Thompson Mine: 350 Return Air Raise – Notice of Alteration Detailed Report

FINAL REPORT

July 6, 2021

Prepared for:

Vale Canada Limited

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Executive Summary

Vale Canada Limited (Vale) operates two underground metal mines adjacent to the City of Thompson governed under *Clean Environment Act* Order No. 960VC: the Thompson T1 Mine and the Thompson T3 Mine, collectively "the Thompson Mine." Vale is proposing to make changes to the existing development to provide required additional ventilation capacity, through building a new Return Air Raise (RAR). The Project would involve installing a new, dual shaft RAR (the "350 RAR") to replace the failing 345 RAR. Furthermore, the 389 RAR that was proposed in the 2019 T3 Mine Extension Notice of Alteration (NOA), has not yet been implemented due to capital considerations. The proposed 350 RAR is considered a Next Best Option to the 389 RAR.

As required under Manitoba's *The Environment Act*, an application for Notice of Alteration (NOA) to the existing mine operations is submitted with supporting information to Manitoba Conservation and Climate (MCC) for consideration. The Clean Environment Commission Order 960VC, dated December 21, 1983, provides the regulatory licence terms for the current mine operations.

The Project is to remove the 345 RAR from service and construct the 350 RAR to provide required additional ventilation capacity for the existing mining facilities at the Thompson Mine. With the replacement, noise from air raises is not expected to increase and the replacement may further reduce noise in the community. The Project includes:

- Early works to prepare the Project site
- Twin 10-ft diameter RARs (350 RAR)
- Electrical building (E-house)
- New two-lane access road (approx. 65 m) to the 350 RAR fan station
- Surface water management for the Project

The Project does not include changes to mine production, ore transportation (or rock hauling) to the existing mill, increases in tailings placement in the Tailings Management Area, or process water management.

This NOA has been prepared by Stantec Consulting Ltd. (Stantec) on behalf of Vale. Potential adverse environmental effects of the Project are limited to the construction phase and are related to fairly routine activities. Residual adverse operational effects are considered to be negligible. On the basis of a desktop review of the location of the alteration undertaken and information available to date as presented in this report, effects associated with the proposed alteration are determined to be not significant.

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

Vale Canada Limited (the Proponent) operates two underground metal mines (Thompson T1 Mine and Thompson T3 Mine) adjacent to the City of Thompson, Manitoba. The Project being proposed is to build a new Return Air Raise (RAR), referred to as the 350 RAR, to provide additional ventilation capacity and replace the failing 345 RAR currently in use. Furthermore, the 389 RAR that was proposed in the 2019 T3 Mine Extension Notice of Alteration (NOA) was not fully implemented due to capital considerations (Stantec 2019a). The proposed 350 RAR is considered a Next Best Option to the 389 RAR.

The Project will consist of constructing twin ten foot (ft) diameter raises with surface fans, variable frequency drives, and underground ventilation controls, as well as an associated electrical building (E-house), access road, and associated ditching and culverts around the 350 RAR fan station's graded pad (**Figure 1-1**). Following construction and commissioning of the 350 RAR, the failing 345 RAR will be removed from active service. The proposed alterations involve making changes to the existing development to provide required additional ventilation capacity for the existing mining facilities at Thompson Mine. These changes may result in a change in the air contaminant ground level concentrations. With the replacement, noise from air raises is not expected to increase and the replacement may further reduce noise in the community.

The Thompson Mine is governed under *Clean Environment Act* Order No. 960VC (**Appendix C**). Section 14(1) of *The Environment Act* requires a Proponent to notify the Director (for Class 1 and 2 developments) if the Proponent intends to alter a licenced development so that it no longer conforms to license conditions or has the potential to change the environmental effects (Manitoba Sustainable Development [MSD] 2017).

This NOA request has been prepared by Stantec Consulting Ltd. (Stantec) on behalf of the Proponent. The existing mine operation is considered a Class 2 Development under the Classes of Development Regulation (MR 164/88). This report documents the relevant portions of the mine, the proposed alterations, the potential environmental effects, and planned mitigation measures associated with construction and operation of the altered mine site.

1.2 THE PROPONENT

For the purposes of development licensing, the Proponent is Vale Canada Limited (hereafter "Vale"). For further information regarding the Project please contact the following:

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1.3 LAND OWNERSHIP AND PROPERTY RIGHTS

The Thompson Mine occupies parts of Sections 2 and 11, Township 78, Range 3W1 on property under sole ownership by The International Nickel Company of Canada (Inco Ltd., now Vale) since 1958 (**Appendix C**). The legal description for the subject property is described under Plan 4745 (NLTO). Current Mining Rights for the patented owned lands (the Site) are registered to Vale Canada Limited (**Figure 1-2**). The Site is already heavily developed as part of the Thompson mining operation.

1.4 PREVIOUS ALTERATIONS/STUDIES

In 2016, Vale submitted a NOA application to Manitoba Conservation and Climate (MCC) for the Thompson Concentrate Load Out Project. The alteration involved the construction and operation of a dewatering plant, including a dry soda ash system, located in the mill facility's existing copper concentrate area and a new copper concentrate load out facility located adjacent to the mill building at Vale's site. MCC approved this NOA as a minor alteration in November 2016.

Vale's Thompson Smelter and Refinery shut down in 2018. A closure NOA was submitted to MCC in March 2017 and approved as a minor alteration in March 2018.

In 2019, Vale submitted five NOAs to MCC:

- The first, submitted in May 2019, requested the deposit of Birchtree Eluate to the Tailings Management Area (TMA). MCC approved this NOA as a minor alteration in October 2019.
- A second NOA, the Truck to Rail Project Trial, which involves the transfer of concentrate from the Thompson Concentrate Load Out facility to a shear shed, and subsequently to rail cars, was submitted in July 2019. MCC approved this NOA as a minor alteration in July 2019.
- The third NOA, to transport concentrate from the Thompson Concentrate Load Out Facility exclusively by rail following the Truck to Rail Project Trial, was submitted in August 2019. MCC approved this NOA as a minor alteration in October 2019.
- The fourth NOA, the Thompson Mine Extension Phase 1 Project, proposed an extension of the existing Thompson T3 Mine, including development of the 389 RAR, was submitted in September 2019. MCC approved this NOA as a minor alteration in January 2020.

- The fifth NOA, requesting to revise their Concentration Load Out Approval to include both on-spec and off-spec product, was submitted in November 2019. MCC approved this NOA as a minor alteration in January 2020.

In 2020, Vale submitted two NOAs to MCC:

- The first, submitted in May 2020, requested an increase in the total maximum storage of concentrate material from 2,000 tonnes to 3,500 tonnes at the Thompson Concentration Load Out Facility. MCC approved this NOA as a minor alteration in July 2020.
- The second NOA, requesting to incorporate two existing Vale Waste Management Facilities into Environment Act Licence 960 VC, was submitted in July 2020. MCC approved this NOA as a minor alteration in October 2020.

In 2021, Vale submitted one NOA to MCC to date, to decommission Copper Pond No. 4.

For the subject Project, Vale undertook air quality and noise modelling, a desktop biophysical review of the location of the alteration, reconfirmed that the Heritage Screening completed in 2019 with the Historic Resources Branch is still valid for the Project, and leveraged existing baseline environmental data available for the Site. The results are summarized in this report.

1.5 PUBLIC ENGAGEMENT

Pending regulatory approval, communication of the changes to Vale's return air raises, as proposed within this NOA, will be made through existing external engagement mechanisms. This will include updates through Community Liaison Committee meetings – held three times a year with stakeholders from within Thompson and surrounding areas, ranging from educators and health care providers to Indigenous organizations and municipal officials.

1.6 FUNDING

Vale will provide funding for all undertakings related to the Project.

2.0 PROJECT DESCRIPTION

2.1 EXISTING LICENCED DEVELOPMENT

The Project will support existing mine infrastructure, including the T1 and T3 Mines and will comprise two phases: construction and commissioning of the 350 RAR and removal of the 345 RAR from service. Alterations to the mine surface will consist of construction of a graded pad for the 350 RAR fan station, installation of new infrastructure associated with the Project, a new access road, and surface water management (**Figures 1-3).** An on-site laydown area will be included at the 350 RAR graded pad. The entire 350 RAR portion of the Project is contained within approximately 1.5 hectares (ha).

2.2 PROPOSED ALTERATIONS

The Project comprises the following alterations at the Thompson Mine:

- Early works to prepare the Project site
- 350 RAR
- E-house
- New two-lane access road to the 350 RAR fan station
- Surface water management for the Project

The Project does not include changes to mine production, ore transportation (or rock hauling) to the existing mill, increases in tailings placement in the TMA, or process water management.

2.2.1.1 Early Works

Early works as part of the Project included clearing and grubbing required for surface Project components of the 350 RAR fan station. Prior to clearing, pre-clearing nest searches were carried out. This area will be added to the total cleared areas, with KMZ files to be submitted to the regulator for timber accounting, as requested.

A temporary access road will be developed for the construction phase only to support bringing in large equipment that exceeds the height of existing power line that crosses the permanent access road. The temporary access road will connect the pad to the existing access road a few 100 m north of the permanent access road where the existing power line is higher. The temporary access road will be decommissioned following the construction phase.

2.2.1.2 350 RAR and Associated Infrastructure

The new 350 RAR will consist of:

- Twin ten ft. diameter RARs installed to a depth of 3,500 ft., complete with pilings and 84” diameter vent fans per RAR (types to be determined), as well as variable frequency drives and underground ventilation controls.
- An E-house complete with electrical and associated equipment.
- A new two-lane access road approximately 65 meters (m) in length to the 350 RAR fan station

Additionally, the Project will involve various works to the existing underground ventilation system.

2.2.1.3 Retiring of the 345 RAR

The 345 RAR will be removed from active service. Infrastructure removals will be outside of the scope of the current Project; however, will be completed in accordance with the site closure plan at a future date.

2.2.1.4 Surface Water Management

Surface water management for the Project will be addressed as follows (see **Figure 1-3**; **Figures 1-6**):

- A grassed swale will be constructed around the perimeter of the 350 RAR site, which will direct surface contact waters from the Project to a containment pond on the east side of the 350 RAR pad.
- A culvert beneath the 350 RAR access road will be installed to address surface water flow at the access road. Water will be directed to the grassed swale constructed around the perimeter of the 350 RAR pad, and subsequently to a containment pond on the east side of the 350 RAR pad.
- The 350 RAR will be equipped with a condensate drain system that will capture and pump condensation to a containment pond on the east side of the 350 RAR pad.
- Water from the containment pond will be pumped to the TMA for treatment. Water will be pumped to the TMA through a heat-traced pipe installed up to 1 m deep using a trenching method. The new pipe (approximately 4” diameter) will either be installed from the containment pond to the TMA utilizing an existing right-of-way, or will tie the existing Geho line that conveys wastewater to the TMA
- The 350 RAR access road will be constructed with clean fill to reduce the potential to contaminate surface contact water.

2.2.2 350 RAR Construction Inputs and Outputs

During the construction phase of the Project, materials required may include concrete, steel, rebar, flooring, fuel and other materials. Raw materials such as gravel, water, and fill will also be required for site works. Most of these materials will be brought to the Site from other areas. There may be temporary storage of construction materials in lay-down areas on the Site. Heavy equipment used on-site will be

typical for construction, which may include cranes, drill rigs, front-end loaders, excavators, brush clearing machines, rock/dump trucks, and RAR supplies. Construction activities at the Site will consist of clearing and grubbing, surveying, and ground preparation for the surface Project components.

Construction is anticipated to take 25 months, from August 2021 to September 2023. The number of contract workers for construction at the Site will total approximately 37, with a maximum peak workforce of 20 occurring in the year 2022. Accommodations for the construction workforce are expected to be in Thompson's hotels, motels, and rental properties (i.e., apartment blocks, townhouse rental units).

Outputs during construction could include surface runoff and fugitive dust and vehicle emissions from construction equipment. Other outputs generated from construction work (e.g., related to spent packaging materials, solvents, used oils, surplus building materials, etc.) will be regularly transported off the Site and disposed of or recycled according to applicable regulations. Ground clearing and site preparation will produce construction noise through the operation of heavy equipment.

During construction, portable toilets will be available near construction areas until completion of the construction works. Permanent facilities are also available at the T3 Mine. Large volumes of construction waste are not anticipated during construction. Containers for solid waste disposal (i.e., demolition waste, domestic waste, paper, cardboard, wood) will be located at appropriate locations on the construction site.

2.2.3 350 RAR Operation Inputs and Outputs

2.2.3.1 Waste Management

In accordance with Licence Number 960 VC and amendments thereto, Vale segregates and manages wastes, including asbestos, waste oil and concrete and disposes of them as authorized. Vale's Waste Management Facility is located on-site and accepts waste in accordance with its operating permits.

As the 350 RAR replaces the existing 345 RAR, it is not expected to create new types of waste or waste in quantities above typical operations.

2.2.3.2 Fuel and Electrical Utilities

The electrical demands for the Project will be accommodated within the existing electrical load at the Site.

2.2.3.3 Emissions

Atmospheric emissions associated with the Project are typical of mining industrial activities specifically, metal-bearing particulate matter and products of fuel combustion. As the Project is to provide additional ventilation capacity and replace the failing 345 RAR currently in use, exhaust emissions increases are associated with the improved ventilation capacities of the 350 RAR in relation to the 345 RAR. Noise will be generated through various activities during construction and operation of the RARs, access road, and E-house.

2.2.3.4 Workforce

No projected additions to the current operational workforce requirements are expected.

2.3 PROJECT SCHEDULE

Early work to support geotechnical investigations consisted of clearing and was completed in June 2021. Clearing was preceded by pre-clearing nest searches with no active nests found. Further clearing may occur during the breeding bird season for migratory birds in the area; therefore, pre-clearing nest searches will be conducted, and appropriate setbacks will be applied to active nests or areas where nesting is suspected according to guidance offered by the MB CDC (2015).

Dependent on company and regulatory approvals, the start of the construction phase of the Project is expected to be August 2021, with completion and commissioning of the entire Project by September 2023. It is anticipated that the 345 RAR will be put out of service following commissioning of the 350 RAR in September 2023.

3.0 SCOPE OF THE ASSESSMENT

3.1 SPATIAL AND TEMPORAL BOUNDARIES

For the purposes of this NOA, the spatial boundaries are defined as:

- **Project Development Area (PDA)** – the physical footprint of the RAR, E-house, and access road. Additionally, the approximately 355' x 60' containment pond on the east side of the pad (**Figure 1-3)**.
- **Local Assessment Area (LAA)** – encompasses the area in which the construction and operation of the Project could have potential direct and/or indirect effects on the environment. For this project, the biophysical LAA includes the PDA and a one-km buffer of the PDA boundary and the socio-economic LAA includes the PDA and a three-km buffer of the PDA boundary (**Figure 1-4**).
- **Regional Assessment Area (RAA)** – encompasses the area that establishes context for determining the significance of project-specific effects, including the LAA and PDA. For this Project, the RAA is a 10-km buffer from the PDA boundary (**Figure 1-5**).

The temporal boundaries for the assessment are defined as Construction phase and Operation phase as follows:

- **Construction phase** – a period of 25 months from August 2021 to September 2023 over which time construction is planned to occur.
- **Operation phase –** the period over which the 350 RAR will be in operation, starting September 2023.

4.0 ASSESSMENT APPROACH

This NOA has been prepared in general accordance with MCC's 2017 Information Bulletin, "*Alterations to Development with Environment Act Licences*" and in accordance with Section 14(1) of *The Environment Act*. The approach focuses on potential environmental and human health effects that could result from the proposed alteration. Potential project-related environmental effects are discussed, considering design and mitigation measures that help to reduce or avoid the effect. Residual project-related environmental effects are characterized using specific criteria (e.g., direction, magnitude, geographic extent, duration, frequency). Definitions of the effects description criteria included in the assessment are provided in **Table 4-1**.

Table 4-1 Description of Residual Environmental Effects Criteria

Characterization	Quantitative Measure or Qualitative Categories
Direction	**Positive**— an improvement in the component compared with existing conditions and trends **Adverse**— a decline in the component compared with existing conditions and trends
Magnitude	**Negligible**—no measurable change **Low**— a change that falls within the level of natural variability **Moderate**— a measurable change which is unlikely to affect the component **High**— a measurable change which is likely to affect the component
Geographic Extent	**PDA**—residual effects are restricted to the Project Development Area **LAA**—residual effects extend into the LAA (up to a 1 km buffer of the PDA) **RAA**—residual effects extend to adjacent areas of the property (up to a 10 km buffer)
Frequency	**Single event**— residual effect occurs once throughout the life of the Project **Multiple irregular event**— residual effect occurs sporadically throughout **Multiple regular event**— residual effect occurs repeatedly and regularly throughout **Continuous**—residual effect occurs continuously throughout the life of the Project
Duration	**Short-term**— residual effect restricted to the duration of construction **Medium-term**— residual effect extends to ten years **Long-term**— residual effect extends for longer than ten years
Reversibility	**Reversible**— the effect is likely to be reversed after activity completion and decommissioning **Irreversible**— the effect is unlikely to be reversed even after decommissioning
Ecological and Socio-economic Context	**Undisturbed**— area is relatively undisturbed or not adversely affected by human activity **Disturbed**— area has been substantially previously disturbed by human development or human development is still present

The NOA focuses on environmental components that could be affected through interactions of the environment and the Project. The rationale for including or excluding each environmental component is explained and potential general interactions between the Project and components are identified in **Table 4-2**.

Table 4-2 Environmental Components and Rationale for Inclusion

Environmental Component	Potential Project Interaction	Rationale for Exclusion or Inclusion in the NOA
Air quality	✓	Included because ventilation changes to air raises and construction equipment have the potential to change ground level concentrations of air emissions.
Noise	✓	Included because heavy equipment use during site preparation will produce construction noise. In addition, changes to the air raises have the potential to increase noise effects.
Greenhouse gas (GHG) emissions	×	Excluded because GHG emissions associated with Vale's Thompson Operations are not changing as a result of the Project. GHG emissions associated with the Project are expected to be within the year-to-year variation of the facility.
Soils / terrain	✓	Included because the Project will result in some disturbance of soils in the PDA that have been previously undisturbed.
Surface water / groundwater	✓	Included because the Project will require surface work for the construction of the surface components of the RARs, access road, and E-house that may affect surface water. In addition, the construction of new RARs have the potential to interact with groundwater through dewatering.
Vegetation	✓	Included because the Project will result in the loss or alteration of native vegetation communities within a previously disturbed LAA.
Wildlife and wildlife habitat	✓	Included because the Project will result in the loss and alteration of wildlife habitat, despite limitations on the quantity and quality of habitat due to existing disturbance in the LAA.
Fish and fish habitat	×	Excluded because fish habitat is not present in the PDA.
Heritage resources	×	Excluded because the PDA is located within an existing industrial area that is already disturbed; there are no heritage concerns.
Human Health	×	Excluded because contractors engaged in Project construction will be subject to site specific health and safety plans and worker protection standards under *The Workplace Safety and Health Act*. The Site is located within an existing mining industrial area. The site is not in immediate vicinity of residential receptors. The Project is not anticipated to change the risks for worker/public Health and Safety

Based on **Table 4-2**, environmental components included in this assessment are:

- Air quality
- Noise
- Soils and terrain
- Surface water/ groundwater
- Vegetation
- Wildlife and wildlife habitat

5.0 EXISTING ENVIRONMENT

5.1 BIOPHYSICAL ENVIRONMENT

The Project is located in the Sipiwesk Lake Ecodistrict in the Hayes River Upland Ecoregion of the Boreal Shield Ecozone. The Sipiwesk Lake Ecodistrict is part of the glacial Lake Agassiz basin (Smith et al. 1998).

5.1.1 Air Quality

Ambient air quality data is available for the City of Thompson (Vale 2021; MSD 2021). Background ambient air quality data for $PM_{2.5}$, PM_{10}, SO_2 and O_3 collected at 1-hour intervals for 2020 indicated:

- $PM_{2.5}$ – average of 2.8 µg/m^3, 95th percentile of 5.6 µg/m^3
- PM_{10} – average of 7.2 µg/m^3, 95th percentile of 19.7 µg/m^3
- SO_2 – average of 0.003 ppm (8.28 µg/m^3), 95th percentile of 0.012 ppm (32.1 µg/m^3)
- O_3 – average of 16.7 ppb

Data on concentration levels for particulate matter ($PM_{2.5}$) and ozone (O_3), collected in 2015 as part of Manitoba's Ambient Air Quality Monitoring Program, are shown in **Table 5-1**. The 24 hour and annual average $PM_{2.5}$ recorded at the Thompson monitoring station was 21 µg/m^3 and 3.7 µg/m^3 respectively (MSD 2016). The trend in particulate matter concentrations ($PM_{2.5}$) over the period 2005 to 2014 increased, largely as a result of a highly active wildfire season in 2013 (MSD 2016). In terms of ozone, data collection in Thompson only started in 2012, so no long-term trend could be identified; however, the levels did show a decrease over the three-year period (MSD 2016). In terms of air zone management level, Thompson has been designated as "Yellow" which indicates actions are required for avoiding air quality deterioration (MSD 2016).

Maximum short-term and annual mean concentrations of four air pollutants for the Thompson station recorded in 2013 are also summarized in **Table 5-1**. There was one exceedance of ground level ozone (O_3) guidelines and one exceedance of the 24-hour average for particulate matter ($PM_{2.5}$ and PM_{10}) (MCWS 2013). Vale's smelting and mining operations and transportation were the main sources of emissions in Thompson (MSD 2016). However, Vale's smelter and nickel refinery closed in 2018.

Table 5-1 Air Pollution Concentration Summary, Thompson Monitoring Site (2013-2018)

Pollutant	Period	Thompson (Westwood School) (2013)	Canadian Ambient Air Quality Standards - CAAQ (2015)	Manitoba Air Quality Objective – MTL (2005)	Manitoba Air Quality Objective – MAL (2005)	Manitoba Air Quality Objective – MDL (2005)
Ozone (O_3) ppb	1 hour	**54.1* /** 28.6[1]	n/a	200	82	50
	8 hour	n/a	63	n/a	n/a	n/a
	24 hour	52.23*	n/a	n/a	n/a	n/a
	Annual	**28.0***	n/a	n/a	15	n/a
Sulphur Dioxide (SO_2) ppb	1 hour	0.44*+ / 0.008[1]	n/a	n/a	2.0+	n/a
	24 hour	54*	n/a	n/a	n/a	n/a
	Annual	3*	n/a	n/a	n/a	n/a
Particulate Matter 10 (PM_{10}) µg/m^3	1 hour	783.7* / 13.1[1]	n/a	n/a	n/a	n/a
	24 hour	**70.4***	n/a	n/a	50	n/a
	Annual	11.8*	n/a	n/a	n/a	n/a
Particulate Matter 2.5 ($PM_{2.5}$) µg/m^3	1 hour	186.2* / 6.1[1]	n/a	n/a	n/a	n/a
	24 hour	21^ **/ 63.0***	28	n/a	30	n/a
	Annual	3.7^ / 4.3*	10	n/a	n/a	n/a

Notes: Numbers in **bold** indicate exceedance; n/a – no guideline or objective; + indicates objective level in parts per million; underlined indicates objective level that is exceeded

CAAQ – values for selected air pollutants consisting of fine particulate matter ($PM_{2.5}$) and ozone (O_3)

MTL – the maximum tolerable level denotes a time-based concentration of an air contaminant beyond which, given a diminishing margin of safety, appropriate action is required to protect the health of the general population

MAL – the maximum acceptable level deemed essential to provide adequate protection for soil, water, vegetation, materials, animals, visibility, personal comfort and well-being

MDL – the maximum desirable level defined as the long-term goal for air quality providing a basis for an anti-degradation policy for unpolluted areas of Manitoba and for the continuing development of control technology

Source**:** Vale 2021[1]; MSD 2021[1]; MSD 2016^**;** MCWS 2013*; Manitoba Conservation 2005

5.1.2 Noise

An environmental noise study was undertaken for the Project in 2021. For the study, noise baseline data was collected for the existing fresh and return air raises on Site. An environmental noise model was developed to determine the maximum allowable sound level for the existing noise sources and the proposed 350 RAR (RWDI 2021; **Appendix E)**. Determining maximum allowable sound levels reduces the likelihood that new equipment will increase the sound levels for residential receptors. The noise model was calibrated and verified using noise baseline data collected from two points located at the nearest City of Thompson boundary. Spot measurement locations were chosen to reflect the area most affected by the addition of future noise sources. During lulls in local noise, sound levels at these two points were found to be at 52 dBA and 45 dBA (RWDI 2021; **Appendix E**). Existing noise sources at the Site were modelled and the calculated sound levels from existing noise sources at Site range from 121.5 to 136.1 dBA under winter and summer conditions, respectively (RWDI 2021; **Appendix E**).

5.1.3 Soils and Terrain

Regional topography around the Site is relatively flat, with the Burntwood River being approximately 15-20 m lower than the surrounding lands. The Site is at an elevation of approximately 210 m above mean seal level (amsl); the bog area north of the Site is at an equal or slightly higher elevation (210-220 amsl) (Stantec 2019c).

Physiography in the region is characteristic of a level to undulating clayey, glaciolacustrine plain with prominent, hummocky granitoid outcrops generally capped by glaciolacustrine blankets and veneers (Smith et al. 1998). The region has a cold, sub-humid to humid Cryoboreal soil climate with permafrost observed in areas as deep as 30 m (Stantec 2019b; Dillon 1996; HBT Agra 1992).

The surficial geology conditions in the Thompson, MB area generally consist of a combination of glaciolacustrine and glaciofluvial sediments, with a 1- to 20-m thick layer of clay, silt, and minor sand low-relief deposits to a 1- to 20-m-thick layer consisting of a sand and gravel complex as well as thin, low-relief deposits (Matile and Keller 2006). The underlying bedrock consists of rocks of the Precambrian Shield and is overlain by a discontinuous veneer of Holocene Offshore glaciolacustrine sediments and organic deposits with numerous outcrops daylighting (Stantec 2019b; Manitoba Energy and Mines 1995).

Little information exists on the extent of overburden sand and gravel deposits in the RAA. Based on recent investigation, soils in the area were observed to consist of peat (0 - 1 m thick) overlying clay with a thin layer of silt sand in bedrock depressions at lower elevations, overlying granitic gneiss bedrock (Stantec 2019b). The predominant soil series in the region include imperfectly drained Gray Luvisols and some Eutric Brunisols developed on clayey deposits (Smith et al. 1998).

5.1.4 Surface Water

The Site is located in the Burntwood River watershed. Drainage in the area is generally to the northeast (Smith et al. 1998). A total of 11 watersheds (2,855 ha) have been delineated in and around the Site (Golder 2019). Surface water at site drains northward either towards tributaries of the Burntwood River or towards the onsite pit. The PDA does not cross or enter any surface waterways (Figure 1-6). Surface waters from the swale surrounding the 350 RAR pad and the culvert beneath the 350 RAR access road will be directed to a containment pond on the east side of the 350 RAR pad. Water from the containment pond will be pumped to the TMA for treatment. Water will be pumped to the TMA through a heat traced pipe installed up to 1 m deep using a trenching method.

5.1.5 Groundwater

The RAA consists of Precambrian bedrock of the Churchill/Superior geological provinces. The general bedrock geology is made up of mainly Granites and Granitoid Gneiss rock types. Within the bedrock, groundwater flow is expected to be restricted to fractures and joints. Additionally, permafrost conditions up to 20 m below ground surface (BGS) including ice crystals and ice seams were observed on the Site (Stantec 2019b; Dillon 1996). Few active water wells have been drilled in the Thompson area although there have been numerous test wells. The groundwater wells that have been advanced in the RAA were

for domestic and industrial water use, primarily for production purposes (Groundwater Information Network 2014). With respect to private well water supply, the nearest groundwater wells (two) are situated approximately 3 km northwest of the proposed 350 RAR, on the northside of the Burntwood River. The presence of the Burntwood River provides some hydraulic separation to these wells (Stantec 2019b). There have been very little to no intensive groundwater investigations in the Precambrian bedrock regime. Three groundwater monitoring wells were installed on the Site in March 2019 and static groundwater levels were observed at 0.70-2.23 m BGS, representing the shallow, thawed groundwater (Stantec 2019b). Groundwater was sampled in July 2019 for general chemistry, dissolved metals, and total metals. Overall, the groundwater quality was within Manitoba and Canadian guideline limits (i.e., Manitoba Water Quality Standards, Objectives and Guidelines, Guidelines for Canadian Drinking Water Quality, and Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life) for dissolved metals, with the exception of chromium and manganese; however, several exceedances were observed for total metals suggesting sediment-bound metals in groundwater are prominent (Stantec 2019b). Hydraulic conductivity in the overburden/bedrock interface was observed to range from 3.3×10^{-6} m/s to 1.1×10^{-7} m/s (Stantec 2019b).

5.1.6 Vegetation

The Site supports mostly existing mine infrastructure and adjacent brownfield sites, and associated access roads, trails, and rail lines. Lands have been heavily modified by human development. The PDA consists of deciduous and mixed wood forest. The LAA landcover consists of coniferous forest, broadleaf/deciduous forest, shrubland, wetland, water, and mixed wood forest (**Figure 1-7**).

The predominant tree species in the area include black spruce, along with tamarack larch in low-lying areas and white spruce in upland areas. Upland stands on well drained soils support mixed wood species including trembling aspen, black poplar, and black spruce. Large, shallow water wetlands exist between the T1 Mine and the T3 Mine, while smaller wetlands and peat bogs are prevalent around the 378 RAR and in the northern part of the LAA. Mixed wood forests in the LAA tend to occur along the edges of infrastructure and previously disturbed sites, while larger patches of coniferous forest are more prevalent north of the PDA. Broadleaf forest and shrubland is limited to small patches near the northern edge of the LAA (Stantec 2019c). The RAA has the potential to support nine plant SAR based on range maps and land cover data (**Table B1**, **Appendix B**); however, the highly modified nature of the LAA means it is unlikely to provide habitat for plant SAR. Furthermore, no plant SAR were observed during the 2019 field program for the Thompson Mine Extension Phase 1 NOA (Stantec 2019a). As a result, no rare plants are anticipated in the LAA.

5.1.7 Wildlife and Wildlife Habitat

In general, wildlife habitat in the LAA is highly altered and composed predominately of fragmented stands of coniferous forest interspersed with wetland habitats (Section 5.1.6). The LAA contains natural wildlife habitat (i.e., wetland, water, forest, shrubland) and urban/developed lands.

5.1.7.1 Birds

The RAA has the potential to provide breeding habitat for approximately 195 bird species (Carey et al. 2003, MB BBA 2019). During a 2019 breeding bird survey at the Site 35 breeding bird species were observed, including 24 species of passerines (Stantec 2019c). The most commonly observed species were Tennessee warbler (*Leiothlypis peregrina*), rubycrowned kinglet (*Regulus calendula*), dark-eyed junco (*Junco hyemalis*), and alder flycatcher (*Empidonax alnorum*). Other species observed incidentally during breeding bird surveys included great blue heron (*Ardea herodias*), lesser yellowlegs (*Tringa flavipes*), mallard (*Anas platyrhynchos*), sandhill crane (*Antigone canadensis*), and spotted sandpiper (*Actitis macularius*). No SAR were observed during the 2019 breeding bird surveys.

A pre-clearing bird survey and nest sweep was carried out by Vale Environment Department personnel on May 26, 2021 to support early work at the 350 RAR. No nests were found in the survey area nor calls heard, and a relative absence of signs of wildlife in the survey area were noted. A single Wilson's Warbler was encountered to the south of the survey area at the end of an access road, however no nest was found and the observation was made outside of the area to be cleared. (Vale 2021)

5.1.7.2 Mammals

The RAA has the potential to provide habitat for species such as moose (*Alces alces*), black bear (*Ursus americanus*), woodland caribou (*Rangifer tarandus caribou*), Canada lynx (*Lynx canadensis*), muskrat (*Ondatra zibethicus*), snowshoe hare (*Lepus americanus*), and bats (Smith et al. 1998). Given the previously disturbed and developed nature of the Site, disruption to mammal habitat due to the Project is thought to be negligible. A bat survey at the Site was conducted in 2019 (Stantec 2019c), with three survey sites approximately 0.8 km north, 1 km northeast, and 1.2 km southwest of the 350 RAR PDA. Since both little brown myotis (*Myotis lucifugus*) and northern myotis (*Myotis septentrionalis*) are SARA listed as endangered (Government of Canada 2021) and most likely species to be affected at the Site. Four bat species in total were detected with the most common being hoary bat (*Lasiurus cinereus*), followed by silver-haired bat (*Lasionycteris noctivagans*), little brown myotis (*Myotis lucifugus*), and eastern red bat (*Lasiurus borealis*) (Stantec 2019c).

5.1.7.3 Amphibians

The LAA has the potential to provide habitat for boreal chorus frog (*Pseudacris maculate*), wood frog (*Lithobates sylvaticus*), and northern leopard frog (*Lithobates pipiens*; SARA-listed as special concern [Government of Canada 2021]). All but northern leopard frog have been recorded in the LAA (MHA 2020).

5.1.7.4 Species at Risk

The RAA has the potential to provide habitat for 17 animal SAR, as defined in Sections 5.1.7.1 to 5.1.7.3 based on range maps and land cover data (**Table B1**, **Appendix B**): 12 bird species, 4 mammal species, and 1 amphibian species. Historical records exist within the LAA for nine SAR with three being observed during 2019 field surveys at the Site: common nighthawk (*Chordeiles minor)*, barn swallow (*Hirundo*

rustica), and little brown myotis (*Myotis lucifugus*) (Stantec 2019c). These three species typically tolerate an elevated level of anthropogenic disturbance.

The relatively high degree of existing anthropogenic development and disturbance in the LAA and RAA likely limits the suitability of the available habitat for some SAR that are more sensitive to such influences, such as woodland caribou and wolverine. It is unlikely that these species would inhabit the LAA now or in the future.

5.2 SOCIO-ECONOMIC ENVIRONMENT

5.2.1 Land Use and Infrastructure

Land use in the region revolves around natural resources. There are currently no hydroelectric, eco-tourism, winter weather testing, or forestry operations adjacent to or near the Site.

Vale's holdings east of the city (in which the Project is located) fall within Registered Trapline 44 of the Pikwitonei Section. The total area of Trapline 44 is 254 square km. There are four registered trappers with whom Vale communicates regularly. The Project will have no impact on their traplines because there will be no change to off-site water drainage.

The City of Thompson has a municipal water service system that uses surface water (i.e., the Burntwood River) as the primary source (MSD 2015). The Thompson Water Treatment Plant was constructed by Vale and was transferred over to the City of Thompson in advance of the June 2019 revocation date of Vale's licence to operate the plant. The water supply system consists of a river pumphouse/intake structure, the water treatment plant, raw water and potable water pipes to Vale (which Vale still maintains), and a city potable water distribution system (City of Thompson 2019, 2018; Vale 2014).

5.2.2 Population and Economy

The City of Thompson population (2016) is approximately 13,678 people. The population growth rate between 2011 and 2016 was 4.2%. Of the total 5,482 private dwellings recorded in 2016, 4,910 dwellings were occupied. The total land area of the City of Thompson is 20.8 km^2 with a population density of 657.6 persons per sq. km. (Statistics Canada 2016).

There are 658 hotel rooms in Thompson able to accommodate 860 persons, not counting the use of extra cots, hide-a-beds, etc. Most hotels provide long-term stay rates. In addition, there are four apartment blocks / townhouse rental units that offer short-term or month-to-month rates suitable for contractors. In 2019, there was a 14% apartment vacancy in the city, which is high for Thompson (Vale 2019b).

Mining has been, and still is, an important driver of the city's economy. The city also has a diversified service hub economy based on industrial and business, health and education, and government services. Tourism remains an important part of economic development for the city. The city is also home to aerospace winter weather testing as well as winter testing for the automotive sector (City of Thompson 2019).

The closest Indigenous community to Thompson is Nisichawayasihk Cree Nation (NCN), 88 km by all-weather road and with a population exceeding 2,500. Vale and the City of Thompson are in the traditional lands of NCN (Treaty 5), Vale has worked to consult with and partner with NCN on a number of employment and training initiatives.

5.2.3 Heritage Resources

A review of the provincial Archaeological Sites Inventory Database in 2019 relative to the proposed 389 RAR revealed 16 recorded sites within the region. The closest sites are two campsites located more than 2 km north of the PDA on the Burntwood River (Historic Resources Branch pers. comm. 2019).

6.0 ENVIRONMENTAL EFFECTS AND MITIGATION

6.1 ASSESSMENT OF ENVIRONMENTAL EFFECTS

6.1.1 Air Quality

Potential air quality emission sources associated with the Project related to the new ventilation system include:

- Exhaust from the new 350 RAR.
- Emissions and fugitive dust generation from construction equipment used for the 350 RAR and associated infrastructure including the new access road and E-house.

