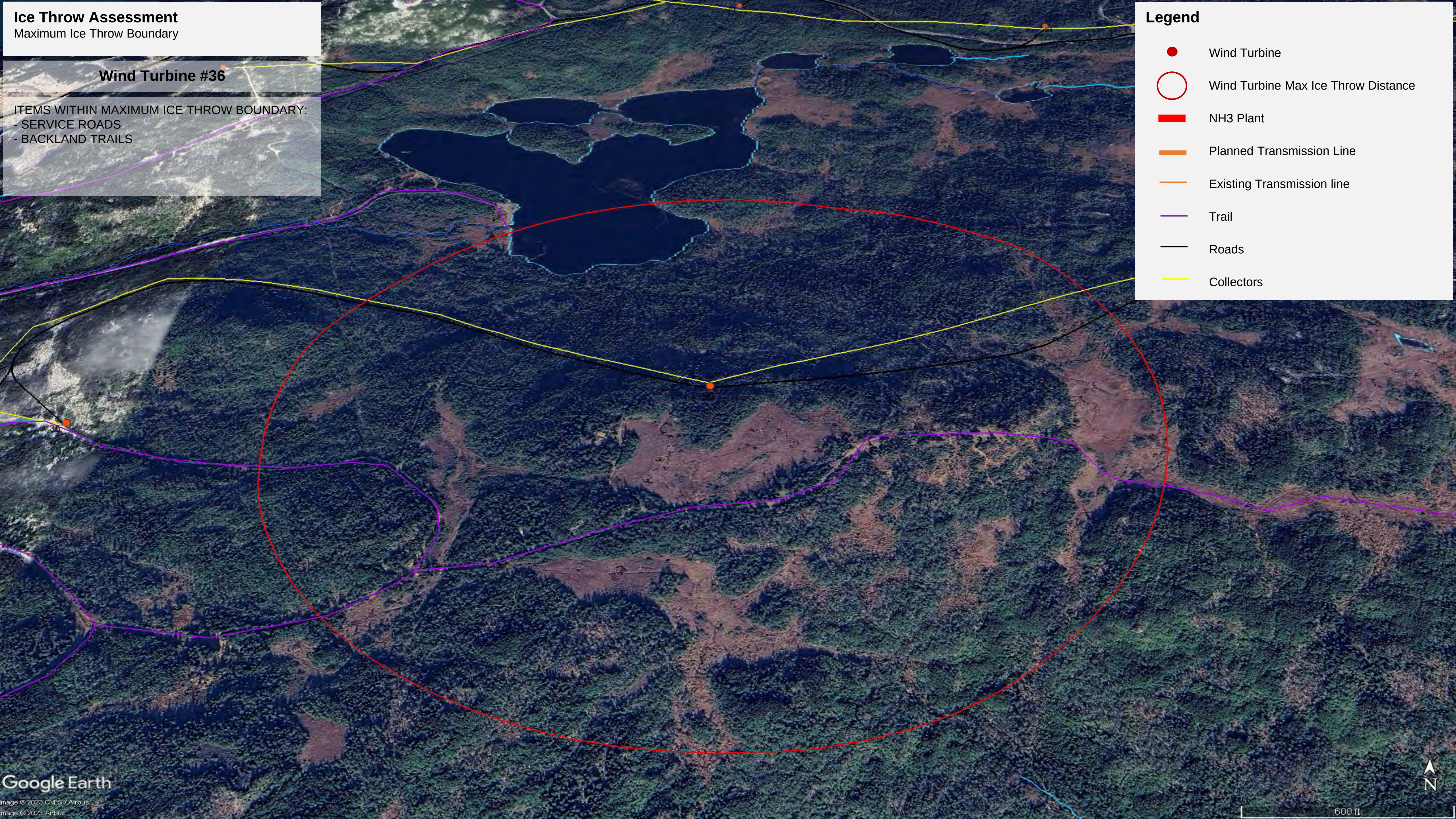
Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #35
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #34
- ARGENTIA POND ROAD
- SERVICE ROADS
- BACKLAND TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Google Earth
600 ft
N

