PHASE 2 INITIAL BOREHOLE DRILLING AND TESTING, SOUTH BRUCE

Construction Noise and Vibration Study for SB_BH01 and SB_BH02 Sites

APM-REP-01332-0426 **November 2023**

Geofirma Engineering

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

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Phase 2 Initial Borehole Drilling and Testing, South Bruce

WP01: Construction Noise and Vibration Study for SB_BH01 and SB_BH02 Sites

Revision: 1 (Final)

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NWMO Document ID: APM-REP-01332-0426

Prepared for:

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Project Number: 20-211-1

Document ID: WP01_Construction Noise & Vibration Report_R1

November 27, 2023

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Approved by:	 Sean Sterling, M.Sc, P.Eng., P.Geo. – Project Manager - Principal	

Revision Tracking Table

Revision	Revision Release Date	Description of Modifications/Edits
R0	January 16, 2022	Initial Release
R1	November 27, 2023	Revised to address site specific standards

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APPENDICES

1 INTRODUCTION

Geofirma Engineering Ltd. (Geofirma) has been contracted by the Nuclear Waste Management Organization (NWMO) to implement several components of the NWMO Phase 2 Geoscientific Preliminary Field Investigations within the South Bruce area, near Teeswater, Ontario as part of the NWMO's Adaptive Phased Management (APM) Site Selection Phase.

One component completed by Geofirma included a drilling and testing program for two deep bedrock boreholes (SB_BH01 & SB_BH02). Borehole SB_BH01 was drilled to a total depth 880.82 metres below ground surface (mBGS) between April and September 2021. Borehole SB_BH02 was drilled to a total depth 900.57 mBGS between August 2021 and March 2022. Boreholes SB_BH01 and SB_BH02 are located approximately 4 km northwest of the community of Teeswater, Ontario (Figure 1).

To observe best practices under relevant provincial legislations, Geofirma was tasked with completing due diligence studies related to the potential for air emissions and noise emissions associated with the drilling program. Geofirma subcontracted Cambium Inc. (Cambium), based in Peterborough, Ontario to assist with the scoping and completion of this work.

The scope of work Cambium was assigned included:

- Site visit to survey work site as well as nearby potential receptors;
- Review of equipment specifications and site activities (schedule of use) to establish a noise source summary;
- Background vibration measurements;
- Measurements during drilling operations;
- Selection of appropriate assessment criteria; and,
- Provide summary of noise impact calculations, acoustic assessment summary, and an assessment of vibration impacts.

Appendix A includes the Cambium report that contains all of the technical data, discussions, and conclusions.

MUNICIPALITY OF BROCKTON
Riversdale
Little Egypt
Greenock Swamp
F012077
Salem
Kinlough
T003553
Westford
BRUCE ROAD 4
TOWNSHIP OF HURON-KINLOSS
MUNICIPALITY OF SOUTH BRUCE
F012068
Holyrood
BRUCE ROAD 1
BRUCE ROAD 6
CONCESSION 8
Kinloss Creek
SB_BH02
SB_BH01
Culross
Kinloss
Teeswater
Dickies Creek Wetland Complex
F012062
Lower Langside
T004881
Langside
Teeswater Wetland Complex
Anderson Creek Wetland Complex

LEGEND

- SB_BH01 Drill Site
- SB_BH02 Drill Site
- Municipality of South Bruce
- Municipality of Brockton
- Township of Huron-Kinloss
- Provincially Significant Wetland
- Wetland
- Waterbody
- Watercourse
- Major Road
- Local / Street
- OGSRL Well Locations

INSET MAP

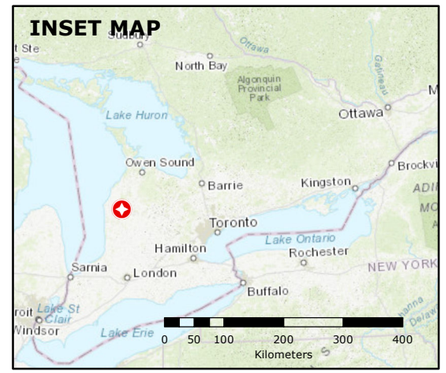

Figure 1
Location of SB_BH01 and SB_BH02 Drill Sites

Scale 1:60,000

0 500 1,000 2,000 3,000 4,000
Meters

N

Projection: NAD 1983 UTM Zone 17N

Source: NWMO, Ontario GeoBase

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

PROJECT No. 20-211-1

NWMO South Bruce
Drilling and Testing

DESIGN: ADG
CAD/GIS: ADG
CHECK: SNS
REV: 1

DATE: 2021-05-12

Geofirma Engineering Ltd

F:\Data\Project\Bruce\Maps\20-211-1_SouthBruce\20-211-1_Figure1_SB_BH02_TestPlans_R1.mxd

Appendix A

Construction Noise and Vibration Study, Exploration Drilling Operations (Cambium, 2023)

Construction Noise and Vibration Study for SB_BH01 and SB_BH02 sites, in South Bruce

November 20, 2023

Prepared for:
Geofirma Engineering Ltd.

Cambium Reference: 11714-001

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Peterborough | Barrie | Oshawa | Kingston

Version Control

Revision	Date	Revision Description	Prepared By:	Submitted To:
1.0	2023-11-20	Construction Noise and Vibration Study for SB_BH01 and SB_BH02 sites, in South Bruce	Cambium Inc.	Geofirma Engineering Ltd.

Executive Summary

Cambium Inc. was retained by Geofirma Engineering Ltd., to complete an assessment of construction noise and vibration related to the exploration drilling operations that occurred at two locations south of Concession Road 8 in the Municipality of South Bruce, Ontario. The purpose of this study is to provide an assessment of the potential construction noise.

The exploration drilling operations were a temporary use of the sites and are considered construction activities.

Construction noise is generally exempt from provincial noise guidelines related to land use compatibility and is largely constrained by local municipal noise by-laws. However, by-laws are generally qualitative and can use subjective terms. Therefore, Cambium has referenced general environmental noise guidelines set by the World Health Organization, the US Environmental Protection Agency, and the US Federal Transit Administration. Cambium has partially applied the provincial noise guidelines to inform the definition of terms and the method of assessment.

As a reasonable worst-case scenario, the operations involved site preparation, followed by shallow drilling using ‘Cable Rig’ type equipment and deep drilling using core drilling equipment. Bore hole casings were also installed. Minimal material handling is required.

Cambium concludes the site operated within the referenced construction noise guidelines.

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1.0 Introduction

Cambium Inc. (Cambium) was retained by Geofirma Engineering Ltd. (Geofirma), to complete a construction noise and vibration study for the exploration drilling operations that occurred at two locations south of Concession Road 8 in the Municipality of South Bruce, Ontario. The purpose of this study is to provide an assessment of the noise and vibration impacts from the operations onto the nearby residential properties.

Noise limits were set based on the World Health Organization (WHO) and the US Environmental Protection Agency (EPA) guidance as described in the publications *Environmental Health Criteria 12 – Noise* (World Health Organization, 1980) and *Make Listening Safe* (World Health Organization, 2018). We also referenced US Federal Transit Administration (FTA) publication (US Federal Transit Administration, 2018) and the Ontario Ministry of Environment, Conservation, and Parks (MECP) document *NPC-300 – Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning* (Ontario Ministry of the Environment, Conservation, and Parks, 2017) (NPC-300) to inform the definition of terms and the method of assessment. Since the Municipality of South Bruce does not appear to have a published a noise control by-law, Cambium will reference the MECP *Model Municipal Noise Control By-Law* (Ontario Ministry of the Environment, 1978) where applicable.

The exploration drilling operations are a temporary use of the sites and are considered construction activities. When the drilling is completed, the sites will return to their previous use. Construction noise is generally exempt from provincial noise guidelines related to stationary source compliance and is typically constrained by municipal noise by-laws.

Cambium assessed the operation's noise impacts onto the surroundings. As a reasonable worst-case scenario, the operations involved site preparation, followed by shallow drilling using 'Cable Rig' type equipment and deep drilling using core drilling equipment. Bore hole casings were also installed. Minimal material handling was required.

20 nearby dwellings have been identified as being representative of the most sensitive points of reception in the vicinity of the Site.

2.0 Description

The operation consisted of exploration drilling through ground and bedrock to depths of approximately 1000 metres dependent on the core analysis. The drilling equipment was supported by a drill fluid recirculation system, a mobile office, and amenity spaces.

The operation did not produce any materials other than the extracted core samples obtained from drilling. The significant noise emissions were from the engine noise associated with the drilling equipment and generator and impulsive noise from the casing installation.

The operation used the following significant equipment:

- One mobile “Cable Rig’ drill (not operating with the core drill)
- One 285 hp mobile core drill (not operating with the Cable Rig)
- One 800 kW mobile generator/compressor.

A site location plan is provided on Figure 1.

The operations could occur 24 hours per day. However, certain activities were limited to daytime only.

Noise sources associated with the operation of the site are described in section 3.0.

Again, the exploration drilling operations were a temporary use of the sites and can be considered as construction activities. When the drilling is completed, the sites will return to their previous use.

3.0 Noise Source Summary

The noise producing equipment (with the source identification referenced) is summarized below and further in Table 1. The locations of these noise sources can be found on Figure 2.

- DR01_A, DR01_B – These noise point sources represent the Christenson CS4002 truck mounted core drill rig. Operations for active drilling and core recovery are encompassed in these noise sources.
- DR02_A – This noise point source represents the cable tool drilling rig during steady ground subsoil and till drilling operations.
    - DR02_B – This noise point source captures the impulsive operations when the equipment was used to hammer down steel bore-hole casings.
- CP01 – This noise point source represents one Caterpillar 3412 diesel engine connected to an 1800 CFM Sullair Compressor. This equipment was used to help install bore-hole casings. Manufacturer specified sound power levels of equivalent equipment were used to represent this source.

Insignificant noise sources:

- Various small generators were used to provide power to lighting and administrations trailers.
- Various small electric pumps were used to handle drilling fluids and the fluid recycling systems.
- Staff vehicles and trucking numbers were minimal and when compared with the sound powers of the larger rigs and engines and were considered insignificant.
- The occasional delivery of goods and removal of garbage were considered insignificant.

Agricultural and residential activities on the property are not considered as part of the operations so were not considered in this report.

4.0 Point of Reception Summary

Cambium attended the proposed development site on October 26, 2020 and September 15, 2021. 20 nearby dwellings were identified as being representative of the most sensitive receptors in the vicinity of the Sites, labeled as POR01 through POR20 and depicted on Figure 1.