Other emissions associated with the Project include fugitive dust generation and gasoline/diesel emissions due to vehicular traffic on the Site, and odors from activities and materials used during construction.

6.1.1.1 Ventilation Upgrades

The Thompson Mine currently operates eight RARs. The new ventilation upgrades associated with the proposed Project include removing the 345 RAR from service and replacing it with the new 350 RAR, both of which exhaust via two discharges. The emissions associated with the new ventilation system consist of exhaust from the new 350 RAR including particulate matter, metals, and products of combustion from existing underground operations such as material handling, welding, blasting, diesel equipment operation, and comfort and shaft heating. The primary potential emissions include dust, metals, NO_x, NH_3, CS_2, COS, SO_2, and CO (Vale 2021).

Air dispersion modelling was conducted by Vale (2021) to predict the change in ground level concentrations that would result from the ventilation system changes to the RARs associated with the Project (**Appendix D**). Overall, the model indicated that the exhaust from the RARs on site will increase from 1.73 million cubic feet per minute (Mcfm) to 2.11 Mcfm, representing a 22% increase in RAR emissions (**Appendix D**). Current and future RAR emissions are presented in **Table 6-1** along with historical emissions from Vale Thompson operations (including the smelter and refinery which was shut down in 2018), as reported to the National Pollutant Release Inventory (NPRI).

Table 6-1 Current and Future RAR Emissions Compared to Historical Emissions

Contaminant	Current RAR Emissions	Future RAR Emissions	2015 NPRI Report	2017 NPRI Report
	Tonnes/year			
TSP	11.60	14.14	1715	747
PM_{10}	11.60	14.14	894	594
$PM_{2.5}$	11.60	14.14	618	273
Ammonia	5.93	7.23	not reported	not reported
Carbon Disulfide	0.05	0.07	not reported	not reported
Carbonyl Sulfide	0.08	0.10	not reported	not reported
SO_2	5.52	6.74	151,154	117,192
CO	74.68	91.08	not reported	not reported
NO_x	90.96	110.94	not reported	not reported
Nickel	0.24	0.29	65	47
Copper	0.0184	0.0225	5.6	3.5
Cobalt	0.0034	0.0041	1.6	1.5
Arsenic	0.0059	0.0072	6.3	3.2
Lead	0.0015	0.0018	4.8	2.97
Silver	7.30E-06	8.91E-06	not reported	not reported
Iron	1.40	1.70	not reported	not reported

Note: TSP – total suspended particulate; PM_{10} and $PM_{2.5}$ – particulate matter
Source: Vale 2021

The effect of ventilation upgrades on air quality is expected to be adverse in direction, continuous in frequency, and medium-term in duration in the LAA, since the new RAR system is expected to be in operation in perpetuity or until resources are exhausted. The magnitude of the Project air emissions is anticipated to be negligible within the LAA, given that the air quality emission for the Thompson Mine as reported to the NPRI in 2015 and 2017 are historically several orders of magnitude higher than the RAR emissions for all reported parameters due to the historical operation of the smelter.

6.1.1.2 Combustion Emissions, Fugitive Emissions and Dust

During construction, changes to air quality can occur due to vehicle movements and construction equipment exhaust, blasting, general use of equipment, as well as the generation of dust from on-site traffic. Odors typical of some construction processes and materials may also be generated during the construction phase of the project, including those associated with asphalt roofing, adhesives, and painting.

Construction equipment will be maintained in good working order to reduce emissions. In comparison to the existing truck traffic on the Site as well as traffic on PTH 6 immediately adjacent to the Site, the change in local air quality due to these emissions are expected to be adverse in direction, low magnitude

within the PDA, and are considered negligible in the LAA. The effect will be short term (limited to the construction phase) and reversible upon completion of the construction phase of the Project.

Odors typical of some construction processes and materials may also be generated during the construction phase of the Project. The activities generating these odors are expected to be short term, occurring multiple times irregularly over the construction phase. The prevailing wind direction for Thompson in the spring is from the northeast and for the remainder of the year from the west, based on the Thompson Airport meteorological station (Environment and Climate Change Canada [ECCC] 2021). The closest residence to the Site is approximately 2 km west of the PDA. The lands surrounding the PDA are largely industrial with vacant, undisturbed lands to the east and residential development to the northwest. The nature and short-term duration of odor generating activities reduces the effect of odors at the Site on air quality in the LAA. The adverse effects of odor on air quality for receptors in the area are expected to be negligible in the LAA.

Similar to odors, fugitive dust emissions from construction equipment movements may result in nuisance to nearby residents. However, the potential for Project-related air quality effects from dust emissions is expected to be negligible given the nature of the construction activities and location of the planned construction activities. As a continued mitigation measure, if required, additional dust suppression activities such as limiting traffic speeds in specific areas of the site or applying dust suppressants to select areas, may be considered if deemed necessary at the Site.

Summary

With the implementation of the mitigation measures described above the potential effects on air quality from the construction of the Project are expected to be negligible, limited to the LAA, short-term in duration, and multiple and irregular in frequency. The potential effects from operation are expected to be negligible, limited to the LAA, short-term (fugitive emissions) to medium-term (RAR emissions) in duration, and continuous in frequency. All air quality effects are expected to be reversible upon Project decommissioning.

6.1.2 Noise

An increase in noise levels at the Site could potentially affect sensitive receptors (residences) and wildlife resources (in terms of distribution and abundance) from construction and operation activities.

Outdoor noise emissions during construction and decommissioning activities are limited to construction equipment, including pumps and generators used for surface works at the Site. There will be some noise associated with ground clearing and site preparation, and the operation of heavy equipment. Noise level monitoring and mitigation methods will be incorporated into the overall construction monitoring process. The potential construction related noise effects are expected to be short-term in duration and negligible.

As discussed in Section 5.1.2, a noise study was carried out to assess the effect of noise from the fresh and return air raises at the Vale Thompson site (**Appendix E**). The study characterized current noise from the Vale Thompson Mine Site (with 345 RAR in service) through on-site measurements to provide maximum allowable sound power levels for future air raise equipment (including the 350RAR) to be

installed at the Thompson Mine Site and evaluate that sound levels at nearby points of reception do not increase.

The result of the noise model assessment did not indicate a substantive change to the predicted overall sound level from current levels at calibration points located at the nearest City of Thompson boundary next to a designated industrial heavy zone. The sound power levels modelled for the 350 RAR anticipate noise to be at or below the maximum allowable sound power level of 132 dBa for the RAR. It was determined that the existing 378 RAR, with a maximum allowable sound power level of 136.1 dBa, remained the loudest predicted sound source at the receptor points. As such, the soundscape at the receiver is not anticipated to substantially change from the current conditions (RWDI 2021).

Operation of the 350 RAR will generate noise; however, the location and orientation of the RAR is not anticipated to increase noise levels over current conditions to and within the City based on the noise assessment study. As part of the commissioning process, the noise from the 350 RAR and the community noise levels will be measured to ensure compliance with the specifications.

Further, anecdotal observations have noted that the 345 RAR is a potential source of noise heard in the community. It is closer to the community than the proposed 350 RAR and replacement of the 345 RAR with the 350 RAR may then serve to mitigate some of the concerns noted.

Summary

With the adherence to mitigation measures, such as adjusting construction activities through equipment usage modification (i.e., duration, quantity), advising nearby residents of major noise generating activities on-site, and maintaining appropriate noise-abatement equipment, the potential effects of noise from construction are expected to be negligible, limited to the LAA, short-term in duration, and multiple/ irregular in frequency.

With adherence to the installation of equipment with sound power levels at or below the maximum noted levels, the potential effects from operation are expected to be negligible, limited to the LAA, short-term in duration, and continuous in frequency. All noise effects are expected to be reversible upon Project decommissioning.

6.1.3 Soils/Terrain

Potential effects on soils related to the Project include the disturbance and movement of previously undisturbed soils in the PDA for the development of 350 RAR, graded pad, E-house, access road, and surrounding drainage ditches. Construction activities have the potential to alter soil capability as a result of soil handling, admixing, compaction and rutting, and wind and water erosion of disturbed ground. These activities can also result in a loss in soil thickness and volume.

Construction activities that have the potential to alter soil quality/quantity or terrain stability in the LAA include site preparation for the 350 RAR, E-house, and access road (e.g., vegetation clearing, grubbing, uncontrolled burning of slash, earthworks, movement and operation of heavy equipment, excavation for building foundations, drilling, trenching activities for utilities, and grading for site drainage). Localized

changes to drainage patterns could also affect soil movement during the operation of the Project infrastructure.

The 350 RAR PDA consists of a small area (approximately 1.5 ha) of previously undisturbed soil footprint that is expected to be disturbed due to construction activities for the 350 RAR, graded pad, E-house, and access road. To the extent practically feasible, construction equipment and vehicle movement will be restricted to designated roads and pathways within and around work areas. Compaction of soils, if any, would be limited to the immediate cleared footprint for the Project and excavation activities associated building foundations.

To mitigate the effects on soils and terrain, during clearing activities for construction, overburden will be separated and used as fill in areas where needed. Rock excavated from the sinking of the RAR will be used underground as fill, leaving negligible effects to surface properties. Topsoil will be removed and stockpiled on site to be used during site re-vegetation upon project decommissioning. Soil stockpiled on-site will be regularly inspected for evidence of erosion. Should soil erosion become evident, mitigation measures such as tarpaulin covers will be used to cover the materials. Silt fencing or other erosion control materials will be used during the construction and excavation activities to prevent soil losses associated with bank erosion and downstream sedimentation. Cleared areas outside of required footprints will be re-seeded using a native seed mixture and erosion control materials will remain in place until vegetation re-establishes.

To mitigate potential effects to soil quality, soil materials arriving on site for use during construction will originate from a clean source approved by the contract administrator. Machinery arriving on site will be free of leaks and will be regularly inspected to verify that equipment is in good working order. Should a spill or leak occur such as fuel or hydraulic fluid, emergency spill response procedures will be followed. Equipment will be maintained in a designated area to reduce risks of soil contamination.

During operation, potential effects associated with soil movement from changes to drainage patterns will be considered during the Project's design phase to avoid ponding of water on-site and to use existing established drainage ditches and channels to the extent practically feasible. No residual effects on soils and terrain stability are anticipated.

Summary

With the implementation of the mitigation measures described above, the potential effects on soil and terrain from the construction of the Project are expected to be negligible, limited to the LAA, short term in duration, a single event, and reversible upon Project decommissioning.

6.1.4 Surface Water

Surface drainage on the Site is carefully managed to avoid off-site effects. Surface water affected by the Project will be directed to a containment pond and then be pumped to the TMA for subsequent treatment prior to discharge through the Weir final effluent discharge point.

Negligible and short-term effects on localized surface water quality may occur as a result of construction activities for the Project including the construction of the 350 RAR, graded pad, E-house, and access road through erosion and downstream sedimentation associated with soil mobilization and destabilization, dust generation, accidental releases, and effects to surface water drainage from heavy equipment and vehicle movement.

Ground clearing and site preparation will be entirely on Vale property and could disturb the flow of local surface water drainage. A hydrology study (Golder 2019) was conducted to assess this disturbance and its effects. Mitigation methods are proposed to keep site water within the TMA watershed area so that water quality effects are avoided.

To mitigate effects to surface water during construction and excavation, dewatering will include using appropriate energy arrestors (e.g., splash pads, dewatering silt bags) to prevent downstream sedimentation to surface water drainage features. The existing network of drainage ditches and the low anticipated water velocity in those drainage ditches is expected to allow for sediments to filter/settle out prior to discharging to surface water bodies off the mine site. Stormwater management during operation will be addressed through construction of a grassed swale around the 350 RAR and surface grading to direct stormwater from the350 RAR PDA to the TMA for treatment. A culvert will be added underneath the new 350 RAR access road to allow for natural surface water flow to avoid possible flooding. Condensate collected from a condensate drain system on the 350 RAR will capture and pump condensate to the TMA for treatment. The total discharge to the TMA (stormwater and condensate) is approximately 250 gallons per minute, of which, approximately 10% is condensate.

During operation, potential effects associated with soil movement from changes to drainage patterns will be considered during the Project's design phase to avoid ponding of water on-site and to use existing established drainage ditches and channels to the extent practically feasible.

Summary

With the implementation of proposed mitigation measures and surface water management processes, the effect of the construction of proposed alterations at the 350 RAR Site on surface water is expected to be negligible, short-term in duration, multiple irregular, and reversible upon decommissioning of the Project. For surface water drainage effects from associated soil movement during operation, potential effects are expected to be negligible, limited to the surrounding LAA, long-term in duration, continuous in frequency, and reversible upon Project decommissioning.

6.1.5 Groundwater

The Project has the potential to affect groundwater quantity and quality through the construction of the 350 RAR. Potential project interactions with groundwater are predominantly related to the potential lowering of groundwater levels through dewatering of the newly drilled boreholes for the 350 RAR (twin RARs) and management of the groundwater discharge. Groundwater affected by the Project will be directed to the TMA for subsequent treatment. Mitigation methods were developed to reduce groundwater effects to underground development (Stantec 2019b).

The 350 RAR will be unlined; as such, fractures encountered that transmit notable groundwater seepage will be grouted. Furthermore, a full depth exploration hole will be drilled prior to construction and packer testing will be completed to identify if any groundwater infiltration is expected. No permanent groundwater dewatering requirements are expected to be associated with the 350 RAR. Some groundwater may require management during construction. A cement collar through overburden, sealed into the top of bedrock prior to excavation of the 350 RARs will be used to address groundwater seepage.

Based on analytical data collected from three groundwater monitoring wells developed across overburden and shallow bedrock on-site, groundwater generally meets federal and provincial water quality objectives (Stantec 2019b). Two dissolved metal parameters were found to exceed the regulatory criteria, chromium for Freshwater Aquatic Life under the Manitoba Water Quality Standards, Objectives, and Guidelines (MSOG) and manganese for the Aesthetic Objective under the Guidelines for Canadian Drinking Water Quality (CWQG-DWS). Total metals concentrations for several parameters (including total aluminum, arsenic, chromium, iron, lead, manganese, and silver) did not meet the MSOG and/or CWQG criteria in groundwater samples collected from different monitoring wells (Stantec 2019b). The difference in the number of parameters found to exceed the MSOG and/or CWQG criteria related to total metals versus dissolved metals, this exceedance is likely related to the presence of higher amounts of sediment entrained in the groundwater from sampling methods. Groundwater does not typically carry sediment as it moves through the pore spaces or fractures in rocks therefore water quality is best determined by considering only dissolved metal concentrations rather than total metal concentrations, which are more representative of water that may be pumped during construction activities. Total metals concentrations in excess of any regulatory parameters can be mitigated through the use of an effective filtration system to remove the sediment where the metals are adsorbed prior to water being discharged to the environment (Stantec 2019b). It is noted that the water quality samples were collected from shallow groundwater wells and therefore the conditions and concentrations encountered may not be representative of groundwater quality at deeper depths. However, deeper groundwater is likely to be similar to that previously encountered in the developed portions of the T3 Mine (Stantec 2019b). Based on the expected operations of the 350 RAR, no substantive effects to shallow or deep groundwater quality are anticipated and therefore additional monitoring wells are not required. Groundwater quality at Site will continue to be monitored by Vale via available and operational monitoring wells.

The nearest private water supply wells (two) are situated approximately 3 km northwest of the proposed 350 RAR, on the north side of the Burntwood River. Potential effects to these two water supply wells were considered to be negligible given the horizontal and vertical separation distance to the proposed mining activities at the Site and the presence of the Burntwood River providing some hydraulic separation (Stantec 2019b). Potential effects on Thompson's municipal raw water supply (i.e., Burntwood River) are also considered negligible as the estimated maximum entire groundwater mine inflow of 0.072 m^3/s (72 L/s) represents between 0.01% and 0.006% of the flow in the Burntwood River, which is 600 m^3/s to 1,000 m^3/s.

Summary

With the implementation of proposed mitigation measures described above, such as grouting areas with groundwater seepage, installation of a cement collar, and continued monitoring of groundwater levels and

quality, the effect of construction and operation of the proposed alterations at the PDA on groundwater is expected to be negligible, short to long-term in duration, continuous, and irreversible upon decommissioning of the Project.

6.1.6 Vegetation

The 350 RAR PDA consists of a small area (approximately 1.5 ha) with deciduous and mixed wood forest, wetland, and shrubland cover types, along with an infrastructure land class cover type. Much of this natural cover will be removed during construction. However, throughout the LAA native vegetation and wetlands remain, and potential effects to vegetation are related to the loss or alteration of land cover types (i.e., vegetation communities) and loss or change in wetland area and function. Limited clearing will be required for this Project. The loss of habitat for plant SAR is not expected to occur as plant SAR were not detected in the PDA during the desktop study and furthermore no plant SAR were observed during the 2019 field program for the Thompson Mine Extension Phase 1 NOA (Stantec 2019a).

Construction and operation of the Project could introduce or spread noxious and invasive species through vehicle and equipment movement. Weed species could spread throughout the LAA during Project construction and operation as weeds tend to thrive in disturbed sites. Equipment must arrive to the site in a condition free of remnant soil or plant material to reduce the risk of weed introduction. Equipment that arrives containing loose or compacted oil and plant material will not be allowed on the Site until it has been cleaned using brooms, brushes, shovels, high pressure water, or compressed air. Additionally, weed control measures will be developed in accordance with *The Noxious Weeds Act* (Government of Manitoba 2019).

Summary

With the implementation of proposed mitigation measures, the effect of the Project on vegetation is expected to be negligible, limited to the PDA, long-term in duration, continuous, and reversible upon decommissioning of the Project.

6.1.7 Wildlife and Wildlife Habitat

The Project has the potential to affect wildlife and wildlife habitat through direct and indirect habitat loss or alteration and increased mortality risk. Land clearing in parts of the PDA will result in the direct loss of wildlife habitat, while noise and activity from construction equipment will result in indirect habitat loss (i.e., wildlife avoiding otherwise suitable habitat). Increased mortality risk is primarily associated with changes in collision risk for wildlife with heavy construction equipment (Stantec 2019c).

Clearing for construction activities are scheduled to occur within the nesting period (late-April to mid-August; ECCC 2018). Key mitigation measures to be implemented during construction and operation to limit effects on wildlife and wildlife habitat include the following:

- If vegetation clearing cannot avoid the sensitive nesting period, pre-clearing nest searches will be conducted, and appropriate setbacks applied to active nests or areas where nesting is suspected. For

most birds, a 30-m buffer is applied, however, for SAR or species of management concern, setbacks may be applied according to guidance offered by the MB CDC (2015).

Construction effects on bats are anticipated to be low as the PDA is not known to support suitable bat hibernacula or maternity roosts (Stantec 2019c). Similarly, vegetation clearing is not expected to affect SAR bird habitat as the suitability of breeding habitat for species is likely low due to ongoing mining noise and activity.

Construction and operation of the 350 RARs may result in an indirect loss or alteration of habitat adjacent to the PDA through sensory disturbance (i.e., noise from equipment and vehicles). Sensory disturbance may cause wildlife to avoid portions of the LAA during construction and/or operation. Given the existing level of disturbance in the PDA and LAA, wildlife inhabiting the area are likely habituated or tolerant to some of the ongoing noise and activity disturbances. Wildlife may continue to use the area during construction or avoid parts of the PDA temporarily, returning shortly after construction of the Project is complete.

The potential for increased wildlife mortality risk by wildlife coming into direct contact with equipment and vehicles may occur during Project construction and operation and decommissioning activities. Small mammals, amphibians, and ground-nesting birds are particularly susceptible; however, with mitigation the effect is anticipated to be small given the existing level of disturbance within the small Project footprint.

Summary

With the implementation of proposed mitigation measures, the effect of the Project on wildlife and wildlife habitat is expected to be negligible, extending to the LAA, medium-term in duration, continuous, and reversible upon decommissioning of the Project.

6.2 SUMMARY OF BIOPHYSICAL MITIGATION MEASURES

Air Quality

- Construction equipment will be maintained in good working order to reduce emissions.
- Dust generation from exposed or disturbed areas will be kept low; additional dust suppression will be undertaken at the construction site as required (i.e., spraying material stockpiles and work areas with water or other measures.
- Construction traffic speeds will be limited in specific areas of the Project as an additional measure of dust suppression.
- Vale will obtain all required permits and certificates prior to drilling on-site.

Noise

- Construction activity will be limited to normal daylight hours only in accordance with local municipal by-law provisions.

- Noise generation from construction activities will be addressed through equipment usage modification (i.e., timing, duration, quantity).
- Nearby residents will be advised of major noise generating activities on-site.
- Appropriate noise-abatement equipment will be maintained on-site.
- Noise level monitoring will be incorporated into the overall construction monitoring process on-site.
- Newly installed ventilation equipment will be operated below the determined sound power levels with no net increase in current noise levels to the community.
- Vale will follow-up with a noise assessment after the 350 RAR is commissioned and operating.

Soils/Terrain

- To the extent practically feasible, construction equipment and vehicle movement will be restricted to designated roads and pathways within and around work areas.
- Compaction of soils, if any, will be limited to the immediate cleared footprint for the Project and excavation activities associated with building foundations.
- Overburden will be used as fill in areas where needed. Rock excavated from the sinking of the RAR will be used underground as fill, leaving minimal impact to surface properties.
- Mineralized mine waste material generated at the Site, including drill core and construction rock, will be disposed of at an appropriate location for potentially acid generating material.
- Excavated topsoil will be stockpiled separately at the Site for future use in leveling activities and vegetating disturbed areas.
- Material stockpiles will be placed in areas identified and approved by Vale; stockpile heights will be limited.
- Soil stockpiled on site will be regularly inspected for evidence of erosion. Should soil erosion become evident, mitigation measures such as tarpaulin covers will be used to cover the materials.
- Disturbed areas will be kept as small as feasible and site restoration will occur as soon as practically possible where necessary.
- Silt fencing or other erosion control materials will be used during the construction and excavation activities to prevent soil losses associated with bank erosion and downstream sedimentation.
- Buried pipes will be insulated and/or heat traced where excavation constraints exist.
- Exposed slopes will be stabilized using scarification and back-blading methods.

Surface Water and Groundwater

- Construction activities will be limited during heavy precipitation/runoff events.
- Surface water and groundwater entering any excavations will be de-watered using appropriate energy arrestors (e.g., splash pads, dewatering silt bags) to prevent downstream sedimentation to surface water drainage features.
- Surface water drainage patterns will continue to discharge to existing drainage channels.
- A minimum buffer zone of 30 m of natural vegetation from the highwater mark of waterbodies will be maintained around work areas; a wider buffer zone will be maintained if there are no space constraints between construction areas and watercourses.
- Construction of a cement collar through overburden, sealed into the top of bedrock prior to excavation of 350 RAR will address groundwater seepage.
- A full depth exploration hole will be drilled prior to construction and packer testing will be completed to identify if any groundwater infiltration is expected.
- Fractures encountered that transmit notable groundwater seepage will be grouted.
- Groundwater levels and quality will be monitored to allow for the identification of potential hydraulic or chemical anomalies as the Project proceeds.

Vegetation

- Equipment must arrive to the site in a condition free of remnant soil or plant material to reduce the risk of weed introduction. Equipment that arrives containing loose or compacted oil and plant material will not be allowed on the site until it has been cleaned using brooms, brushes, shovels, high pressure water, or compressed air.
- Clearing activities will be limited to those areas required for Project activities.
- Trees will be felled inward toward the work areas to avoid damage to standing trees; slash will be piled for subsequent disposal.
- Cleared areas outside of required footprints will be re-seeded using a native seed mixture and erosion control materials will remain in place until vegetation re-establishes.
- Construction traffic and equipment movements will be limited to designated access routes within the Site.
- Weed control measures will be developed in accordance with *The Noxious Weeds Act* (Government of Manitoba 2019).

Wildlife and Wildlife Habitat

- If vegetation clearing cannot avoid the sensitive nesting period, pre-clearing nest searches will be conducted, and appropriate setbacks applied to active nests or areas where nesting is suspected. For most birds, a 30-m buffer is applied; however, for SAR or species of management concern, setback may be applied according to guidance offered by the MB CDC (2015).

Access, Waste Management, Workforce

- Construction access will be limited to existing access points only; appropriate construction signage and flag persons will be used as required for work on the construction site.
- Construction wastes will be gathered and properly disposed of at Vale's Waste Management Facility; recycling will be encouraged to the extent possible.
- Proper procedures for storage and handling of hazardous substances in designated areas will be adhered to (i.e., fuels, chemicals).
- An emergency response spill kit will be maintained and emergency response measures for spill clean-up and remediation will be implemented.
- The Site will be regularly inspected for loose debris and construction waste to maintain a clean site.
- Contractors engaged in construction activities at the Site will adhere to federal and provincial Health and Safety legislation.
- Contractors will adhere to a Project-specific environmental protection plan developed as appropriate.
- Site employees will be kept aware of safety requirements and on-site construction works for worker safety.
- Workers will be provided with appropriate personal protection equipment (PPE); hearing protection will be provided to employees/workers as required.

6.3 SUMMARY OF RESIDUAL EFFECTS CHARACTERIZATION

A summary of residual environmental effects characterization is found in **Table 6-2**.

Table 6-2 Summary of Residual Environmental Effects

Project Effects	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic
Air Quality								
RAR air emissions	O	A	N	LAA	MT	C	R	D
Fugitive emissions, dust	C, O, D	A	N	LAA	ST	MI/C	R	D
Noise								
Outdoor noise generation	C, O, D	A	N	LAA	ST	MI/C	R	D
Soils/Terrain								
Soil disturbance	C, D	A	N	LAA	ST	S	R	D
Surface Water								
Surface water drainage	C, O, D	A	N	LAA	ST/LT	MI/C	R	D
Groundwater								
Dewatering, water supply alteration	C, O	A	N	PDA	ST/LT	C	IR	D
Vegetation								
Flora loss and alteration	C, O	A	N	PDA	LT	C	R	D
Wildlife and Wildlife Habitat								
Fauna and habitat loss and alteration	C, O	A	N	LAA	MT	C	R	D

KEY

Project Phase
C Construction
O Operation
D Decommissioning

Direction
P Positive
A Adverse

Magnitude
N Negligible
L Low
M Moderate
H High

Geographical Extent
PDA Project Development Area
LAA Local Assessment Area
RAA Regional Assessment Area

Duration
S Short-term
M Medium-term
L Long-term

Frequency
S Single event
MI Multiple irregular event
MR Multiple regular event
C Continuous

Reversibility
R Reversible
IR Irreversible

Ecological/Socio-Economic Context:
U Undisturbed
D Disturbed

N/A Not applicable

7.0 CONCLUSION

Potential interactions of the proposed Project and the environment were evaluated with likely interactions examined to assess residual effects. Those interactions deemed to potentially generate adverse effects were described and evaluated with the assumption of typical mitigation measures representative of best practices and previous construction methods employed at the Site.

On the basis of the desktop data review, a desktop biophysical review of the location of the alteration, and information available to-date as presented in this report, potential effects associated with the proposed alterations are determined to be not significant.

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8.2 PERSONAL COMMUNICATIONS

Senior Air Quality Engineer, Vale Canada Ltd. Email correspondence with Environmental Planner, Stantec Consulting Ltd. June 9, 2021.

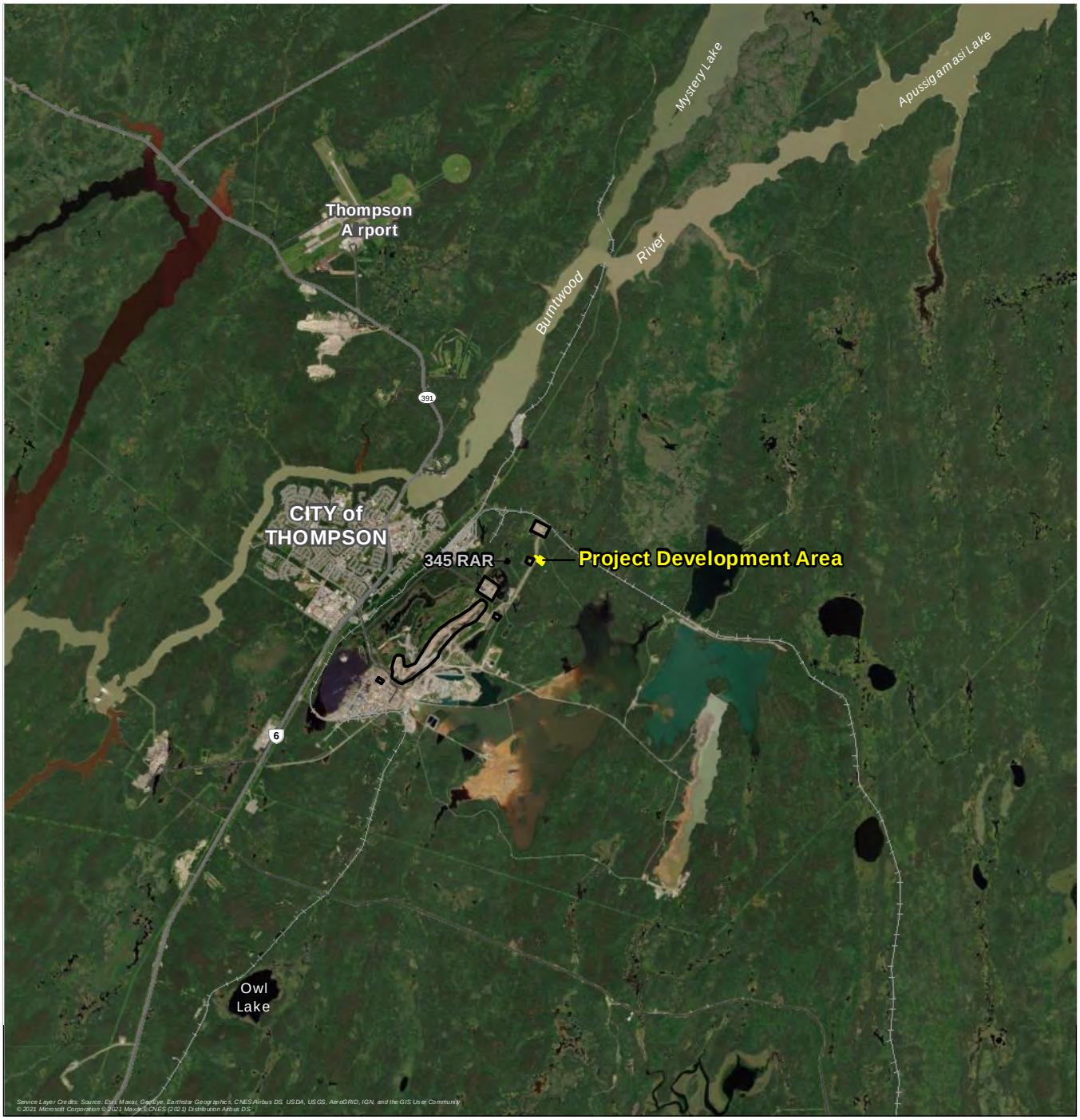
Environmental Advisor, Vale Canada Ltd. Email correspondence with Environmental Planner, Stantec Consulting Ltd. June 9, 2021.

Information Manager, Manitoba Conservation Data Centre. Wildlife and Fisheries Branch. Manitoba Sustainable Development. Email correspondence with Stantec Consulting Ltd. June 17, 2021.

Senior Impact Assessment Archaeologist, Historic Resources Branch. Manitoba Sport, Culture and Heritage. Email correspondence with Stantec Consulting Ltd. September 19, 2019.