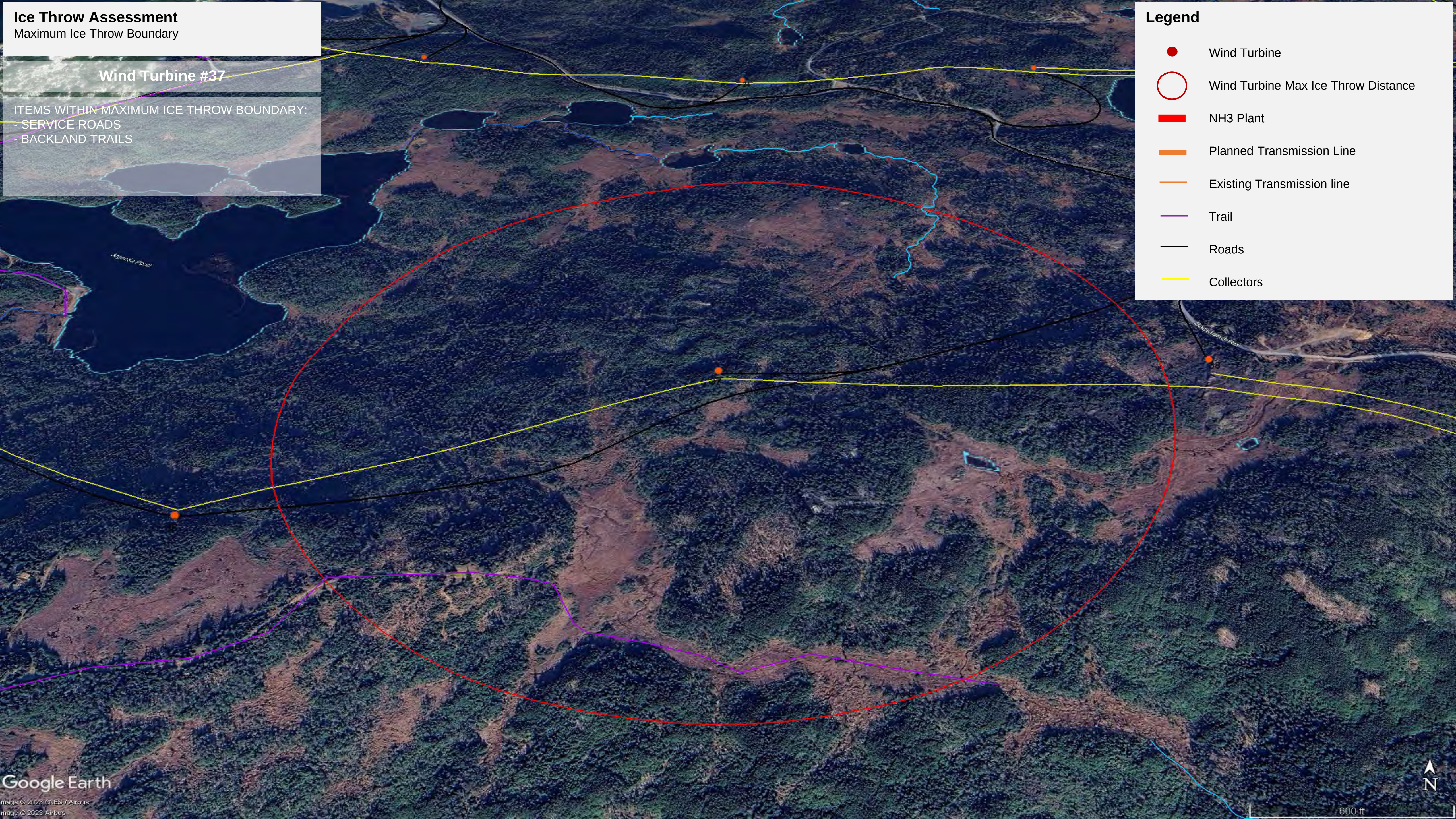
Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #36