Note that Cambium has ignored the participating on-property receptors in this assessment of construction noise impact.

For assessment purposes we selected the points with the predictable worst-case noise impacts.

The receptors are also listed in Table 2.

Receptor heights were all assumed to represent potential second storey receptors at 4.5 m.

5.0 Assessment Criteria

The exploration drilling operations were a temporary use of the sites and were considered as construction activities. Construction noise is generally exempt from NPC-300 and is largely constrained by municipal noise by-laws. Most noise by-laws have no specific limit for construction noise aside from prohibiting it at certain times of day. The Municipality of South Bruce has no noise by-law currently that Cambium could obtain through our typical research methods.

Therefore, Cambium has referenced WHO and EPA guidance which define a noise exposure limit of 70 dBA for the protection of hearing. The WHO and EPA research and guidelines define a noise exposure limit of 70 dBA, 24-hour ($L_{eq(24)}$).

5.1 Municipal By-Laws

The Municipality of South Bruce does not publish a noise control by-law, therefore, Cambium has referenced the MECP Model Municipal Noise Control By-Law which may be applicable to certain activities at the site.

The MECP publishes a guideline called NPC-115 “Construction Equipment” which provides sound level limits for construction equipment used in quiet zones and residential areas:

Type of Equipment	Max Sound Level (dBA)	Distance	Sound Power Level (dBA)
Excavation Equipment <75 kW	83	15	114
Excavation Equipment >75 kW	85	15	117
Pneumatic Equipment	85	7	110
Portable Compressors	76	7	104
Tracked Drills	100	15	132

The MECP also publishes a guideline call NPC-118 “Motorized Conveyances” which provides sound level limits for vehicles using diesel engines and weighing more than 4,500 kg

Type of Equipment	Max Sound Level (dBA)	Distance	Sound Power Level (dBA)
Diesel Engine Conveyances	95	7.5	120

As shown in Table 1 some of the equipment used may have exceeded the typical NPC-115 and NPC-118 sound power levels. Therefore, Cambium has completed assessing the noise impacts against the published WHO sound level limits.

6.0 Noise Impact Assessment

The acoustic analysis at the PORs incorporates the noise emission points as described in Section 3.0. Cambium has based sound power levels for equipment on measurements on site or manufacturer's specifications.

The corresponding sound power level calculations from each noise producing unit are detailed in Appendix A. The assumed, most conservative, sound power levels in accordance with the MECP's requirement for "worst-case" noise source sound power levels are summarized in Table 1. Note that Table 1 includes sources located at borehole site 1 (BH1) and borehole site 2 (BH2).

Impact assessment results are provided in Appendix B and the modelled Site noise impacts at the identified PORs are summarized in Table 2.

6.1 Sound Power Level

Sound power levels were based on calculations from measurements at the site and manufacturer's specifications; the supporting information can be found in Appendix A. All measurements were completed following MECP guidance for measurements including satisfactory weather conditions and pre-post calibrations.

6.2 Tonality Assessment

Some types of sound have a special quality which may tend to increase their audibility and potential disturbance or annoyance. For tonal sound, the MECP NPC-104 guideline stipulates that a penalty of five A-weighted decibels (dBA) is to be added to the measured sound level if the sound has a "pronounced audible tonal quality such as a whine, screech, buzz or hum".

Based on site observations Cambium did not find any of the sources to be tonal.

6.3 Variable Operations of Noise Sources

The drilling occurred day, evening, and night. However, certain activities were limited by equipment logistics to daytime. Of various possible operating scenarios and equipment

combinations, we have assessed the two operating scenarios which represents the 'worst-case' with respect to noise impact.

For assessment purposes, all sources were assumed to operate continuously and simultaneously with the exception of the following.

6.3.1 Steady (24 hours per day)

Cambium assessed the two possible operating scenarios for steady drilling, one included the core drill a low idle, with the generator/compressor operating 100 percent of the hour. The other possible scenario would be the generator/compressor shut down with the core drill actively coring. It was found that the scenario including the generator/compressor was the worst case, and therefore only one steady scenario at each borehole is addressed:

- The Generator/Compressor (CP01) was generally only active during the steady 'worst-case' operating scenario. Therefore, it is represented as operating at 100%.
- The Core Drill – Low Idle (DR01_A) represents the contribution of the core drill to the steady 'worst-case' operating scenario with respect to noise impact. During this condition DR01_A is operating only 50% of any given hour.
- The Core Drill – Active Coring (DR01_B) is not active during the steady 'worst-case' operating scenario. Therefore, it is represented as operating at 0%, operationally the active coring would not occur simultaneously with the generator/compressor.

6.3.2 Impulsive (Daytime only)

The cable rig drill at times has to complete a hammering action pounding the well casing into the ground. This was measure and modelled as an impulsive noise source operating in daytime only:

- The Cable Rig Hammer (DR02_B) will generally only be active during impulsive 'worst-case' operating scenario. Therefore, it is represented as operating at 100%.

7.0 Noise Impact Calculation Procedure

The noise impact calculations were performed using the Bruel Kjaer *Predictor Type 7810 version 2023* (Predictor) environmental noise prediction and control software. The calculations completed by this software are based on established prediction methods accepted by the MECP; mainly ISO 9613-2 *Acoustics – Attenuation of Sound during Propagation Outdoors – Part 2: General Method of Calculation* (ISO, 1996). Predictor is an internationally marketed software package that offers calculation algorithms that comply with ISO 9613-2.

The Predictor software tool is a proprietary noise calculation package used to calculate, assess, predict, and display environmental noise.

7.1 Calculation Assumptions

We have assessed the plane of window of the residences at 4.5 metres relative elevation and at the perimeter of the residence, representing the plane of a potential second storey exterior room window within which, a person may be exposed to sound if open.

The noise impact modelling included a general ground factor assumption of one, which is fully absorptive to account for the vegetated surroundings. While the gravel surface drill sites were modelled as fully reflective.

This version of Predictor allows for settings to ignore barrier effects if line of sight is not broken, as well as avoiding overestimating barrier effect due to porous ground in the case of a negative Agr value in Equation 12 of the ISO 9613-2 calculation method. We activated these settings:

- The terrain was modelled with consideration from Ontario Base Map sources; and
- Onsite buildings were considered, and were incorporated into the model as being mostly reflective, no other offsite sources of sound were considered (i.e. traffic, etc.).

7.1.1 Existing Noise Control Measures

The site berm at the BH1 location was included in the Predictor model as a screening barrier.

The BH2 location did not have a berm during the site visit, therefore, no berm was modelled at this location.

8.0 Acoustic Assessment Summary

The sound power levels for each noise source are summarised in Table 1. The noise impact from the operation at each receptor are presented in Table 2. The sound pressure level contour plot files and the predicted sound levels at the receptors are provided in Appendix B. As indicated in Table 2, the development noise impact at each established POR is predicted to be less than the applicable WHO/EPA criteria.

9.0 Vibration

Cambium competed a background vibration study (Cambium Inc., 2021) of the Sites before any of the operations were active. This study demonstrated that there were no significant ambient vibrations present at the Sites in question. Any other potential vibration sources in the area of the Sites were deemed negligible in terms of potential vibration impacts onto the sites.

Following guidance from the Ministry, a peak particle velocity (PPV) vibration level of 0.1 mm/s is considered the threshold for perceptible vibration. This threshold is much lower than standard construction vibration limits.

During the September 15, 2021, site visit, Cambium staff conducted vibration measurements at various distances from the operating equipment using an Instantel Micromate vibration monitor and geophone. The purpose of these measurements was to establish a ‘zone of influence’ for the operations, where, outside this zone of influence the vibration impacts would be less than the threshold of perception discussed above.

See Table 3 for a summary of the vibration measurements. The data quality of the vibration measurements was good for measurements in close proximity to the operations (as in less than 25 metres). For measurable vibration impacts at distances greater than 25 metres, vibration levels were near or below noise threshold of the Micromate unit.

The propagation of ground borne vibrations can be predicted using the method published by the United States of America (USA) Federal Transit Administration, *FTA-VA-90-1003-06* (Office of Planning and Environment, 2006). This method focuses on geometric divergence

based on empirical measurements of similar equipment. It should be noted that generally speaking, these prediction methods are a screening level assessment. Specific geological conditions may be present at a site that could significantly affect the vibration propagation conditions. This screening calculation however is the most practical initial assessment.

An example the calculation for active coring is provided here:

$$PPV_{predict} = PPV_{Ref} \times (\frac{D_p}{D_{ref}})^{1.5}$$

$Where\ PPV\ predict\ and\ PPV\ ref\ represent\ the\ predicted\ and\ reference\ peak\ particle\ velocity\ in \frac{mm}{s}\ respectively\ and\ D\ represents\ the\ seperation\ distance\ in\ metres\ (m), rearranging,\ to\ solve\ for\ D\ we\ have:$

$$D_p = \frac{7.5}{\left(\frac{PPV_{predict}}{PPV_{Ref}}\right)^{\frac{1}{1.5}}}$$

$$D_p = \frac{7.5}{\left(\frac{0.1}{0.175}\right)^{\frac{1}{1.5}}}$$

$$D_p = 10.89\ m$$

Therefore, the maximum predicted zone of influence for a 0.1 mm/s impact for this specific operation is within 10.9 m.

Based on conservative assumptions and the average results from the measured vibration levels, the following distances should be considered as the zone of influence of the operations with respect to a threshold of perception. Note that the zone of influence for actual concern to structural damage would be significantly less than these values.

- Active coring using the Drill Rig – 12 m
- Active Drilling using the Cable Rig – 35 m
- Hammering using the Cable Rig – 45 m

Note that these distances are significantly less than the actual setbacks of local sensitive uses.

10.0 Closing

Cambium Inc. (Cambium) was retained by Geofirma Engineering Ltd. (Geofirma), to complete a construction noise and vibration study for the exploration drilling operations that occurred at two locations south of Concession Road 8 in the Municipality of South Bruce, Ontario. The purpose of this study is to provide an assessment of the noise impacts from the operations onto the nearby residential properties. Measurements were completed during operations. Predicted sound impact results are provided with comparison to WHO sound level limits and were found to be less than the WHO sound level limit for the protection of hearing.

Respectfully submitted,

Cambium Inc.

Trevor Copeland, P. Eng.
Senior Project Manager

Trevor Ross,
Project Specialist

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11.0 References

Cambium Inc. (2021). *Dust, Noise, and Vibration Background Study, 1021 Con.8 and 1257 Con.8, South Bruce, 11714-001.*

ISO. (1996). *ISO 9613-2 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation.* International Organization for Standardization.