Appendix A FIGURES

G:_GIS_Project_Folder\169518673_ValeThompson\Figures\NOA_350_RAR\Figure 1-1 REVD_350RARLocation.mxd Revised: 2021-06-28 By: JHiebert



Legend

- Project Development Area (PDA)
- Existing Mine Features
- Highway
- Major Road
- Local Road
- Railway

0 1.5 3 Kilometres

(At original document size of 8.5x11)
1:125,000

N

Stantec

Project Location
Thompson,
Manitoba

Prepared by JH on 2021-06-28
TR by IH on 2021-06-28

Client/Project 169518673

VALE
Thompson Mine: 350 RAR
Notice of Alteration

Map No.
1-1

Title

Thompson Mine: 350 RAR
Notice of Alteration

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba, Vale, Stantec Consulting

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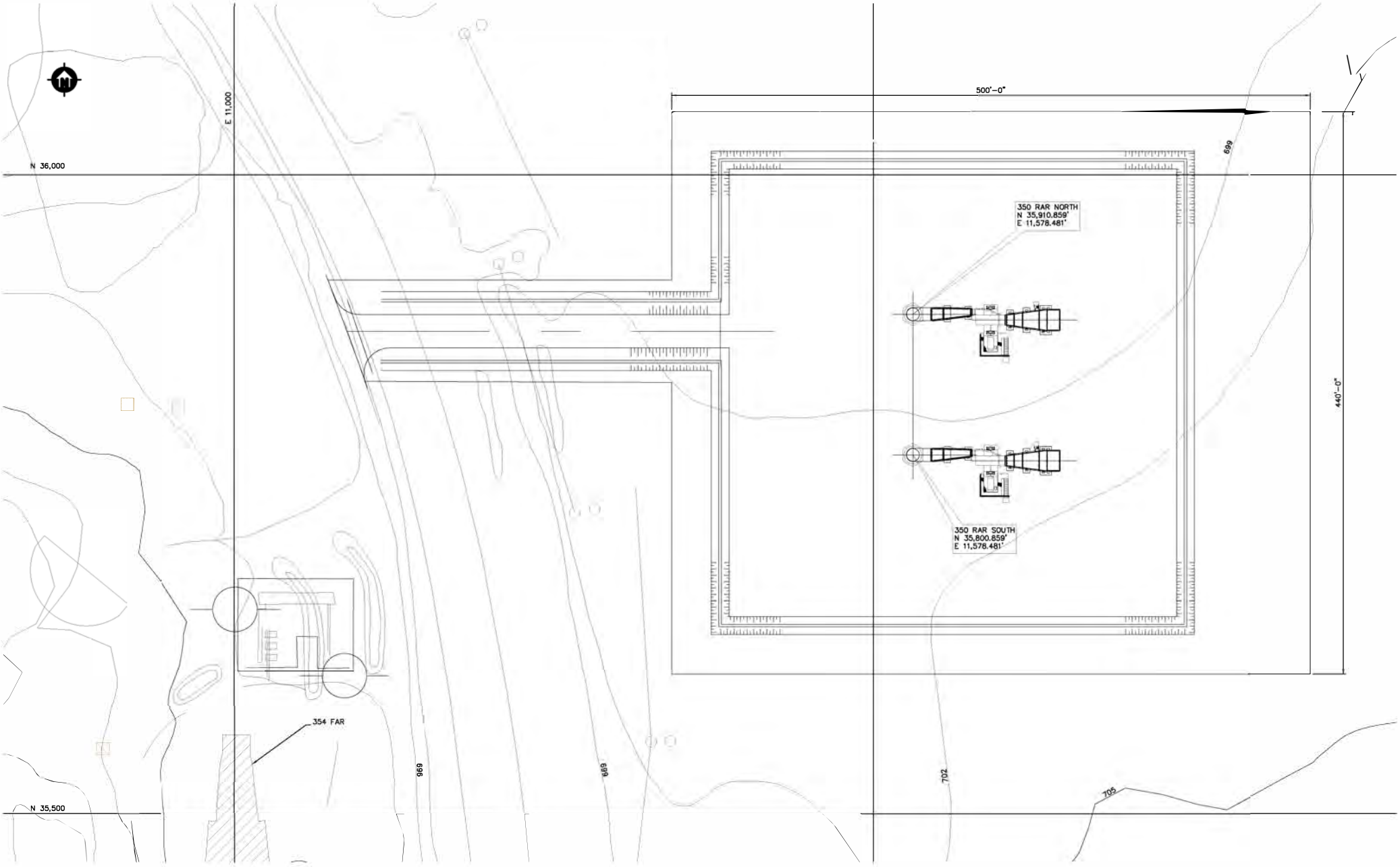
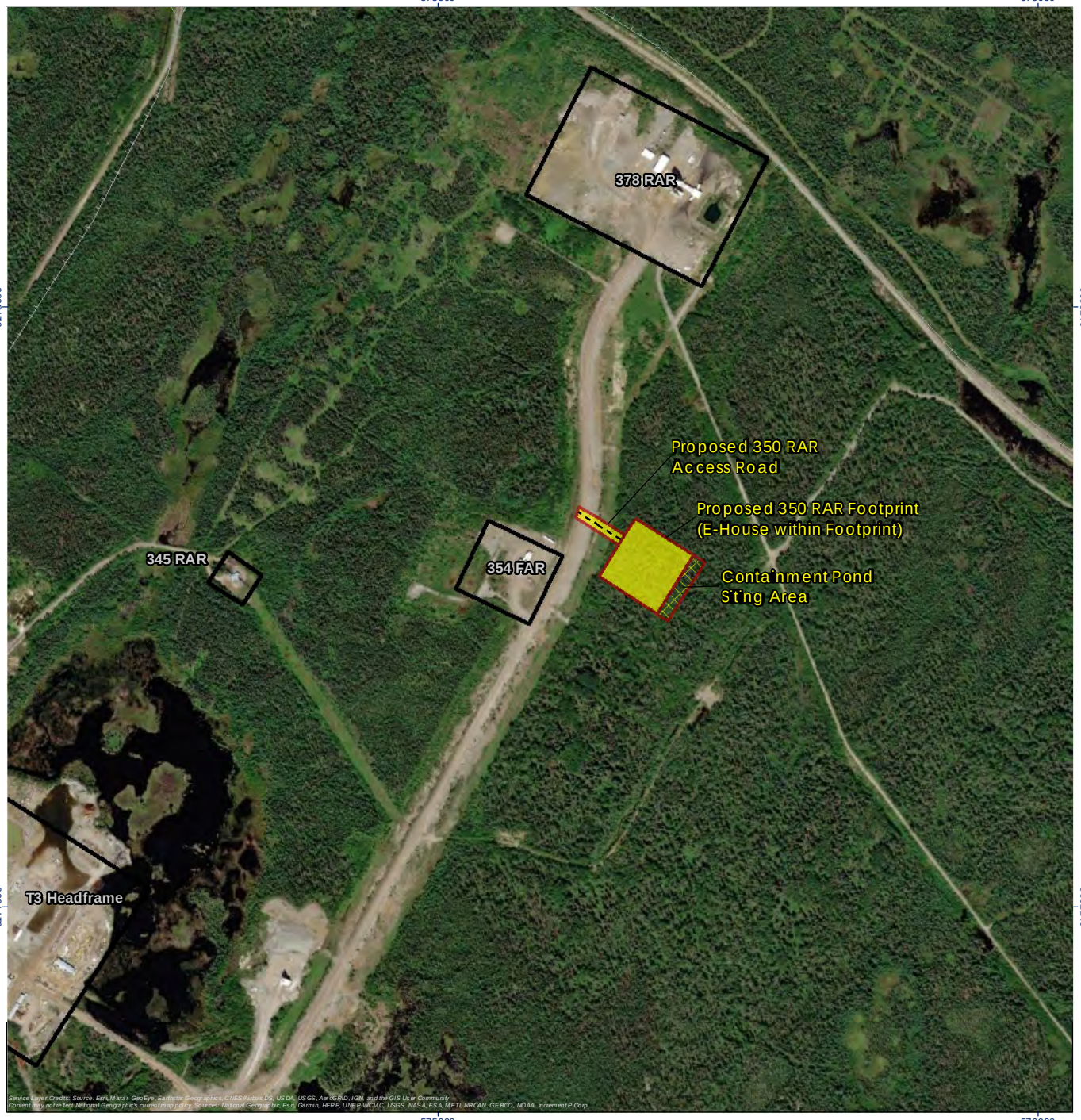
Figure 1-2 Site Plan



G:\...G\5. Project Folder\169521695\8673 Vale Thompson\Figures\NOA 350 RAR\Figure 1-3 REVE 350RAR PDA.mxd Revised: 2021-06-29 By: JHiebert



Legend

Project Development Area (PDA) Components

- Access Road & 350 RAR Footprint
- Containment Pond Siting Area
- Existing Mine Features
- Highway
- Major Road
- Local Road
- Railway

0 0.1 0.2 Kilometres

N

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

Stantec

Project Location
Thompson,
Manitoba

Prepared by JH on 2021-06-29
TR by IH on 2021-06-29

Client/Project 169521505

VALE
Thompson Mine: 350 RAR
Notice of Alteration

Map No.
1-3

Title
Thompson Mine: 350 RAR
Notice of Alteration -
350 RAR Project Development Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba, VALE, Stantec Consulting

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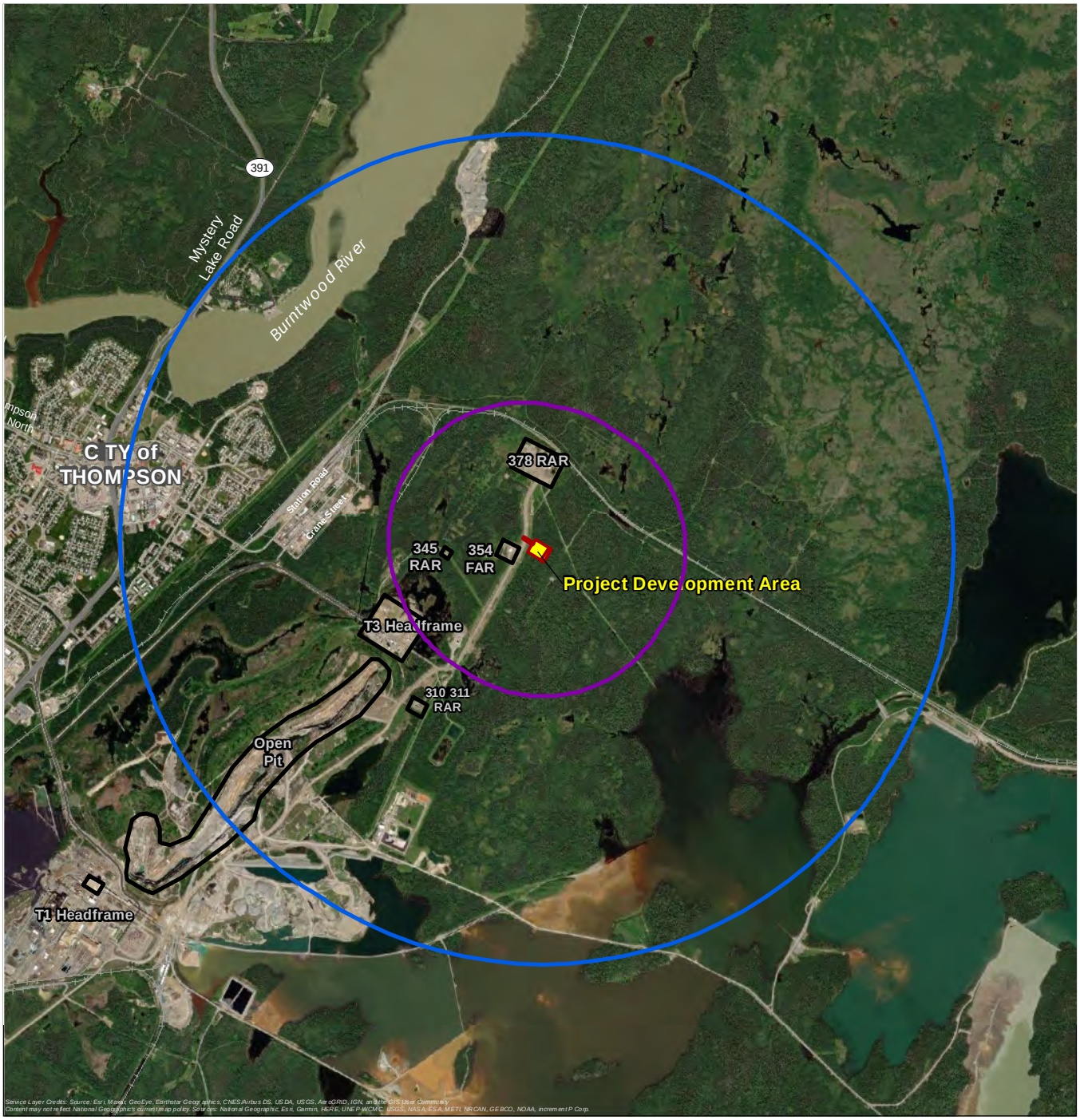
G:_GIS_Project_Folder\169518673_ValeThompson\Figures\NOA_350_RAR\Figure 1-4 REVD_350RAR LAA.mxd Revised: 2021-06-28 By: JHiebert



Legend

- Project Development Area (PDA)
- Biophysical Local Assessment Area (LAA) - 1km
- Socio-Economic Local Assessment Area (LAA) - 3km
- Existing Mine Features
- Highway
- Major Road
- Local Road
- Railway

0 0.5 1 Kilometres

N

(At original document size of 8.5x11)
1:45,000

Stantec

Project Location
Thompson, Manitoba

Prepared by JH on 2021-06-28
TR by IH on 2021-06-28

Client/Project
169521505

VALE
Thompson Mine: 350 RAR
Notice of Alteration

Map No.
1-4

Title
Thompson Mine: 350 RAR Notice of Alteration - 350 RAR Local Assessment Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba, VALE, Stantec Consulting

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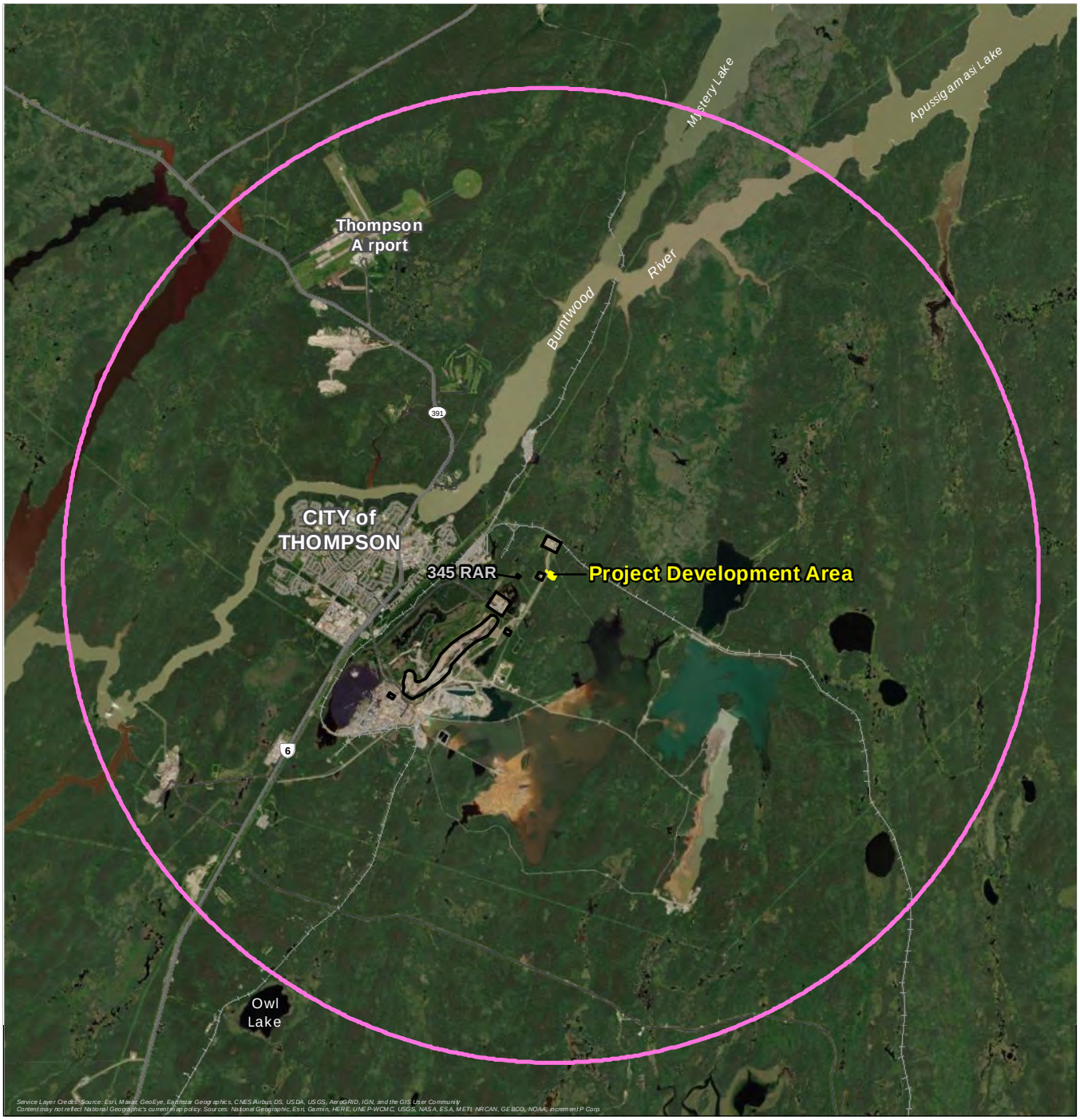
G:\ GIS_Project_Folder\169518673_ValeThompson\Figures\NOA_350_RAR\Figure 1-5_REVD_350RAR_RAA.mxd Revised: 2021-06-28 By: JHiebert



Legend

- Project Development Area (PDA)
- Regional Assessment Area (RAA) - 10km
- Existing Mine Features
- Highway
- Major Road
- Local Road
- Railway

0 1.5 3 Kilometres

(At original document size of 8.5x11)
1:125,000

N

Stantec

Project Location
Thompson,
Manitoba

Prepared by JH on 2021-06-28
TR by IH on 2021-06-28

Client/Project 169521505

VALE
Thompson Mine: 350 RAR
Notice of Alteration

Map No.
1-5

Title

Thompson Mine: 350 RAR
Notice of Alteration -
350 RAR Regional Assessment Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba, Vale, Stantec Consulting

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G:_GIS_Project_Folder\169518673_ValeThompson\Figures\NOA_350_RAR\Figure_1-7 REVD_350RAR_Surface Water Flow.mxd Revised: 2021-06-28 By: JHiebert

Legend

- Project Development Area
- Surface Water Flow Direction
- Highway
- Major Road
- Local Road
- Railway
- Watercourse
- Waterbody

0 0.5 1 Kilometres

(At original document size of 8.5x11)
1:50,000

N

Stantec

Project Location
Thompson,
Manitoba

Prepared by JH on 2021-06-28
TR by IH on 2021-06-28

Client/Project
169521505

VALE
Thompson Mine: 350 RAR
Notice of Alteration

Map No.
1-6

Title

Thompson Mine: 350 RAR Notice of Alteration - Surface Water Flow

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba
3. Aerial Imagery: Microsoft product screen shot reprinted with permission from Microsoft Canada

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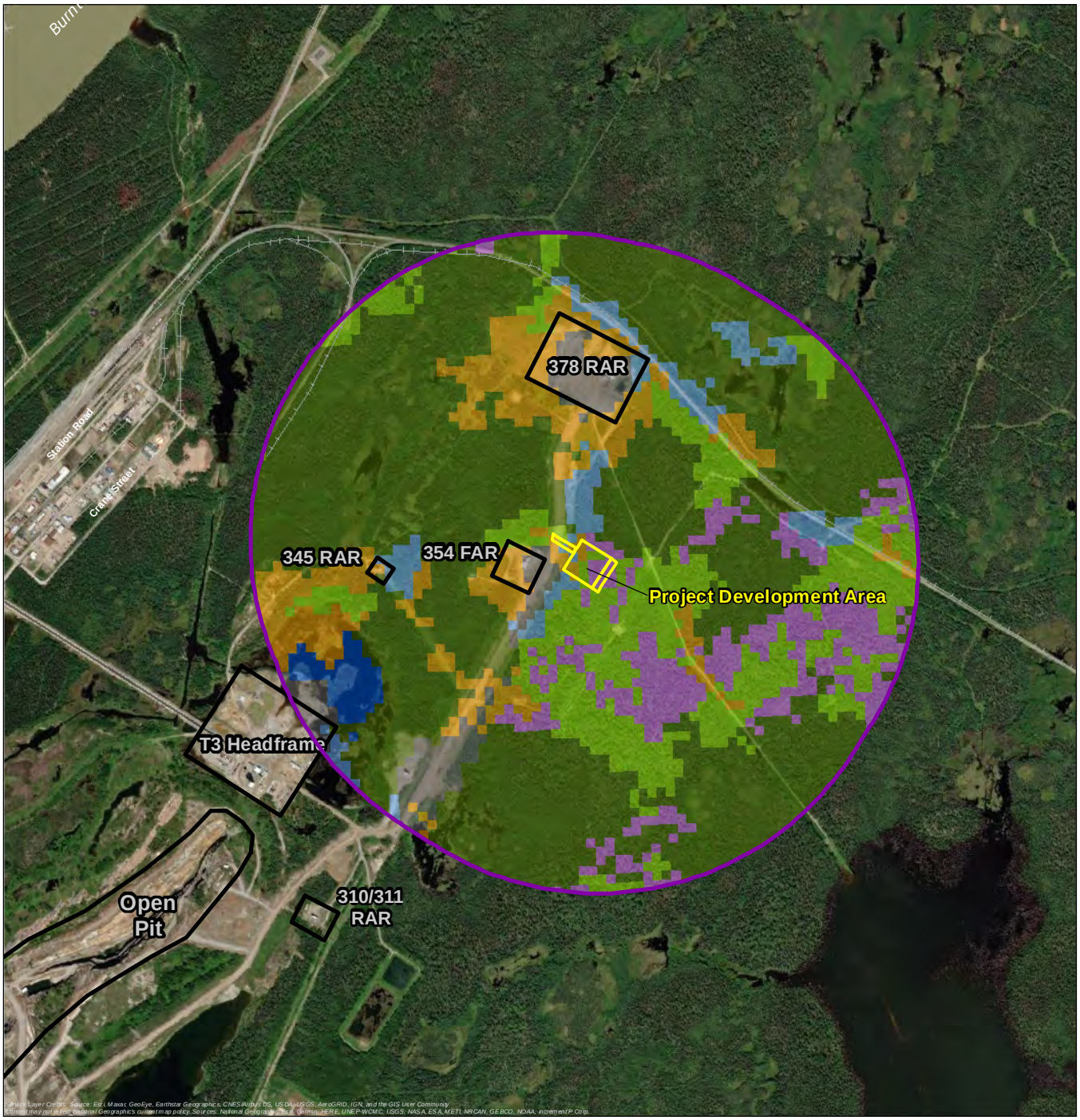
G:_GIS_Project_Folder\169518673_ValeThompson\Figures\NOA_350_RAR\Figure 1-6 REVD_350 RAR_Landcover_LAA.mxd Revised: 2021-06-28 By: JHiebert



Legend

- Biophysical Local Assessment Area (LAA)
- Project Development Area (PDA)

Landcover

- Coniferous
- Deciduous
- Mixedwood
- Shrubland
- Wetland
- Urban/Developed
- Water

- Existing Mine Features
- Highway
- Major Road
- Local Road
- Railway

0 0.25 0.5 Kilometres

(At original document size of 8.5x11)
1:20,000

N

Stantec

Project Location
Thompson, Manitoba

Prepared by JH on 2021-06-28
TR by IH on 2021-06-28

Client/Project
169521505

VALE
Thompson Mine: 350 RAR
Notice of Alteration

Map No.
1-7

Title

Thompson Mine: 350 RAR
Notice of Alteration - Landcover Data within the Biophysical Environment LAA

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba, VALE, Stantec Consulting

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Appendix B TABLES

Appendix B Tables
July 6, 2021

Table B1 Species at Risk with Potential to Occur in the RAA

Common Name	Scientific Name	Status	Authority[1,2,3]	MB CDC Rank[4]	Suitable Habitat Within the LAA	Occurrence Record Within the LAA
Birds						
Trumpeter swan	*Cygnus buccinator*	*Endangered*	MESEA	S1S2B	-	-
Horned grebe	*Podiceps auritus*	*Special concern*	SARA	S3B	-	-
Western grebe	*Aechmophorus occidentalis*	*Special concern*	COSEWIC	S4B	-	-
Common nighthawk	*Chordeiles minor*	*Threatened*	SARA & MESEA	S3B	✓	✓
Yellow rail	*Coturnicops noveboracensis*	*Special concern*	SARA	S3S4	-	-
Short-eared owl	*Asio flammeus*	*Special concern*	SARA	S2S3B	✓	-
Olive-sided flycatcher	*Contopus cooperi*	*Threatened*	SARA	S3S4B	✓	✓
Barn swallow	*Hirundo rustica*	*Threatened*	COSEWIC	S4B	✓	✓
Bank swallow	*RIparia riparia*	*Threatened*	COSEWIC	S4B	-	✓
Evening grosbeak	*Coccothraustes vespertinus*	*Special concern*	COSEWIC	S3	✓	✓
Canada warbler	*Cardellina canadensis*	*Threatened*	SARA	S3B	✓	✓
Rusty blackbird	*Euphagus carolinus*	*Special concern*	SARA	S3S4B	✓	✓
Mammals						
Little brown myotis	*Myotis lucifugus*	Endangered	SARA & MESEA	S2	✓	✓
Northern myotis	*Myotis septentrionalis*	Endangered	SARA & MESEA	S3S4	✓	-
Wolverine	*Gulo gulo*	Special Concern	SARA	S3S4	-	-
Woodland caribou	*Rangifer tarandus caribou*	*Threatened*	SARA & MESEA	S2S3	-	✓
Amphibians						
Northern leopard frog	*Lithobates pipiens*	Special Concern	SARA	S4	-	-
Plants						
Bodin's milkvetch	*Astragalus bodinii*	Not Listed	Not Listed	S1	-	-
Daisy-leaf moonwort	*Botrychium matricariifolium*	Not Listed	Not Listed	S1	-	-
Rye-grass sedge	*Carex loliacea*	Not Listed	Not Listed	S2	-	-
Seaside sedge	*Carex maritima*	Not Listed	Not Listed	S2	-	-
False uncina sedge	*Carex microglochin*	Not Listed	Not Listed	S2	-	-

Table B1 Species at Risk with Potential to Occur in the RAA

Common Name	Scientific Name	Status	Authority[1,2,3]	MB CDC Rank[4]	Suitable Habitat Within the LAA	Occurrence Record Within the LAA
Ground-fir	*Diphasiastrum sitchense*	Not Listed	Not Listed	S1	-	-
Graceful manna grass	*Glyceria pulchella*	Not Listed	Not Listed	S2	-	-
Mountain club-moss	*Huperzia selago*	Not Listed	Not Listed	S2	-	-
Hooker's orchid	*Platanthera hookeri*	Not Listed	Not Listed	S2	-	-
Northern woodsia	*Woodsia alpina*	Not Listed	Not Listed	S2	-	-

NOTES:

[1] *Species At Risk Act* Registry (Government of Canada 2021)

[2] *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC) species database (COSEWIC 2020)

[3] *The Endangered Species and Ecosystems Act* (MESEA) (Government of Manitoba 2018)

[4] Manitoba Conservation Data Centre rankings (MB CDC) are as follows:

S = Province-wide status

1 = Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2 = Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3 = Uncommon throughout its range or in the province (21 to 100 occurrences).

4 = Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (>100 occurrences).

5 = Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

S#S# = Range of uncertainty about the exact rarity of the species.

B = Breeding status of a migratory species.

Appendix C CERTIFICATES OF TITLE AND LICENCE

CERTIFICATES OF TITLE AND LICENCE

Form 174A

The International Nickel Company of Canada, Limited

Real Estate (Land Titles) Record

Township -78, Range 3, West of the Principal Meridian

Parcel No. Lot Concession

Mining Claim No. Acreage — Mining Surface Waterline - pumphouse To west side Water Treatment Plant Plan 4620

CERT.

Patent No. 125402 Date of Patent

Nature of Title Fee Simple

Acquired from The Province of Manitoba Transfer No. 20297

Consideration $ 1.00 per Acre Date December 14, 1964 Charged to Real Estate

Description of Property - Parcel Four which Parcel is shown bordered Red on a Plan of Survey of part of Townships Seventy-seven and Seventy-eight, in Ranges Two and Three, West of the Principal Meridian, in Manitoba, registered in the Neepawa Land Titles Office as No. 4745.

88 Acres

FOR INFORMATION ONLY

Remarks

Correspondence in File No. Document Reference

THIS PARCEL IS LIABLE FOR THE FOLLOWING TAXES AND IS IN ORGANIZED ☐ UNORGANIZED ☐ TERRITORY

MUNICIPAL ☐ SCHOOL ☐ ACREAGE ☐ LAND ☐

S PAID	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
MUNICIPAL & SCHOOL																										
ACREAGE																										
LAND																										

Form 174A

The International Nickel Company of Canada, Limited

Real Estate (Land Titles) Record

Township -78, Range 3, West of the Principal Meridian

Parcel No. Lot Concession

Mining Claim No. Acreage — Mining Surface

CERT.
Patent No. 125400 Date of Patent

Nature of Title Fee Simple

Acquired from The Province of Manitoba Transfer No. 20297

Consideration $ 1.00 per acre Date December 14, 1964 Charged to Real Estate

Description of Property - All those portions of Township Seventy-eight, in Range Three, West of the Principal Meridian, in Manitoba, taken for Right of Way for Power Transmission Line, as the same is shown bordered Red on a Plan registered in the Neepawa Land Titles Office as No. 4643 which lies to the South of a straight line drawn from the North East corner of parcel One to the North West corner of Parcel Two, as said Parcels One and Two are shown bordered Red on a Plan registered in the Neepawa Land Titles Office as No. 4745.

HYDRO Row

FOR INFORMATION ONLY

Remarks

Correspondence in File No. Document Reference

THIS PARCEL IS LIABLE FOR THE FOLLOWING TAXES AND IS IN ORGANIZED ☐ UNORGANIZED ☐ TERRITORY

MUNICIPAL ☐ SCHOOL ☐ ACREAGE ☐ LAND ☐

TAXES PAID	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	8
UNICIPAL & SCHOOL																										
CREAGE																										
AND																										

Form 174A

The International Nickel Company of Canada, Limited

Real Estate (Land Titles) Record

Township - 78, Range 3, West of the Principal Meridian

Parcel No. Lot Concession

Mining Claim No. Acreage — Mining Surface

CERT.
Patent No. 125401 Date of Patent

Nature of Title Fee Simple

Acquired from The Province of Manitoba Transfer No. 20297

Consideration $ 1.00 Per Acre Date December 14, 1964 Charged to Real Estate

Description of Property - All that portion of Parcel Three, in Township Seventy-eight and Range Three, West of the Principal Meridian, in Manitoba, which Parcel is shown bordered Red on a Plan of Survey registered in the Neepawa Land Titles Office as No. 4745, lying to the West of the Western limit of the Public Road as same is shown bordered Red on a Plan registered in the said Office as No. 4782, which lies to the North East of the following described b ndary: Commencing at the Intersection of the Western limit of the said Public Road with the North Eastern limit of Parcel One, as the same is wn on a Plan registered in the said Office as No. 4599; thence North terly along the said North Eastern limit of said Parcel One to the North West corner thereof; thence North Westerly in a straight line to the most Southerly corner of Block Lettered "B" as the same is shown on a Plan registered in the said Office as No. 4620.

FOR INFORMATION ONLY

Remarks

Correspondence in File No. Document Reference

T PARCEL IS LIABLE FOR THE FOLLOWING TAXES AND IS IN ORGANIZED ☐ UNORGANIZED ☐ TERRITORY

MUNICIPAL ☐ SCHOOL ☐ ACREAGE ☐ LAND ☐

ES PAID	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	8
MUNICIPAL & SCHOOL																										
ACREAGE																										
LAND																										

Form 174A

The International Nickel Company of Canada, Limited

Real Estate (Land Titles) Record

Township - 78, Range 3, West of the Principal Meridian

Parcel No. | Lot | Concession

Mining Claim No. | Acreage — Mining | Surface

CERT.
Patent No. 125403 | Date of Patent

Nature of Title Fee Simple

Acquired from The Province of Manitoba | Transfer No. 20297

Consideration $ 1.00 per Acre | Date December 14, 1964 | Charged to Real Estate

Description of Property - Parcel Three, which Parcel is shown bordered Red on a Plan of Survey of part of Townships Seventy-seven and Seventy-eight, in Ranges Two and Three, West of the Principal Meridian, in Manitoba, Registered in the Neepawa Land Titles Office as No. 4745.

EXCEPTING THEREOUT: All that portion thereof which lies to the West of the Eastern limit of the Public Road as same is shown bordered Red on a Plan registered in the said Office as No. 4782.

15025 acres.

FOR INFORMATION ONLY

Remarks

Correspondence in File No. | Document Reference

THIS PARCEL IS LIABLE FOR THE FOLLOWING TAXES AND IS IN ORGANIZED ☐ UNORGANIZED ☐ TERRITORY

MUNICIPAL ☐ SCHOOL ☐ ACREAGE ☐ LAND ☐

TAXES PAID	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
MUNICIPAL & SCHOOL																										
ACREAGE																										
LAND																										

Form 174A

The International Nickel Company of Canada, Limited

Real Estate (Land Titles) Record

Township - 78, Range 3, West of the Principal Meridian

Parcel No. | Lot | Concession

Mining Claim No. | Acreage — Mining | Surface

CERT.
Patent No. 125404 | Date of Patent

Nature of Title Fee Simple

Acquired from The Province of Manitoba | Transfer No. 20297

Consideration $ 1.00 per Acre | Date December 14, 1964 | Charged to Real Estate

Description of Property - Parcel Two, which Parcel is shown bordered Red on a Plan of survey of part of Townships Seventy-seven and Seventy-eight, in Ranges Two and Three, West of the Principal Meridian, in Manitoba, registered in the Neepawa Land Titles Office as No. 4745.

4085 acres

FOR INFORMATION ONLY

Remarks

Correspondence in File No. | Document Reference

TH ARCEL IS LIABLE FOR THE FOLLOWING TAXES AND IS IN ORGANIZED ☐ UNORGANIZED ☐ TERRITORY
MUNICIPAL ☐ SCHOOL ☐ ACREAGE ☐ LAND ☐

S PAID	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
UNICIPAL & SCHOOL																										
CREAGE																										
AND																										

960VC

AN ORDER OF THE CLEAN ENVIRONMENT COMMISSION

UNDER THE CLEAN ENVIRONMENT ACT

RE: THE CLEAN ENVIRONMENT COMMISSION and INCO LIMITED, Applicant,

WHEREAS on the 1st day of January, 1970, and again on the 13th day of April, 1970, pursuant to the provisions of The Clean Environment Act, Inco Limited submitted proposals to The Clean Environment Commission to prescribe limits in connection with emissions to the environment from the operation of nickel mine, mill, smelter, refinery, and tailings disposal facilities located in the general vicinity of Thompson, Manitoba;

AND WHEREAS the Commission held a hearing in Thompson on the 14th day of April, 1970, and, on the 1st day of June, 1970, issued the following licences to the Applicant:

Licence No. 20 concerning the T-3 mine,

Licence No. 21 concerning the Birchtree Mine sewage lagoon,

Licence No. 25 concerning the drainage from Thompson Lake,

Licence No. 26 concerning the discharge of sewage effluent from the Thompson mill/smelter complex via the tailings area to the Burntwood River,

Licence No. 27 concerning Thompson tailings area drainage to the Burntwood River,

Licence No. 28 concerning Thompson tailings area drainage to the Grass River, and

Licence No. 29 concerning emissions to the atmosphere from the Applicant's smelter operation,

AND WHEREAS Licence No. 28 expired on the 1st day of June, 1972, Licence No. 29 expired on the 1st day of June, 1973, and Licences No. 20, 25 and 27 expired on the 1st day of June, 1975;

AND WHEREAS on the 21st day of March, 1980, the Applicant filed with the department applications in connection with the continuation of the said operations and a proposal for the development of an open pit mine at Thompson Lake, all located in Townships 77 and 78, Ranges 2 and 3, WPM, in the Local Government District of Mystery Lake, Manitoba;

AND WHEREAS the Commission held a hearing in Thompson on the 15th day of June, 1982, and issued Order No. 960 on the 20th day of September, 1982;

AND WHEREAS the Applicant requested a variation to Order No. 960 on the 31st day of October, 1983, to increase the nickel concentration in discharges to the Burntwood River;

AND WHEREAS the Commission held a hearing in Thompson on the 2nd day of December, 1983;

AND WHEREAS the Commission considered the variation request on the 19th day of December, 1983;

IT IS HEREBY ORDERED THAT ORDER NO. 960 BE VARIED TO READ AS FOLLOWS

1. The Applicant shall not discharge effluent from the final discharge points:

(a) subject to (c), where the concentrations of the following contaminants in the effluent are in excess of the corresponding maximum allowable concentrations shown for those categories listed under Columns I, II, and III of the following table:

	Contaminant	Column I Maximum Monthly Arithmetic Mean Concentration	Column II Maximum Concentration In a Composite Sample	Column III Maximum Concentration In a Grab Sample
(i)	Total Arsenic	0.5 mg/L	0.75 mg/L	1.0 mg/L
(ii)	Total Copper	0.3 mg/L	0.45 mg/L	0.6 mg/L
(iii)	Total Lead	0.2 mg/L	0.3 mg/L	0.4 mg/L
(iv)	Total Nickel	0.5 mg/L	0.75 mg/L	1.0 mg/L
(v)	Total Zinc	0.5 mg/L	0.75 mg/L	1.0 mg/L
(vi)	Total Suspended Matter	25.0 mg/L	37.5 mg/L	50.0 mg/L

1. (b) where the pH of the effluent is below the minimum allowable values shown for those categories listed under Columns I, II and III of the following table:

Column I Minimum Monthly Arithmetic Mean pH	Column II Minimum pH In A Composite Sample	Column III Minimum pH In A Grab Sample
6.0	5.5	5.0

(c) from the 21st day of December, 1983, to the 1st day of May, 1984, where the concentration of the following contaminant in the effluent from the Thompson Lake drainage channel exceeds the maximum concentrations shown for those categories listed under Columns I, II, and III of the following table:

	Column I	Column II	Column III
Contaminant	Maximum Monthly Arithmetic Mean Concentration	Maximum Concentration In a Composite Sample	Maximum Concentration In a Grab Sample
Total Nickel	2.5 mg/L	3.0 mg/L	3.5 mg/L

2. Subject to 3, the Applicant shall sample and analyze the effluent from the final discharge points:

(a) for the following substances at a frequency not less than that specified in the following table whereby the applicability of Columns I, II, III and IV for each substance listed shall be determined on the basis of the arithmetic mean concentration of that substance in the samples of effluent collected and reported in those preceding six months during which effluent discharge occurred:

	Column I	Column II	Column III	Column IV
Substance	At Least Weekly If Concentration Is Equal To Or Greater Than	At Least Every Two Weeks If Concentration Is Equal To Or Greater Than	At Least Monthly If Concentration Is Equal To Or Greater Than	At Least Every Six Months If Concentration Is Less Than
Total Arsenic	0.5 mg/L	0.2 mg/L	0.10 mg/L	0.10 mg/L
Total Copper	0.3 mg/L	0.1 mg/L	0.05 mg/L	0.05 mg/L
Total Lead	0.2 mg/L	0.1 mg/L	0.05 mg/L	0.05 mg/L
Total Nickel	0.5 mg/L	0.2 mg/L	0.10 mg/L	0.10 mg/L
Total Zinc	0.5 mg/L	0.2 mg/L	0.10 mg/L	0.10 mg/L
Total Suspended Matter	25.0 mg/L	20.0 mg/L	15.0 mg/L	15.0 mg/L

2. (b) for pH not less frequently than:

(i) once a week where the pH of the effluent was less than 5.0 at any time in those preceding six months during which effluent discharge occurred;

(ii) once every two weeks, where the pH of the effluent was between 5.0 and 5.5 at any time in those preceding six months during which effluent discharge occurred;

(iii) once a month if (i) and (ii) do not apply.

3. The Applicant shall sample and analyze the effluent from one or all of the final discharge points for such additional substances or characteristics and at such frequency and duration as are specified from time to time by the Commission.

4. The Applicant shall measure the total volume of effluent discharged monthly from each of the final discharge points monthly by a method acceptable to the Environmental Management Division;

5. The Applicant shall submit to the Enviromental Management Division the data assembled pursuant to clauses 2, 3, and 4, in a form acceptable to the Division, within 30 days of the end of the month in which the samples and measurements were taken.

6. The Applicant shall from time to time provide such engineering studies, drawings, specifications, analyses of wastewater streams, and such other information relative to waste treatment, handling and disposal systems as are requested by the Commission.

7. The Applicant shall not dispose of bulky metallic waste or solid wastes, as defined in regulations issued under the said Act, except in waste disposal grounds designated and approved for that purpose.

8. The Applicant shall not cause or permit the emission of sound from dredging carried out on the premises of the said operation which, when measured at any point beyond the property line of the operation and within 15 metres of a building maintained as a dwelling, results in an hourly equivalent sound level in excess of:

   (a) 60 dBA during the daytime hours of 7:00 a.m. to 10:00 p.m., local time;

   (b) 50 dBA during the nighttime hours of 10:00 p.m. to 7:00 a.m., local time.

9. The Applicant shall not cause or permit the emission of sound from blasting at the said open pit mine which, when measured beyond the property line of the said operation, exceeds:

   (a) 130 decibels linear peak sound pressure level when measured within 15 metres of a building used as a dwelling, ;

   (b) 150 decibels linear peak sound pressure level when measured within 15 metres of any building maintained for use other than as a dwelling;

   (c) 140 decibels linear peak sound pressure level when measured in an area where any person other than an employee of the Applicant of the Applicant's contractors is exposed.