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
- BACKLAND TRAILS





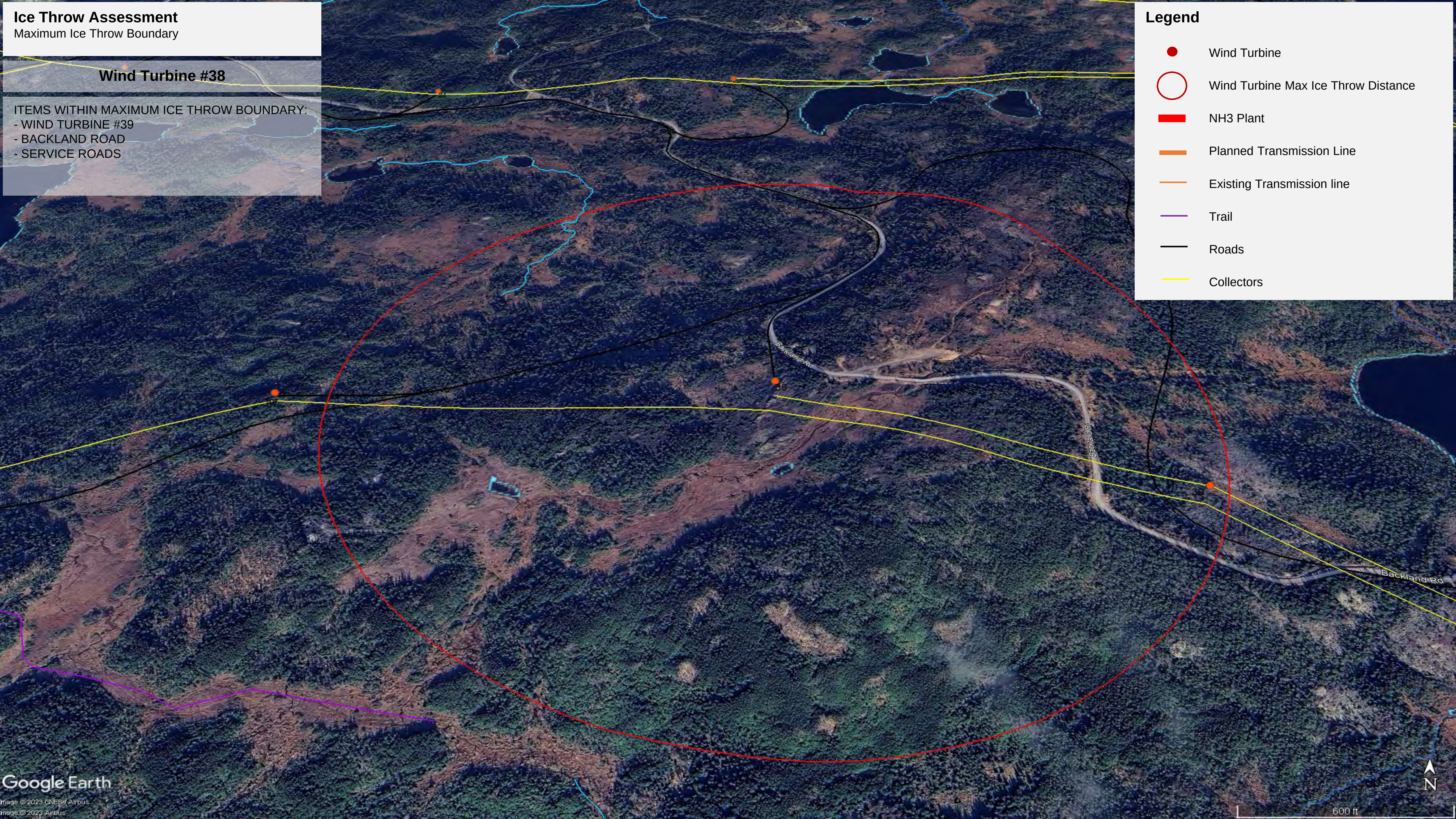
Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #37
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
- BACKLAND TRAILS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Argentia Pond
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
600 ft
N

Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #38

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #39
- BACKLAND ROAD
- SERVICE ROADS