Office of Planning and Environment, F. T. (2006). *Transit Noise and Vibration Impact Assessment .* Department of Transportation.

Ontario Ministry of the Environment. (1978). *Model Municipal Noise Control By-Law .*

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US Federal Transit Administration. (2018). *Transit Noise and Vibration Impact Assessment Manual. Rpt.No.0123.*

World Health Organization. (1980). *Environmental Health Criteria 12 - Noise.*

World Health Organization. (2018). *Noise Exposure for Children in Recreational Settings: Review of Available Evidence.*

12.0 Standard Limitations

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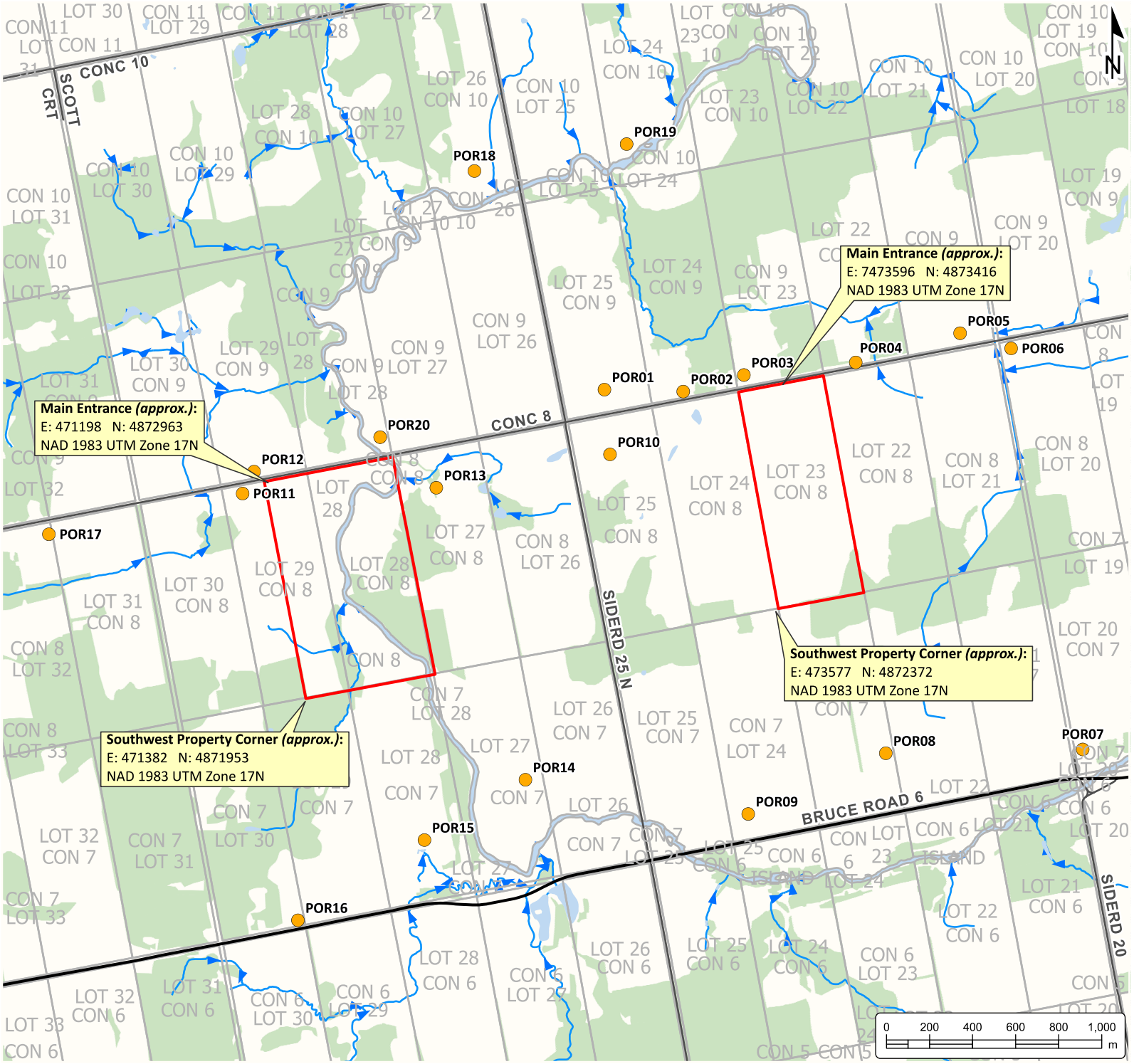
Appended Figures



NOISE IMPACT STUDY

GEOFIRMA ENGINEERING LTD.
Concession Road 8,
South Bruce, Ontario

LEGEND

- Receiver
- Major Road
- Minor Road
- Watercourse, Permanent
- Wooded Area
- Lot/Concession
- Site (approximate)

Notes:
- Features on map are Produced under License with the Ontario Ministry of Natural Resources and Forestry @King's Printer for Ontario, 2022
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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SITE LOCATION PLAN

Project No.: 11714-001		Date: September 2023	
		Rev.:	
Scale: 1:25,000		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: TC	Figure:	1

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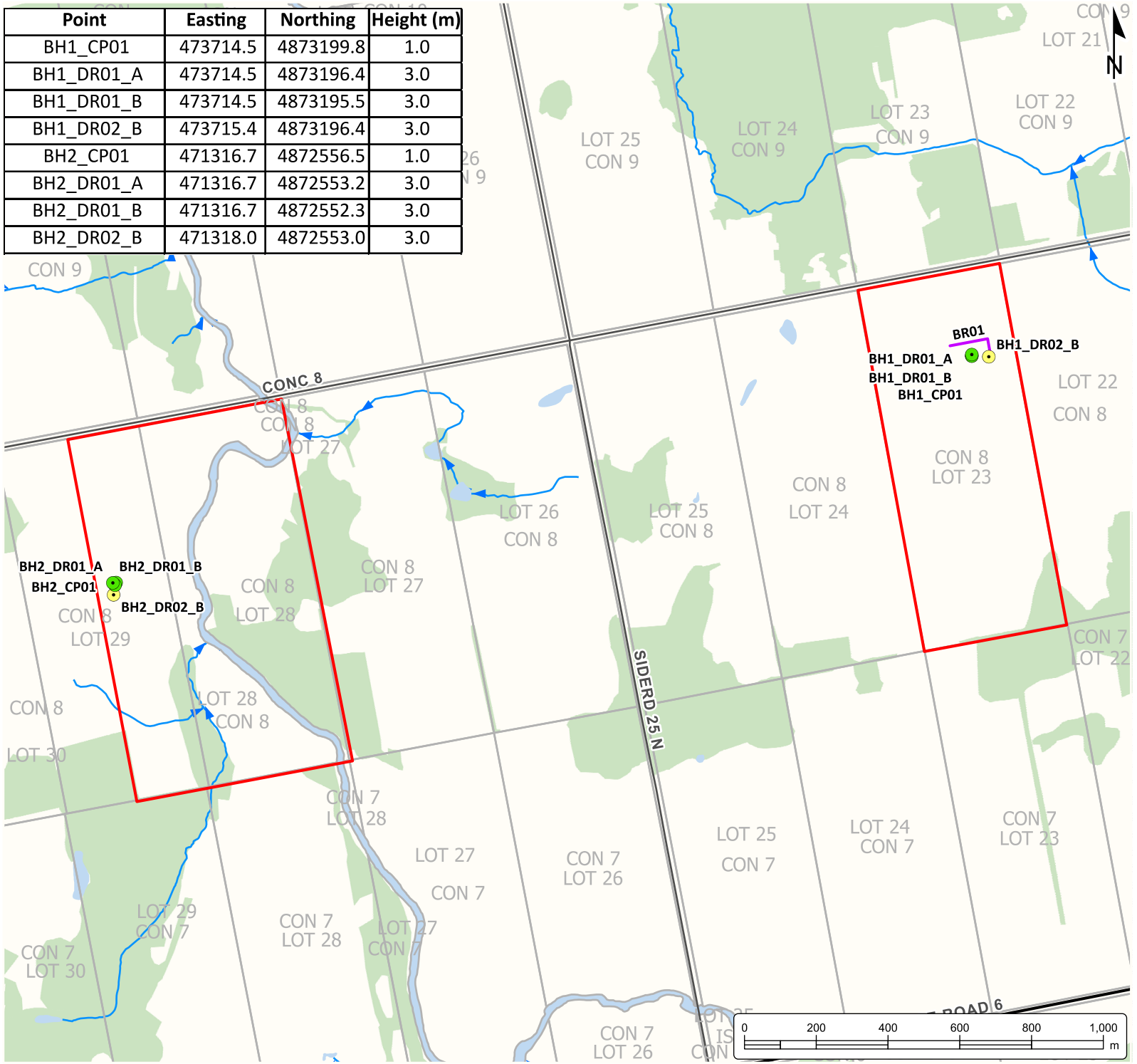
Point	Easting	Northing	Height (m)
BH1_CP01	473714.5	4873199.8	1.0
BH1_DR01_A	473714.5	4873196.4	3.0
BH1_DR01_B	473714.5	4873195.5	3.0
BH1_DR02_B	473715.4	4873196.4	3.0
BH2_CP01	471316.7	4872556.5	1.0
BH2_DR01_A	471316.7	4872553.2	3.0
BH2_DR01_B	471316.7	4872552.3	3.0
BH2_DR02_B	471318.0	4872553.0	3.0



NOISE IMPACT STUDY

GEOFIRMA ENGINEERING LTD.
Concession Road 8,
South Bruce, Ontario

LEGEND

- Point Source, Steady
- Point Source, Impulsive
- Barrier
- Major Road
- Minor Road
- Watercourse, Permanent
- Lot/Concession
- Water Area
- Site (approximate)

Notes:
- Features on map are Produced under License with the Ontario Ministry of Natural Resources and Forestry @King's Printer for Ontario, 2022
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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SITE PLAN AND EQUIPMENT LAYOUT

Project No.: 11714-001		Date: September 2023 Rev.:	
Scale: 1:15,000		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: TC	Figure:	2