10. The Applicant shall not create or permit the creation of soil-borne vibrations which, when measured beyond the property line of the said operation and inside a building below grade or less than one metre above grade, exceed:

   (a) for a building maintained as a dwelling, 12 millimetres per second peak particle velocity in any one of three mutually perpendicular directions (vertical, radial, and transverse to the source);

   (b) for any building maintained for use other than as a dwelling, 50 millimetres per second peak particle velocity in any one of three mutually perpendicular directions (vertical, radial, and transverse to the source).

11. The Applicant shall not, with respect to blasting on the site of the said operation, cause or permit the emission of sound or soil-borne vibrations measurable beyond the property line of the said operation at any time between 4:00 p.m. of any day and 10:00 a.m. of the following day (local time), nor at any time on Sunday, except in emergency conditions.

12. The Applicant shall not permit the emission of particulate matter from any point source of the surface crusher building used in connection with the Thompson open pit mine in excess of 0.23 grams per standard cubic metre calculated at 25 degrees Celsius and 760 millimetres of mercury.

13. The Applicant shall:

(a) on or before the 1st day of August, 1984, submit to the Commission a preliminary rehabilitation scheme with regard to the said operation outlining rehabilitation plans with regard to:

(i) the eventual orderly removal and disposal of all structures, their contents and all other accumulated material on the site of the said operation;

(ii) the steps to be taken to rehabilitate the said site progressively and at the termination of the said operation in line with aesthetic considerations and enhancement of the environment;

(iii) the containment, treatment, and/or preventive measures proposed for dealing with the long-range acid generating potential of the tailings in the post-abandonment period;

which said scheme shall be subject to the consideration, possible amendment and approval, or otherwise, by the Commission;

(b) in the event of an imminent cessation of the said operation, forthwith file with the Commission a firm and detailed rehabilitation plan, to replace the preliminary rehabilitation scheme filed pursuant to (a), for consideration, possible amendment, and approval, or otherwise;

(c) upon termination of the said operation, take all steps necessary to carry out the approved detailed rehabilitation plan within a time frame agreed to by the Commission.

14. Ordinary Licence No. 26 shall be and is hereby rescinded.

15. In this order:

(a) "final discharge points" means:

(i) subject to (iii), the outflow control point adjacent to the bridge which crosses the Thompson Lake drainage channel along the access road to the T-3 minesite; and

(ii) subject to (iii), the outflow control point for the tailings disposal area at or near that location where the liquid effluent passes under the Canadian National Railway tracks; and

(iii) such alternative or additional points as are designated from time to time in writing by the Commission;

(b) "monthly arithmetic mean" for each substance means the average value of the concentrations determined for each substance in all the composite and grab samples collected and reported during that month, with the exception that, if the Applicant collects only one composite or grab sample during a month, the single set of analysis results shall be construed as being representative of the effluent quality for that month and hence shall be treated as the monthly arithmetic mean;

(c) "composite sample" means a quantity of effluent consisting of a minimum of three equal volumes of effluent collected at approximately equal time intervals over a sampling period of not less than 7 hours and not more than 24 hours, or alternatively, consisting of effluent collected continuously at an equal rate over a sampling period of not less than 7 hours and not more than 24 hours.

15. (d) "hourly equivalent sound level" means a sound level measured in terms of the equivalent continuous sound level averaged over a one hour period (60 minutes) using a sound level monitoring device which equals or surpasses the requirements of Canadian Standards Association Standard Z 107.1 - 1973 (or the equivalent) for Type 2 sound level meters, operated on the "A-weighting network" and "slow" meter response;

(e) "linear peak sound pressure level" means the maximum absolute sound pressure as measured using a sound level monitoring device which equals or surpasses the requirements of International Electrotechnical Commission (I.E.C.) Publications 179 (1973) "precision sound level meters" and 179A (1973) "Additional characteristics for the measurement of impulsive sounds", including section 4.5.1, using "linear" weighting network and "peak hold" meter response, or the equivalent;

(f) "peak particle velocity" means the maximum instantaneous velocity experienced by the particles of a medium when set into transient vibratory motion, and is the greatest velocity of any of the three mutually perpendicular directions (vertical, radial, and transverse to the source);

16. Order No. 960 as varied by the Commission is herby designated as Order No. 960VC.

Order No. 960VC

Dated at the City of Winnipeg

this 21st day of December, 1983.

[redacted]

Chairman,
The Clean Environment Commission.

File: 557.1

DISTRIBUTION LIST FOR ORDER NO. 960VC FILE: 557.1

Mr. L. Strachan, Chief,
Environmental Control Programs,
Box 7, Building 2,
139 Tuxedo Avenue,
WINNIPEG, Manitoba. R3C 0V8

Mr. D. D. Blevins,
Departmental Solicitor,
Civil Litigation Branch,
628 Woodsworth Building,
405 Broadway Avenue,
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Mr. Mark Stefanson, Director,
Community Relations,
960 - 330 St. Mary Avenue,
WINNIPEG, Manitoba. R3C 3Z5

Provincial Library,
200 Vaughan Street,
WINNIPEG, Manitoba. R3C 1T5

Mr. F. N. Steele,
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City of Winnipeg Law Department,
Civic Centre,
510 Main Street,
WINNIPEG, Manitoba. R3B 1B9

Mr. Paul H. Rennick,
Acres Consulting Services,
5259 Dorchester Road,
NIAGARA FALLS, Ontario.
L2E 6W1

Mr. Garry McMillan,
Environmental Committee,
Local 6166, U.S.W.A.,
99 Granite Crescent,
THOMPSON, Manitoba.

Mr. Doug McEwen,
Secretary-Treasurer,
City of Thompson,
226 Mystery Lake Road,
THOMPSON, Manitoba.
R8N 1S6

Appendix D THOMPSON MINE 350 RAR DISPERSION MODELLING ASSESSMENT

Thompson Mine
350 Return Air Raise
Dispersion Modelling Assessment

Prepared By:
Madonna Campeau, P.Eng
Senior Air Quality Engineer, Vale Canada Ltd

May 2021

Table of Contents

1.0 Introduction

Vale Canada Limited (Vale) operates two connected underground nickel mines, T1 and T3, collectively known as Thompson Mine, and a mill, at 1 Inco Road, Thompson, Manitoba. The location of the Facility is presented in Figure 1.

The mine is in need of additional ventilation capacity and is proposing to replace the failing 345 Return Air Raise (RAR) with a new RAR, currently referred to as 350 RAR but the naming will likely change as the design is finalized.

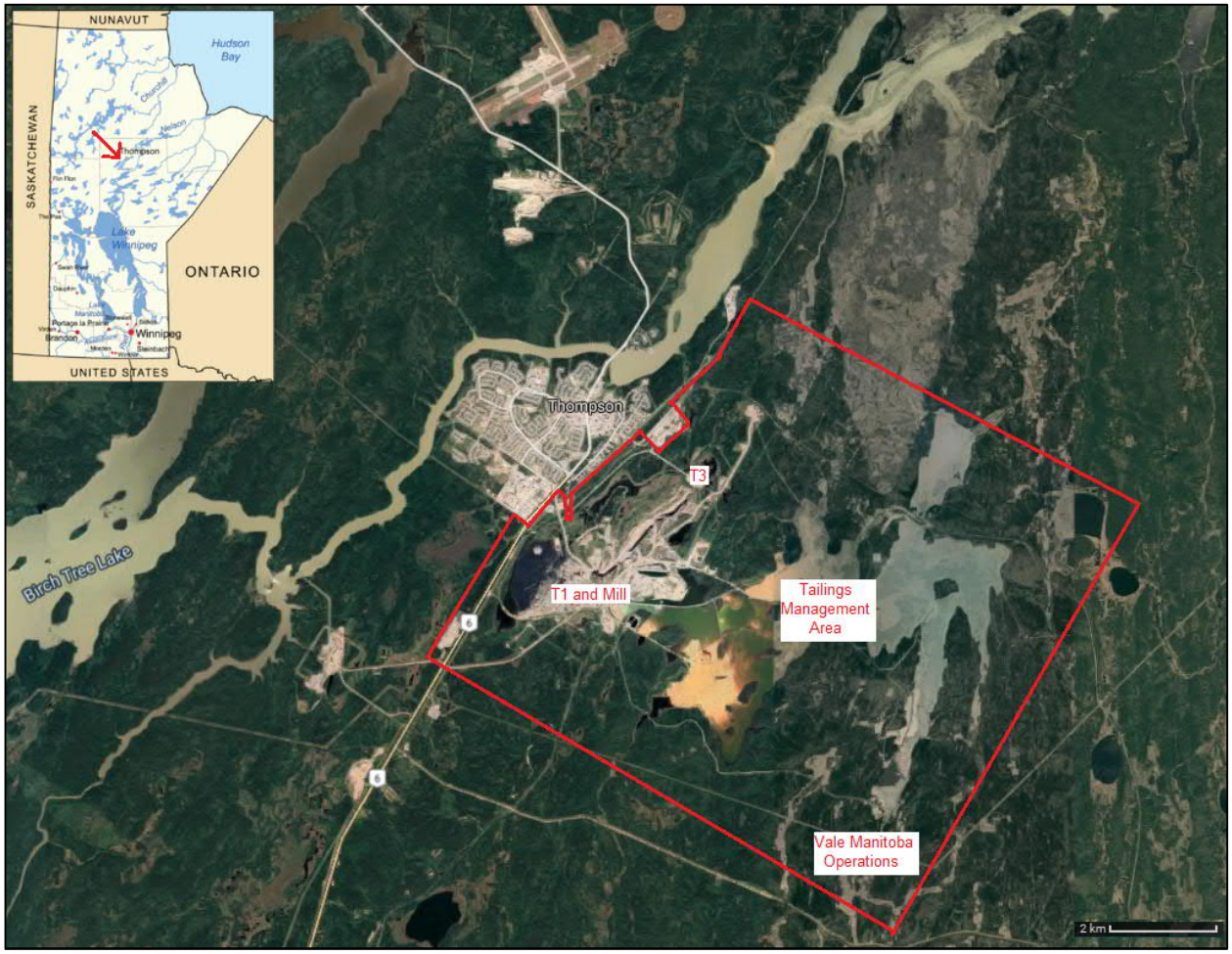

Figure 1: Location of Vale Thompson, Manitoba Operations

1.1 Project Overview (Purpose of the Study)

The purpose of this study is to predict the change in air contaminant ground level concentrations that would result from the ventilation system changes to 345 RAR and 350 RAR. Emissions from non-ventilation sources at Vale's Thompson Operations were specifically excluded as they are not changing due to the change.

Dispersion modelling followed the Draft Guidelines for Air Dispersion Modelling in Manitoba (Manitoba Conservation and Water Stewardship, 2006), supplemented where needed by the Procedure for

Preparing an Emission Summary and Dispersion Modelling Report v.4 (Ontario Ministry of Environment, Conservation and Parks, 2017). A refined model approach was taken using the dispersion model AERMOD (v19191) and its preprocessors AERMAP (v11103), AERMET (v18081) and BPIP (v04274).

Predicted model results were compared against:

- the current standards, guidelines and screening levels listed in the Ontario Air Contaminants Benchmarks (ACB) List: Standards, Guidelines and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants (Ontario Ministry of Environment, Conservation and Parks);
- the current Canadian Ambient Air Quality Standards; and
- the 2005 Manitoba Ambient Air Quality Criteria for particulate matter, PM_{10} and $PM_{2.5}$ (note: there are currently no published criteria for Manitoba).

1.2 Process Description

Thompson Mine is a base metal, underground mine extracting nickel and copper ores from a sulphide ore zone. The existing ore production capacity is 12,000 tonnes/day. The ventilation changes are anticipated to improve actual production, but will not impact the design production capacity.

At Thompson Mine, the ore is mined using a mixture of bulk mining, cut-and-fill mining and specialized methods. It is crushed underground and brought to surface via the T1 shaft and immediately delivered into the Mill. Any wasterock is used as rockfill underground and does not come to surface. Sand and/or tailings from the mill are mixed with cement and pumped underground for backfill. Ventilation for the mine workings is provided by fresh air raises (FARs) which draw the air into the mine and return air raises (RARs) which exhaust the air to the environment. The emissions associated with RARs consist of particulate matter (TSP), metals and products of combustion and result from underground operations such as material handling, blasting, diesel equipment operation, and comfort and shaft heating. The primary raw materials and products as well as potential emission sources are shown in Figure 2.

Thompson Mine operates 24 hours per day, 365 days per year.

The applicable North American Industrial Classification System (NAICS) code for Thompson Mine is 212232 Nickel-Copper Ore Mining.

Though not the focus of this study, it should be noted that Vale's Thompson operations also consist of an operating mill (shown in Figure 2) as well as a Smelter and Refinery which were both shut down in 2018. The mill receives ore from the mine and produces a concentrate for delivery to Ontario, and a tailings stream partly used for backfill but otherwise sent to onsite disposal.

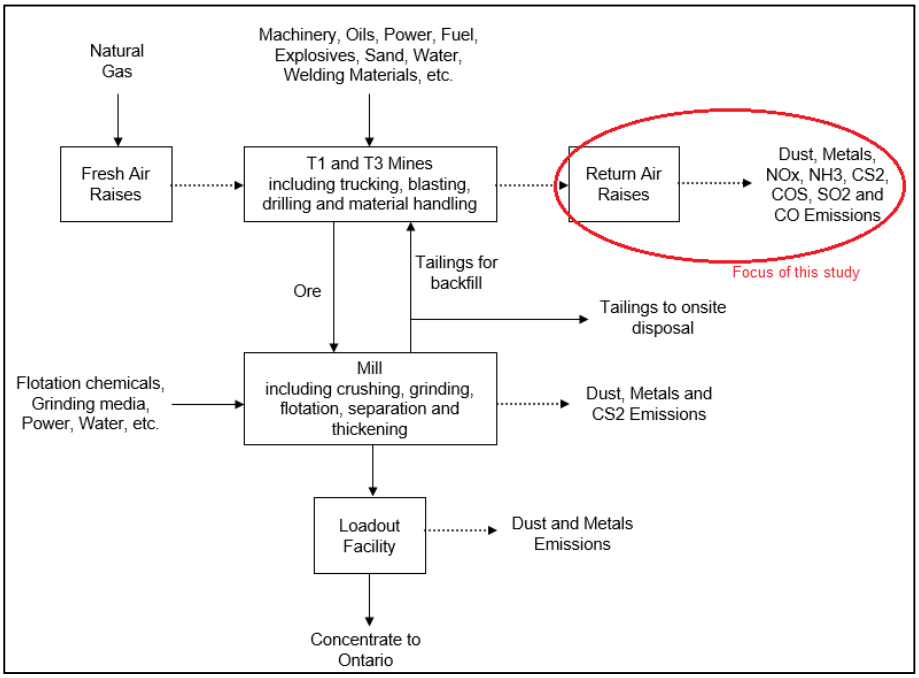

Figure 2: Vale Manitoba Operations, Simplified Process Flow Diagram

2.0 Methodology

The dispersion model used in this assessment was the US EPA AERMOD (v19191) and its preprocessors AERMAP (v11103), AERMET (v18081) and BPIP (v04274). AERMOD was selected given that the highest modelled concentrations would occur within 1km of the release point(s) and the terrain in the area is relatively simple. The model is capable of accounting for emission source characteristics and emission rates, meteorological conditions, terrain effects, building effects, and various dispersion characteristics. As outlined in the Draft Guidelines for Air Dispersion Modelling in Manitoba, AERMOD is an approved dispersion model in Manitoba.

The purpose of this study is to predict the change in air contaminant ground level concentrations that would result from the ventilation system changes to 345 RAR and 350 RAR. Emissions from non-ventilation sources at Vale's Thompson Operations were specifically excluded as they are not changing due to the change.

Note to Reader: A similar dispersion modelling assessment was conducted in 2019 for Vale's Notice of Alteration application for the proposed Thompson Mine Expansion Phase 1 (TMEP1) Project which did not materialize due to financials/economics. The TMEP1 assessment was used as the base for this current assessment and the dispersion modelling methodology was the same. See Appendix C for confirmation from Conservation and Climate's Environmental Approval Branch that the methodology used in the TMEP1 assessment was acceptable.

2.1 Source Data

Thompson Mine currently operates eight RARs. With the proposed changes, 345 RAR (which exhausts via two discharges) will be replaced by 350 RAR (which will also exhaust via two discharges).

RARs are not stacks in the traditional sense. They are not located on buildings and can have very high flowrates. Many RARs discharge horizontally, while shaft RARs effectively discharge inside a building. Following common dispersion modelling practices for mines, the RARs in this assessment were modelled as point sources and volume sources as their configuration dictated. The source parameters and parameters relevant to dispersion modelling are presented in Table 1 and Table 2. The location of the RARs relative to each other are shown in Figure 3.

Table 1: Volume Sources

Source	Modeling Source Type	UTM Coordinates Zone 14N		Base Elevation (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)
		X (m)	X (m)				
T1	VOLUME	572098.65	6175095.08	215.00	6.10	6.49	5.67
T3	VOLUME	574231.64	6176839.62	199.96	6.10	6.49	5.67

Table 2: Point Sources

Source	Modeling Source Type	UTM Coordinates Zone 14N		Base Elevation (m)	Release Height Above Grade (m)	Diameter / Equivalent Diameter (m)	Release Tempera-ture (K)
		X (m)	Y (m)				
259	POINTHOR	572689.66	6175664.48	202.00	2.24	2.74	293
260	POINTHOR	572739.25	6175652.69	201.41	3.7	3.8	293
345W	POINTHOR	574647.74	6177558.52	202.00	1.3	2.92	293
345E	POINTHOR	574671.81	6177541.81	202.00	1.3	2.92	293
378N	POINTHOR	575436.18	6178205.55	213.96	3.3	3.9	293
378S	POINTHOR	575418.83	6178176.79	214.49	3.3	3.9	293
350_1	POINTHOR	575305.00	6177500.00	210.00	3.0	3.44	293
350_2	POINTHOR	575325.00	6177500.00	210.00	3.0	3.44	293

For all point sources, the pre-processor BPIP (v04274) was used to determine the impact of nearby buildings on the sources. This is done by characterizing the dimensions of any nearby infrastructure. Any infrastructure further than 0.8km would not impact the source(s) and was not included in the model. Figures 4 to 7 present each point source and any buildings within 0.8km of them, as well as the Good Engineering Practice (GEP) 5L 360º area of influence that those buildings have. Table 3 presents the GEP stack heights of the point sources as determined by BPIP. The actual stack heights (which were all lower than the GEP stack heights) were used in the AERMOD modelling.

Table 3: Good Engineering Practice (GEP) Stack Heights

Source	Stack height (m)	GEP Stack Height (m)	
		Equation 1 of p6 from the GEP Technical Support Document	Determinants 1&2 of the GEP Technical Support Document
259	2.24	10.36	65
260	3.7	10.79	65
345W	1.3	10.68	65
345E	1.3	10.68	65
378N	3.3	61.38	65
378S	3.3	60.85	65
350_1	3.0	18.75	65
350_2	3.0	18.75	65

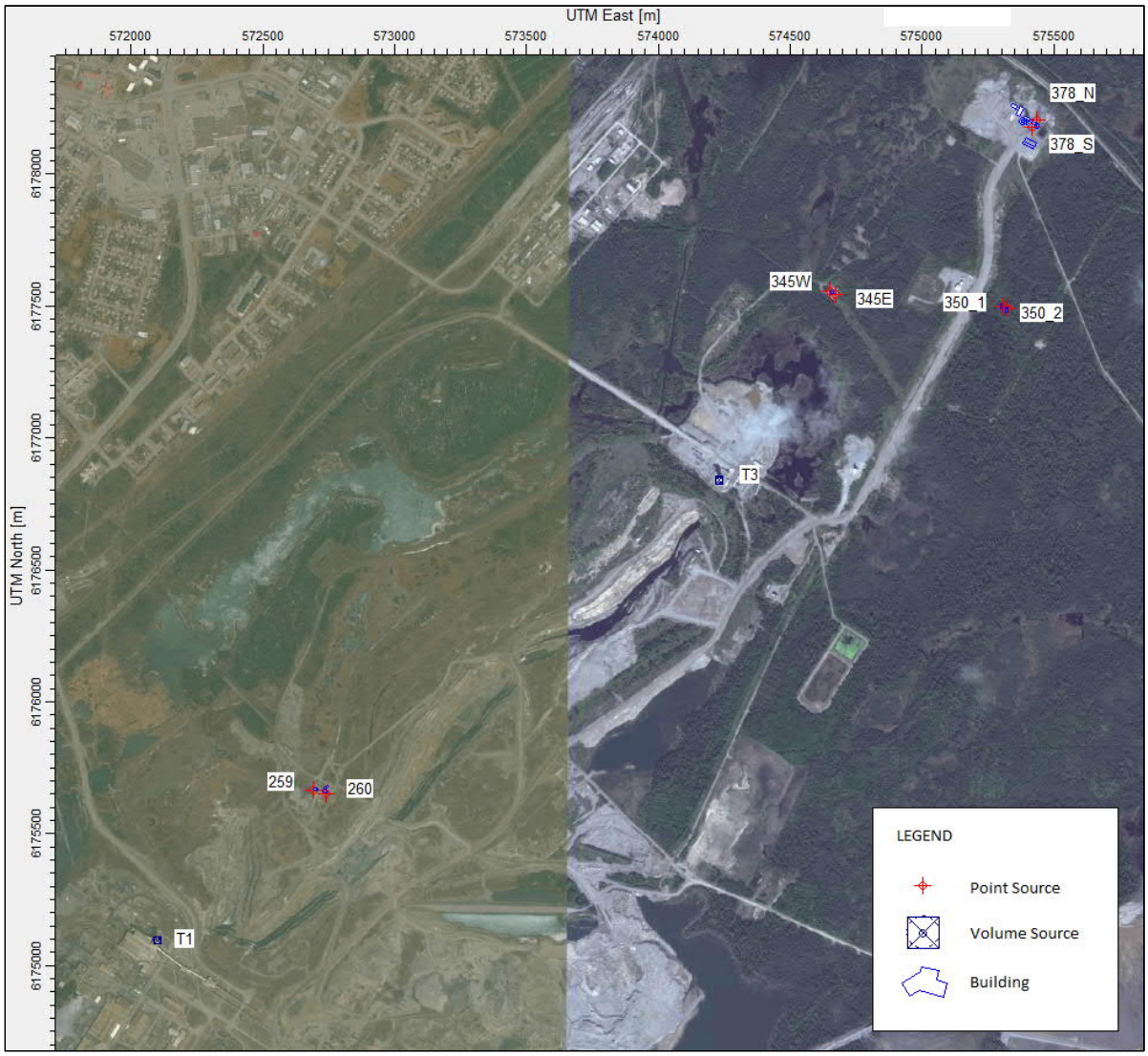

Figure 3: Site Plan, RAR Locations

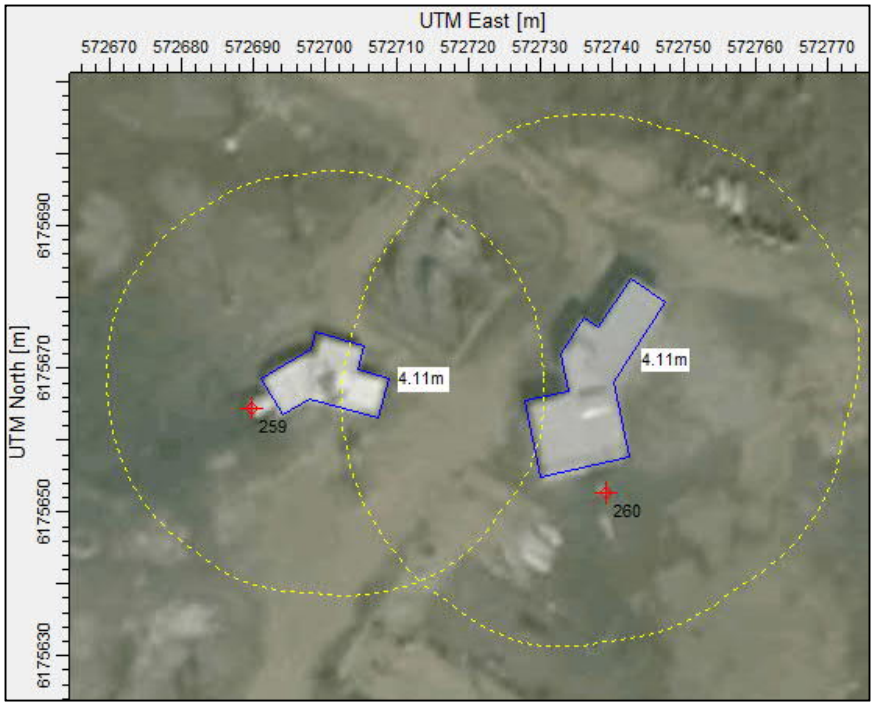

Figure 4: 259 RAR and 260 RAR

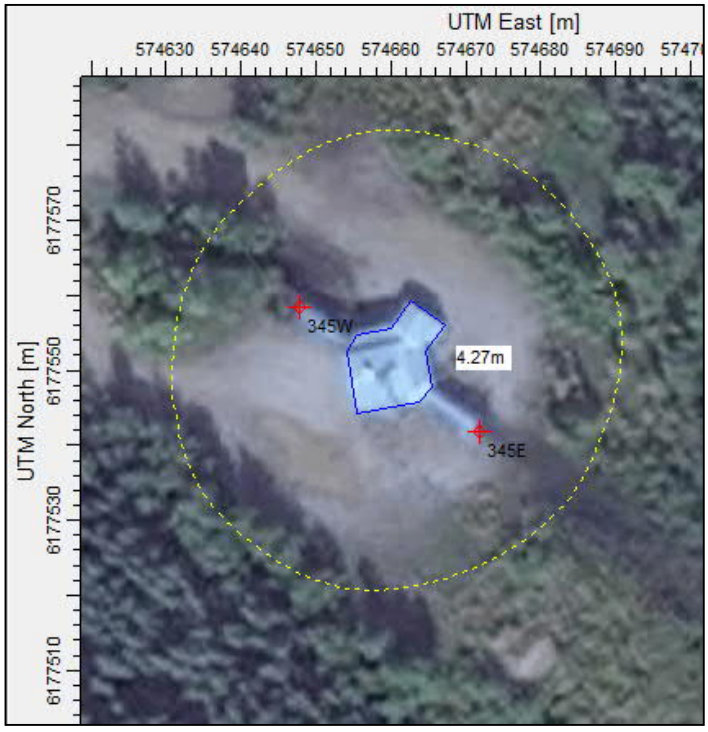

Figure 5: 345 RAR (west and east exhausts)

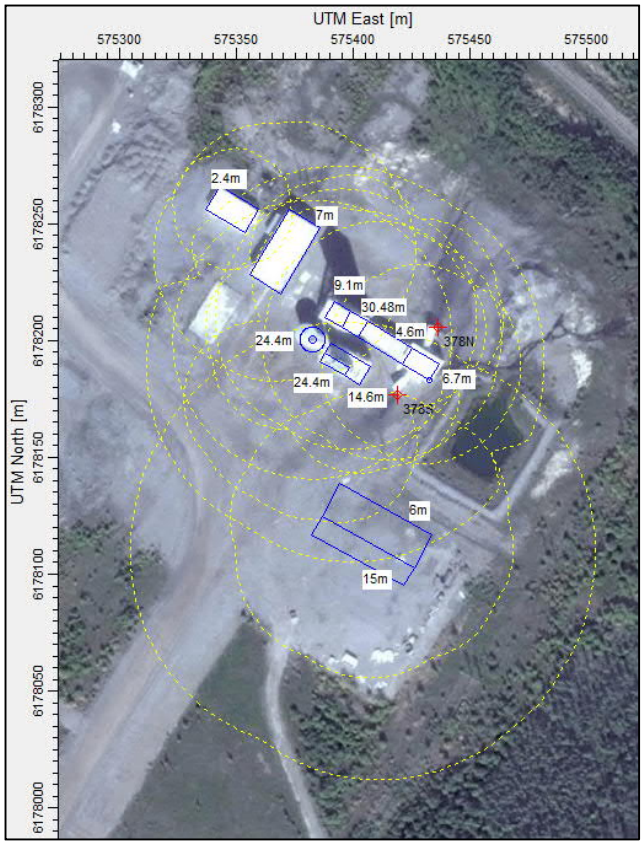

Figure 6: 378 RAR (north and south exhausts)

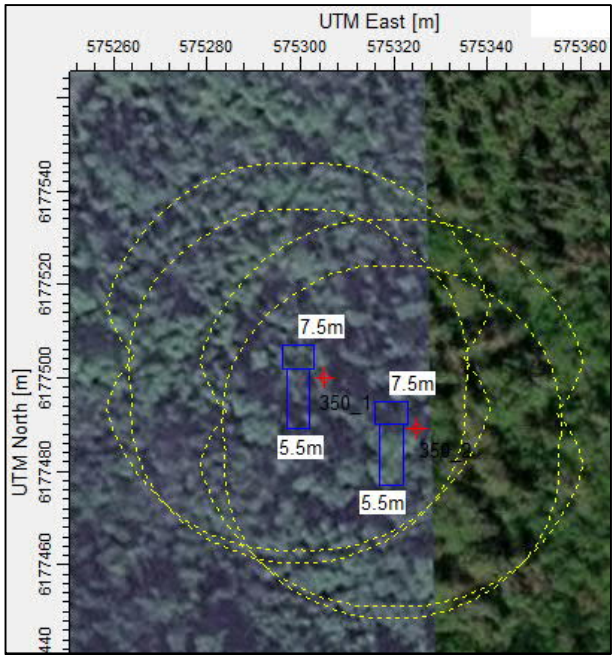

Figure 7: 350 RAR (1 and 2 exhausts)

Emission factors (mg/m³) used to estimate emissions of dust (TSP), ammonia, carbon disulphide, carbonyl sulphide, SO_2, CO and NOx from the return air raises were taken from source testing conducted on RARs at similar mining operations in Sudbury, Ontario. The emission factors used are reflective of the averaging time for the specific contaminant (for example, 24hr emission factor for TSP, 1hr emission factor for NOx, etc).

Emissions are calculated by multiplying the emission factor by the RAR flowrate. The flowrates represent maximum flowrates possible for the fan. Many RAR fans have variable frequency drives to vary the flowrate (and power requirements) depending on the immediate ventilation requirements. It is not likely that all RAR fans would operate at such high rates simultaneously, however the emission rates are calculated as if they were and so the emission rates calculated in this assessment are considered conservative.

Emission rates of metals are calculated by multiplying the TSP emission rate by the metal content of Thompson ore. This method of estimating metal emissions is conservative because dust from the return air raise would comprise of not just ore, but wasterock and diesel particulate as well, which are lower in metal concentration than ore.

Emissions, flowrates and velocities from the RARs are summarized in Table 4 and Table 5.

Table 4: Current Emission Rates

	Return Air Raise		T1	T3	259	260	345-1	345-2	378-1	378-2
	Flowrate (cfm)		40,000	40,000	220,000	350,000	140,000	140,000	400,000	400,000
	Velocity (m/s)		n/a	n/a	17.6	14.6	9.9	9.9	15.8	15.8
Contaminant	Emission Factor	Units	Emission Rate (g/s)							
TSP / PM_{10} / $PM_{2.5}$*	0.45	mg/m³	8.50E-03	8.50E-03	4.68E-02	7.44E-02	2.98E-02	2.98E-02	8.50E-02	8.50E-02
Ammonia	0.23	mg/m³	4.35E-03	4.35E-03	2.39E-02	3.80E-02	1.52E-02	1.52E-02	4.35E-02	4.35E-02
Carbon Disulfide	0.0021	mg/m³	3.91E-05	3.91E-05	2.15E-04	3.43E-04	1.37E-04	1.37E-04	3.91E-04	3.91E-04
Carbonyl Sulfide	0.0033	mg/m³	6.23E-05	6.23E-05	3.43E-04	5.45E-04	2.18E-04	2.18E-04	6.23E-04	6.23E-04
SO_2	0.21	mg/m³	4.05E-03	4.05E-03	2.23E-02	3.54E-02	1.42E-02	1.42E-02	4.05E-02	4.05E-02
CO	2.90	mg/m³	5.48E-02	5.48E-02	3.01E-01	4.79E-01	1.92E-01	1.92E-01	5.48E-01	5.48E-01
NOx	3.53	mg/m³	6.67E-02	6.67E-02	3.67E-01	5.84E-01	2.33E-01	2.33E-01	6.67E-01	6.67E-01
Nickel	2.05	% in ore	1.74E-04	1.74E-04	9.59E-04	1.52E-03	6.10E-04	6.10E-04	1.74E-03	1.74E-03
Copper	0.159	% in ore	1.35E-05	1.35E-05	7.43E-05	1.18E-04	4.73E-05	4.73E-05	1.35E-04	1.35E-04
Cobalt	0.029	% in ore	2.47E-06	2.47E-06	1.36E-05	2.16E-05	8.63E-06	8.63E-06	2.47E-05	2.47E-05
Arsenic	0.051	% in ore	4.34E-06	4.34E-06	2.38E-05	3.79E-05	1.52E-05	1.52E-05	4.34E-05	4.34E-05
Lead	0.013	% in ore	1.11E-06	1.11E-06	6.08E-06	9.67E-06	3.87E-06	3.87E-06	1.11E-05	1.11E-05
Silver	0.000063	% in ore	5.36E-09	5.36E-09	2.95E-08	4.69E-08	1.87E-08	1.87E-08	5.36E-08	5.36E-08
Iron	12.031	% in ore	1.02E-03	1.02E-03	5.63E-03	8.95E-03	3.58E-03	3.58E-03	1.02E-02	1.02E-02

* No emission factor was available for particulate matter fractions, so conservatively assumed all particulate matter was PM_{10} and $PM_{2.5}$.

Table 5: Future Emission Rates

	Return Air Raise		T1	T3	259	260	378-1	378-2	378-1	378-2
	Flowrate (cfm)		40,000	40,000	220,000	350,000	400,000	400,000	400,000	400,000
	Velocity (m/s)		n/a	n/a	17.6	14.6	15.8	15.8	15.8	15.8
Contaminant	Emission Factor	Units	Emission Rate (g/s)							
TSP / PM_{10} / $PM_{2.5}$*	0.45	mg/m³	8.50E-03	8.50E-03	4.68E-02	7.44E-02	8.50E-02	8.50E-02	7.01E-02	7.01E-02
Ammonia	0.23	mg/m³	4.35E-03	4.35E-03	2.39E-02	3.80E-02	4.35E-02	4.35E-02	3.58E-02	3.58E-02
Carbon Disulfide	0.0021	mg/m³	3.91E-05	3.91E-05	2.15E-04	3.43E-04	3.91E-04	3.91E-04	3.23E-04	3.23E-04
Carbonyl Sulfide	0.0033	mg/m³	6.23E-05	6.23E-05	3.43E-04	5.45E-04	6.23E-04	6.23E-04	5.14E-04	5.14E-04
SO_2	0.21	mg/m³	4.05E-03	4.05E-03	2.23E-02	3.54E-02	4.05E-02	4.05E-02	3.34E-02	3.34E-02
CO	2.90	mg/m³	5.48E-02	5.48E-02	3.01E-01	4.79E-01	5.48E-01	5.48E-01	4.52E-01	4.52E-01
NOx	3.53	mg/m³	6.67E-02	6.67E-02	3.67E-01	5.84E-01	6.67E-01	6.67E-01	5.50E-01	5.50E-01
Nickel	2.05	% in ore	1.74E-04	1.74E-04	9.59E-04	1.52E-03	1.74E-03	1.74E-03	1.44E-03	1.44E-03
Copper	0.159	% in ore	1.35E-05	1.35E-05	7.43E-05	1.18E-04	1.35E-04	1.35E-04	1.12E-04	1.12E-04
Cobalt	0.029	% in ore	2.47E-06	2.47E-06	1.36E-05	2.16E-05	2.47E-05	2.47E-05	2.03E-05	2.03E-05
Arsenic	0.051	% in ore	4.34E-06	4.34E-06	2.38E-05	3.79E-05	4.34E-05	4.34E-05	3.58E-05	3.58E-05
Lead	0.013	% in ore	1.11E-06	1.11E-06	6.08E-06	9.67E-06	1.11E-05	1.11E-05	9.12E-06	9.12E-06
Silver	0.000063	% in ore	5.36E-09	5.36E-09	2.95E-08	4.69E-08	5.36E-08	5.36E-08	4.42E-08	4.42E-08
Iron	12.031	% in ore	1.02E-03	1.02E-03	5.63E-03	8.95E-03	1.02E-02	1.02E-02	8.44E-03	8.44E-03

* No emission factor was available for particulate matter fractions, so conservatively assumed all particulate matter was PM_{10} and $PM_{2.5}$.

Overall, the exhaust from the return air raises at Thompson Mine will increase from 1.73 Mcfm to 2.11 Mcfm, representing a 22% increase in emissions.