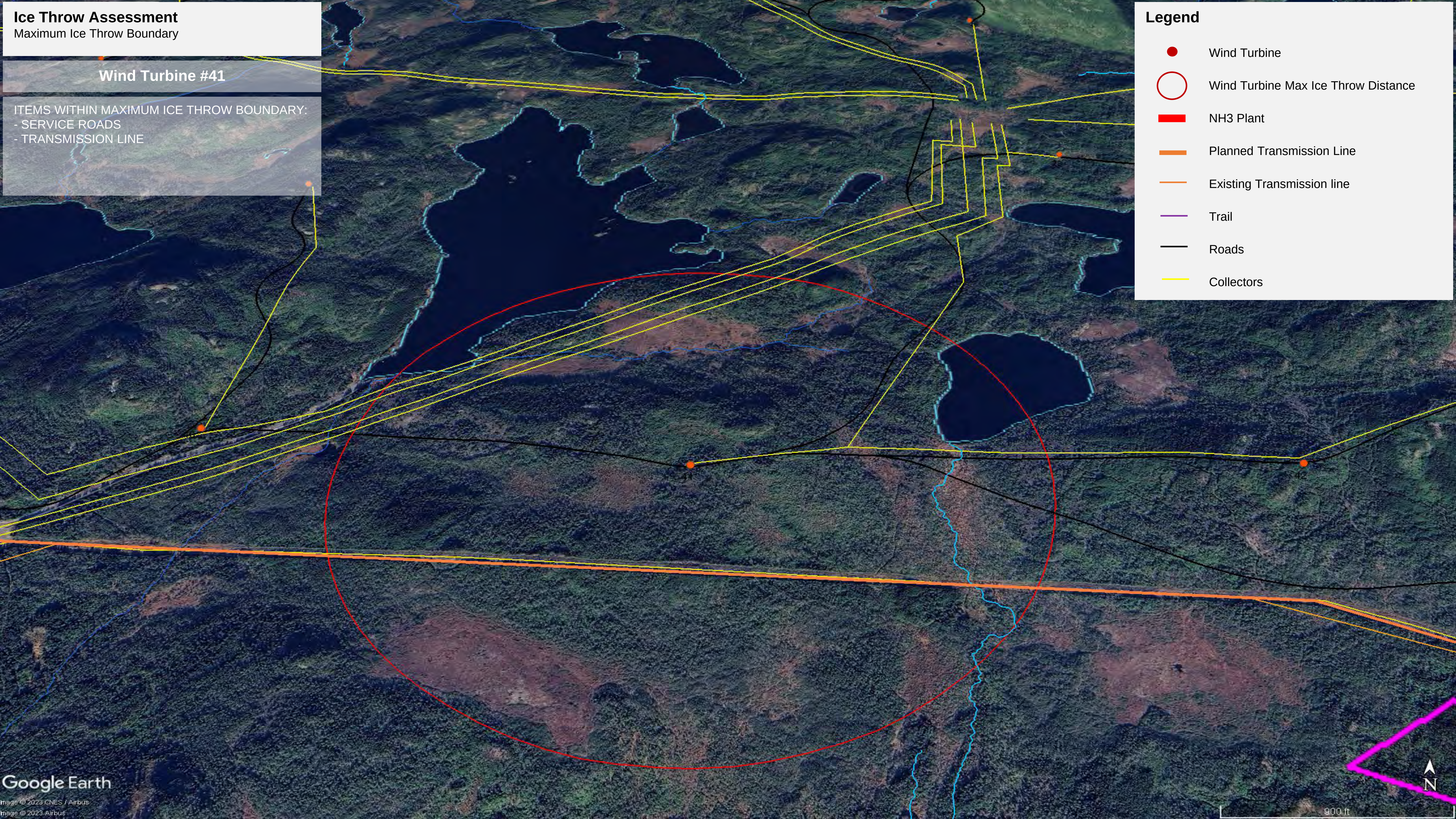


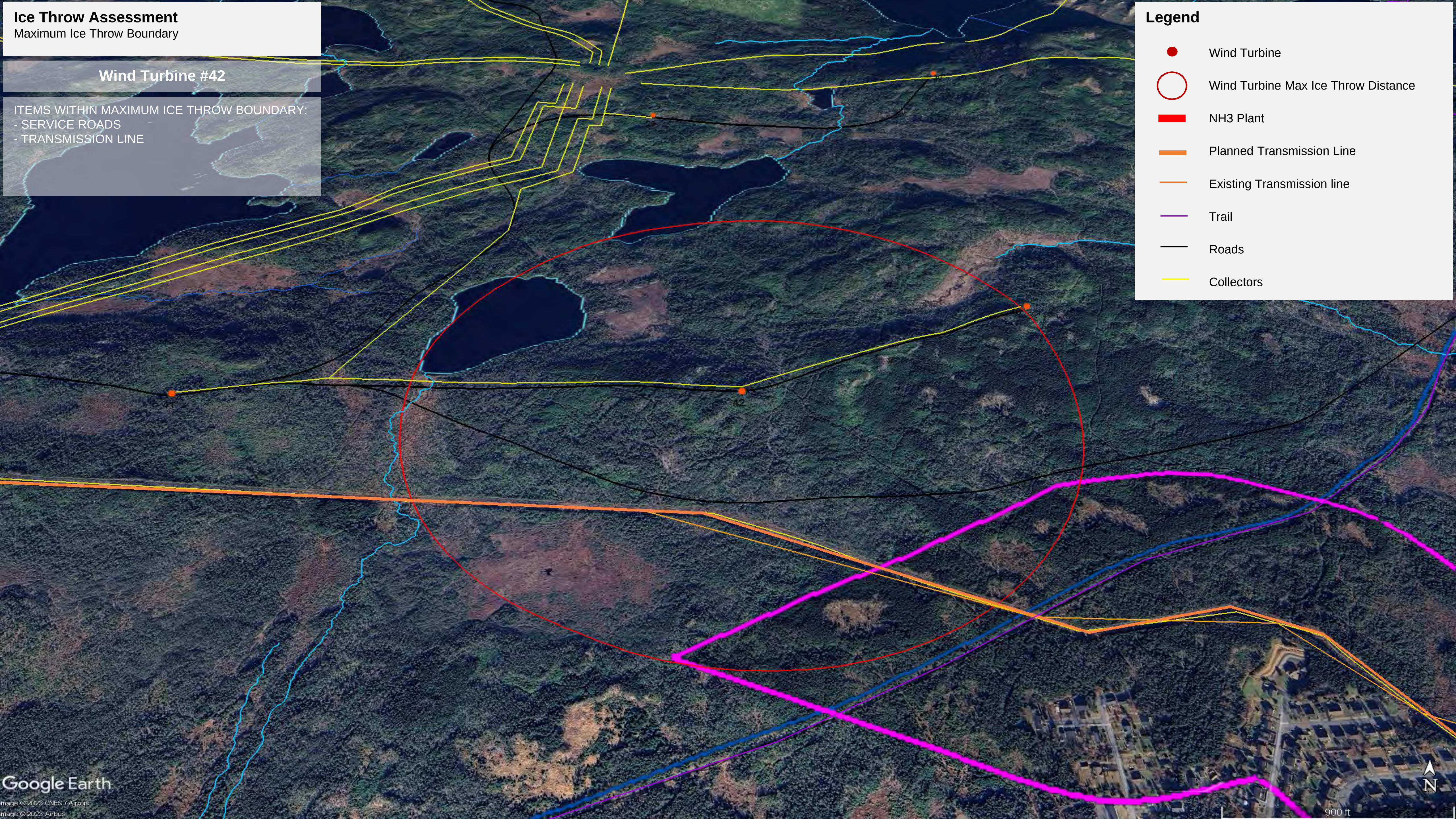
Ice Throw Assessment
Maximum Ice Throw Boundary