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Appended Tables

Table 1 - Noise Source Summary Table

Source ID	Description	A-Weighted Sound Power Level								Total	Data Source	Equipment Location	Operating Times/Limits day,evening,night (%)	Noise Quality[2]	Source Location	UTM Easting	UTM Northing	Height Above Rooftop or Ground
		63	125	250	500	1000	2000	4000	8000	dBA								
BH1_CP01	Generator/Compressor	86	99	108	109	110	109	107	104	116	Manufacturer's Specifications	BH1 Site	100,100,100	SS	At Grade	473714	4873200	1.0
BH1_DR01_A	Core Drill - Low Idle	93	96	96	96	94	95	90	80	103	Measurements, Engineering Calculations	BH1 Site	50,50,50	SS	At Grade	473715	4873196	3.0
BH1_DR01_B	Core Drill - Active Coring	86	103	100	104	105	106	99	90	111	Measurements, Engineering Calculations	BH1 Site	--,--,--	SS	At Grade	473715	4873196	3.0
BH1_DR02_B	IMP - Cable Rig - Hammer	86	96	114	125	129	130	127	117	134	Measurements, Engineering Calculations	BH1 Site	100,--,--	I	At Grade	473715	4873196	3.0
BH2_CP01	Generator/Compressor	86	99	108	109	110	109	107	104	116	Manufacturer's Specifications	BH2 Site	100,100,100	SS	At Grade	471317	4872557	1.0
BH2_DR01_A	Core Drill - Low Idle	93	96	96	96	94	95	90	80	103	Measurements, Engineering Calculations	BH2 Site	50,50,50	SS	At Grade	471317	4872553	3.0
BH2_DR01_B	Core Drill - Active Coring	86	103	100	104	105	106	99	90	111	Measurements, Engineering Calculations	BH2 Site	--,--,--	SS	At Grade	471317	4872552	3.0
BH2_DR02_B	IMP - Cable Rig - Hammer	86	96	114	125	129	130	127	117	134	Measurements, Engineering Calculations	BH2 Site	100,--,--	I	At Grade	471318	4872553	3.0

SS - Steady State
T - Tonal
I - Impulse

Table 2A - Noise Impact Summary - BH1 - Steady

Point of Reception ID	Point of Reception Information				Noise Characteristic	Daytime (dBA)	Evening (dBA)	Nighttime (dBA)	Daytime Limit (dBA)	Evening Limit (dBA)	Nighttime Limit (dBA)	Compliant with Limit
	Description	UTM Easting	UTM Northing	Height POW								
POR01_A	1106 CONCESSION 8	472770	4873390	4.5	Steady State Leq	43	43	43	70	70	70	Yes
POR02_A	1068 CONCESSION 8	473136	4873381	4.5	Steady State Leq	43	43	43	70	70	70	Yes
POR03_A	1036 CONCESSION 8	473418	4873458	4.5	Steady State Leq	47	47	47	70	70	70	Yes
POR04_A	984 CONCESSION 8	473938	4873516	4.5	Steady State Leq	48	48	48	70	70	70	Yes
POR05_A	934 CONCESSION 8	474422	4873652	4.5	Steady State Leq	40	40	40	70	70	70	Yes
POR06_A	907 CONCESSION 8	474660	4873582	4.5	Steady State Leq	38	38	38	70	70	70	Yes
POR07_A	10 SIDEROAD 20A	474992	4871718	4.5	Steady State Leq	18	18	18	70	70	70	Yes
POR08_A	1006 BRUCE ROAD 6	474077	4871700	4.5	Steady State Leq	32	32	32	70	70	70	Yes
POR09_A	1074 BRUCE ROAD 6	473438	4871418	4.5	Steady State Leq	30	30	30	70	70	70	Yes
POR10_A	1105 CONCESSION 8	472796	4873089	4.5	Steady State Leq	43	43	43	70	70	70	Yes
POR11_A	1273 CONCESSION 8	471089	4872907	4.5	Steady State Leq	30	30	30	70	70	70	Yes
POR12_A	1266 CONCESSION 8	471142	4873009	4.5	Steady State Leq	31	31	31	70	70	70	Yes
POR13_A	1185 CONCESSION 8	471989	4872934	4.5	Steady State Leq	36	36	36	70	70	70	Yes
POR14_A	1166 BRUCE ROAD 6	472403	4871577	4.5	Steady State Leq	29	29	29	70	70	70	Yes
POR15_A	1242 BRUCE ROAD 6	471934	4871297	4.5	Steady State Leq	26	26	26	70	70	70	Yes
POR16_A	1292 BRUCE ROAD 6	471346	4870924	4.5	Steady State Leq	27	27	27	70	70	70	Yes
POR17_A	1371 CONCESSION 8	470189	4872718	4.5	Steady State Leq	26	26	26	70	70	70	Yes
POR18_A	519 SIDEROAD 25 N	472166	4874406	4.5	Steady State Leq	34	34	34	70	70	70	Yes
POR19_A	520 SIDEROAD 25 N	472873	4874531	4.5	Steady State Leq	32	32	32	70	70	70	Yes
POR20_A	1206 CONCESSION 8	471728	4873169	4.5	Steady State Leq	34	34	34	70	70	70	Yes

Table 2B - Noise Impact Summary - BH1 - Impulsive

Point of Reception ID	Point of Reception Information				Noise Characteristic	Daytime (dBA)	Evening (dBA)	Nighttime (dBA)	Daytime Limit (dBA)	Evening Limit (dBA)	Nighttime Limit (dBA)	Compliant with Limit
	Description	UTM Easting	UTM Northing	Height POW								
POR01_A	1106 CONCESSION 8	472770	4873390	4.5	Steady State Leq	59	-	-	70	-	-	Yes
POR02_A	1068 CONCESSION 8	473136	4873381	4.5	Steady State Leq	64	-	-	70	-	-	Yes
POR03_A	1036 CONCESSION 8	473418	4873458	4.5	Steady State Leq	69	-	-	70	-	-	Yes
POR04_A	984 CONCESSION 8	473938	4873516	4.5	Steady State Leq	69	-	-	70	-	-	Yes
POR05_A	934 CONCESSION 8	474422	4873652	4.5	Steady State Leq	60	-	-	70	-	-	Yes
POR06_A	907 CONCESSION 8	474660	4873582	4.5	Steady State Leq	58	-	-	70	-	-	Yes
POR07_A	10 SIDEROAD 20A	474992	4871718	4.5	Steady State Leq	29	-	-	70	-	-	Yes
POR08_A	1006 BRUCE ROAD 6	474077	4871700	4.5	Steady State Leq	47	-	-	70	-	-	Yes
POR09_A	1074 BRUCE ROAD 6	473438	4871418	4.5	Steady State Leq	45	-	-	70	-	-	Yes
POR10_A	1105 CONCESSION 8	472796	4873089	4.5	Steady State Leq	60	-	-	70	-	-	Yes
POR11_A	1273 CONCESSION 8	471089	4872907	4.5	Steady State Leq	45	-	-	70	-	-	Yes
POR12_A	1266 CONCESSION 8	471142	4873009	4.5	Steady State Leq	46	-	-	70	-	-	Yes
POR13_A	1185 CONCESSION 8	471989	4872934	4.5	Steady State Leq	51	-	-	70	-	-	Yes
POR14_A	1166 BRUCE ROAD 6	472403	4871577	4.5	Steady State Leq	43	-	-	70	-	-	Yes
POR15_A	1242 BRUCE ROAD 6	471934	4871297	4.5	Steady State Leq	40	-	-	70	-	-	Yes
POR16_A	1292 BRUCE ROAD 6	471346	4870924	4.5	Steady State Leq	41	-	-	70	-	-	Yes
POR17_A	1371 CONCESSION 8	470189	4872718	4.5	Steady State Leq	40	-	-	70	-	-	Yes
POR18_A	519 SIDEROAD 25 N	472166	4874406	4.5	Steady State Leq	49	-	-	70	-	-	Yes
POR19_A	520 SIDEROAD 25 N	472873	4874531	4.5	Steady State Leq	52	-	-	70	-	-	Yes
POR20_A	1206 CONCESSION 8	471728	4873169	4.5	Steady State Leq	50	-	-	70	-	-	Yes

Table 2C - Noise Impact Summary - BH2 - Steady

Point of Reception ID	Point of Reception Information				Noise Characteristic	Daytime (dBA)	Evening (dBA)	Nighttime (dBA)	Daytime Limit (dBA)	Evening Limit (dBA)	Nighttime Limit (dBA)	Compliant with Limit
	Description	UTM Easting	UTM Northing	Height POW								
POR01_A	1106 CONCESSION 8	472770	4873390	4.5	Steady State Leq	34	34	34	70	70	70	Yes
POR02_A	1068 CONCESSION 8	473136	4873381	4.5	Steady State Leq	32	32	32	70	70	70	Yes
POR03_A	1036 CONCESSION 8	473418	4873458	4.5	Steady State Leq	30	30	30	70	70	70	Yes
POR04_A	984 CONCESSION 8	473938	4873516	4.5	Steady State Leq	28	28	28	70	70	70	Yes
POR05_A	934 CONCESSION 8	474422	4873652	4.5	Steady State Leq	25	25	25	70	70	70	Yes
POR06_A	907 CONCESSION 8	474660	4873582	4.5	Steady State Leq	21	21	21	70	70	70	Yes
POR07_A	10 SIDEROAD 20A	474992	4871718	4.5	Steady State Leq	20	20	20	70	70	70	Yes
POR08_A	1006 BRUCE ROAD 6	474077	4871700	4.5	Steady State Leq	28	28	28	70	70	70	Yes
POR09_A	1074 BRUCE ROAD 6	473438	4871418	4.5	Steady State Leq	31	31	31	70	70	70	Yes
POR10_A	1105 CONCESSION 8	472796	4873089	4.5	Steady State Leq	35	35	35	70	70	70	Yes
POR11_A	1273 CONCESSION 8	471089	4872907	4.5	Steady State Leq	52	52	52	70	70	70	Yes
POR12_A	1266 CONCESSION 8	471142	4873009	4.5	Steady State Leq	50	50	50	70	70	70	Yes
POR13_A	1185 CONCESSION 8	471989	4872934	4.5	Steady State Leq	44	44	44	70	70	70	Yes
POR14_A	1166 BRUCE ROAD 6	472403	4871577	4.5	Steady State Leq	38	38	38	70	70	70	Yes
POR15_A	1242 BRUCE ROAD 6	471934	4871297	4.5	Steady State Leq	38	38	38	70	70	70	Yes
POR16_A	1292 BRUCE ROAD 6	471346	4870924	4.5	Steady State Leq	36	36	36	70	70	70	Yes
POR17_A	1371 CONCESSION 8	470189	4872718	4.5	Steady State Leq	41	41	41	70	70	70	Yes
POR18_A	519 SIDEROAD 25 N	472166	4874406	4.5	Steady State Leq	34	34	34	70	70	70	Yes
POR19_A	520 SIDEROAD 25 N	472873	4874531	4.5	Steady State Leq	31	31	31	70	70	70	Yes
POR20_A	1206 CONCESSION 8	471728	4873169	4.5	Steady State Leq	46	46	46	70	70	70	Yes