Annual emissions are presented in Table 6. Historical emissions from Thompson Operations from when the Smelter and Refinery were operating, as reported to the National Pollutant Release Inventory (NPRI), are also presented to demonstrate how small of a contribution the mine RARs are relative to the Operations' historic emissions.

Table 6: Annual Emissions

	Current RAR Emissions	Future RAR Emissions	2015 NPRI Report	2017 NPRI Report
Contaminant	tonnes/year			
TSP	11.60	14.14	1715	747
PM_{10}*	11.60	14.14	894	594
$PM_{2.5}$*	11.60	14.14	618	273
Ammonia	5.93	7.23	not reported	not reported
Carbon Disulfide	0.05	0.07	not reported	not reported
Carbonyl Sulfide	0.08	0.10	not reported	not reported
SO_2	5.52	6.74	151,154	117,192
CO	74.68	91.08	not reported	not reported
NOx	90.96	110.94	not reported	not reported
Nickel	0.24	0.29	65	47
Copper	0.0184	0.0225	5.6	3.5
Cobalt	0.0034	0.0041	1.6	1.5
Arsenic	0.0059	0.0072	6.3	3.2
Lead	0.0015	0.0018	4.8	2.97
Silver	7.30E-06	8.91E-06	not reported	not reported
Iron	1.40	1.70	not reported	not reported

* No emission factor was available for particulate matter fractions, so conservatively assumed all particulate matter was PM_{10} and $PM_{2.5}$.

2.2 Receptors

The receptor grid for this dispersion modelling assessment was created in four stages:

1. A polar grid of radius 10km was created with 10 equally spaced concentric circles with 36 radii at 10° intervals for a total of 360 receptors.
2. A uniform Cartesian grid was created to cover the community of Thompson, at 3200m x 4600m, with receptors spaced 50m apart for a total of 6045 receptors.
3. Receptors in the polar grid that fell within the uniform Cartesian grid were removed.
4. Receptors that fell within the Vale plant boundary were removed.
5. Receptors that fell outside of Vale's LiDAR data (used to determine base elevations) were removed. While this isn't typical, the results (as discussed in Section 3.1) indicate that the highest point of impingement (POI) was at the property boundary such that the receptors removed were, in the end, irrelevant.

This left 4813 receptors for the dispersion modelling assessment, as shown in Figure 8.

Because the fine Cartesian grid was defined with receptors spaced 50m apart, receptors naturally landed on or very near to all sensitive receptors such as schools, hospitals, senior homes, parks, etc. There are no particularly high buildings in Thompson which would require flag pole receptors.

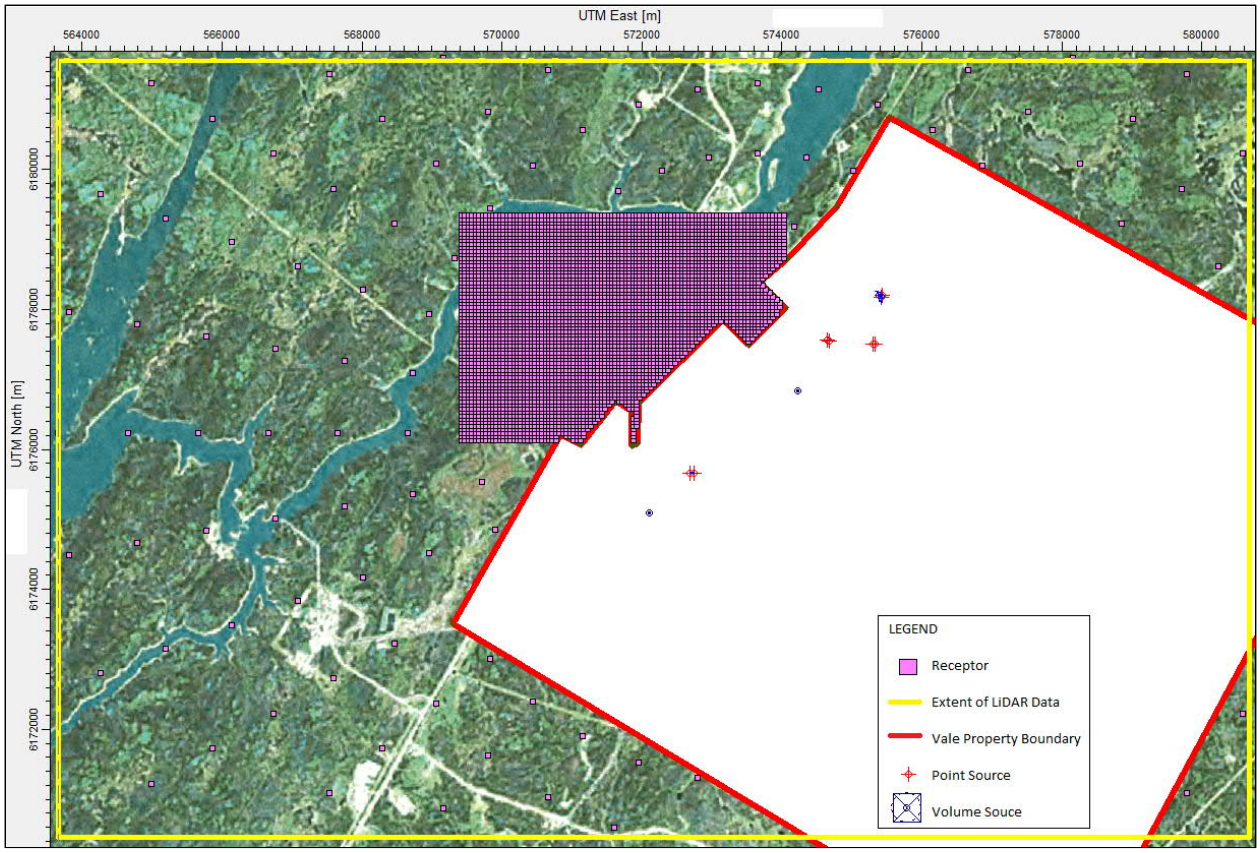

Figure 8: Receptor Grid

2.3 Meteorological Data

Consistent with the Guidelines for Air Dispersion Modelling in Manitoba, meteorological data for 5 calendar years, 2012 to 2016 was obtained for use in this dispersion modelling assessment. Surface station data was obtained from Environment Canada for the Thompson Airport Station, and upper station data was obtained from National Climatic Data Centre for the Pas Airport Station. With the exception of 2015, less than 5% hourly records were missing from the surface station, less than 10% of the hourly records were missing for 2015. Missing data were not filled for this assessment. The data was processed in AERMET (v18081) to account for seasonal surface land use. The data indicated that seasonal and hourly stability variations trended as expected, and that winds were predominantly from the west, northwest and north, with a common wind speed range of 2 to 4 m/s. Further information on the meteorological data processing is included in Appendix A – Develop 5YR Meteorological Data Set (RWDI, May 2019).

Fumigation, wind direction shear, lee side effects, terrain induced downwash, deposition chemical transformation of the pollutant, variable plume trajectories and long range transport were not relevant factors in this analysis and were not considered/incorporated.

2.4 Land Use Analysis

The area within a 3km radius of Thompson Operations is shown in Figure 9. The land can be classified as:

- I1 (heavy Industrial) and A3 (undeveloped wasteland) on Vale property;
- R1 (common residential) in the town of Thompson; and
- A3-A4 (undeveloped, undeveloped rural and water surface) for the surrounding areas.

The area that can be classified as I1 is very limited, and there is no land that could be classified as I2 (light-moderate industrial), C1 (commercial), R2 or R3 (compact residential). Since less than 50% of the area can be classified as I1, I2, C1, R2 and R3, the site was not modelled using urban dispersion coefficients.

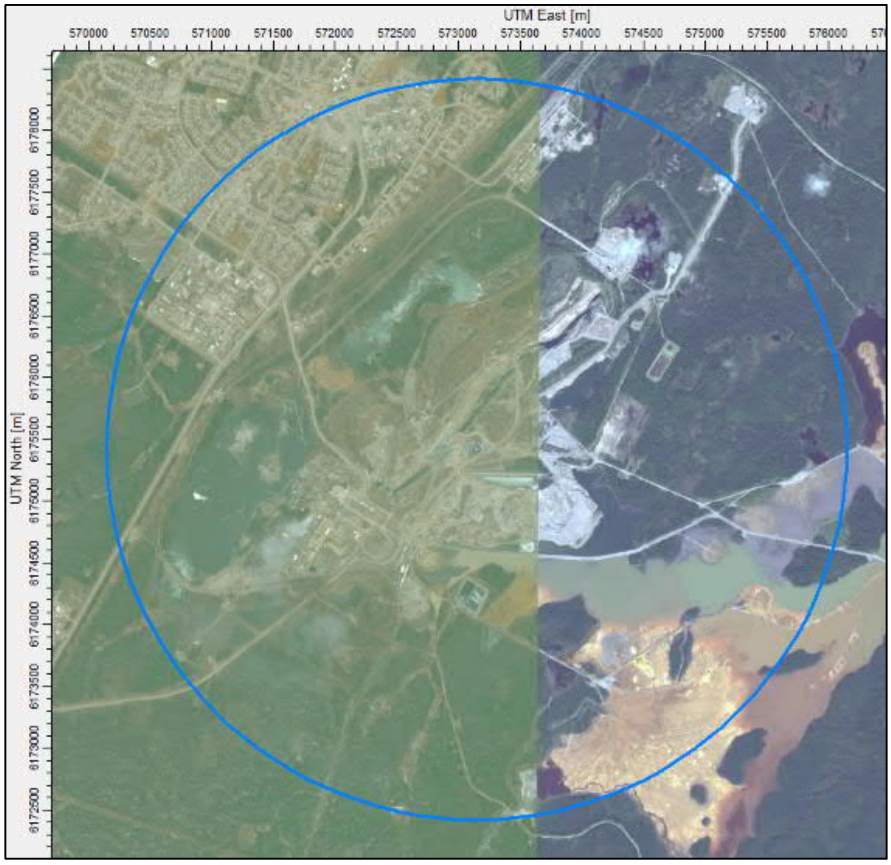

Figure 9: 3km around the Site

2.5 Topography

Vale has conducted LiDAR scans with 1m resolution of the area. This data was used during the 2019 dispersion modelling assessment (for the Thompson Mine Expansion Phase 1 Project) to determine the base elevation of the sources, buildings and receptors in this assessment using the preprocessor AERMAP (v11103). Because of the magnitude of this data, it wasn't possible to re-run AERMAP for this assessment for the 350 RAR. As per Figure 10 which shows the topography of the area per the LiDAR scan, 350 RAR would have a base elevation between 210m and 220m. The lower elevation is more conservative (predicts higher impact in the community), so 210m was used for 350 RAR. Figure 11 shows an aerial of the same area, which helps demonstrate significant topographical features.

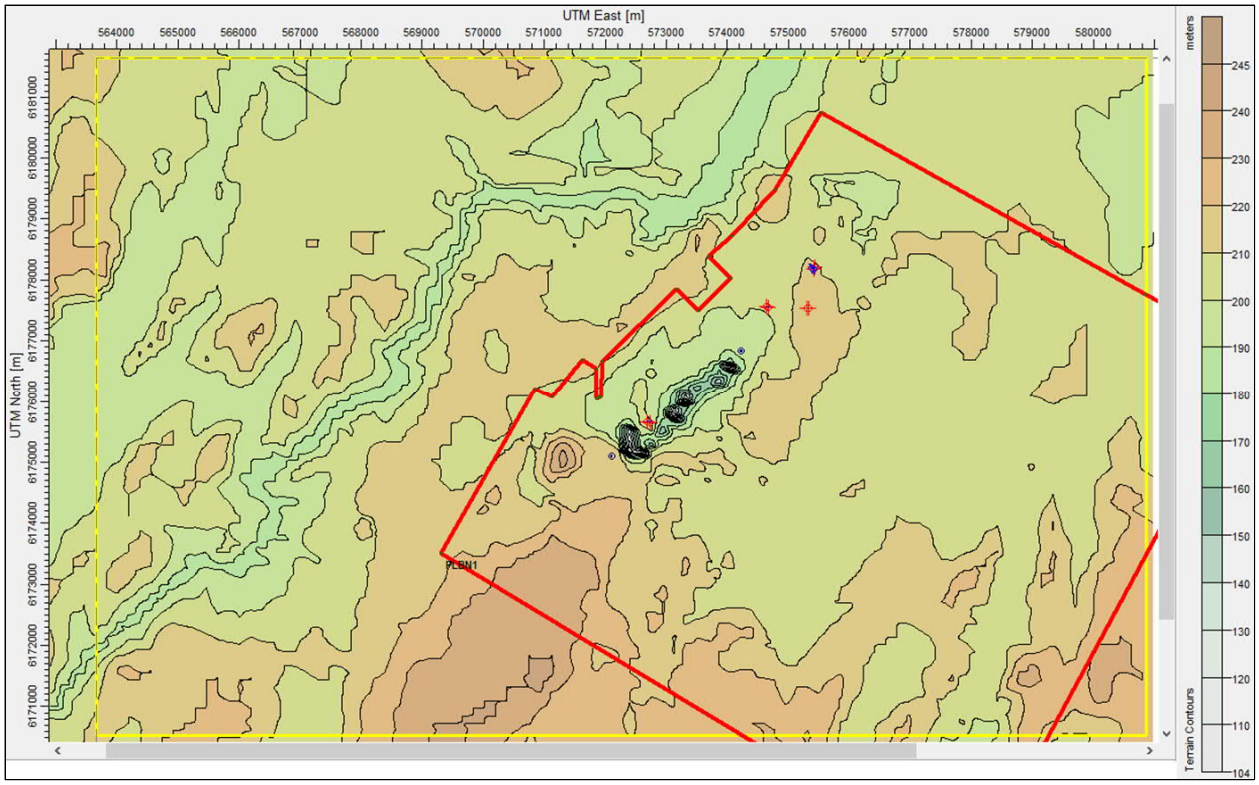

Figure 10: LiDAR Topography

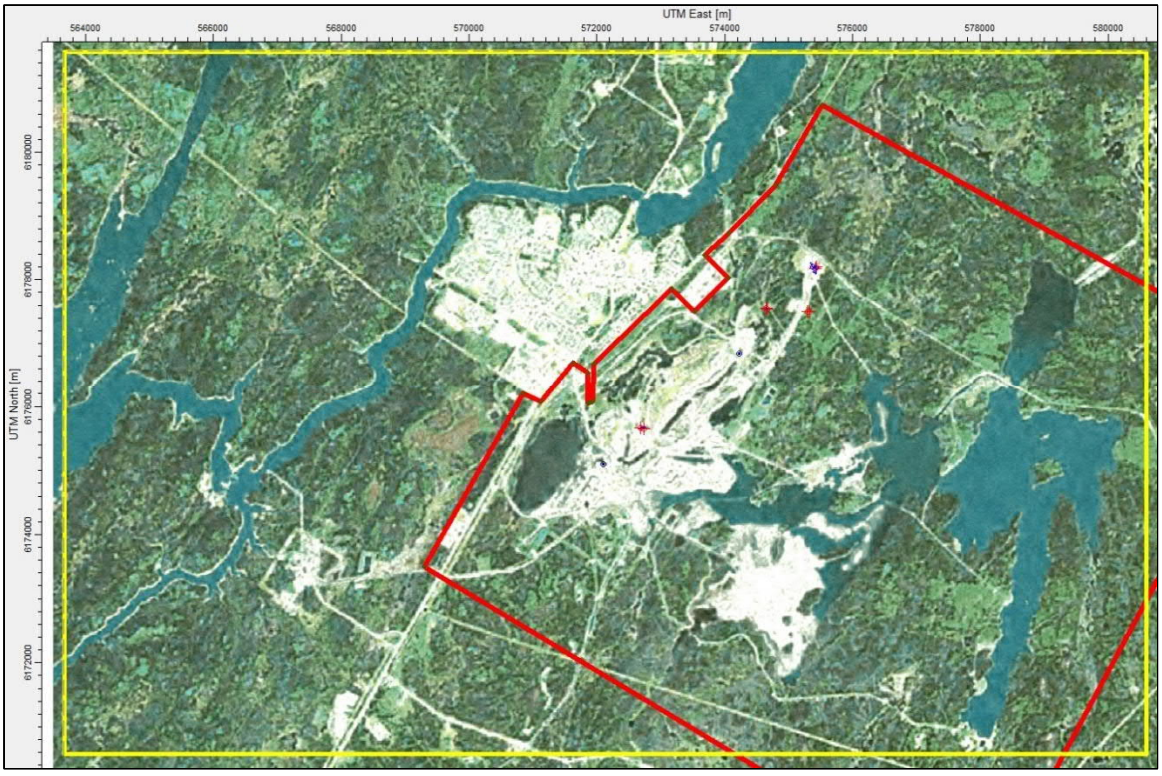

Figure 11: Aerial Topography

Due to the nature of RARs, much of the terrain within 50km is above the top of the stack(s) - this is accounted for in the AERMOD modelling. Within 3km of the source, the terrain consists of cleared land for industrial purposes including a pit and tailings ponds / management area, boreal forest and the city of Thompson. There are no high-rises or valleys (other than the onsite pit). Burntwood River located north of the city of Thompson runs from the north-east to south-west, connecting various lakes along its course. The closest provincial border is further than 200km west (Saskatchewan), and the closest international border is further than 800km south (United States).

2.6 Background Ambient Air Quality

Ambient air quality data for Thompson is only available for PM_{10}, $PM_{2.5}$ and SO_2. The 2020 data, collected at 1hr intervals until June 23, indicates:

- $PM_{2.5}$ – average of 2.8 µg/m³, 95th percentile of 5.6 µg/m³
- PM_{10} – average of 7.2 µg/m³, 95th percentile of 19.7 µg/m³
- SO_2 – average of 0.003 ppm (8.28 µg/m³), 95th percentile of 0.012ppm (32.1 µg/m³)

These ambient values will be included in the results discussion as per the Manitoba guidelines. However, because this study specifically only considered the impact from RARs, and specifically did not include the impact from any other source, it should be noted that it is not necessarily appropriate to add the modelling results to the background ambient air quality.

2.7 Good Engineering Practice Stack Height Analysis

GEP stack height analysis was included in the discussion in Section 2.1.

3.0 Assessment of Air Quality Modelling Results

3.1 Environmental Assessment

The purpose of this study is to predict the change in air contaminant ground level concentrations that would result from the ventilation system changes to 345 RAR and 350 RAR.

Since all the sources in this assessment emit emissions that are proportional to each other, it was only necessary to run one model with source groups defining the “Current” and “Future” ventilation scenarios. The “emission rate” used in the model files was the flowrate in cfm divided by 100, and the results simply had to be multiplied by conversion factors and contaminant specific emission factors. Appendix B is a digital appendix containing an Excel file with all calculations (emission rates and resulting POIs) and all the modelling files (input and output for AERMOD, AERMAP, AERMET and BPIP).

The dispersion modelling indicated that for any contaminant assessed using the 1-hr averaging period, the future impact would be 1.12% higher than the current impact; using the 8-hr averaging period, the future impact would be 17.5% higher than the current impact; using the 24-hr averaging period, the future impact would be 9.57% higher than the current impact; using the 30-day averaging period, the future impact would be 7.39% higher than the current impact; and using the annual averaging period, the future impact would be 0.60% higher than the current impact. These differences are explained by the meteorological data used in the modelling.

Table 7 presents the dispersion modelling results per contaminant relative to specific limits, including the addition of available ambient air quality data described in Section 2.6. For the ambient air quality

data, the 95th percentile was used for contaminants assessed over 1 hour, and the average was used for contaminants assessed over greater time periods. Predicted model results were compared against:

- the current standards, guidelines and screening levels listed in the Ontario Air Contaminants Benchmarks (ACB) List: Standards, Guidelines and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants (Ontario Ministry of Environment, Conservation and Parks);
- the current Canadian Ambient Air Quality Standards; and
- the 2005 Manitoba Ambient Air Quality Criteria for particulate matter, PM_{10} and $PM_{2.5}$ (note: there are currently no published criteria for Manitoba).

When only considering the RARs, the dispersion modelling indicates that both the current and future ventilation scenarios are in compliance with the Ontario, Manitoba and Canadian air quality standards, and that the difference between the current and future scenarios is relatively insignificant when compared against those standards.

When the particulate and SO_2 ambient air quality data is incorporated, modelling compliance is maintained except for the annual impact of SO_2 compared against the Canadian standard. The background level, at 32.1 µg/m^3, is already 3 times the standard. The addition of 0.019 µg/m^3 from the site's RARs does not significantly impact the compliance assessment.

Figures 12 to 22 show the dispersion modelling results graphically.

Table 7: Dispersion Modelling Results versus Standards

Contaminant	CAS Number	Jurisdiction	Limit (µg/m³)	Averaging Period	Dispersion Modelling Results				Dispersion Modelling Results + 2020 Ambient Air Quality			
					Current Ventilation Scenario		Future Ventilation Scenario		Current Ventilation Scenario		Future Ventilation Scenario	
					Max POI (µg/m³)	Percent of Limit	Max POI (µg/m³)	Percent of Limit	Max POI (µg/m³)	Percent of Limit	Max POI (µg/m³)	Percent of Limit
Total Particulate Matter	N/A	O	120	24-hr	0.471	0.392%	0.516	0.430%				
		M	70	Annual	0.041	0.058%	0.041	0.058%				
PM_{10} *	N/A	M	50	24-hr	0.471	0.942%	0.516	1.03%	20.2	40.4%	20.2	40.1%
$PM_{2.5}$ *	N/A	M	30	24-hr	0.471	1.57%	0.516	1.72%	6.07	20.2%	6.12	20.4%
		C	27	24-hr		1.74%		1.91%		22.5%		22.7%
		C	8.8	Annual	0.041	0.460%	0.041	0.463%	2.83	32.2%	2.83	32.2%
Ammonia	7664-41-7	O	100	24-hr	0.241	0.241%	0.264	0.264%				
Carbon Disulphide	75-15-0	O	330	24-hr	0.002	0.001%	0.002	0.001%				
Carbonyl Sulphide	473-58-1	O	13	24-hr	0.003	0.108%	0.004	0.118%				
SO_2	7446-09-5	O	690	1-hr	1.813	0.263%	1.833	0.266%	10.1	1.46%	10.1	1.47%
		C	270	1-hr		1.07%		1.08%		5.94%		5.95%
		O	275	24-hr	0.224	0.082%	0.246	0.089%	8.50	3.09%	8.53	3.10%
		C	10	Annual	0.019	0.193%	0.019	0.194%	32.1	321%	32.1	321%
CO	630-08-0	O	6000	30-min	29.8	0.496%	30.1	0.502%				
NOx	10102-44-0	O	400	1-hr	29.9	7.46%	30.2	7.55%				
		C	78	1-hr		38.3%		38.7%				
		O	200	24-hr	3.693	1.85%	4.047	2.02%				
		C	22	Annual	0.318	1.44%	0.320	1.45%				
Nickel	7440-02-0	O	0.04	Annual	0.001	2.08%	0.001	2.09%				
		O	2	24-hr	0.010	0.483%	0.011	0.529%				
Copper	7440-50-8	O	50	24-hr	0.001	0.001%	0.001	0.002%				
Cobalt	7440-48-4	O	0.1	24-hr	0.000137	0.015%	0.000150	0.017%				
Arsenic	7440-38-2	O	0.3	24-hr	0.000240	0.080%	0.000263	0.088%				
Lead	7439-92-1	O	0.5	24-hr	0.000061	0.012%	0.000067	0.013%				
		O	0.2	30-day	0.000012	0.006%	0.000013	0.006%				
Silver	7440-22-4	O	1	24-hr	0.0000003	0.00003%	0.0000003	0.00003%				
Iron	7439-89-6	O	4	24-hr	0.057	1.42%	0.062	1.55%				

* No emission factor was available for particulate matter fractions, so conservatively assumed all particulate matter was PM_{10} and $PM_{2.5}$.

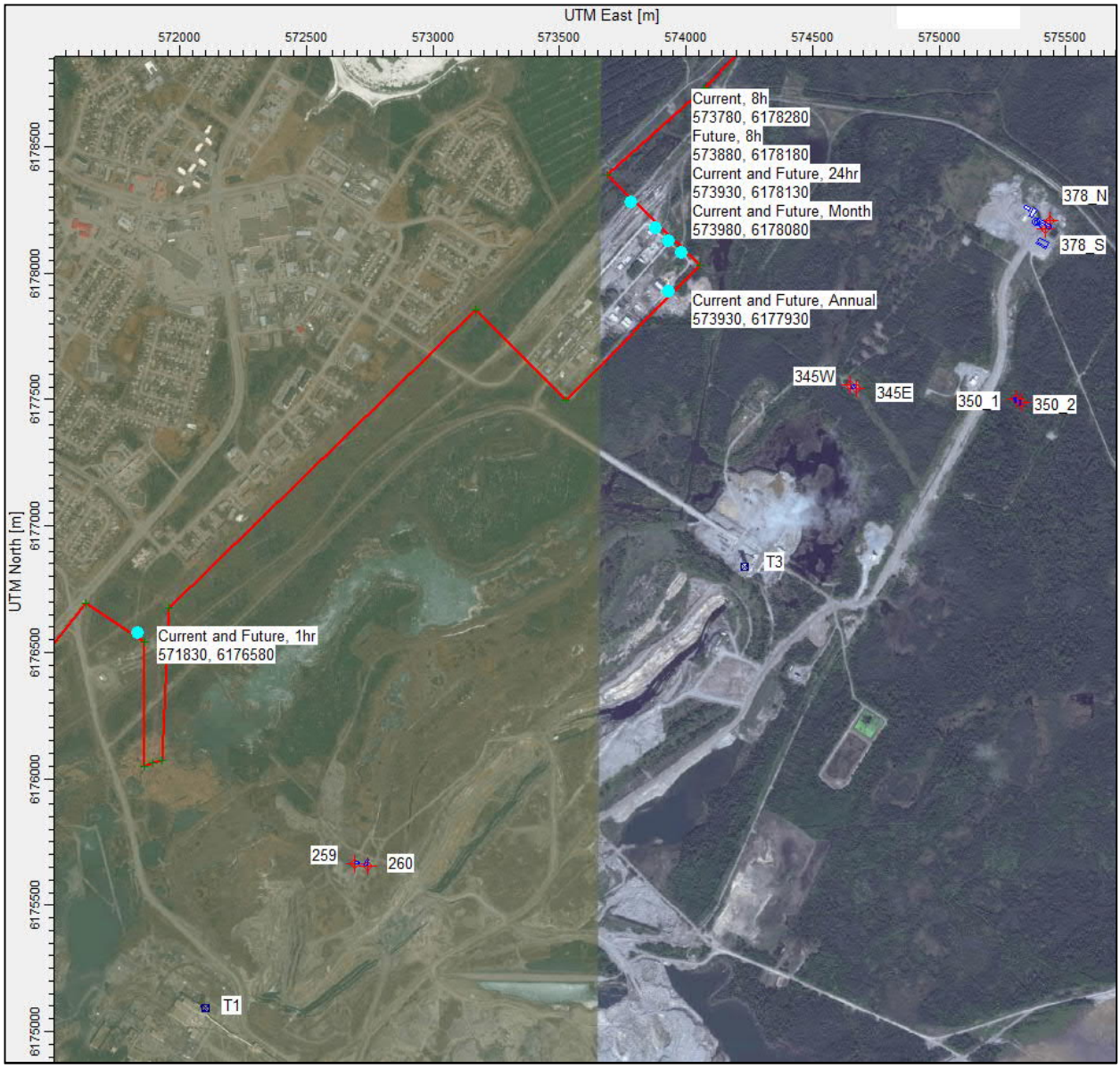

Figure 12: Location of the Maximum Points of Impingement (POIs)