Wind Turbine #39

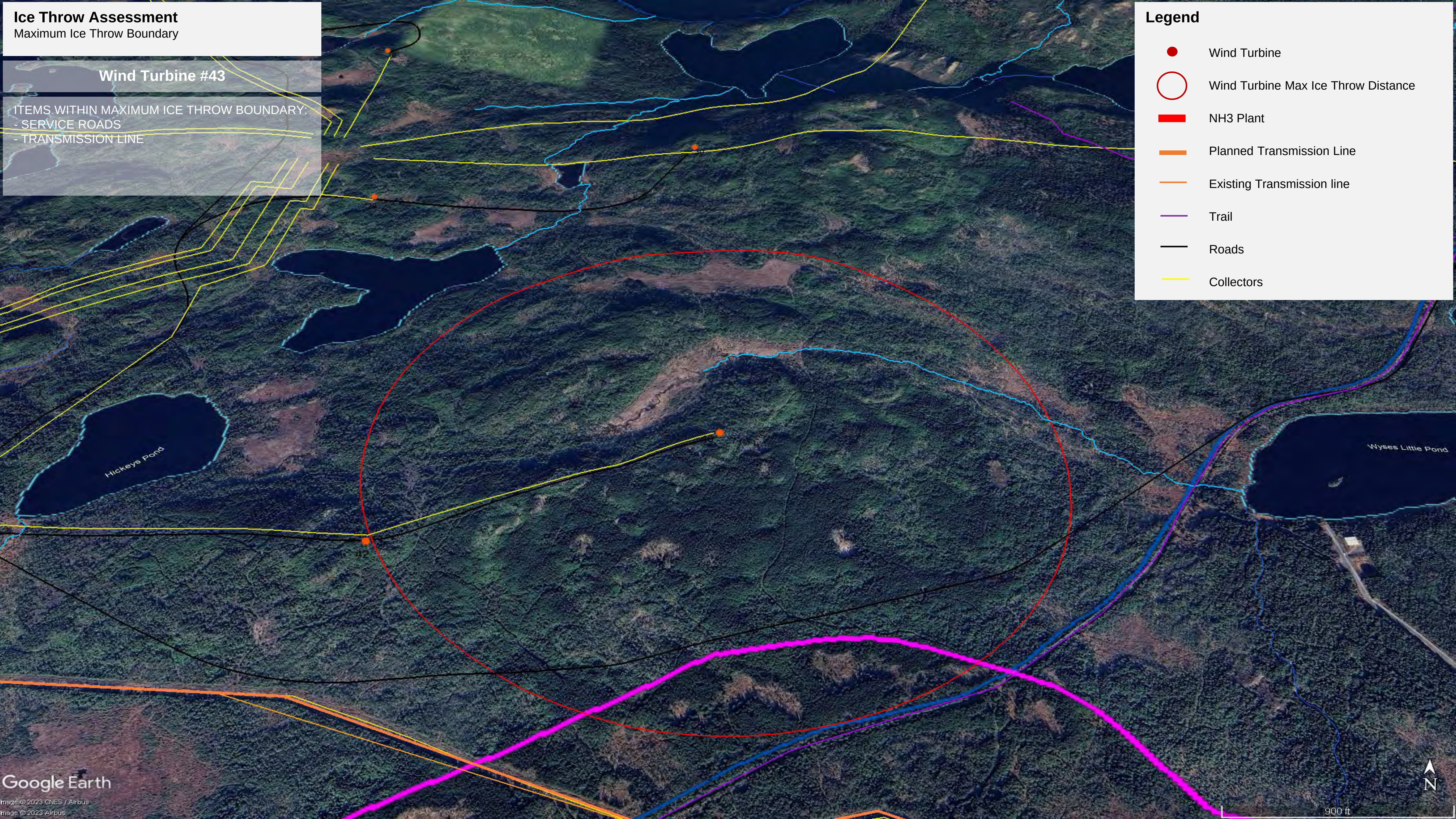
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- WIND TURBINE #38
- BACKLAND ROAD
- SERVICE ROADS


Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #40
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- BACKLAND ROAD
- SERVICE ROADS
- POWER TRANSMISSION LINE
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Google Earth
N
600 ft


Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #41
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
- TRANSMISSION LINE
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
N
900 ft



Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #42
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
- TRANSMISSION LINE
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
900 ft
N



Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #43
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
- TRANSMISSION LINE
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Hickeys Pond
Wyses Little Pond
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
900 ft
N

Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #44

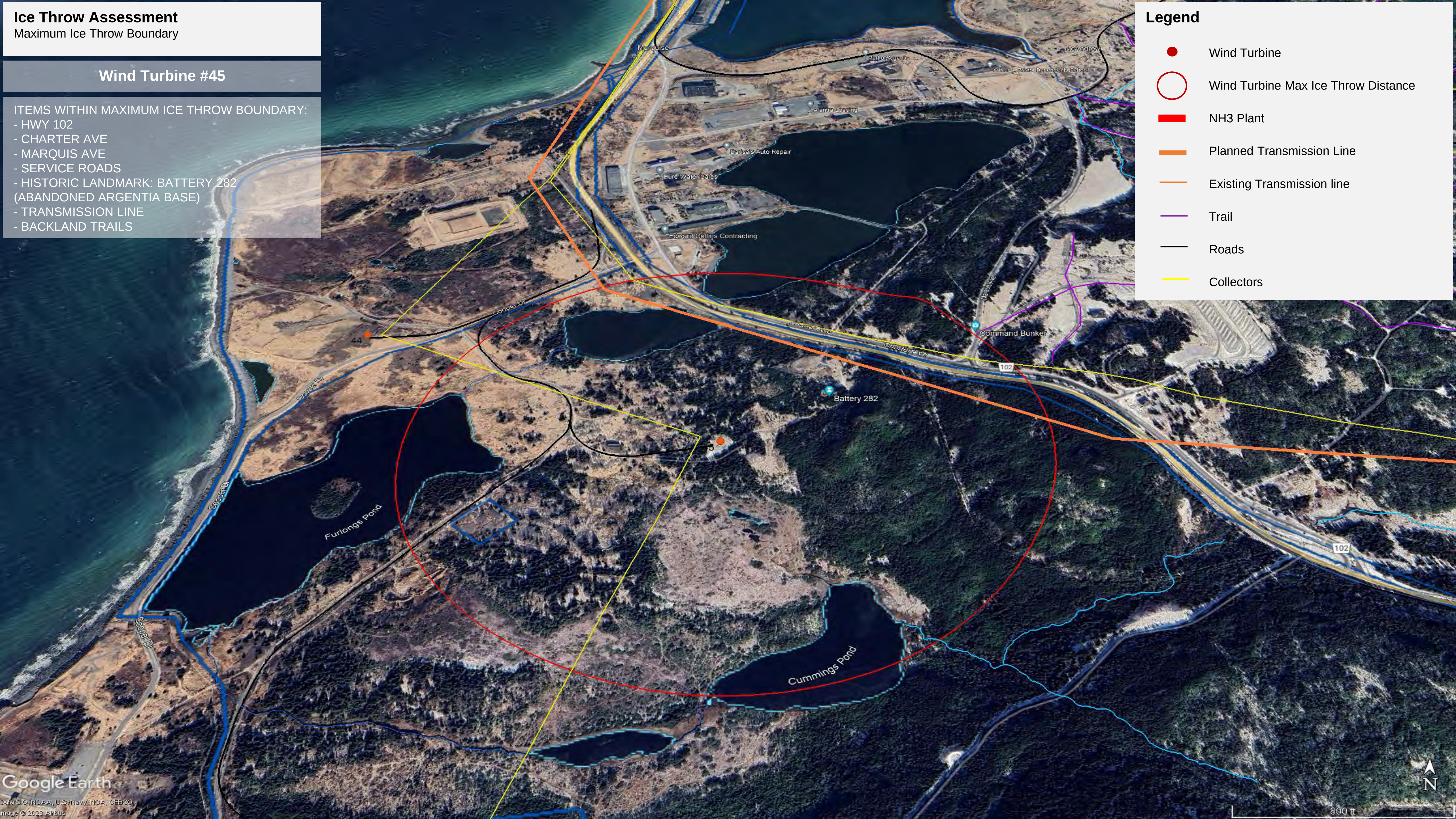
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- INDUSTRIAL AREA
- COOPER DRIVE
- TRANSMISSION LINE
- SERVICE ROAD

Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #45

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- HWY 102
- CHARTER AVE
- MARQUIS AVE
- SERVICE ROADS
- HISTORIC LANDMARK: BATTERY 282 (ABANDONED ARGENTIA BASE)
- TRANSMISSION LINE
- BACKLAND TRAILS



Ice Throw Assessment

Maximum Ice Throw Boundary

Wind Turbine #46

ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- COOPER DRIVE
- INDUSTRIAL AREA


Ice Throw Assessment
Maximum Ice Throw Boundary
Wind Turbine #47
ITEMS WITHIN MAXIMUM ICE THROW BOUNDARY:
- SERVICE ROADS
Legend
Wind Turbine
Wind Turbine Max Ice Throw Distance
NH3 Plant
Planned Transmission Line
Existing Transmission line
Trail
Roads
Collectors
Cummings Pond
Battery 282
Margie's Place By The Pond
Castle Landing
Google Earth

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