Table 2D - Noise Impact Summary - BH2 - Impulsive

Point of Reception ID	Point of Reception Information				Noise Characteristic	Daytime (dBA)	Evening (dBA)	Nighttime (dBA)	Daytime Limit (dBA)	Evening Limit (dBA)	Nighttime Limit (dBA)	Compliant with Limit
	Description	UTM Easting	UTM Northing	Height POW								
POR01_A	1106 CONCESSION 8	472770	4873390	4.5	Steady State Leq	51	-	-	70	-	-	Yes
POR02_A	1068 CONCESSION 8	473136	4873381	4.5	Steady State Leq	48	-	-	70	-	-	Yes
POR03_A	1036 CONCESSION 8	473418	4873458	4.5	Steady State Leq	46	-	-	70	-	-	Yes
POR04_A	984 CONCESSION 8	473938	4873516	4.5	Steady State Leq	43	-	-	70	-	-	Yes
POR05_A	934 CONCESSION 8	474422	4873652	4.5	Steady State Leq	40	-	-	70	-	-	Yes
POR06_A	907 CONCESSION 8	474660	4873582	4.5	Steady State Leq	35	-	-	70	-	-	Yes
POR07_A	10 SIDEROAD 20A	474992	4871718	4.5	Steady State Leq	33	-	-	70	-	-	Yes
POR08_A	1006 BRUCE ROAD 6	474077	4871700	4.5	Steady State Leq	42	-	-	70	-	-	Yes
POR09_A	1074 BRUCE ROAD 6	473438	4871418	4.5	Steady State Leq	45	-	-	70	-	-	Yes
POR10_A	1105 CONCESSION 8	472796	4873089	4.5	Steady State Leq	52	-	-	70	-	-	Yes
POR11_A	1273 CONCESSION 8	471089	4872907	4.5	Steady State Leq	69	-	-	70	-	-	Yes
POR12_A	1266 CONCESSION 8	471142	4873009	4.5	Steady State Leq	67	-	-	70	-	-	Yes
POR13_A	1185 CONCESSION 8	471989	4872934	4.5	Steady State Leq	61	-	-	70	-	-	Yes
POR14_A	1166 BRUCE ROAD 6	472403	4871577	4.5	Steady State Leq	53	-	-	70	-	-	Yes
POR15_A	1242 BRUCE ROAD 6	471934	4871297	4.5	Steady State Leq	54	-	-	70	-	-	Yes
POR16_A	1292 BRUCE ROAD 6	471346	4870924	4.5	Steady State Leq	51	-	-	70	-	-	Yes
POR17_A	1371 CONCESSION 8	470189	4872718	4.5	Steady State Leq	56	-	-	70	-	-	Yes
POR18_A	519 SIDEROAD 25 N	472166	4874406	4.5	Steady State Leq	48	-	-	70	-	-	Yes
POR19_A	520 SIDEROAD 25 N	472873	4874531	4.5	Steady State Leq	45	-	-	70	-	-	Yes
POR20_A	1206 CONCESSION 8	471728	4873169	4.5	Steady State Leq	62	-	-	70	-	-	Yes

Table 3 - Vibration Monitoring Results

File ID	Start Time	Measurement Type	Description	Geophone Setup	Distance to Equipment (m)	Max Measured PPV (mm/s)	Criteria PPV (MECP) (mm/s)	Resulting Setback (m)
Project 007	2021-09-15 5:49	Waveform	Drill Rig - Active Coring	On Packed Gravel, Sandbag	7.5	0.175	0.100	12
Project 008	2021-09-15 5:50	Histogram	Drill Rig - Active Coring	On Packed Gravel, Sandbag	7.5	0.206	0.100	
Project 009	2021-09-15 6:05	Waveform	Drill Rig - Active Coring	On Packed Gravel, Sandbag	3.5	0.476	0.100	
Project 010	2021-09-15 6:06	Histogram	Drill Rig - Active Coring - Ending	On Packed Gravel, Sandbag	3.5	0.587	0.100	
Project 012	2021-09-15 7:33	Histogram	Cable Rig - Drilling Active	On Packed Gravel, Sandbag	7.5	0.984	0.100	35
Project 013	2021-09-15 7:56	Waveform	Cable Rig - Drilling Active	On Packed Gravel, Sandbag	7.5	0.286	0.100	
Project 015	2021-09-15 9:16	Histogram	Cable Rig - Hammer Active	On Packed Gravel, Sandbag	7.5	1.222	0.100	45
Project 016	2021-09-15 9:17	Waveform	Cable Rig - Hammer Active	On Packed Gravel, Sandbag	7.5	1.381	0.100	

Appendix A

Noise Source Supporting Information

Raw Measurement Data

Source ID	1/3rd Octave Centre Frequency (Hz), Sound Pressure Level (dB)																							
	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
DR01_A	77.13	64.69	56.28	67.97	61.06	62.78	58.23	56.32	59.22	55.60	49.93	46.89	46.58	46.77	47.00	48.00	46.92	45.15	43.09	41.51	40.65	36.80	32.60	28.72
DR01_B	68.02	64.05	58.22	75.89	70.82	64.27	60.91	63.58	61.32	57.80	56.64	62.50	59.21	58.92	56.81	58.88	58.85	54.60	53.31	51.17	49.01	47.11	44.10	40.83
DR02_A	78.52	67.07	66.05	70.59	63.71	65.41	63.08	65.35	63.48	59.34	58.47	58.50	61.78	62.43	62.51	60.74	57.48	55.77	54.00	50.18	47.01	43.42	39.89	35.98
DR02_B	80.86	80.07	77.93	77.76	76.74	79.07	83.85	89.77	89.77	90.35	93.35	92.57	94.40	94.59	94.02	92.55	90.77	92.68	89.98	91.73	87.90	86.27	84.33	78.25
DR02_B	83.12	80.32	81.49	82.43	81.71	81.75	85.90	93.11	94.29	92.85	96.84	100.47	100.90	95.44	98.12	97.68	97.04	99.92	96.28	96.33	90.39	87.88	89.00	83.59
CP01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Logarithmic Mean Impulsive Sound Power Level Calculation For Site Impacts

$$L_{LM} = 10\log\left[\frac{\sum_{i=1}^{20} 10^{\frac{LAI_i}{10}}}{20}\right]$$

*Lw=Lp+20*log(r)+11-10*log(Q)*

Instructions*
Copy LAI Max values from Measurement Data (copy to side somewhere)
Use sort function to select 20 loudest and copy paste values into table

Source ID	Measurement #	Impulsive Sound Pressure Level (LAI)
DR02_B Hammer	1	110.37
	2	106.13
	3	110.37
	4	106.13
	5	110.37
	6	106.13
	7	110.37
	8	106.13
	9	110.37
	10	106.13
	11	110.37
	12	106.13
	13	110.37
	14	106.13
	15	110.37
	16	106.13
	17	110.37
	18	106.13
	19	110.37
	20	106.13
Logarithmic Mean Impulsive Sound Power Level		
Logarithmic Mean Impulsive Sound Pressure Level (dBAI)		108.75
Measurement Distance [r] (m)		7.5
Directivity [Q]		2
Logarithmic Mean Impulsive Sound Power Level (dBAI)		**134.24**

	Octave Band (Hz)								
	63	125	250	500	1000	2000	4000	8000	Total
Measured	86.23	96.41	113.75	125.19	129.14	129.83	126.50	116.80	**134.20**
Average	86.23	96.41	113.75	125.19	129.14	129.83	126.50	116.80	**134.20**
DR02_B - Corrected to Match LLM	86.27	96.45	113.79	125.23	129.18	129.87	126.54	116.84	**134.24**

Point Source Sound Power Level Calculations

*[1]Lw=Lp+20*log(r)+11-10*log(Q)*
*Lp(total)=10*log(10(Lp(31Hz)/10)+10(Lp(63Hz)/10)+…+10(Lp(8kHz)/10))*
r is distance measurement was taken, Q is directivity index, t is operating time

Source ID	Source Description	Operating Condition	Horizontal Measurement Distance (m)	SLM Height (m)	Source Height (m)	Total Measurement Distance (m)	Directivity Factor (Q)	Tonal (Yes/No)		Octave Band (Hz) 63	125	250	500	1000	2000	4000	8000	Total
DR01_A	Drill Rig	Low Idle w fluid pump	50	1.5	3	50.0	2	No	**Measured SPL (dB)**	77.40	69.75	62.85	57.08	51.56	51.61	46.64	38.66	78.28
									Calculated PWL (dBA)	93.38	95.72	95.83	96.05	93.53	94.59	89.61	79.64	102.99
									Msmnt Directionality Correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
									Receptor Directionality Correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
									Applied PWL with Penalties (dBA)	**93.38**	**95.72**	**95.83**	**96.05**	**93.53**	**94.59**	**89.61**	**79.64**	**102.99**
DR01_B	Drill Rig	Active Coring	50	1.5	3	50.0	2	No	**Measured SPL (dB)**	69.80	77.29	66.87	64.54	63.21	62.62	56.28	49.50	78.77
									Calculated PWL (dBA)	85.77	103.26	99.85	103.51	105.18	105.59	99.26	90.48	111.22
									Msmnt Directionality Correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
									Receptor Directionality Correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
									Applied PWL with Penalties (dBA)	**85.77**	**103.26**	**99.85**	**103.51**	**105.18**	**105.59**	**99.26**	**90.48**	**111.22**
DR02_A	Cable Rig	Active Drilling - Exhaust	30	1.5	3	30.0	2	No	**Measured SPL (dB)**	79.04	72.38	68.86	63.56	67.02	63.27	56.08	45.53	80.61
									Calculated PWL (dBA)	90.59	93.92	97.40	98.10	104.57	101.81	94.62	82.07	107.95
									Msmnt Directionality Correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
									Receptor Directionality Correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
									Applied PWL with Penalties (dBA)	**90.59**	**93.92**	**97.40**	**98.10**	**104.57**	**101.81**	**94.62**	**82.07**	**107.95**
CP01	Cummins C200D6D	Steady	n/a	1	1	-	2	No	**Measured SPL (dB)**	-	-	-	-	-	-	-	-	-
									Calculated PWL (dBA)	86.00	99.00	108.00	109.00	110.00	109.00	107.00	104.00	116.08
									Msmnt Directionality Correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
									Receptor Directionality Correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
									Applied PWL with Penalties (dBA)	**86.00**	**99.00**	**108.00**	**109.00**	**110.00**	**109.00**	**107.00**	**104.00**	**116.08**

Specification sheet

Diesel generator set

QSB7 series engine
125-200 kW @ 60 Hz
EPA Tier 3 emissions

Description

Cummins® generator sets are fully integrated power generation systems providing optimum performance, reliability and versatility for stationary Standby applications.