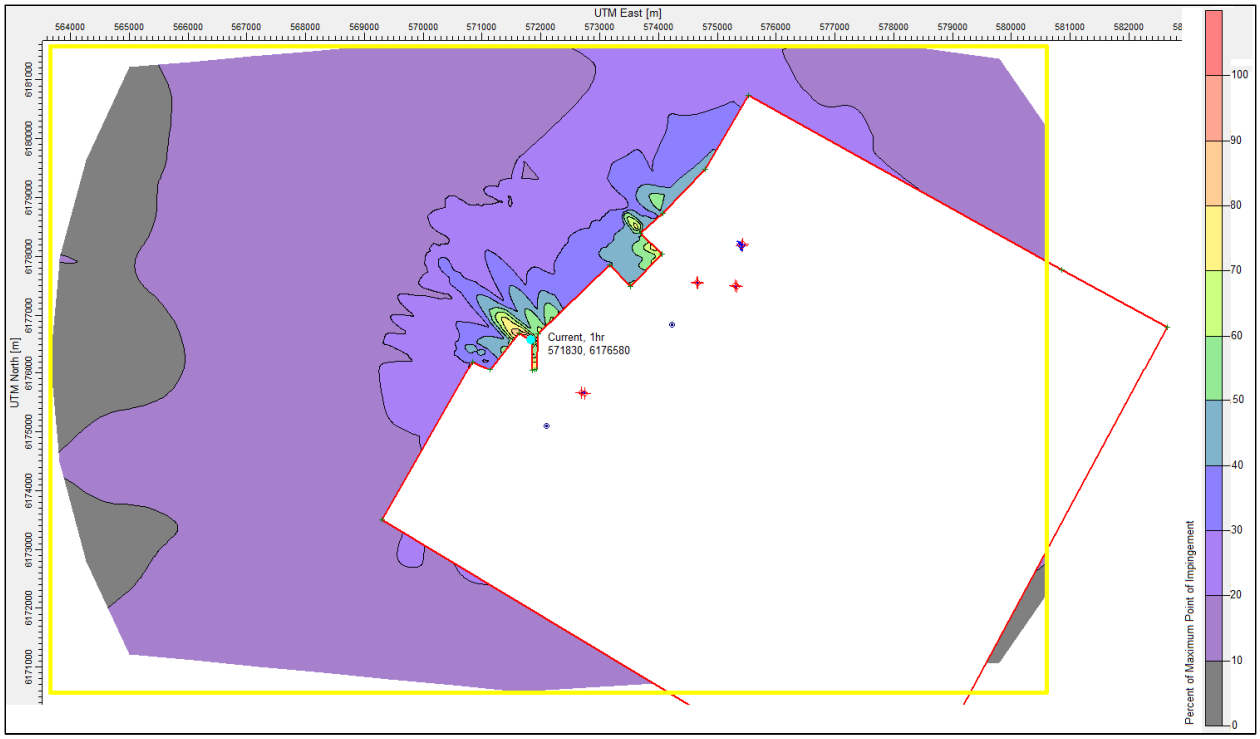

Figure 13: Isopleth – Current, 1hr

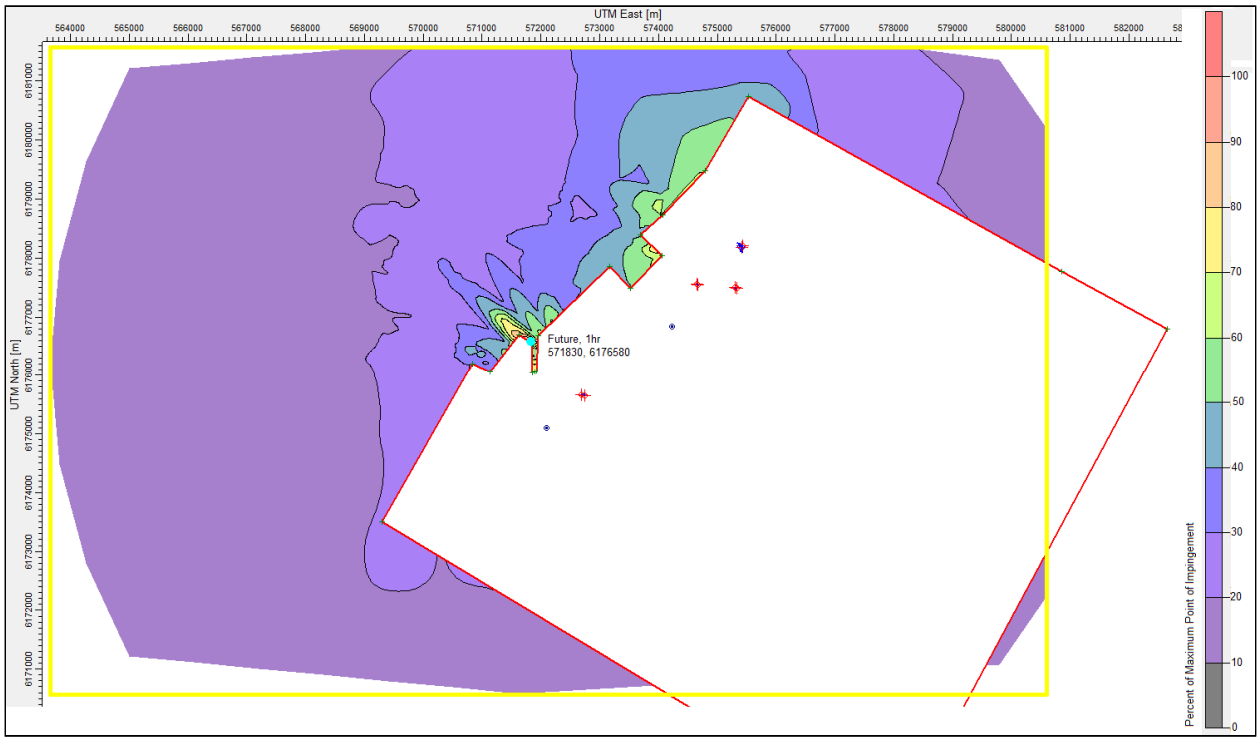

Figure 14: Isopleth – Future, 1hr

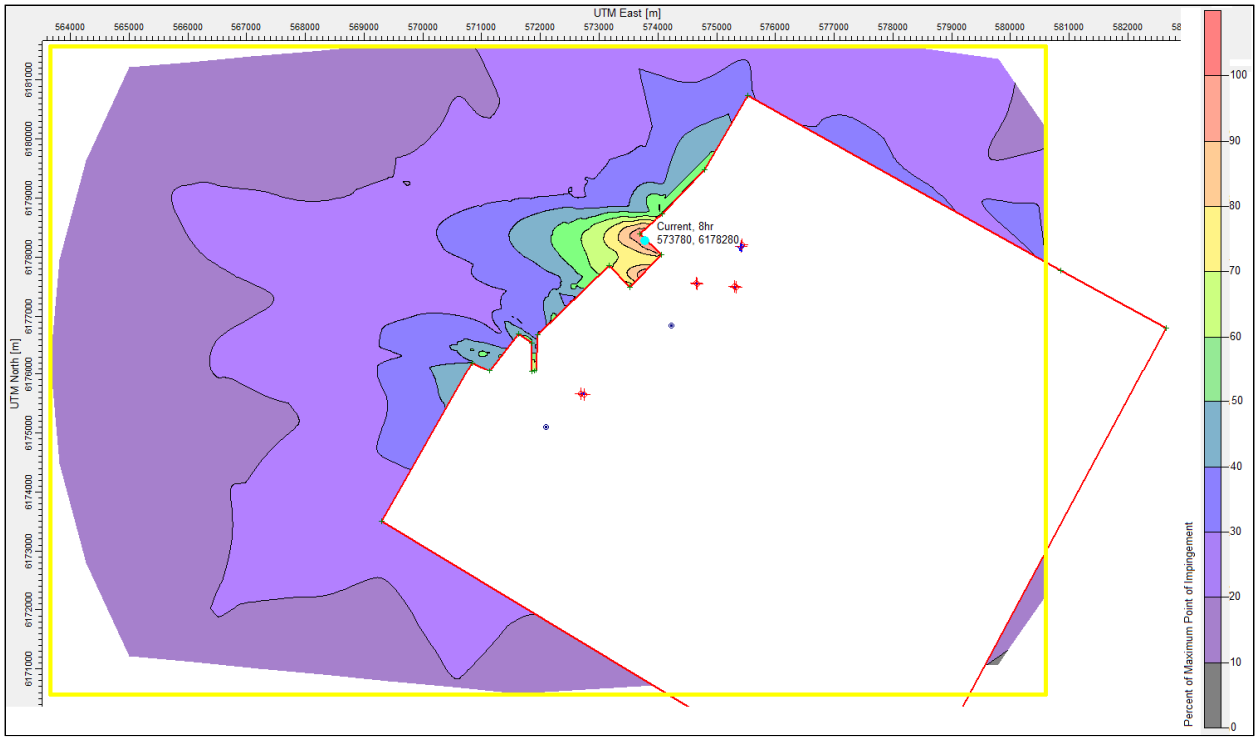

Figure 15: Isopleth – Current, 8hr

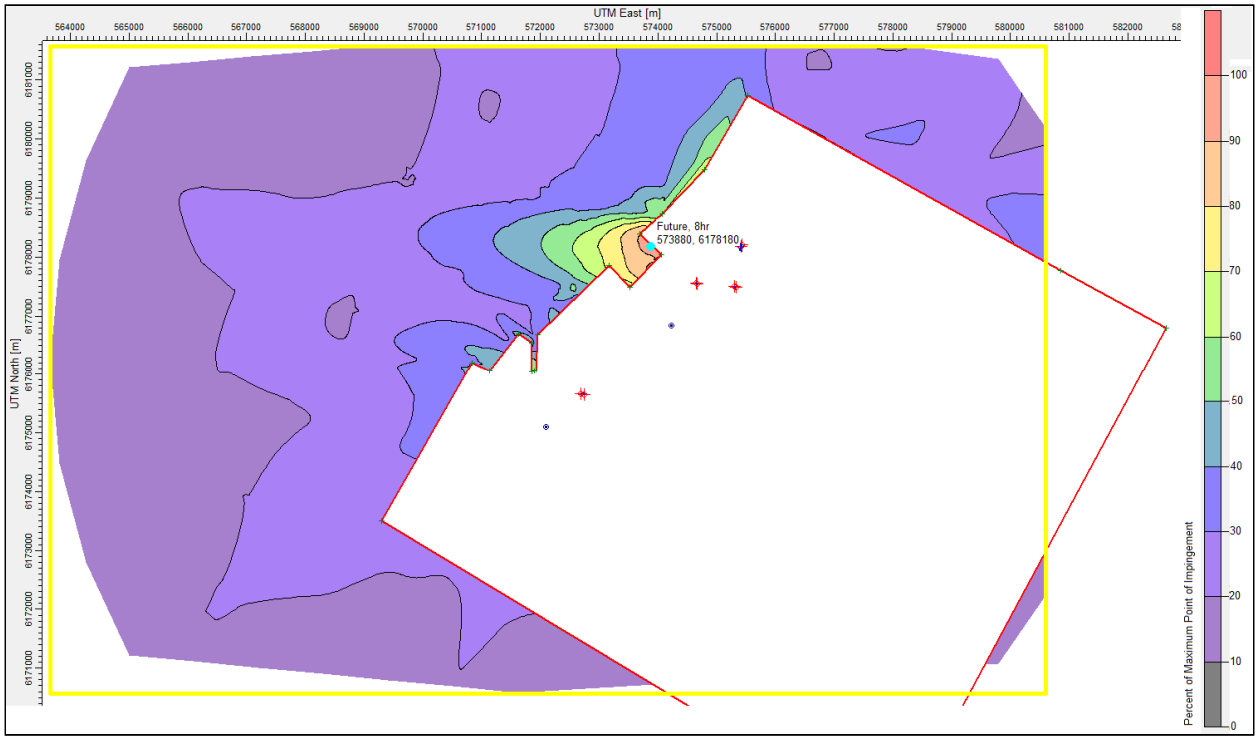

Figure 16: Isopleth – Future, 8hr

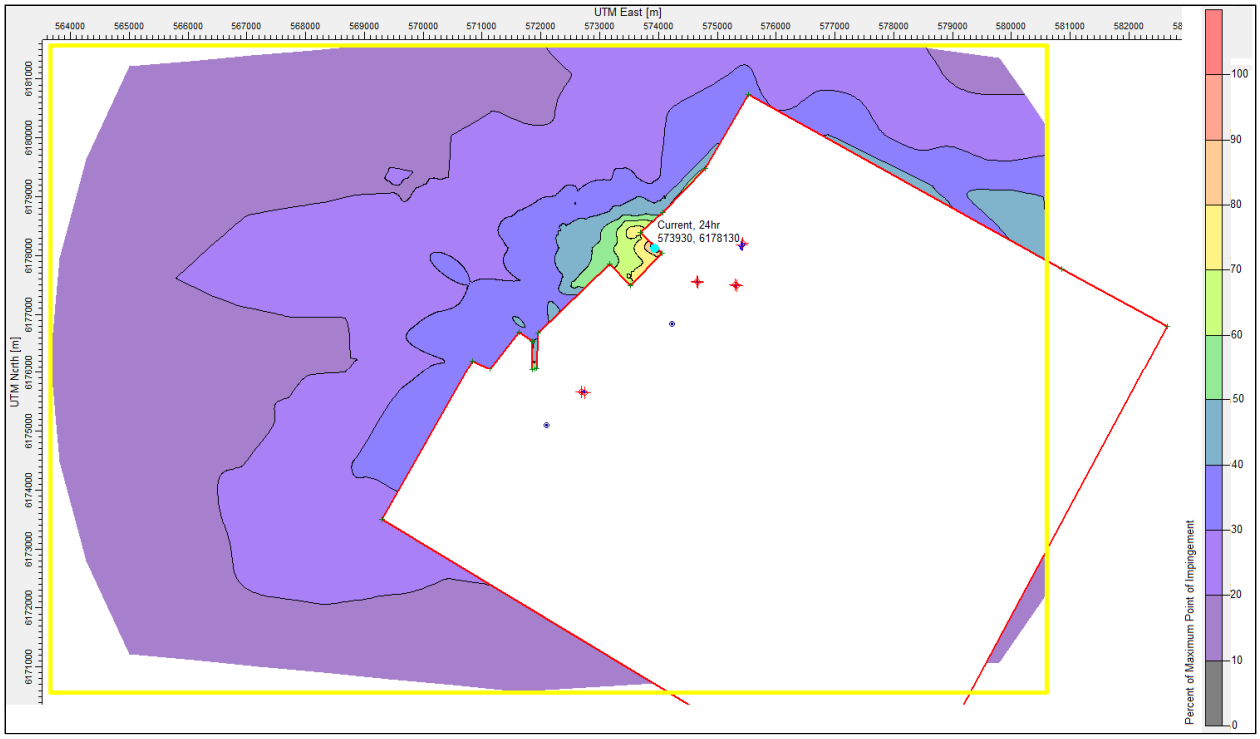

Figure 17: Isopleth – Current, 24hr

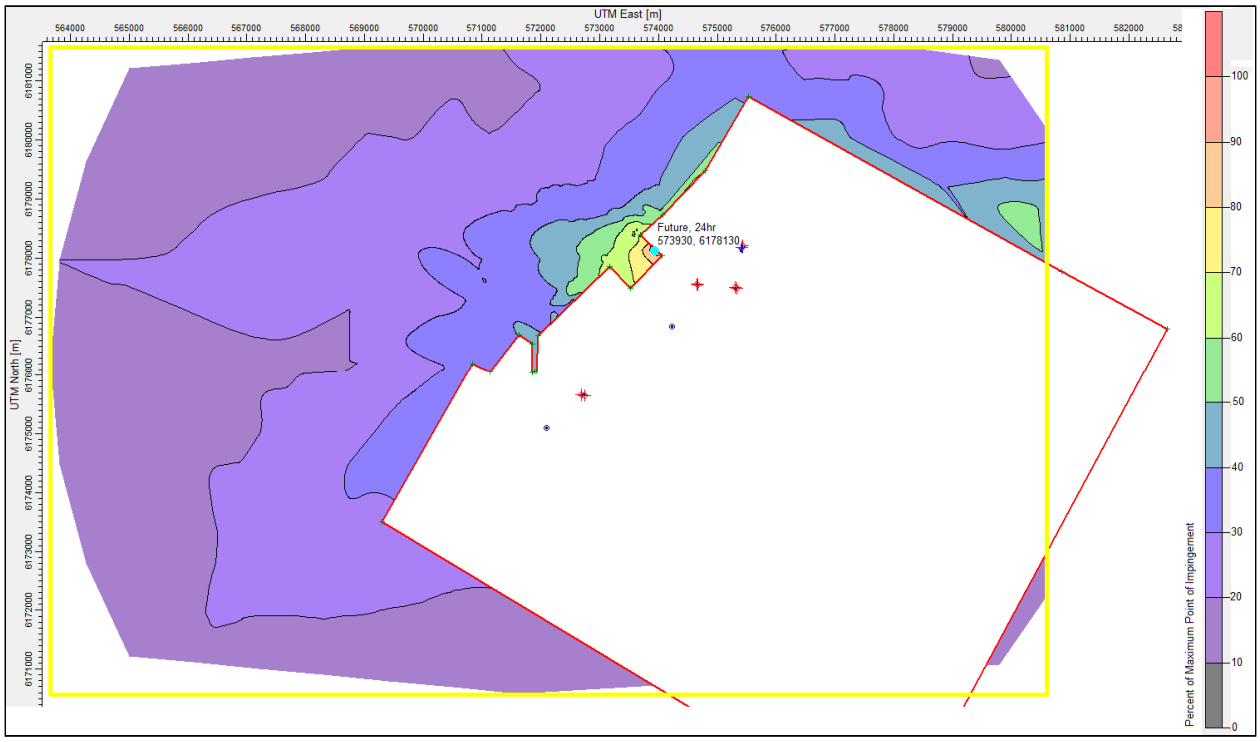

Figure 18: Isopleth – Future, 24hr

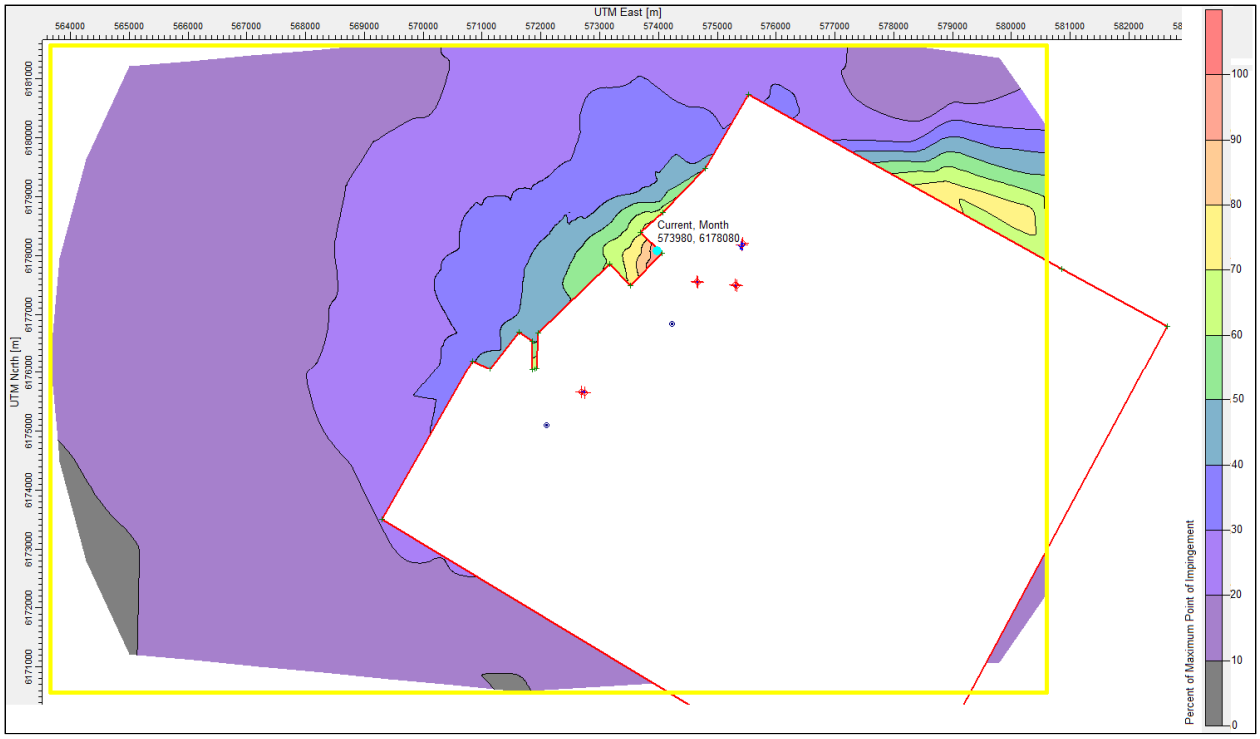

Figure 19: Isopleth – Current, Monthly

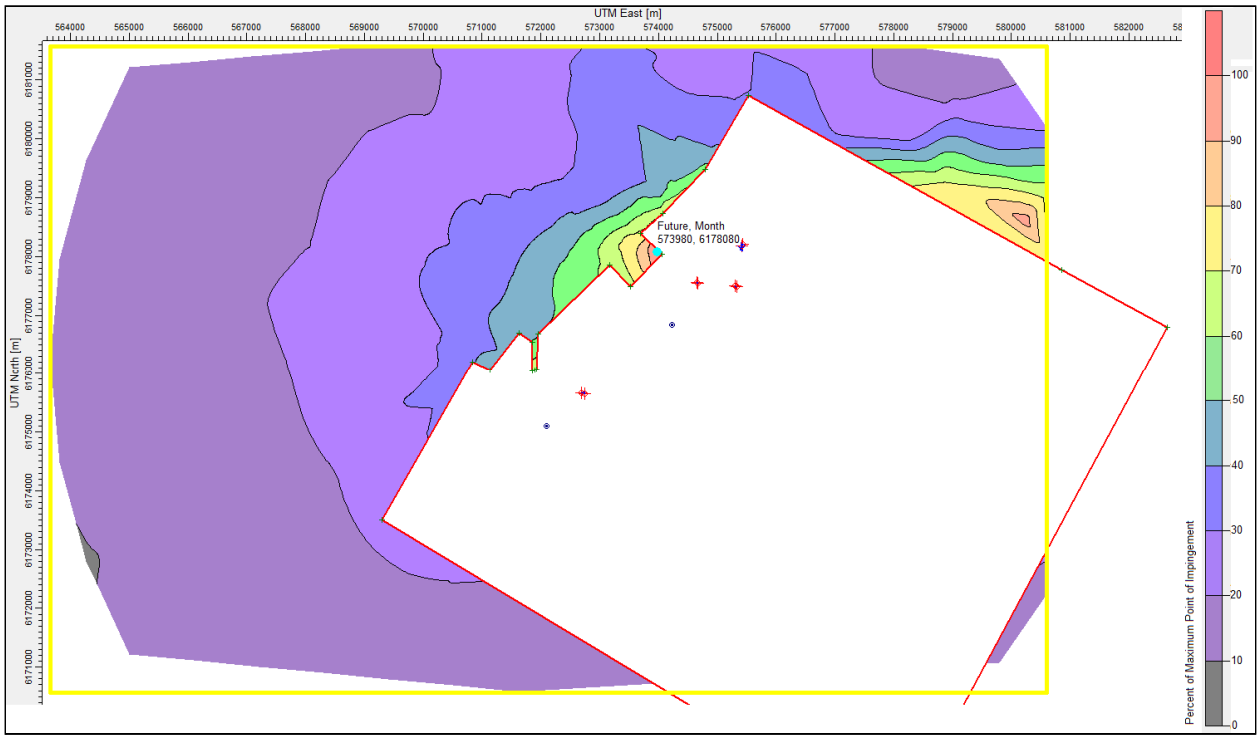

Figure 20: Isopleth – Future, Monthly

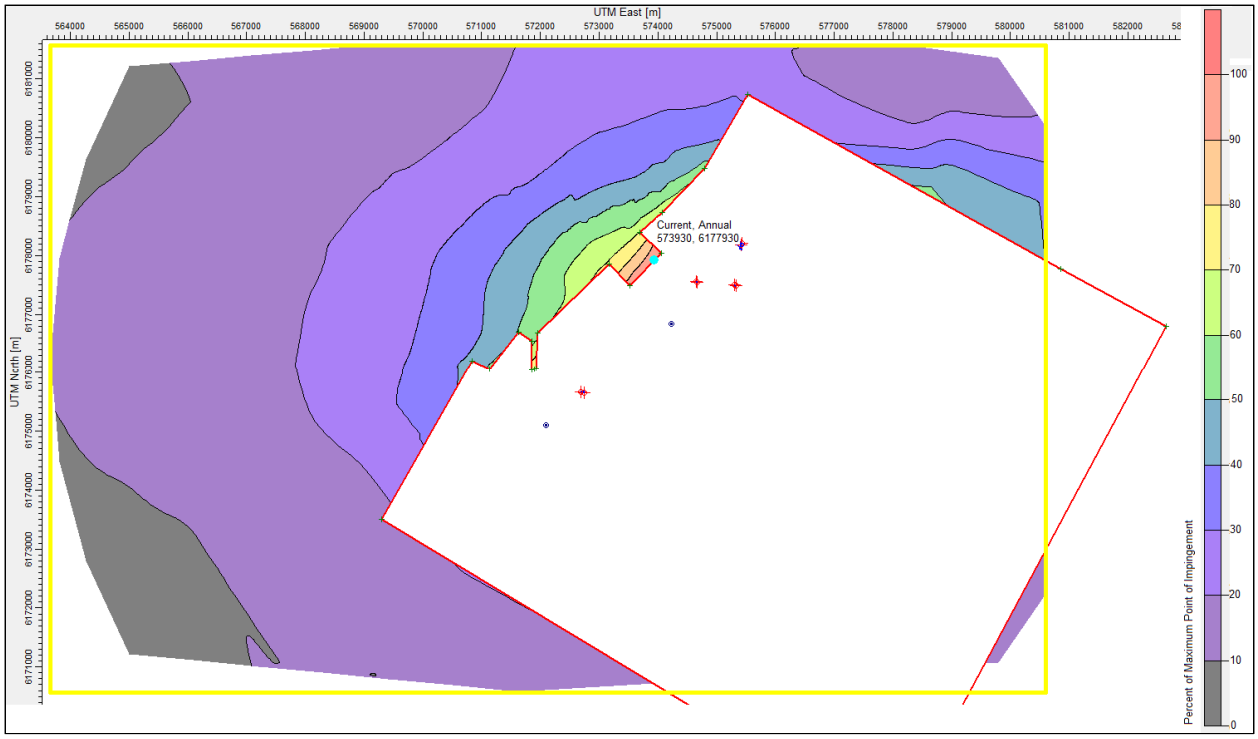

Figure 21: Isolpleth – Current, Annual

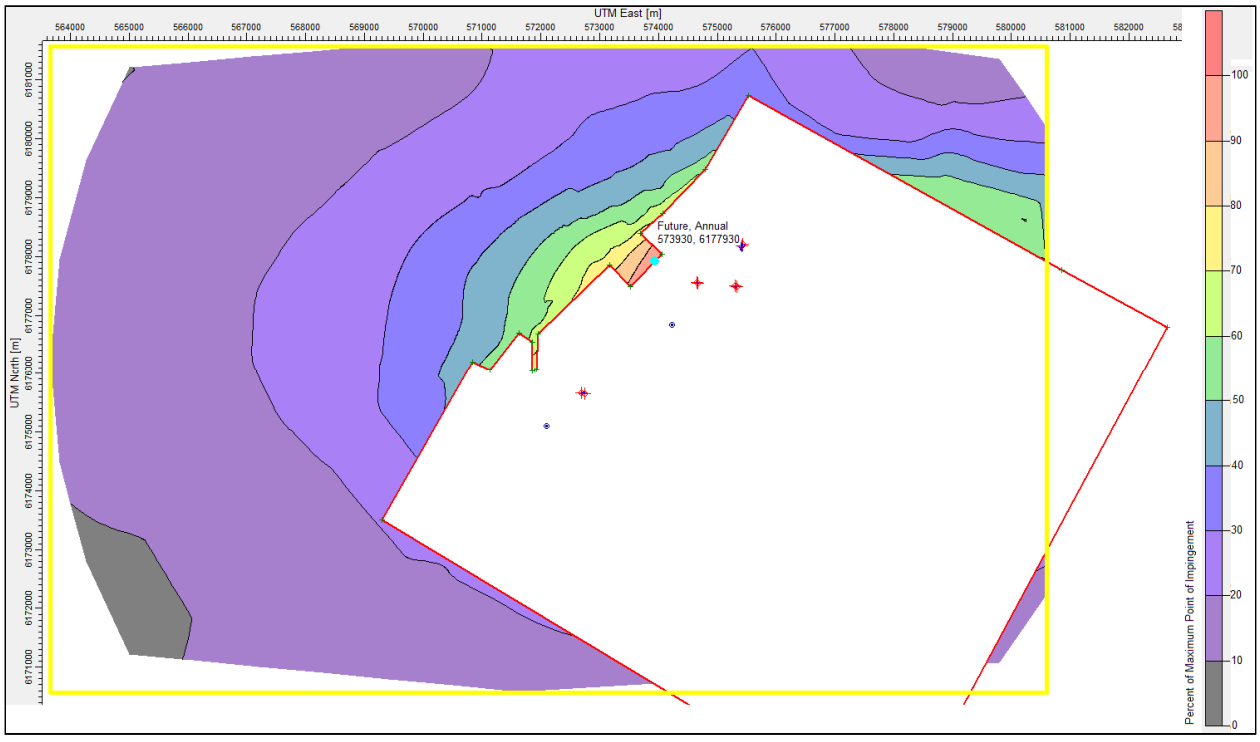

Figure 22: Isopleth – Future, Annual

3.2 Health Risk Assessment

Only required upon request. Note that although they are environmental standards, the Ontario Air Contaminant Benchmarks are generally health based.

4.0 Conclusion

This dispersion modelling assessment was conducted to determine the change in air contaminants in the community associated with the proposed ventilation changes at Thompson Mine – specifically the replacement of 345 RAR with 350 RAR. The only source of emissions associated with the Project were Return Air Raises, and so the focus of this study was on Return Air Raises only.

The dispersion modelling indicated that for any contaminant assessed using the 1-hr averaging period, the future impact would be 1.12% higher than the current impact; using the 8-hr averaging period, the future impact would be 17.5% higher than the current impact; using the 24-hr averaging period, the future impact would be 9.57% higher than the current impact; using the 30-day averaging period, the future impact would be 7.39% higher than the current impact; and using the annual averaging period, the future impact would be 0.60% higher than the current impact. These differences are explained by the meteorological data used in the modelling.

Looking at the future scenario, compared against the Ontario Air Contaminant Benchmarks, the highest impact relative to the standard was NOx (1hr) at 7.55%; compared against the Canadian Ambient Air Quality Standards, the highest impact relative to the standard was NOx (1hr) at 38.7%. When background particulate and SO_2 were incorporated in the assessment, compliance against the Ontario, Manitoba and Canadian standards was maintained except for the annual impact of SO_2 compared to the Canadian standard. The background level, at 32.1 $\mu g/m^3$, is already 3 times the standard and the SO_2 emission impact from the mine return air raises was negligible in comparison.

The assessment found that the air emission changes associated with the proposed ventilation changes would not present any additional risk to the environment.

Appendix A – Develop 5YR Meteorological Data Set, RWDI, 2019

Appendix B – Digital Appendix – Calculations and modelling files

Appendix C – Email from Environmental Approvals Branch

Appendix E VALE THOMPSON OPERATION NOISE STUDY – 2021 UPDATE RWDI REFERENCE NO. 2103230

600 Southgate Drive
Guelph ON Canada
N1G 4P6

Tel: +1.519.823.1311
Fax: +1.519.823.1316
E-mail: solutions@rwdi.com

June 9, 2021

Madonna Campeau, P.Eng.
Vale Canada
486 Power St.
Copper Cliff, ON P0M 1N0
T. (705) 682-5846
madonna.campeau@vale.com

Re: Vale Thompson Operation Noise Study – 2021 Update
RWDI Reference No. 2103230

Dear Ms. Campeau,

RWDI was retained by Vale Canada Limited (Vale) to conduct an environmental noise study to assess the noise impact of the fresh and return air raises at the Vale Thompson site. The objective of this study was to characterize the current noise impacts from the Vale Thompson Mine site through on-site measurements and to provide maximum allowable sound power levels for the future 350 Return Air Raise (RAR). The objective of setting maximum allowable sound power levels for new equipment is to ensure that sound levels at nearby points of reception do not increase when this equipment is installed. This letter updates the previous assessments completed in Feb 2019 and August 2019 and reflects the current upgrade plans for the Vale Thompson Mine.

Measurement Methodology

Sound pressure level measurements of the fresh and return air raises were performed using a Larson-Davis Model 824 Precision Integrating Sound Level Meter (SLM). The Model 824 uses a Larson-Davis Model PRM902 preamplifier and a Larson-Davis Model 2559 precision air-condenser microphone. The SLM was field-calibrated using a Larson-Davis Model CA250 precision acoustic calibrator prior to measurements. The calibration was checked using the same field calibrator at the conclusion of measurements. A Larson Davis windscreen (90mm) was used during all measurements. A list of the acoustic equipment used, including serial numbers, is provided as Attachment 1.

Environmental Conditions

The testing was conducted on Wednesday, December 12th, 2018 and Thursday, December 13th, 2018. Based on the Thompson, Manitoba, Environment Canada station data weather conditions were generally -6 to -13°C with light winds (i.e., 5-6 km/hr) from the northeast and high humidity (approximately 80-90%). Local metrological data was collected with a Kestrel Handheld weather and wind meter. Local wind conditions correlated well with Environment Canada data however localized relative humidity was verified to be in the range of 75 – 85% during measurements. These conditions

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are appropriate for conducting outdoor sound level measurements and are well within the operating ranges of the measurement equipment. Additional details on the environmental conditions at the time of testing are included in Attachment 2.

Environmental Noise Modelling

In order to determine maximum allowable sound levels for future equipment, an environmental noise model was created. Modelling for this assessment was conducted CadnaA (Version 2021 – 181.5100) sound level prediction software set to use the environmental sound propagation calculation methods prescribed by the ISO Standard 9613 (ISO 1993, 1996).

The noise model was calibrated and verified using off-site measurements that were conducted in the vicinity of the city of Thompson. Spot measurements were conducted at the North-East corner of Crane Street where the sound level was found to be 52 dBA, and at Waterloo Place where the sound level was 45 dBA during lulls in local noise. Spot measurement locations were chosen to reflect the area most impacted by the addition of the future noise sources.

Due to the large separation distance between noise sources and receivers in the town, atmospheric and ground conditions play a large role in the noise predictions. The model was calibrated to winter conditions to be consistent with the measurement conditions.

The modelling parameters associated with the winter condition noise model are as follows:

- Ground Absorption index value of 1.0. A ground absorption of 1 implies that the area between source and receiver is completely soft ground which is representative of soft snow-covered conditions in the area during the noise measurements.
- Temperature – modelled using -10° Celsius to match measurement conditions.

The noise modelling for the summertime conditions follows the typical modelling as described in ISO9613. The ISO 9613 sound propagation method predicts sound levels under moderately developed temperature inversion and downwind conditions, which enhance sound propagation to the receptor. The following parameters were used in the summertime noise model:

- Ground Absorption index value 0.8. The value of 0.8 implies that the ground is 80% absorptive.
- Temperature – modelled using 10 degrees as per ISO9613 standards.

The measured sound pressure levels were converted to sound power levels to allow for modelling and determination of maximum allowable sound power levels for new equipment. The calculated power levels (PWLs) of existing equipment are presented in Table 1.

Table 1: Sound Power Levels of Existing Equipment

Source Description	Sound Power Level (dBA)
378 Return Air Raise - North	136.1
378 Return Air Raise - South	136.1
259 Return Air Raise	132.2
260 Return Air Raise	131.5
345 Return Air Raise - West	131.5
345 Return Air Raise - East	131.5
234 Fresh Air Raise	121.5
235 Fresh Air Raise	123.3
354 Fresh Air Raise	128.4
310 Fresh Air Raise	122

Measurements of Return Air Raises 345 were not conducted during the site visit as it was, at the time, scheduled to be converted to a Fresh Air Raise. The ventilation plans have since been updated to shut down 345 RAR, replacing it with the new 350 RAR. The modelling utilized sound power levels from Return Air Raise 260 as proxy which calibrated well with off site measurements and results from Vale's internal noise audit. Fresh Air Raise 311 was not considered in the modelling as it was not operational during the site visit and based on conversations with Vale has not been operational for quite some time. Sound level contours (isopleths of equal sound level) were generated for winter and summer conditions, and for the existing and future predicted condition. Contours are presented in Figures 2 through 5. The higher sound levels shown in summer contours are primarily in consideration of lower ground absorption without snow covered ground. The assessment of the future noise sources was completed based on drawings and information provided by Vale. In particular, the ventilation plan now includes a new horizontally discharging, dual exhaust 350 RAR, and the removal of the existing 345 RAR. The future scenario also includes a sand plant in the 378 RAR area. The maximum allowable sound power levels for future noise sources are presented in Table 2.

Table 2: Maximum Allowable Sound Power Levels for New Equipment

Source Description	Maximum Allowable Sound Power Level (dBA)
350 Return Air Raise – Exhaust Discharge 1	132
350 Return Air Raise – Exhaust Discharge 2	132
Cement unloading at the new sand plant	120

Discussion

If the equipment in Table 2 is installed with sound power levels at or below the maximum level noted, it is expected that the overall sound level at points of reception will have no significant change. However, any time significant sources are added to an existing soundscape, there is a likelihood of the change being noticeable, due to the change in sound character. It can be expected that even with the sound level at points of reception maintained, some community members may find the change in the soundscape to be objectionable. Complying with the maximum sound levels recommended herein does not, therefore, guarantee a positive response from the community.

We trust that this information meets your present needs.

Yours truly,

RWDI

[redacted]

Michel Parent, C.E.T.,
Senior Acoustical Consultant
Michel.Parent@rwdi.com

[redacted]

Khalid Hussein, P.Eng,
Noise and Vibration Engineer | Project Manager
Khalid.Hussein@rwdi.com

MPP/KAMH/klm

Attach.

FIGURES

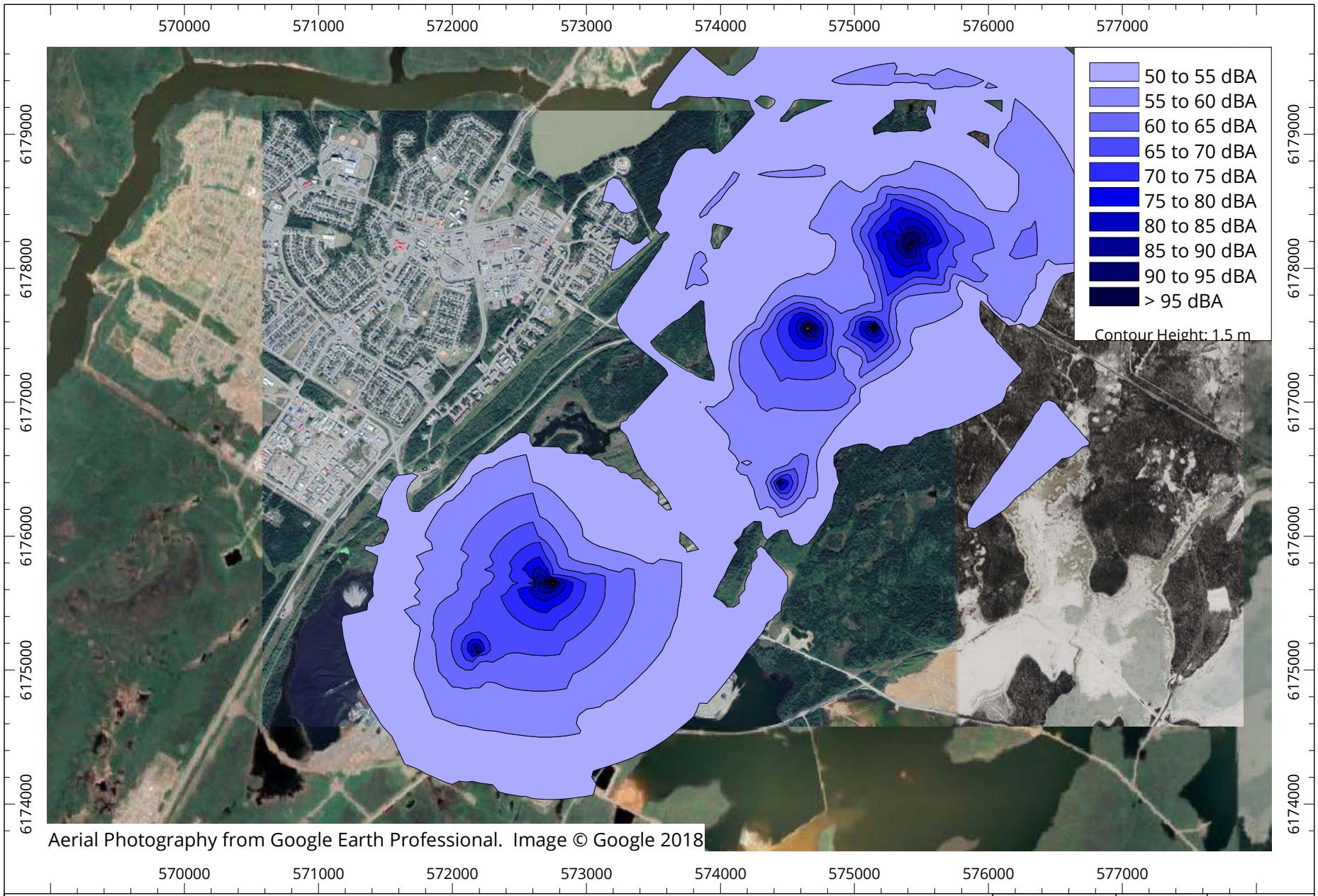
Noise Source Locations

Vale Thompson Operations - Thompson, Manitoba

True North

Project #2103230

Drawn by: KAMH	Figure: 1
Scale:	1:25000
Date:	June 8, 2021



Sound Levels - Winter Conditions

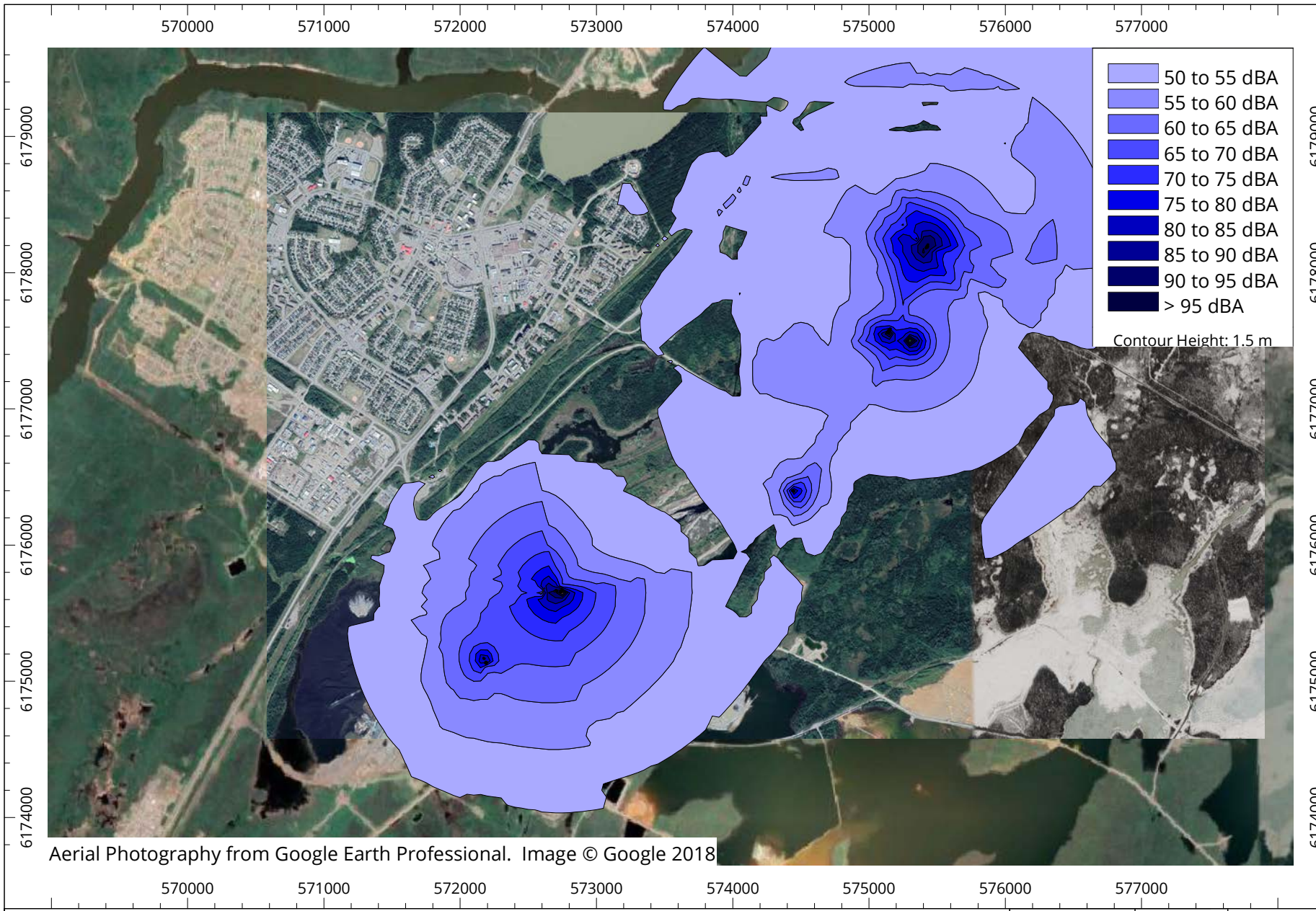
Current Operations

Vale Thompson Operations - Thompson, Manitoba

True North

Project #2103230

Drawn by: MPP	Figure: 2
Scale:	1:40000
Date:	May 28, 2021



Sound Levels - Winter Conditions

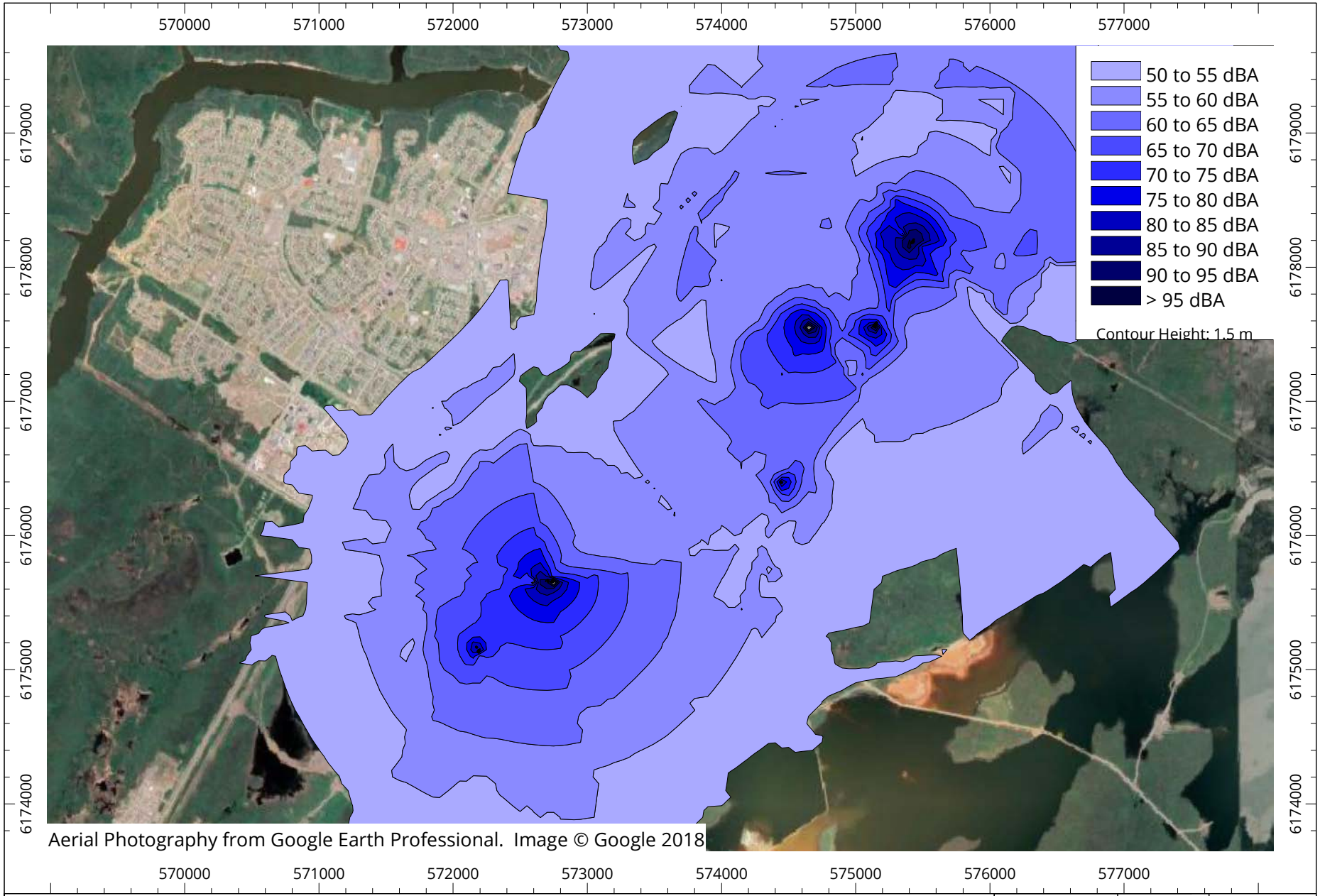
Future Operations

Vale Thompson Operations - Thompson, Manitoba

True North

Project #2103230

Drawn by: MPP	Figure: 3
Scale:	1:40000
Date:	May 28, 2021



Sound Levels - Summer Conditions

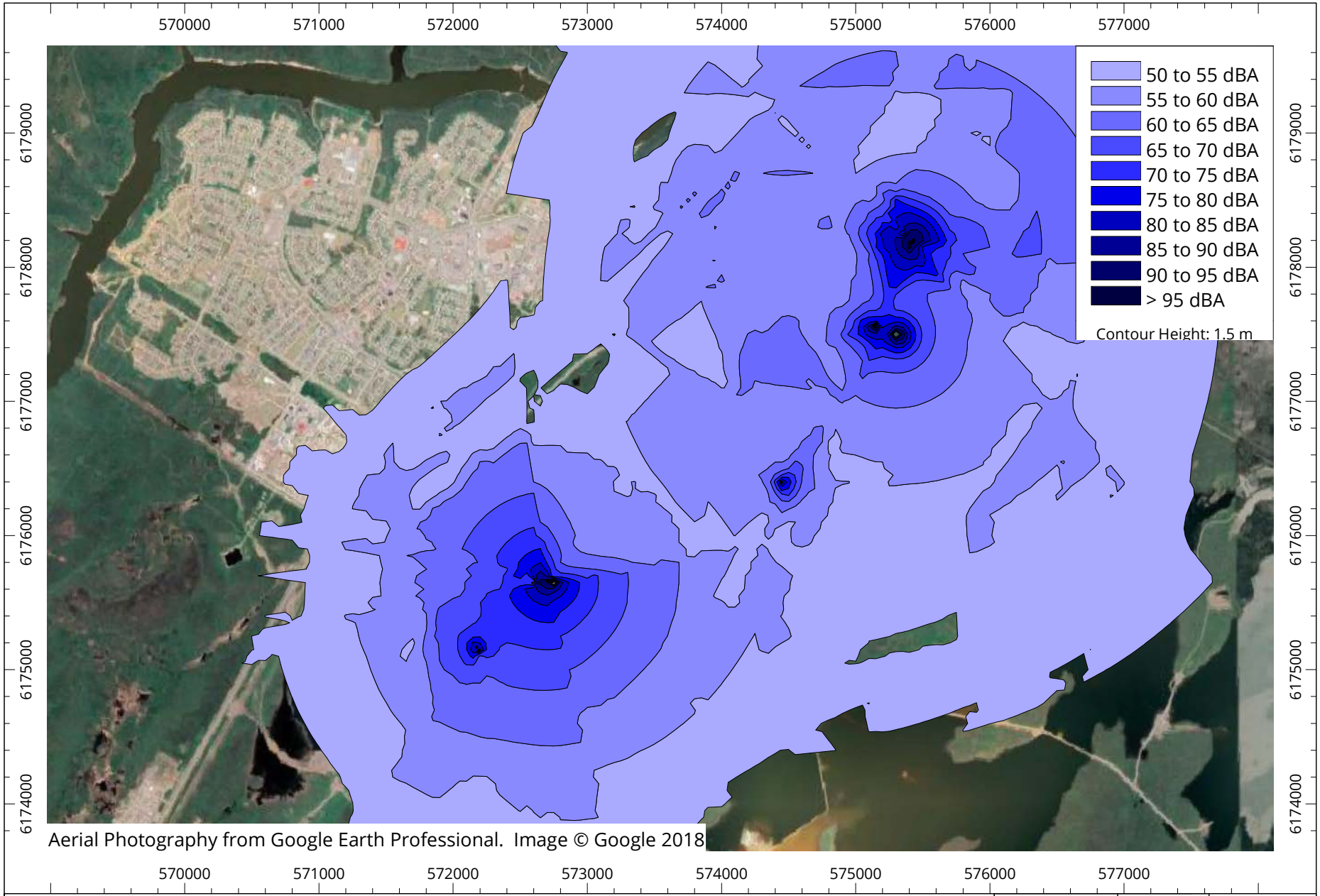
Current Operations

Vale Thompson Operations - Thompson, Manitoba

True North

Project #2103230

Drawn by: MPP	Figure: **4**
Scale:	1:40000
Date:	May 28, 2021



Sound Levels - Summer Conditions

Future Operations

Vale Thompson Operations - Thompson, Manitoba

True North

Project #2103230

Drawn by: MPP	Figure: 5
Scale:	1:40000
Date:	May 28, 2021

ATTACHMENT 1

Calibration Certificate

Certificate Number 2017001733

Customer:
RWDI Air
600 Southgate Drive
Guelph, ON N1G4P6, Canada

Model Number	CAL200	***Procedure Number***	D0001.8386		
Serial Number	2570	***Technician***	Scott Montgomery		
Test Results	**Pass**	***Calibration Date***	15 Feb 2017		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	15 Feb 2019		
		Temperature	23	°C	± 0.3 °C
Description	Larson Davis CAL200 Acoustic Calibrator	***Humidity***	29	%RH	± 3 %RH
		Static Pressure	101.1	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 60942:2003 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 17025:2005.
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 9001:2008.

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.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	09/07/2016	09/07/2017	001021
Sound Level Meter / Real Time Analyzer	04/07/2016	04/07/2017	001051
Microphone Calibration System	08/17/2016	08/17/2017	005446
1/2" Preamplifier	10/06/2016	10/06/2017	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/22/2016	08/22/2017	006507
1/2 inch Microphone - RI - 200V	03/15/2016	03/15/2017	006510
Pressure Transducer	07/01/2016	07/01/2017	007368

Output Level

Nominal Level [dB]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
94	101.1	94.04	93.80	94.20	0.14	Pass
114	101.3	114.03	113.80	114.20	0.13	Pass

-- End of measurement results--

Frequency

Nominal Level [dB]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
94	101.1	1,000.14	990.00	1,010.00	0.20	Pass
114	101.3	1,000.14	990.00	1,010.00	0.20	Pass

-- End of measurement results--

Total Harmonic Distortion + Noise (THD+N)

Nominal Level [dB]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
114	101.3	0.30	0.00	2.00	0.25	Pass
94	101.1	0.48	0.00	2.00	0.25	Pass

-- End of measurement results--

Level Change Over Pressure

Tested at: 114 dB, 23 °C, 29 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
101.3	101.4	0.00	-0.30	0.30	0.04 ‡	Pass
108.0	107.7	-0.04	-0.30	0.30	0.04 ‡	Pass
92.0	92.1	0.03	-0.30	0.30	0.04 ‡	Pass
83.0	82.8	0.01	-0.30	0.30	0.04 ‡	Pass
74.0	73.9	-0.07	-0.30	0.30	0.04 ‡	Pass
65.0	65.0	-0.21	-0.30	0.30	0.04 ‡	Pass

-- End of measurement results--

Frequency Change Over Pressure

Tested at: 114 dB, 23 °C, 29 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
108.0	107.7	0.00	-10.00	10.00	0.20 ‡	Pass
101.3	101.4	0.00	-10.00	10.00	0.20 ‡	Pass
92.0	92.1	0.00	-10.00	10.00	0.20 ‡	Pass
83.0	82.8	0.00	-10.00	10.00	0.20 ‡	Pass
74.0	73.9	0.00	-10.00	10.00	0.20 ‡	Pass
65.0	65.0	-0.01	-10.00	10.00	0.20 ‡	Pass

-- End of measurement results--

Certificate Number 2017001733

Total Harmonic Distortion + Noise (THD+N) Over Pressure

Tested at: 114 dB, 23 °C, 29 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
101.3	101.4	0.30	0.00	2.00	0.25 ‡	Pass
92.0	92.1	0.30	0.00	2.00	0.25 ‡	Pass
108.0	107.7	0.29	0.00	2.00	0.25 ‡	Pass
83.0	82.8	0.32	0.00	2.00	0.25 ‡	Pass
74.0	73.9	0.33	0.00	2.00	0.25 ‡	Pass
65.0	65.0	0.36	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Signatory: [redacted]

Larson Davis, a division of PCB Piezotronics, Inc
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

[redacted]

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2017-204801

Instrument Model 824, Serial Number A0988, was calibrated on 22 Feb 2017. The instrument meets factory specifications per Procedure D0001.8046, IEC 61672-1:2002 Class 1; IEC 60651-2001, 60804-2000 and ANSI S1.4-1983 Type 1 1/3, 1/1 Oct. Filters; S1.11-1986 Type 1C; IEC61260-am1-2001 Class 1 .

Instrument found to be in calibration as received: YES
Date Calibrated: 22 Feb 2017
Calibration due: 22 Feb 2019

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0662/0114	12 Months	8 Dec 2017	2016-204417

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 24 ° Centigrade

Relative Humidity: 25 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"As received" data is the same as shipped data.
Tested with PRM902 S/N 1462

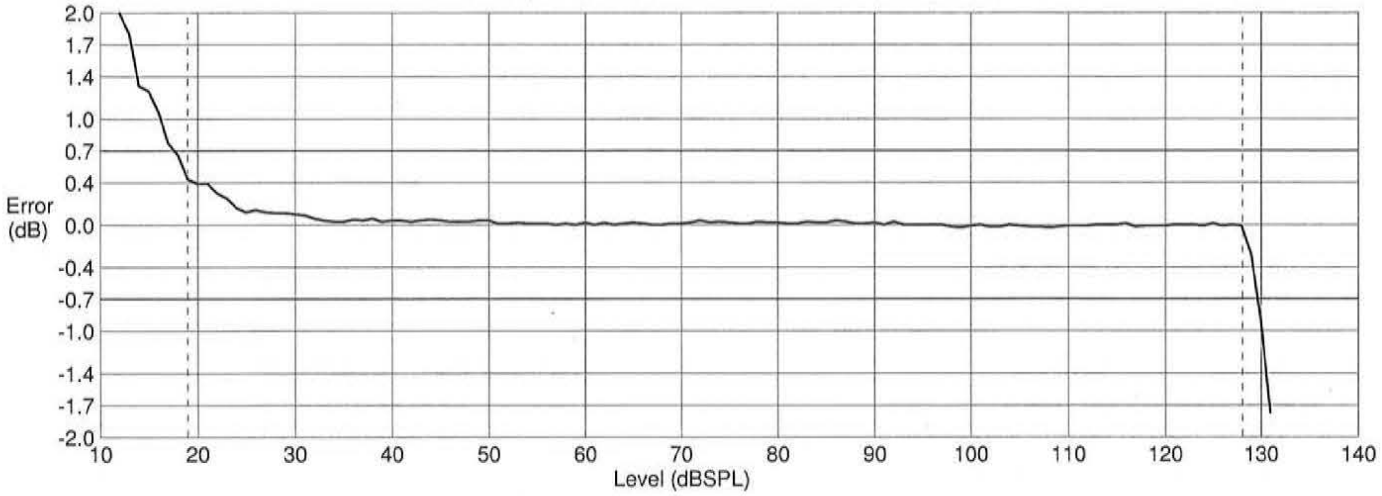
Signed: [redacted]

Technician: Sean Childs

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

Sound Level Meter Model: 824 Serial Number: A0988
Log Linearity, Differential Linearity and Range Data

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's Log Linearity A-weighted fast response was then electrically tested using a 1kHz sine wave from 11.0 dBSPL to 131.0 dBSPL in 1.0 dB increments.



Levl dBSPL	Meas dBSPL	Uncert +/- dB	Err dB	Levl dBSPL	Meas dBSPL	Uncert +/- dB	Err dB	Levl dBSPL	Meas dBSPL	Uncert +/- dB	Err dB	Levl dBSPL	Meas dBSPL	Uncert +/- dB	Err dB
11.0	**13.6**	**0.27**	**2.6**	42.0	42.0	0.11	0.0	73.0	73.0	0.11	0.0	104.0	104.0	0.11	0.0
12.0	**14.4**	**0.27**	**2.4**	43.0	43.0	0.11	0.0	74.0	74.0	0.11	0.0	105.0	105.0	0.11	0.0
13.0	**14.8**	**0.27**	**1.8**	44.0	44.0	0.11	0.0	75.0	75.0	0.11	0.0	106.0	106.0	0.11	0.0
14.0	**15.3**	**0.27**	**1.3**	45.0	45.0	0.11	0.0	76.0	76.0	0.11	0.0	107.0	107.0	0.11	0.0
15.0	**16.3**	**0.27**	**1.3**	46.0	46.0	0.11	0.0	77.0	77.0	0.13	0.0	108.0	108.0	0.11	0.0
16.0	**17.1**	**0.27**	**1.1**	47.0	47.0	0.11	0.0	78.0	78.0	0.13	0.0	109.0	109.0	0.11	0.0
17.0	**17.8**	**0.27**	**0.8**	48.0	48.0	0.11	0.0	79.0	79.0	0.12	0.0	110.0	110.0	0.11	0.0
18.0	**18.7**	**0.26**	**0.7**	49.0	49.0	0.11	0.0	80.0	80.0	0.12	0.0	111.0	111.0	0.11	0.0
19.0	19.4	0.26	0.4	50.0	50.0	0.11	0.0	81.0	81.0	0.12	0.0	112.0	112.0	0.11	0.0
20.0	20.4	0.26	0.4	51.0	51.0	0.11	0.0	82.0	82.0	0.12	0.0	113.0	113.0	0.11	0.0
21.0	21.4	0.26	0.4	52.0	52.0	0.11	0.0	83.0	83.0	0.12	0.0	114.0	114.0	0.11	0.0
22.0	22.3	0.26	0.3	53.0	53.0	0.11	0.0	84.0	84.0	0.12	0.0	115.0	115.0	0.11	0.0
23.0	23.2	0.26	0.3	54.0	54.0	0.11	0.0	85.0	85.0	0.11	0.0	116.0	116.0	0.11	0.0
24.0	24.2	0.16	0.2	55.0	55.0	0.11	0.0	86.0	86.0	0.11	0.0	117.0	117.0	0.11	0.0
25.0	25.1	0.16	0.1	56.0	56.0	0.11	0.0	87.0	87.0	0.11	0.0	118.0	118.0	0.11	0.0
26.0	26.1	0.16	0.1	57.0	57.0	0.11	0.0	88.0	88.0	0.11	0.0	119.0	119.0	0.11	0.0
27.0	27.1	0.16	0.1	58.0	58.0	0.11	0.0	89.0	89.0	0.11	0.0	120.0	120.0	0.11	0.0
28.0	28.1	0.16	0.1	59.0	59.0	0.11	0.0	90.0	90.0	0.11	0.0	121.0	121.0	0.11	0.0
29.0	29.1	0.16	0.1	60.0	60.0	0.11	0.0	91.0	91.0	0.11	0.0	122.0	122.0	0.11	0.0
30.0	30.1	0.16	0.1	61.0	61.0	0.11	0.0	92.0	92.0	0.11	0.0	123.0	123.0	0.11	0.0
31.0	31.1	0.16	0.0	62.0	62.0	0.11	0.0	93.0	93.0	0.11	0.0	124.0	124.0	0.11	0.0
32.0	32.1	0.16	0.0	63.0	63.0	0.11	0.0	94.0	94.0	0.11	0.0	125.0	125.0	0.11	0.0
33.0	33.0	0.16	0.0	64.0	64.0	0.11	0.0	95.0	95.0	0.11	0.0	126.0	126.0	0.11	0.0
34.0	34.0	0.15	0.0	65.0	65.0	0.11	0.0	96.0	96.0	0.11	0.0	127.0	127.0	0.11	0.0
35.0	35.0	0.15	0.0	66.0	66.0	0.11	0.0	97.0	97.0	0.11	0.0	128.0	128.0	0.11	0.0
36.0	36.1	0.15	0.0	67.0	67.0	0.11	0.0	98.0	98.0	0.11	0.0	**129.0**	**128.7**	**0.11**	**-0.3**
37.0	37.0	0.15	0.0	68.0	68.0	0.11	0.0	99.0	99.0	0.11	0.0	**130.0**	**129.1**	**0.11**	**-0.9**
38.0	38.1	0.15	0.0	69.0	69.0	0.11	0.0	100.0	100.0	0.11	0.0	**131.0**	**129.2**	**0.11**	**-1.8**
39.0	39.0	0.15	0.0	70.0	70.0	0.11	0.0	101.0	101.0	0.11	0.0				
40.0	40.0	0.11	0.0	71.0	71.0	0.11	0.0	102.0	102.0	0.11	0.0				
41.0	41.0	0.11	0.0	72.0	72.0	0.11	0.0	103.0	103.0	0.11	0.0				

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

Plotted per typical sensitivity of a 2541 microphone; 44.5 mV/Pa & 17.1 pF.

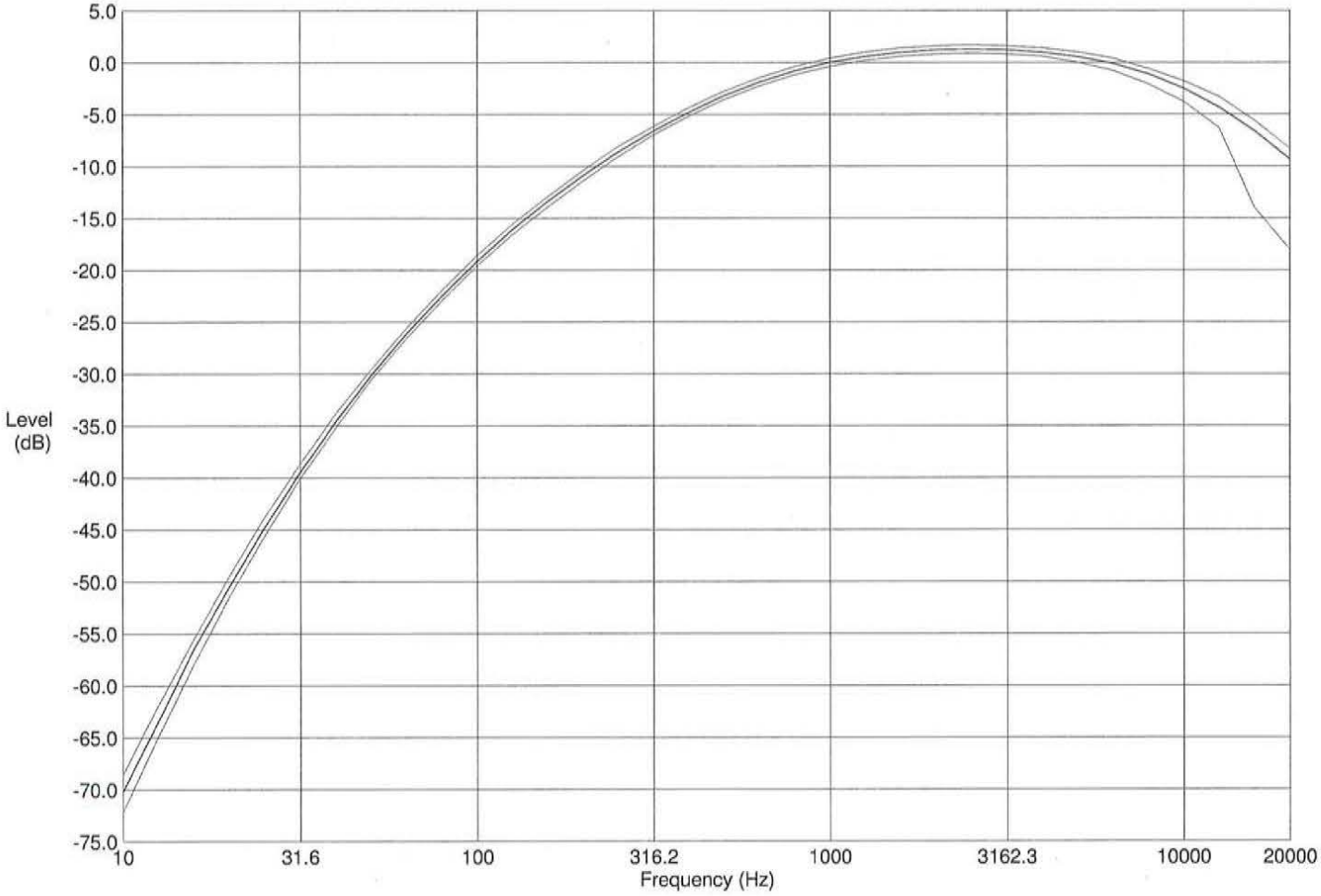
Overload occurs at 128.2 dBSPL.
Primary indicator range: 109.1 dB (lower limit: 19.0 dBSPL to upper limit: 128.1 dBSPL).
Dynamic range: 118.0 dB (noise floor: 10.1 dBSPL to upper limit: 128.1 dBSPL).

This instrument is in compliance with IEC 60651 (2001-10) 7.9 and 7.10, ANSI S1.4-1983 3.2, IEC 61672-1 (2002-05) 5.5 class 1 and IEC 60804 (2001-10) 9.2.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of A-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's A-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-70.4	-70.20	0.10	0.20	+1.8, -1.8
12.59	-63.4	-63.45	0.10	-0.05	+1.5, -1.5
15.85	-56.7	-56.43	0.10	0.27	+1.2, -1.2
19.95	-50.5	-50.53	0.10	-0.03	+1.0, -1.0
25.12	-44.7	-44.78	0.10	-0.08	+0.9, -0.9
31.62	-39.4	-39.50	0.10	-0.10	+0.7, -0.7
39.81	-34.6	-34.70	0.10	-0.10	+0.7, -0.7
50.12	-30.2	-30.27	0.10	-0.07	+0.5, -0.5
63.10	-26.2	-26.23	0.10	-0.03	+0.5, -0.5
79.43	-22.5	-22.54	0.10	-0.04	+0.5, -0.5
100.00	-19.1	-19.16	0.10	-0.06	+0.5, -0.5
125.89	-16.1	-16.13	0.10	-0.03	+0.5, -0.5
158.49	-13.4	-13.37	0.10	0.03	+0.5, -0.5
199.53	-10.9	-10.90	0.10	0.00	+0.5, -0.5
251.19	-8.6	-8.66	0.10	-0.06	+0.5, -0.5
316.23	-6.6	-6.64	0.10	-0.04	+0.4, -0.4
398.11	-4.8	-4.83	0.10	-0.03	+0.4, -0.4
501.19	-3.2	-3.23	0.10	-0.03	+0.4, -0.4
630.96	-1.9	-1.91	0.10	0.00	+0.4, -0.4
794.33	-0.8	-0.83	0.10	-0.03	+0.4, -0.4
1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
1258.90	0.6	0.59	0.10	0.00	+0.4, -0.4
1584.90	1.0	0.97	0.10	-0.03	+0.4, -0.4
1995.30	1.2	1.20	0.10	0.00	+0.4, -0.4
2511.90	1.3	1.27	0.10	-0.03	+0.4, -0.4
3162.30	1.2	1.20	0.10	0.00	+0.4, -0.4
3981.10	1.0	0.97	0.10	-0.03	+0.4, -0.4
5011.90	0.5	0.54	0.10	0.04	+0.5, -0.5
6309.60	-0.1	-0.12	0.10	-0.02	+0.5, -0.7
7943.30	-1.1	-1.12	0.10	-0.02	+0.5, -1.0
10000.00	-2.5	-2.50	0.12	0.00	+0.7, -1.3
12589.00	-4.3	-4.33	0.12	-0.03	+1.0, -2.0
15849.00	-6.6	-6.60	0.12	0.00	+1.0, -7.4
19953.00	-9.3	-9.34	0.12	-0.04	+1.0, -8.7

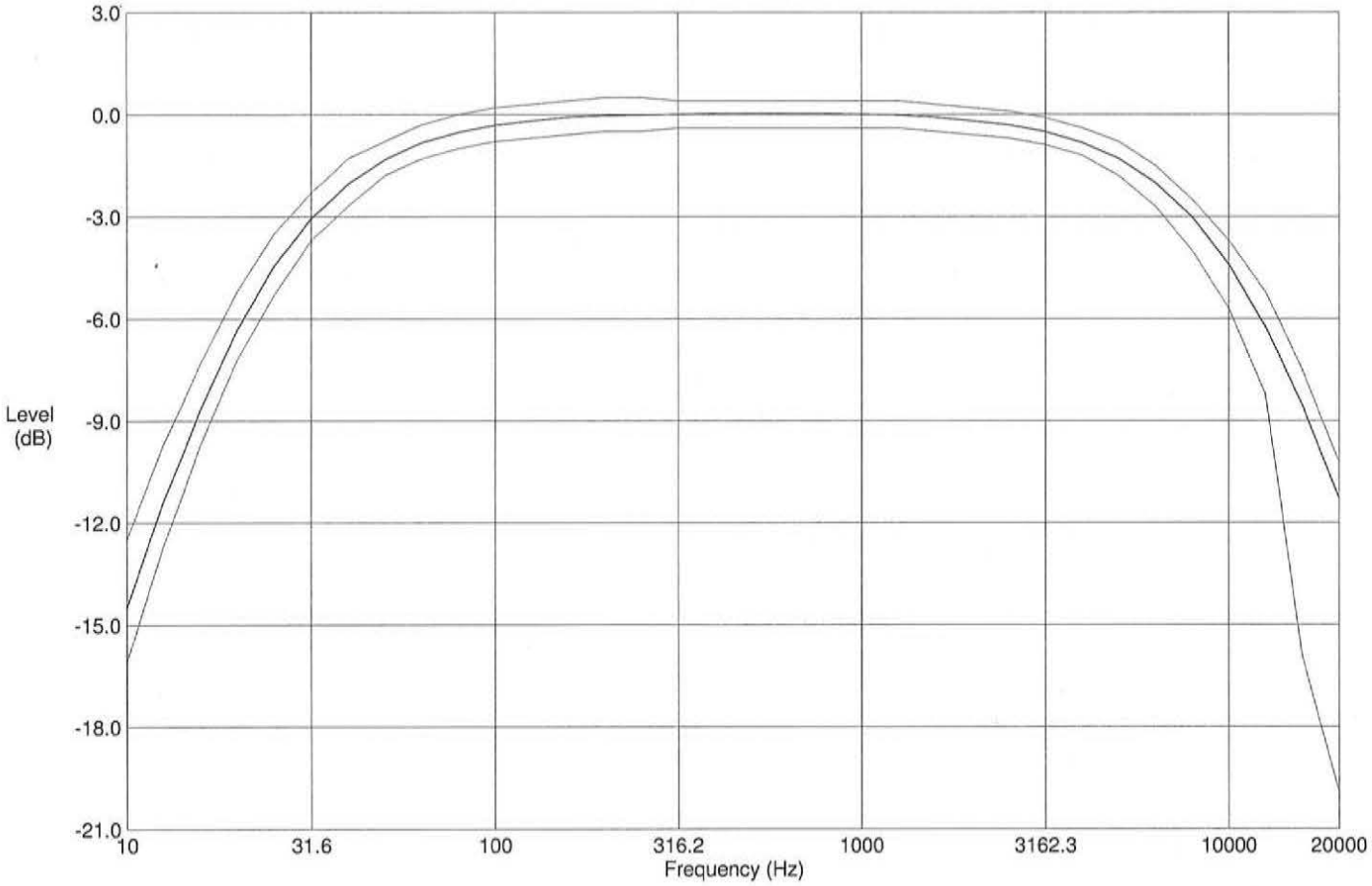
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of C-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's C-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-14.3	-14.51	0.10	-0.21	+1.8, -1.8
12.59	-11.2	-11.38	0.10	-0.18	+1.5, -1.5
15.85	-8.5	-8.65	0.10	-0.15	+1.2, -1.2
19.95	-6.2	-6.33	0.10	-0.13	+1.0, -1.0
25.12	-4.4	-4.45	0.10	-0.05	+0.9, -0.9
31.62	-3.0	-3.06	0.10	-0.06	+0.7, -0.7
39.81	-2.0	-2.05	0.10	-0.05	+0.7, -0.7
50.12	-1.3	-1.33	0.10	-0.03	+0.5, -0.5
63.10	-0.8	-0.83	0.10	-0.03	+0.5, -0.5
79.43	-0.5	-0.53	0.10	-0.03	+0.5, -0.5
100.00	-0.3	-0.32	0.10	-0.02	+0.5, -0.5
125.89	-0.2	-0.19	0.10	0.01	+0.5, -0.5
158.49	-0.1	-0.09	0.10	0.01	+0.5, -0.5
199.53	0.0	-0.04	0.10	-0.04	+0.5, -0.5
251.19	0.0	-0.02	0.10	-0.02	+0.5, -0.5
316.23	0.0	0.00	0.10	0.00	+0.4, -0.4
398.11	0.0	0.03	0.10	0.03	+0.4, -0.4
501.19	0.0	0.03	0.10	0.03	+0.4, -0.4
630.96	0.0	0.03	0.10	0.03	+0.4, -0.4
794.33	0.0	0.03	0.10	0.03	+0.4, -0.4
1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
1258.90	0.0	-0.02	0.10	-0.02	+0.4, -0.4
1584.90	-0.1	-0.09	0.10	0.01	+0.4, -0.4
1995.30	-0.2	-0.19	0.10	0.01	+0.4, -0.4
2511.90	-0.3	-0.31	0.10	0.00	+0.4, -0.4
3162.30	-0.5	-0.51	0.10	0.00	+0.4, -0.4
3981.10	-0.8	-0.83	0.10	-0.03	+0.4, -0.4
5011.90	-1.3	-1.29	0.10	0.01	+0.5, -0.5
6309.60	-2.0	-2.00	0.10	0.00	+0.5, -0.7
7943.30	-3.0	-3.01	0.10	0.00	+0.5, -1.0
10000.00	-4.4	-4.40	0.12	0.00	+0.7, -1.3
12589.00	-6.2	-6.23	0.12	-0.03	+1.0, -2.0
15849.00	-8.5	-8.54	0.12	-0.04	+1.0, -7.4
19953.00	-11.2	-11.27	0.12	-0.07	+1.0, -8.7

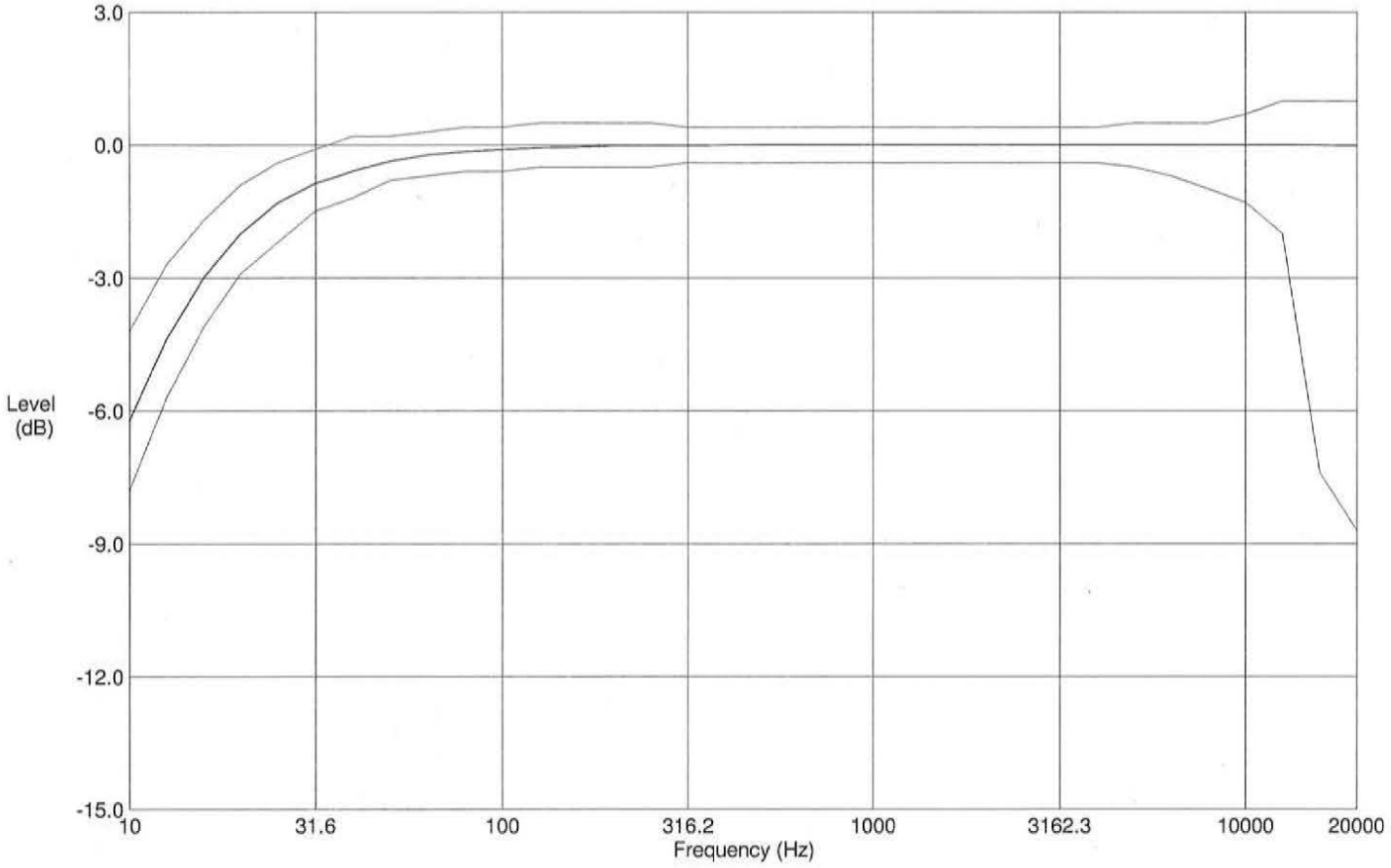
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of Flat-Weight Electrical Conformance

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's Flat-weighted response was then electrically tested using a 1.6 Vrms sinewave at exact frequencies as specified in IEC 60651 (2001-10) and ANSI S1.4-1983.