Features

Heavy duty engine - Rugged 4-cycle industrial diesel delivers reliable power and fast response to load changes.

Alternator - Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings, low waveform distortion with non-linear loads and fault clearing short-circuit capability.

Control system - The PowerCommand® 1.1 electronic control is standard equipment and provides total generator set system integration including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, output metering, auto-shutdown at fault detection and NFPA 110 Level 1 compliance.

Cooling system - Standard cooling package provides reliable running at up to 50 ℃ (122 ℉) ambient temperature.

Enclosures - The aesthetically appealing enclosure incorporates special designs that deliver one of the quietest generators of its kind. Aluminium material plus durable powder coat paint provides the best anti-corrosion performance. The generator set enclosure has been evaluated to withstand 180 MPH wind loads in accordance with ASCE7 -10. The design has hinged doors to provide easy access for service and maintenance.

Fuel tanks - Dual wall sub-base fuel tanks are offered as optional features, providing economical and flexible solutions to meet extensive code requirements on diesel fuel tanks.

NFPA - The generator set accepts full rated load in a single step in accordance with NFPA 110 for Level 1 systems.

Warranty and service - Backed by a comprehensive warranty and worldwide distributor network.

	Standby 60 Hz		Prime 60 Hz		
Model	kW	kVA	kW	kVA	Data sheets
C125D6D	125	156	113	141	NAD-6371-EN
C150D6D	150	188	135	169	NAD-6372-EN
C175D6D	175	219	158	197	NAD-6373-EN
C200D6D	200	250	180	225	NAD-6374-EN

Generator set specifications

Governor regulation class	ISO8528 Part 1 Class G3
Voltage regulation, no load to full load	± 1.0%
Random voltage variation	± 1.0%
Frequency regulation	Isochronous
Random frequency variation	± 0.50%
Radio frequency emissions compliance	FCC code title 47 part 15 class A and B

Engine specifications

Design	Turbocharged and charge air cooled
Bore	107 mm (4.21 in.)
Stroke	124 mm (4.88 in.)
Displacement	6.7 L (408 in^3)
Cylinder block	Cast iron, in-line 6 cylinder
Battery capacity	2 x 850 amps per battery at ambient temperature of 0 °C (32 °F)
Battery charging alternator	100 amps
Starting voltage	2 x 12 volt in parallel, negative ground
Lube oil filter type(s)	Spin-on with relief valve
Standard cooling system	High ambient radiator
Rated speed	1800 rpm

Alternator specifications

Design	Brushless, 4 pole, drip proof, revolving field
Stator	2/3 pitch
Rotor	Direct coupled, flexible disc
Insulation system	Class H per NEMA MG1-1.65
Standard temperature rise	120 ºC (248 °F) Standby
Exciter type	Torque match (shunt) with PMG as option
Alternator cooling	Direct drive centrifugal blower
AC waveform Total Harmonic Distortion (THDV)	< 5% no load to full linear load, < 3% for any single harmonic
Telephone Influence Factor (TIF)	< 50 per NEMA MG1-22.43
Telephone Harmonic Factor (THF)	< 3%

Available voltages

1-phase	3-phase				
• 120/240	• 120/208	• 120/240	• 277/480	• 347/600	• 127/220

Generator set options

Fuel system
- Basic fuel tanks
- Regional fuel tanks

Engine
- Engine air cleaner – normal or heavy duty
- Shut down – low oil pressure
- Extension – oil drain
- Engine oil heater

Alternator
- 120 °C temperature rise alternator
- 105 °C temperature rise alternator
- PMG excitation
- Alternator heater, 120 V
- Reconnectable full 1 phase output alternator upto 175 kWe

Control
- AC output analog meters
- Stop switch – emergency
- Auxiliary output relays (2)
- Auxiliary configurable signal inputs (8) and relay outputs (8)

Electrical
- One, two or three circuit breaker configurations
- 80% rated circuit breakers
- 80% or 100% rated LSI circuit breakers
- Battery charger

Enclosure
- Aluminium enclosure Sound Level 1 or Level 2, green color
- Aluminium weather protective enclosure with muffler installed, green color

Cooling system
- Shutdown – low coolant level
- Warning – low coolant level
- Extension – coolant drain
- Coolant heater options:
  - <4 °C (40 °F) – cold weather
  - <-18 °C (0 °F) – extreme cold

Exhaust system
- Exhaust connector NPT
- Exhaust muffler mounted

Generator set application
- Base barrier – elevated genset
- Radiator outlet duct adapter

Warranty
- Base warranty – 2 year/1000 hours, Standby
- Base warranty – 1 year/unlimited hours, Prime
- 3 & 5 year Standby warranty options

A-weighted Sound Power Level, dB(A)

See notes 1, 3 and 6-14 listed below

Configuration	Exhaust	Applied Load	Octave Band Center Frequency (Hz)											Overall Sound Power Level
			16	31.5	63	125	250	500	1000	2000	4000	8000	16000	
Standard – Unhoused	Infinite Exhaust	100% Standby	N/A	64	86	99	108	109	110	109	107	104	108	117
F216-2 Weather Aluminum	Mounted	100% Standby	N/A	62	85	102	109	108	109	106	103	99	101	115
F231-2 Sound Attenuated Level 1, Aluminum	Mounted	100% Standby	N/A	64	81	93	99	99	101	99	95	97	95	107
F217-2 Sound Attenuated Level 2, Aluminum	Mounted	100% Standby	N/A	64	82	91	96	95	96	95	93	92	87	103

Exhaust Sound Power Level, dB(A)

See notes 4 and 6-14 listed below

Configuration	Applied Load	Octave Band Center Frequency (Hz)											Overall Sound Power Level
		16	31.5	63	125	250	500	1000	2000	4000	8000	16000	
Open Exhaust (No Muffler)	100% Standby	N/A	63	94	107	117	118	115	114	115	107	95	123

Global Notes:

1. Sound pressure levels at 1 meter are measured per the requirements of ISO 3744, ISO 8528-10, and European Communities Directive 2000/14/EC as applicable. The microphone measurement locations are 1 meter from a reference parallelepiped just enclosing the generator set (enclosed or unenclosed).

2. Seven-meter measurement location 1 is 7 meters (23 feet) from the generator (alternator) end of the generator set, and the locations proceed counterclockwise around the generator set at 45° angles at a height of 1.2 meters (48 inches) above the ground surface.

3. Sound Power Levels are calculated according to ISO 3744, ISO 8528-10, and/or CE (European Union) requirements.

4. Exhaust Sound Levels are measured and calculated per ISO 6798, Annex A.

5. Reference Sound Pressure Level is 20 µPa

6. Reference Sound Power Level is 1 pW (10^{-12} Watt)

7. Sound data for remote-cooled generator sets are based on rated load without cooling fan noise.

8. Sound data for the generator set with infinite exhaust do not include the exhaust noise contribution

9. Published sound levels are measured at CE certified test site and are subject to instrumentation measurement, installation, and manufacturing variability.

10. Unhoused/Open configuration generator sets refers to generator sets with no sound enclosures of any kind.

11. Housed/Enclosed/Closed/Canopy configuration generator sets refer to generator sets that have noise reduction sound enclosure installed over the generator set and usually integrally attached to the skid base/base frame/fuel container base of the generator set.

12. Published sound levels meet the requirements India's Central Pollution Control Board (Ministry of Environment & Forests), vide GSR 371 (E), which states the A-weighted sound level at 1 meter from any diesel generator set up to a power output rating of 1000kVA shall not exceed 75 dB(A).

13. For updated noise pollution information for India see website: http://www.envfor.nic.in/legis/legis.html

14. Sound levels must meet India's Ambient Air Noise Quality Standards detailed for Daytime/Nighttime operation in Noise Pollution (Regulation and Control) Rules, 2000

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

HAND-HELD ANALYZER

Manufactured by:	BRUEL & KJAER
Model No:	2270
Serial No:	2679353
Calibration Recall No:	31707

Submitted By:

Customer:	Trevor Ross
Company:	Cambium Inc.
Address:	52 Hunter Street East
	Peterborough, On Canada K9H 1G5

The subject instrument was calibrated to the indicated specification using standards traceable to the SI through the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. 2270 BRUE

Upon receipt for Calibration, the instrument was found to be:

Within (X)

tolerance of the indicated specification. See attached Report of Calibration.
The information supplied relates to the calibrated item listed above and statement of conformance for ALL given specifications and standards fall under the decision rule: A= (L-(U95)*M), where A is acceptance limit, L is manufacturer specifications, U95 is confidence level of 95% at k=2, and M is managed guard-band mulitiplier. The guard-band multiplier increases false-accept risk in favor of decreasing false-reject risk. Although the false accept risk increases, it is still below the Z540.3 2% risk requirement. The decision rule has been communicated and approved by customer during contract review.

West Caldwell Calibration Laboratories' calibration control system meets the following requirements, ISO 10012-1 MIL STD 45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2015, and ISO 17025

Note: With this Certificate, Report of Calibration is included.

Approved by:

Calibration Date: 26-Feb-21

James Zhu

Quality Manager

Certificate No: 31707 - 1

ISO/IEC 17025:2017

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor, NY 14564, U.S.A.

ACCREDITED

Calibration Lab. Cert. # 1533.01

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

MICROPHONE

Manufactured by:	BRUEL & KJAER
Model No:	4189
Serial No:	2695416
Calibration Recall No:	31707

Submitted By:

Customer:	Trevor Ross
Company:	Cambium Inc.
Address:	52 Hunter Street East
	Peterborough, On Canada K9H 1G5

The subject instrument was calibrated to the indicated specification using standards traceable to the SI through the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. 4189 BRUE

Upon receipt for Calibration, the instrument was found to be:

Within (X)

tolerance of the indicated specification. See attached Report of Calibration.
The information supplied relates to the calibrated item listed above and statement of conformance for ALL given specifications and standards fall under the decision rule: A= (L-(U95)*M), where A is acceptance limit, L is manufacturer specifications, U95 is confidence level of 95% at k=2, and M is managed guard-band mulitiplier. The guard-band multiplier increases false-accept risk in favor of decreasing false-reject risk. Although the false accept risk increases, it is still below the Z540.3 2% risk requirement. The decision rule has been communicated and approved by customer during contract review.

West Caldwell Calibration Laboratories' calibration control system meets the following requirements, ISO 10012-1 MIL STD 45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2015, and ISO 17025

Note: With this Certificate, Report of Calibration is included.

Approved by:

James Zhu

Quality Manager

ISO/IEC 17025:2017

Calibration Date: 26-Feb-21

Certificate No: 31707 - 2

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor, NY 14564, U.S.A.

ACCREDITED

Calibration Lab. Cert. # 1533.01

Calibration Certificate

Certificate Number 2021007227

Customer:
Cambium Inc
194 Sophia Street
Peterborough,ON K9H 1E5,Canada

Model Number	CAL200	***Procedure Number***	D0001.8386		
Serial Number	19013	***Technician***	Scott Montgomery		
Test Results	**Pass**	***Calibration Date***	17 Jun 2021		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	24	°C	± 0.3 °C
Description	Larson Davis CAL200 Acoustic Calibrator	***Humidity***	32	%RH	± 3 %RH
		Static Pressure	101.4	kPa	± 1 kPa

Evaluation Method The data is aquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 µPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2017 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	08/04/2020	08/04/2021	001021
Larson Davis Model 2900 Real Time Analyzer	04/01/2021	04/01/2022	001051
Microphone Calibration System	02/24/2021	02/24/2022	005446
1/2" Preamplifier	08/27/2020	08/27/2021	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/06/2020	08/06/2021	006507
1/2 inch Microphone - RI - 200V	09/24/2020	09/24/2021	006511
Pressure Transducer	07/17/2020	07/17/2021	007368

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo,UT 84601,United States
716-684-0001

ACCREDITED Cert. #3622.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Hourly Data Report for September 15, 2021

If selected Local Standard Time (LST), add 1 hour to adjust for Daylight Saving Time where and when it is observed.

GODERICH
ONTARIO
Current Station Operator: ECCC - MSC

Latitude:	43°46'00.000" N	**Longitude:**	81°43'00.000" W	**Elevation:**	213.70 m
Climate ID:	6122847	**WMO ID:**	71261	**TC ID:**	WGD

TIME LST	Temp °C	Dew Point °C	Rel Hum %	Precip. Amount mm	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
00:00	18.2	14.1	77	0.0	33	22		98.38			NA
01:00	17.7	12.9	74	0.0	33	21		98.45			NA
02:00	17.4	12.9	75	0.0	34	17		98.50			NA
03:00	16.9	12.8	77	0.0	33	11		98.56			NA
04:00	14.1	12.1	88	0.0	8	3		98.54			NA
05:00	13.5	12.1	91	0.0	11	4		98.59			NA
06:00	13.7	12.5	92	0.0	12	4		98.66			NA
07:00	15.3	13.5	89	0.0	13	2		98.75			NA
08:00	15.7	13.6	88	0.0	7	4		98.81			NA
09:00	18.3	13.9	76	0.0	2	3		98.83			NA
10:00	18.6	13.7	73	0.0	33	6		98.91			NA

TIME LST	Temp °C	Dew Point °C	Rel Hum %	Precip. Amount mm	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
11:00	19.9	14.2	70	0.0	27	8		98.93			NA
12:00	19.6	13.9	70	0.0	29	12		98.95			NA
13:00	19.5	14.2	71	0.0	32	7		98.97			NA
14:00	19.6	14.9	74	0.0	33	8		98.98			NA
15:00	19.8	14.7	72	0.0	31	8		98.99			NA
16:00	19.7	14.0	69	0.0	32	11		99.02			NA
17:00	19.7	14.1	70	0.0	33	10		99.07			NA
18:00	18.6	13.5	72	0.0	35	9		99.10			NA
19:00	16.0	13.3	84	0.0	2	5		99.17			NA
20:00	14.6	12.6	88	0.0	10	9		99.26			NA
21:00	13.2	11.3	88	0.0	8	7		99.35			NA
22:00	12.5	10.9	90	0.0	8	8		99.38			NA
23:00	12.3	10.8	90	0.0	10	5		99.43			NA

Legend

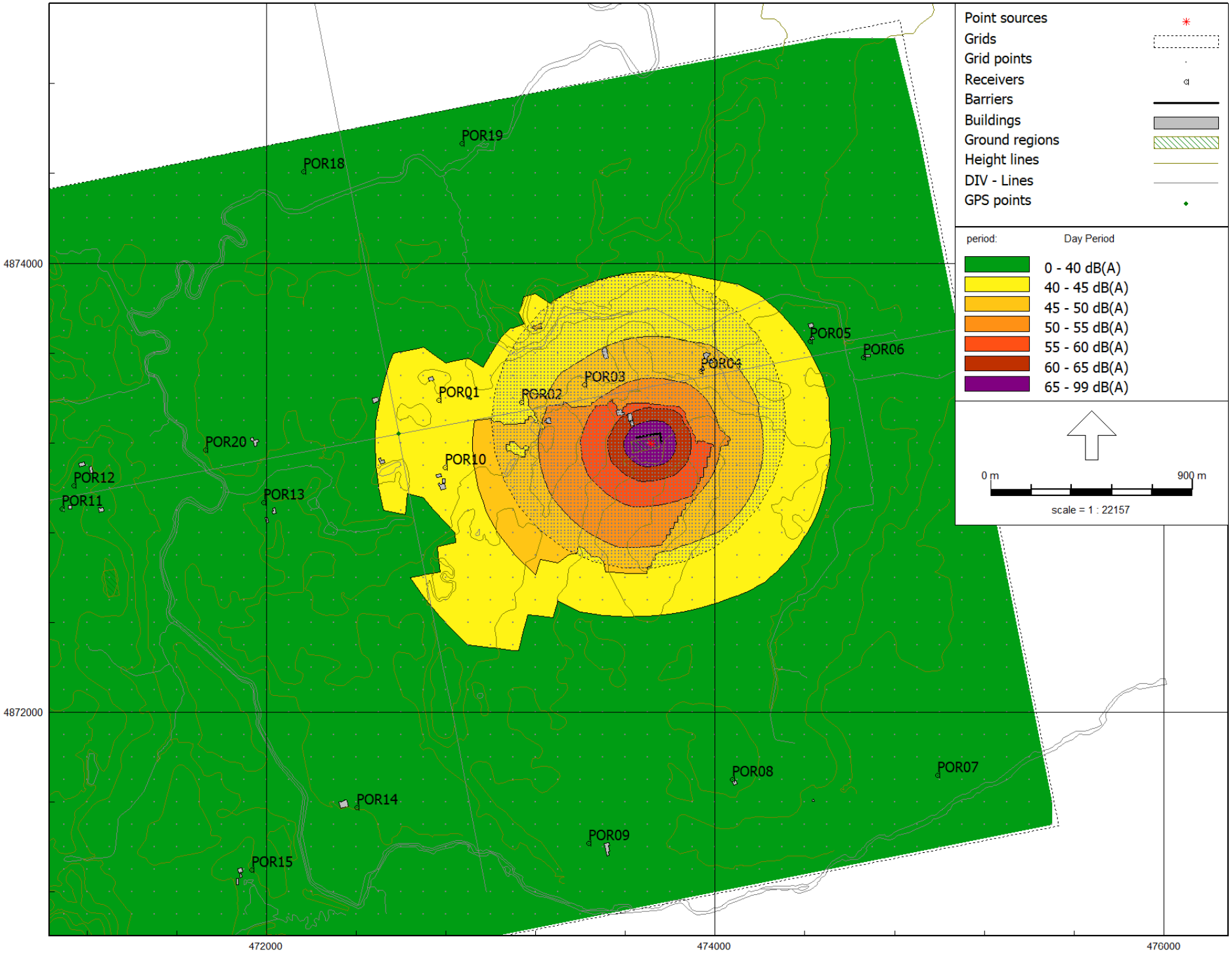
- E = Estimated
- M = Missing
- NA = Not Available*
- [empty] = Indicates an unobserved value

Date modified:

2021-07-09

Appendix B

Impact Assessment Results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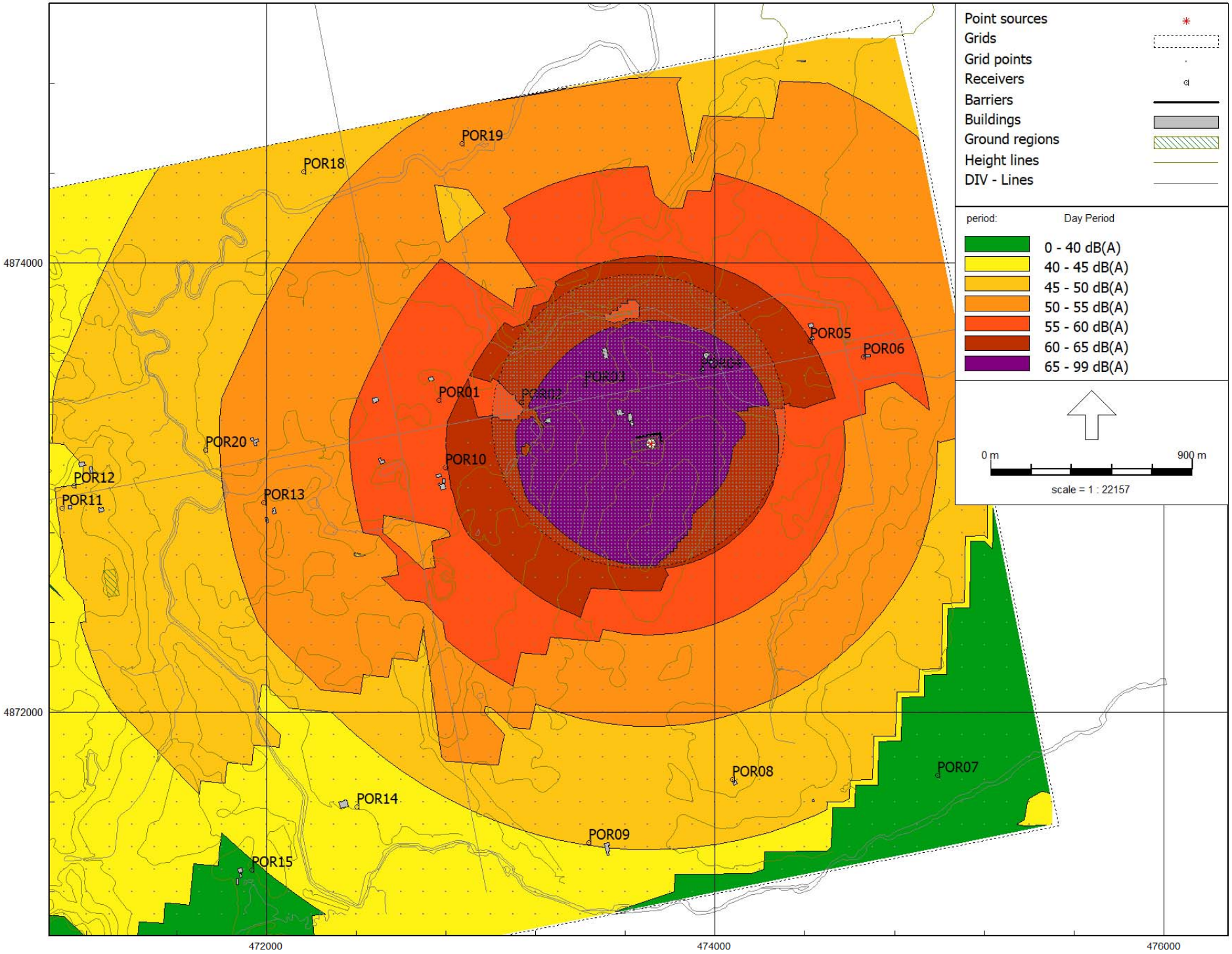
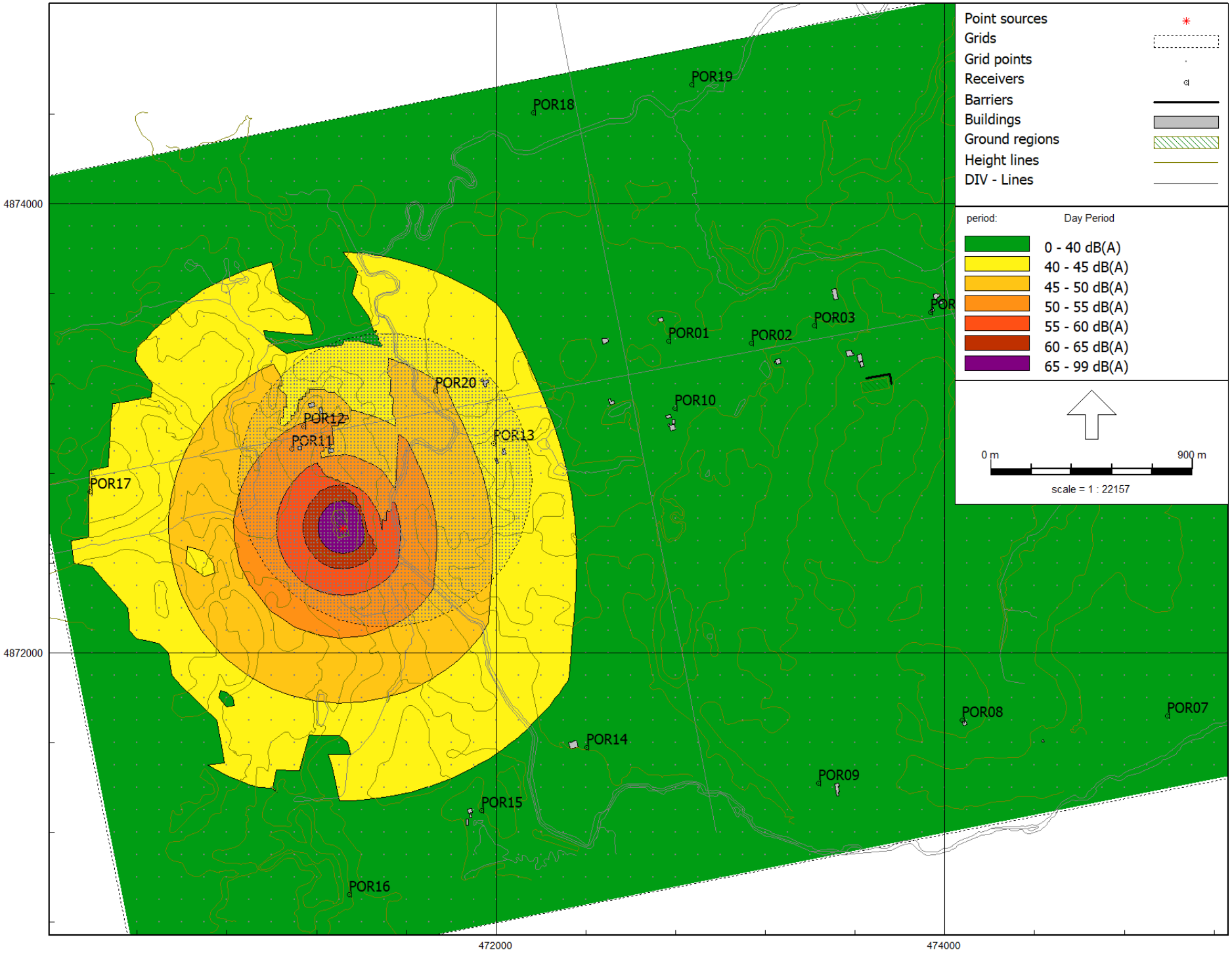
Grids
Grid points
Receivers
Barriers
Buildings
Ground regions
Height lines
DIV - Lines
GPS points
period:
Day Period
0 - 40 dB(A)
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
900 m
scale = 1 : 22157
POR19
POR18
POR05
POR06
POR04
POR03
POR02
POR01
POR20
POR10
POR12
POR11
POR13
POR08
POR07
POR14
POR09
POR15
4874000
4872000
472000
474000
476000



ISO 9613, [2023-07 Report - 04 - SB_BH01 - IMP] , Predictor V2023 Licensed to Cambium Inc., Canada

02 - SB_BH01 - IMP
22 Aug 2023, 14:11

Cambium Inc., Canada


Point sources
Grids
Grid points
Receivers
Barriers
Buildings
Ground regions
Height lines
DIV - Lines
period: Day Period
0 - 40 dB(A)
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
900 m
scale = 1 : 22157
POR01
POR02
POR03
POR07
POR08
POR09
POR10
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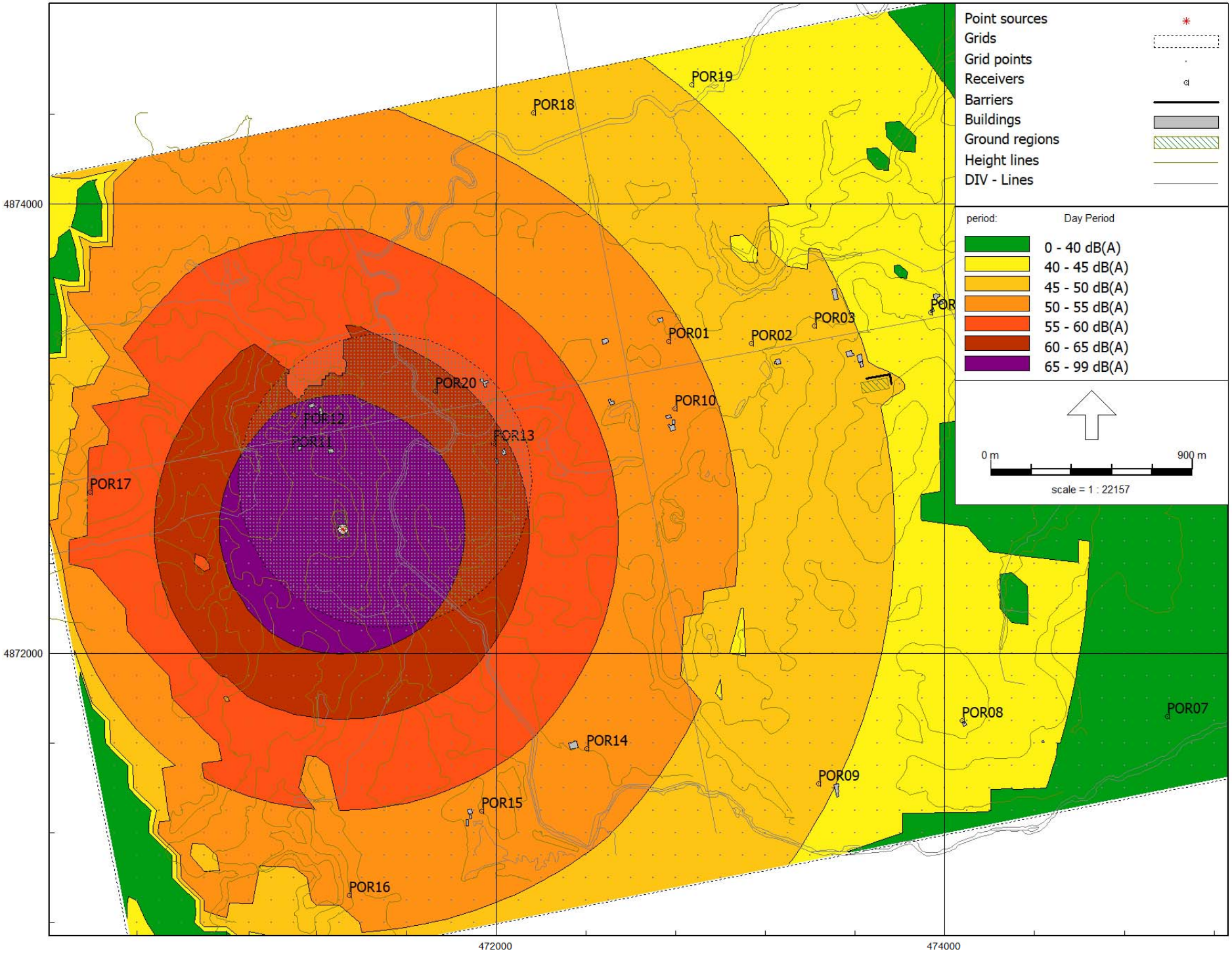
POR18
POR19
POR20
4874000
4872000
472000
474000


Point sources
Grids
Grid points
Receivers
Barriers
Buildings
Ground regions
Height lines
DIV - Lines
period: Day Period
0 - 40 dB(A)
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
900 m
scale = 1 : 22157
POR19
POR18
POR01
POR02
POR03
POR20
POR10
POR12
POR11
POR13
POR17
POR14
POR15
POR16
POR08
POR07
POR09
4874000
4872000
472000
474000