Freq (Hz)	Theor	Measured	Uncertainty	Error	Tolerance
10.00	-6.0	-6.22	0.10	-0.22	+1.8, -1.8
12.59	-4.2	-4.38	0.10	-0.18	+1.5, -1.5
15.85	-2.9	-2.99	0.10	-0.09	+1.2, -1.2
19.95	-1.9	-2.00	0.10	-0.10	+1.0, -1.0
25.12	-1.3	-1.31	0.10	0.00	+0.9, -0.9
31.62	-0.8	-0.87	0.10	-0.07	+0.7, -0.7
39.81	-0.5	-0.59	0.10	-0.09	+0.7, -0.7
50.12	-0.3	-0.37	0.10	-0.07	+0.5, -0.5
63.10	-0.2	-0.23	0.10	-0.03	+0.5, -0.5
79.43	-0.1	-0.16	0.10	-0.06	+0.5, -0.5
100.00	-0.1	-0.11	0.10	0.00	+0.5, -0.5
125.89	0.0	-0.07	0.10	-0.07	+0.5, -0.5
158.49	0.0	-0.05	0.10	-0.05	+0.5, -0.5
199.53	0.0	-0.02	0.10	-0.02	+0.5, -0.5
251.19	0.0	-0.02	0.10	-0.02	+0.5, -0.5
316.23	0.0	-0.02	0.10	-0.02	+0.4, -0.4
398.11	0.0	0.00	0.10	0.00	+0.4, -0.4
501.19	0.0	0.00	0.10	0.00	+0.4, -0.4
630.96	0.0	0.00	0.10	0.00	+0.4, -0.4
794.33	0.0	0.00	0.10	0.00	+0.4, -0.4
1000.00	0.0	0.00	0.10	0.00	+0.4, -0.4
1258.90	0.0	0.00	0.10	0.00	+0.4, -0.4
1584.90	0.0	0.00	0.10	0.00	+0.4, -0.4
1995.30	0.0	0.00	0.10	0.00	+0.4, -0.4
2511.90	0.0	0.00	0.10	0.00	+0.4, -0.4
3162.30	0.0	0.00	0.10	0.00	+0.4, -0.4
3981.10	0.0	0.00	0.10	0.00	+0.4, -0.4
5011.90	0.0	0.00	0.10	0.00	+0.5, -0.5
6309.60	0.0	0.00	0.10	0.00	+0.5, -0.7
7943.30	0.0	0.00	0.10	0.00	+0.5, -1.0
10000.00	0.0	0.00	0.12	0.00	+0.7, -1.3
12589.00	0.0	0.00	0.12	0.00	+1.0, -2.0
15849.00	0.0	0.00	0.12	0.00	+1.0, -7.4
19953.00	0.0	-0.02	0.12	-0.02	+1.0, -8.7

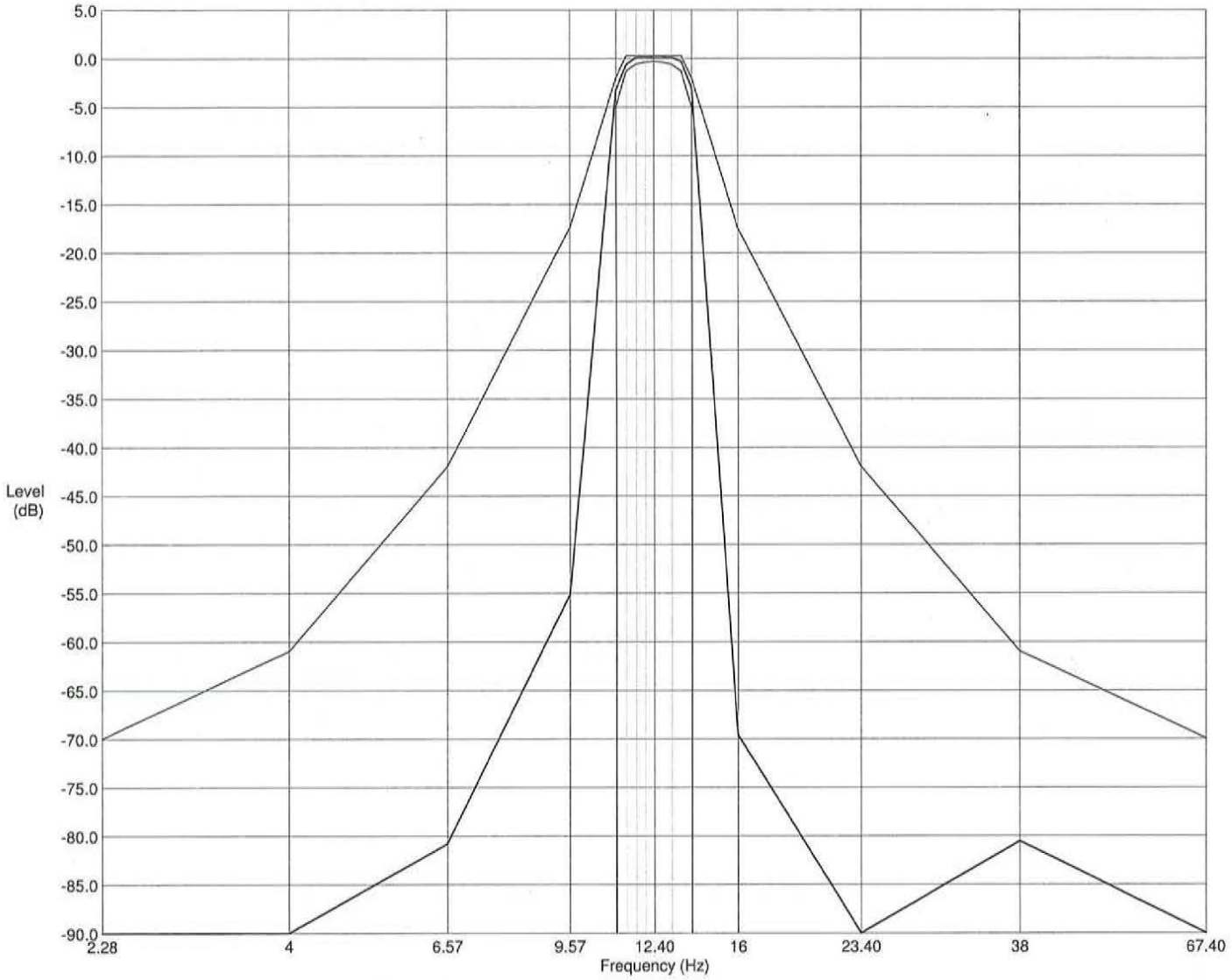
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 60651 (2001-10) 6.1 and 9.2.2, ANSI S1.4-1983 5.1 and 8.2.1, and IEC 60804 (2001-10) 5.1 for Type 1 sound level meters when used with a Larson Davis Type 1 microphone.

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 12.5 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 12.5 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
2.28	-102.83	0.32	-70.00,	-inf
4.04	-91.91	0.23	-61.00,	-inf
6.57	-80.82	0.13	-42.00,	-inf
9.57	-55.20	0.13	-17.50,	-inf
11.05	-3.26	0.10	-2.00,	-5.00
11.40	-0.64	0.10	0.30,	-1.30
11.74	0.11	0.10	0.30,	-0.60
12.08	0.13	0.10	0.30,	-0.40
12.40	0.06	0.10	0.30,	-0.30
12.73	0.06	0.10	0.30,	-0.40
13.10	0.13	0.10	0.30,	-0.60
13.49	-0.30	0.10	0.30,	-1.30
13.92	-3.00	0.10	-2.00,	-5.00
16.07	-69.61	0.10	-17.50,	-inf
23.40	-106.58	0.10	-42.00,	-inf
38.07	-80.57	0.10	-61.00,	-inf
67.40	-115.71	0.10	-70.00,	-inf

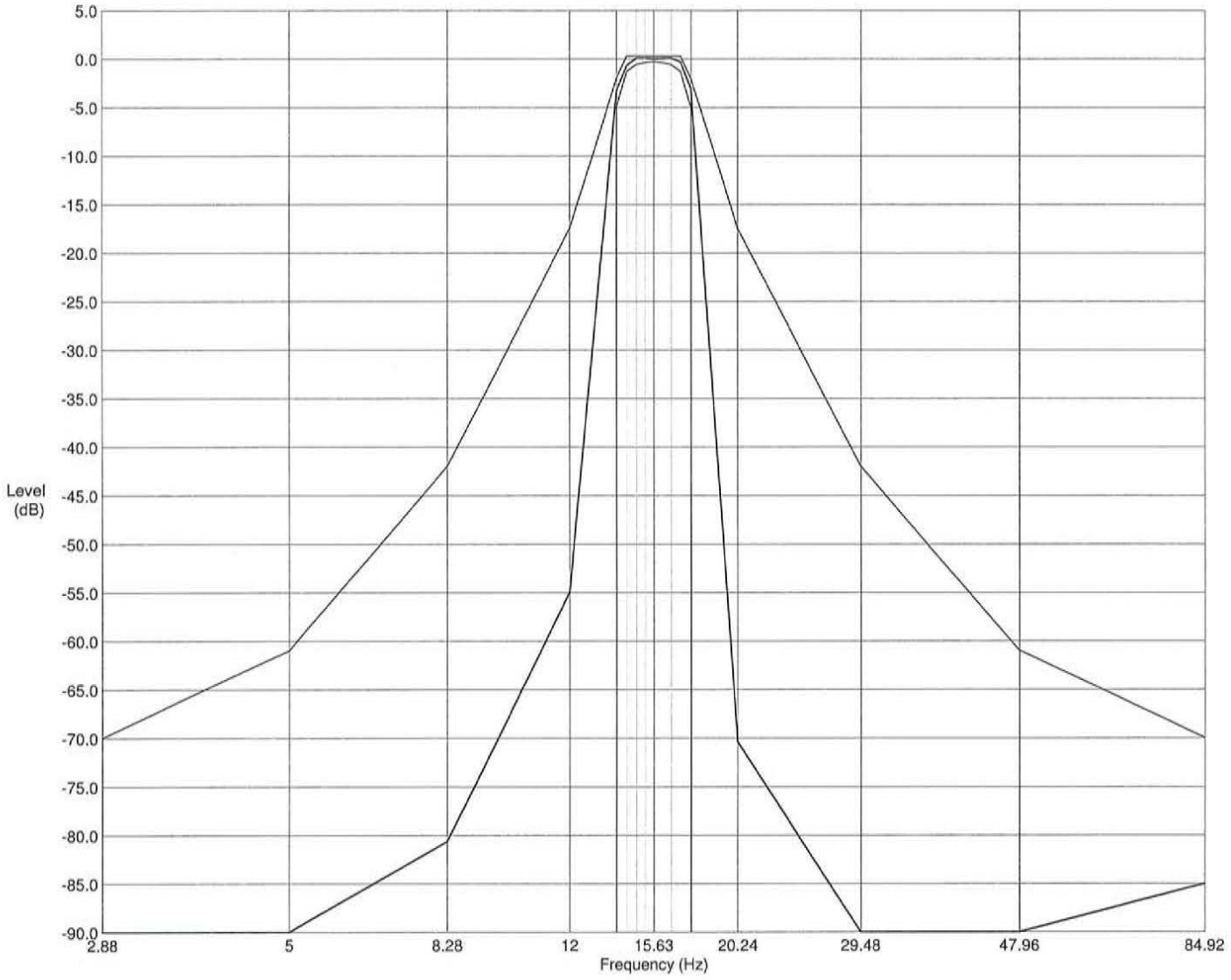
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 16 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 16 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
2.88	-100.41	0.32	-70.00,	-inf	16.04	0.04	0.10	0.30,	-0.40
5.09	-90.64	0.13	-61.00,	-inf	16.50	0.11	0.10	0.30,	-0.60
8.28	-80.65	0.13	-42.00,	-inf	17.00	-0.32	0.10	0.30,	-1.30
12.06	-54.96	0.10	-17.50,	-inf	17.54	-3.02	0.10	-2.00,	-5.00
13.92	-3.31	0.10	-2.00,	-5.00	20.24	-70.43	0.10	-17.50,	-inf
14.36	-0.70	0.10	0.30,	-1.30	29.48	-107.91	0.10	-42.00,	-inf
14.80	0.06	0.10	0.30,	-0.60	47.96	-114.85	0.10	-61.00,	-inf
15.22	0.08	0.10	0.30,	-0.40	84.92	-85.01	0.10	-70.00,	-inf
15.63	0.02	0.10	0.30,	-0.30					

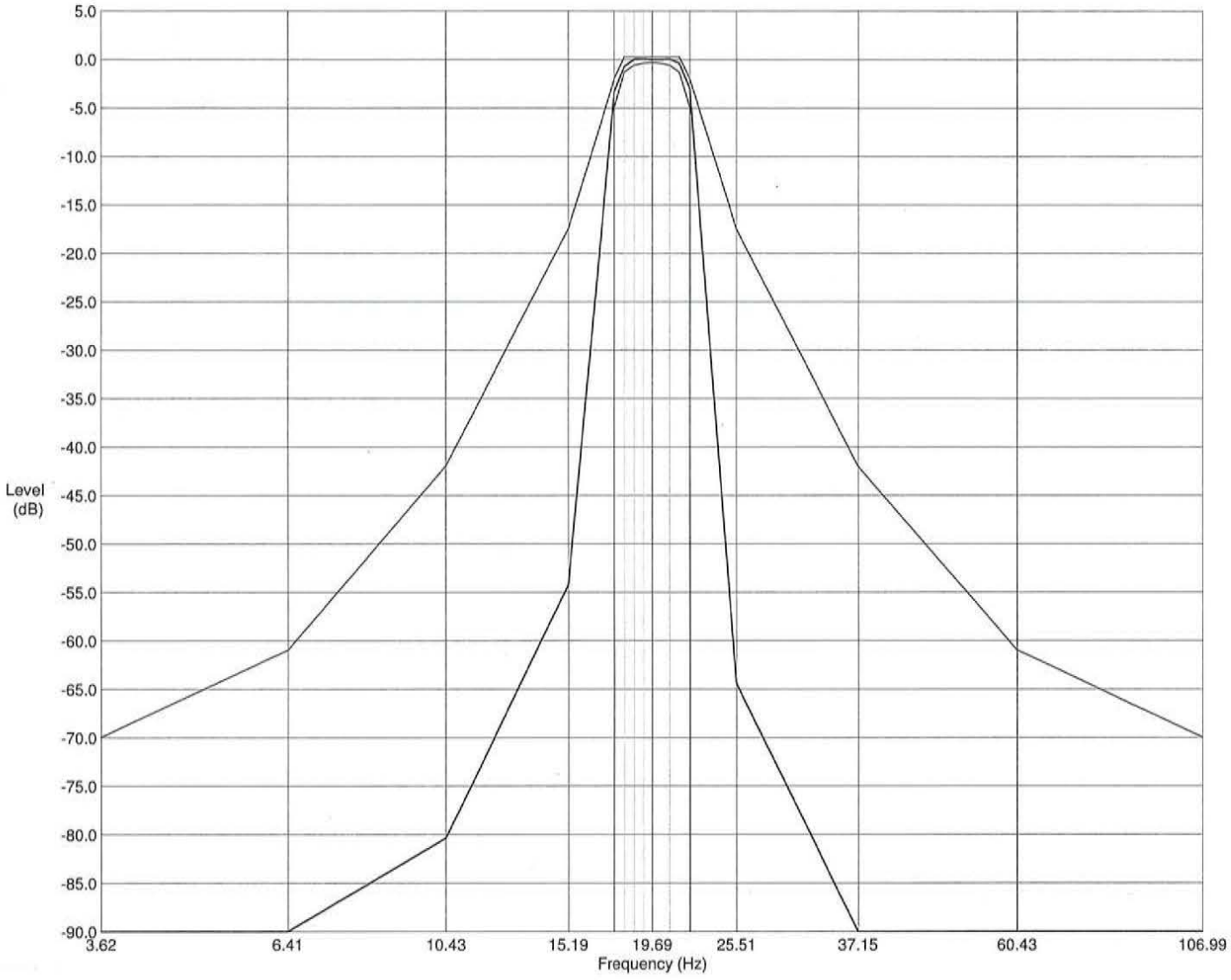
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 20 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 20 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
3.62	-97.64	0.23	-70.00,	-inf	20.21	0.02	0.10	0.30,	-0.40
6.41	-91.89	0.13	-61.00,	-inf	20.79	0.06	0.10	0.30,	-0.60
10.43	-80.39	0.10	-42.00,	-inf	21.41	-0.38	0.10	0.30,	-1.30
15.19	-54.26	0.10	-17.50,	-inf	22.10	-3.02	0.10	-2.00,	-5.00
17.54	-3.34	0.10	-2.00,	-5.00	25.51	-64.41	0.10	-17.50,	-inf
18.10	-0.72	0.10	0.30,	-1.30	37.15	-111.76	0.10	-42.00,	-inf
18.64	0.04	0.10	0.30,	-0.60	60.43	-114.90	0.10	-61.00,	-inf
19.17	0.06	0.10	0.30,	-0.40	106.99	-112.16	0.10	-70.00,	-inf
19.69	0.02	0.10	0.30,	-0.30					

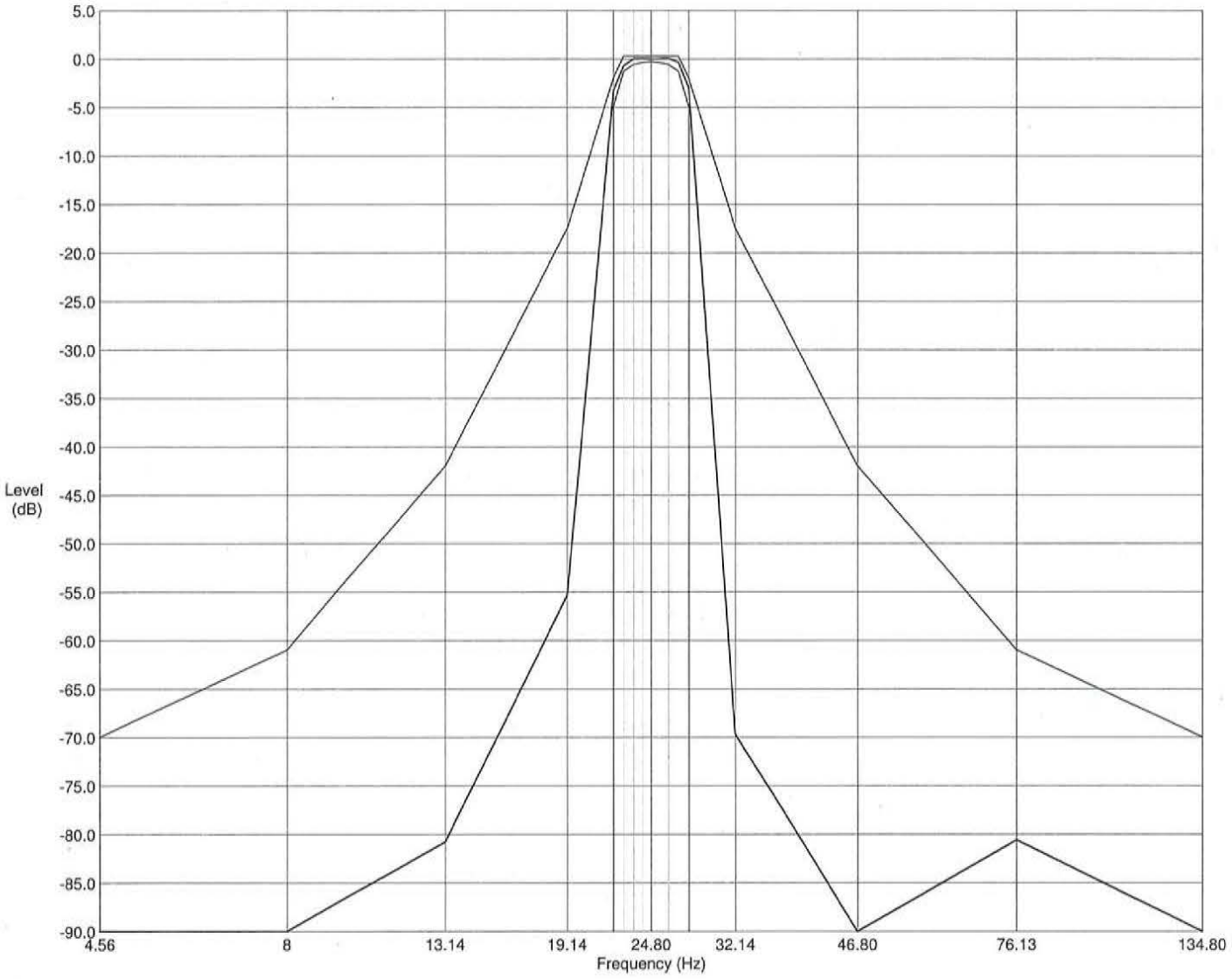
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 25 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 25 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
4.56	-100.23	0.23	-70.00,	-inf	25.47	0.02	0.10	0.30,	-0.40
8.08	-90.22	0.13	-61.00,	-inf	26.19	0.06	0.10	0.30,	-0.60
13.14	-80.78	0.10	-42.00,	-inf	26.98	-0.35	0.10	0.30,	-1.30
19.14	-55.38	0.10	-17.50,	-inf	27.84	-3.04	0.10	-2.00,	-5.00
22.10	-3.34	0.10	-2.00,	-5.00	32.14	-69.69	0.10	-17.50,	-inf
22.80	-0.72	0.10	0.30,	-1.30	46.80	-107.72	0.10	-42.00,	-inf
23.49	0.02	0.10	0.30,	-0.60	76.13	-80.59	0.10	-61.00,	-inf
24.16	0.04	0.10	0.30,	-0.40	134.80	-111.51	0.10	-70.00,	-inf
24.80	-0.01	0.10	0.30,	-0.30					

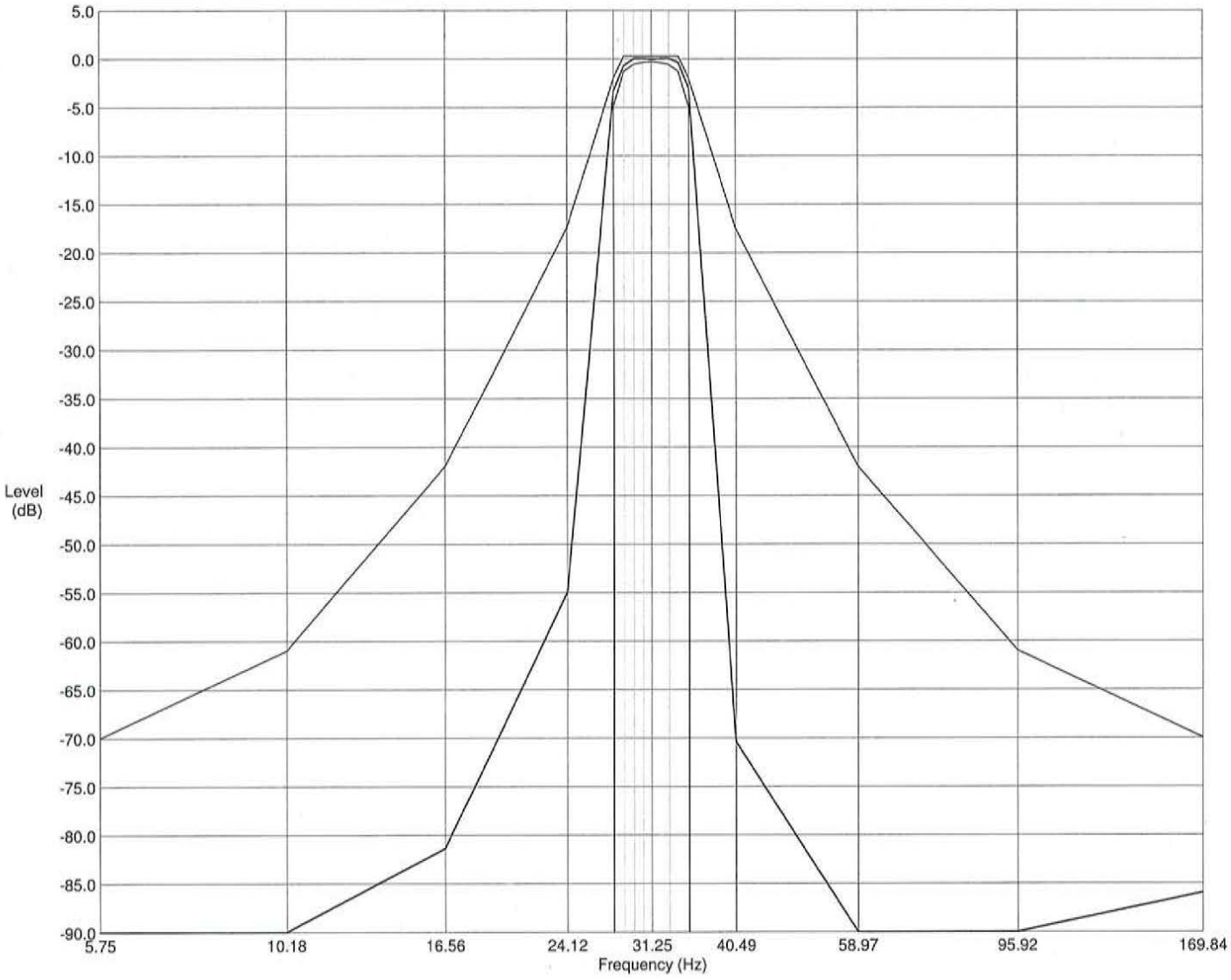
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 31.5 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 31.5 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
5.75	-98.99	0.13	-70.00,	-inf	32.09	-0.01	0.10	0.30,	-0.40
10.18	-90.27	0.10	-61.00,	-inf	33.00	0.06	0.10	0.30,	-0.60
16.56	-81.38	0.10	-42.00,	-inf	33.99	-0.38	0.10	0.30,	-1.30
24.12	-55.00	0.10	-17.50,	-inf	35.08	-3.04	0.10	-2.00,	-5.00
27.84	-3.36	0.10	-2.00,	-5.00	40.49	-70.39	0.10	-17.50,	-inf
28.73	-0.72	0.10	0.30,	-1.30	58.97	-114.14	0.10	-42.00,	-inf
29.59	0.02	0.10	0.30,	-0.60	95.92	-113.58	0.10	-61.00,	-inf
30.44	0.04	0.10	0.30,	-0.40	169.84	-85.96	0.10	-70.00,	-inf
31.25	-0.03	0.10	0.30,	-0.30					

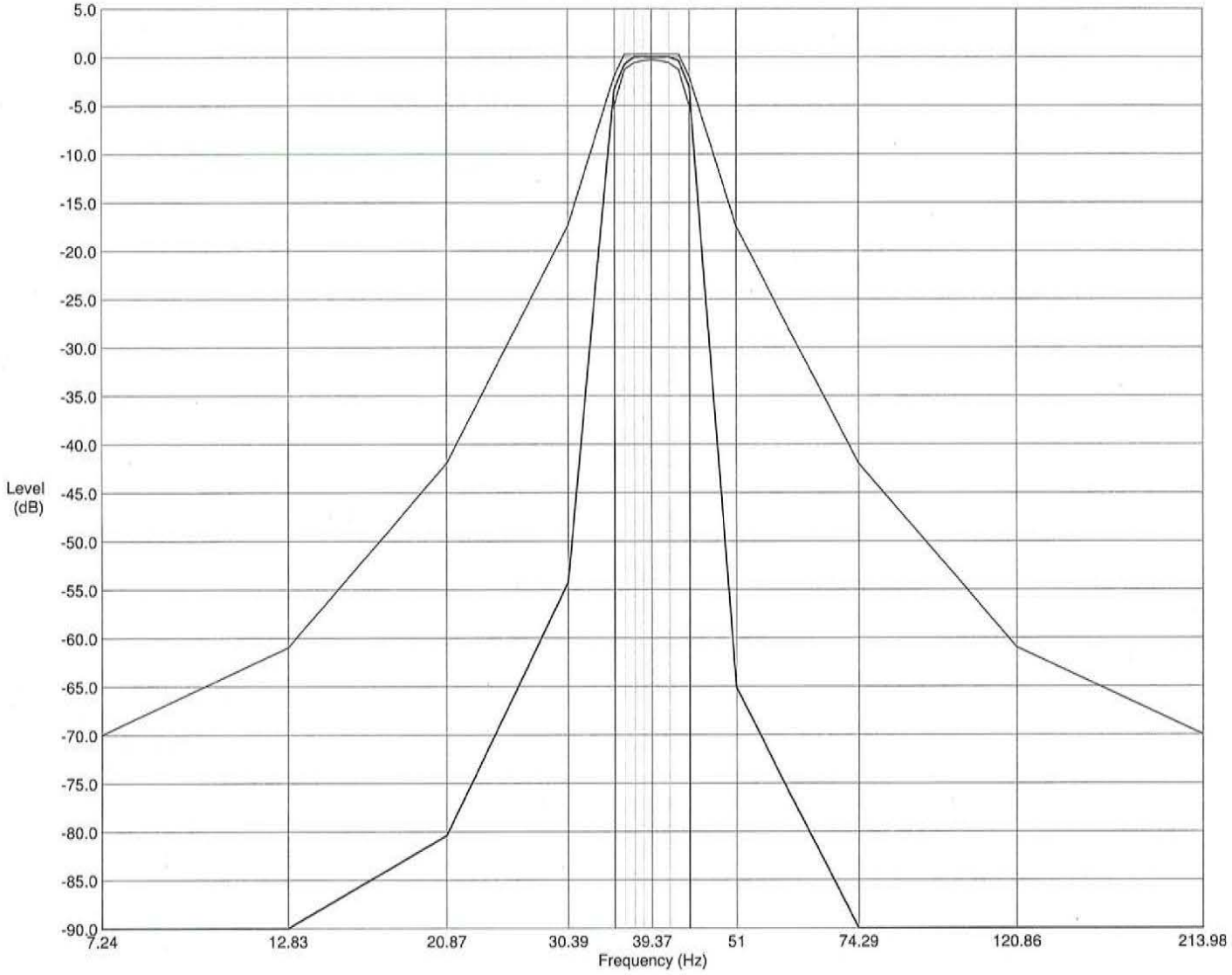
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 40 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 40 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
7.24	-97.98	0.13	-70.00,	-inf
12.83	-90.84	0.10	-61.00,	-inf
20.87	-80.43	0.10	-42.00,	-inf
30.39	-54.26	0.10	-17.50,	-inf
35.08	-3.36	0.10	-2.00,	-5.00
36.20	-0.75	0.10	0.30,	-1.30
37.29	-0.01	0.10	0.30,	-0.60
38.35	0.04	0.10	0.30,	-0.40
39.37	-0.03	0.10	0.30,	-0.30
40.43	-0.01	0.10	0.30,	-0.40
41.58	0.04	0.10	0.30,	-0.60
42.83	-0.40	0.10	0.30,	-1.30
44.19	-3.04	0.10	-2.00,	-5.00
51.01	-65.18	0.10	-17.50,	-inf
74.29	-110.69	0.10	-42.00,	-inf
120.86	-107.00	0.10	-61.00,	-inf
213.98	-98.12	0.10	-70.00,	-inf

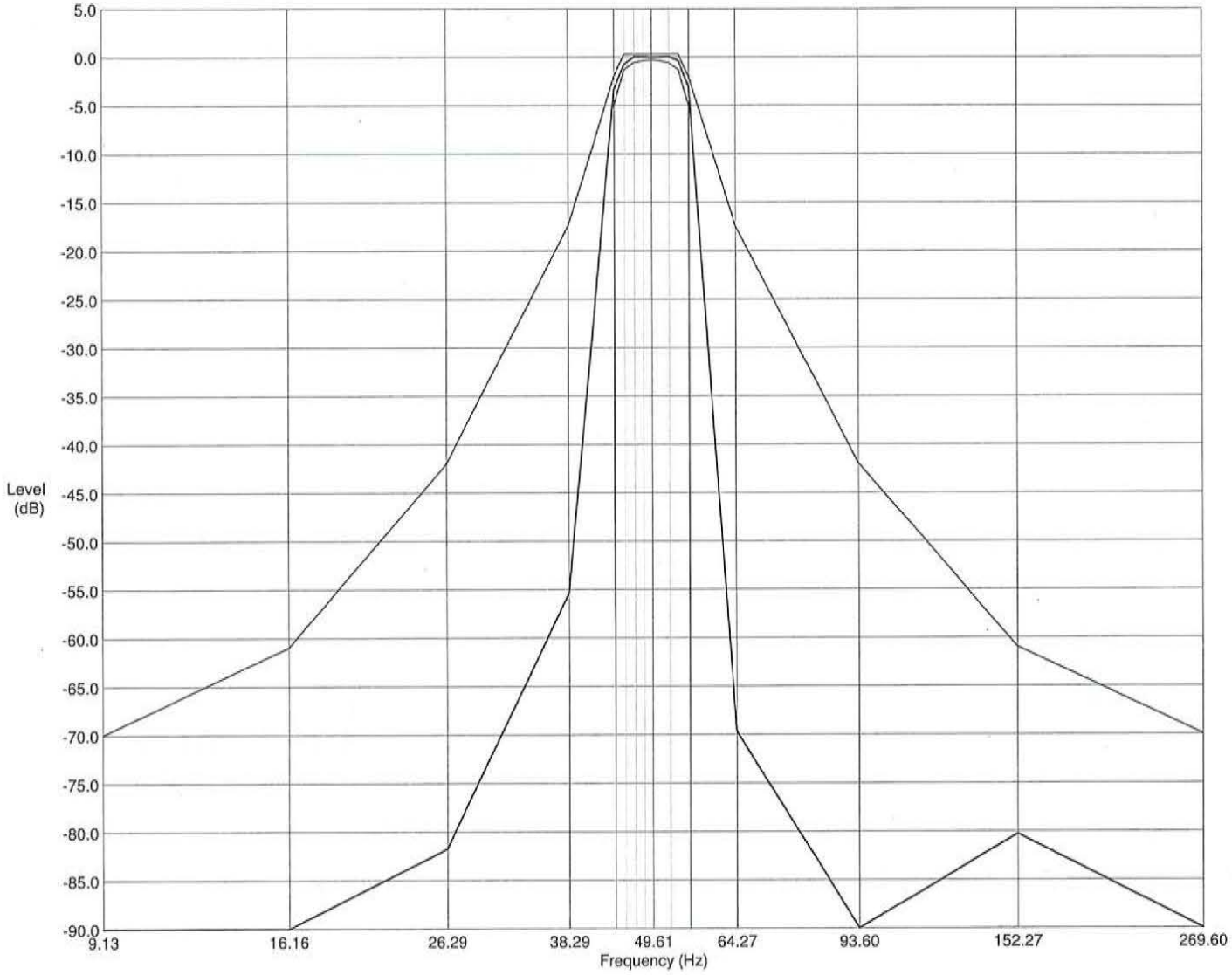
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 50 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 50 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
9.13	-98.34	0.13	-70.00,	-inf
16.16	-90.84	0.10	-61.00,	-inf
26.29	-81.78	0.10	-42.00,	-inf
38.29	-55.41	0.10	-17.50,	-inf
44.19	-3.36	0.10	-2.00,	-5.00
45.60	-0.75	0.10	0.30,	-1.30
46.98	0.02	0.10	0.30,	-0.60
48.31	0.04	0.10	0.30,	-0.40
49.61	-0.03	0.10	0.30,	-0.30
50.93	-0.01	0.10	0.30,	-0.40
52.38	0.06	0.10	0.30,	-0.60
53.96	-0.38	0.10	0.30,	-1.30
55.68	-3.07	0.10	-2.00,	-5.00
64.27	-69.67	0.10	-17.50,	-inf
93.60	-104.71	0.10	-42.00,	-inf
152.27	-80.30	0.10	-61.00,	-inf
269.60	-97.58	0.10	-70.00,	-inf

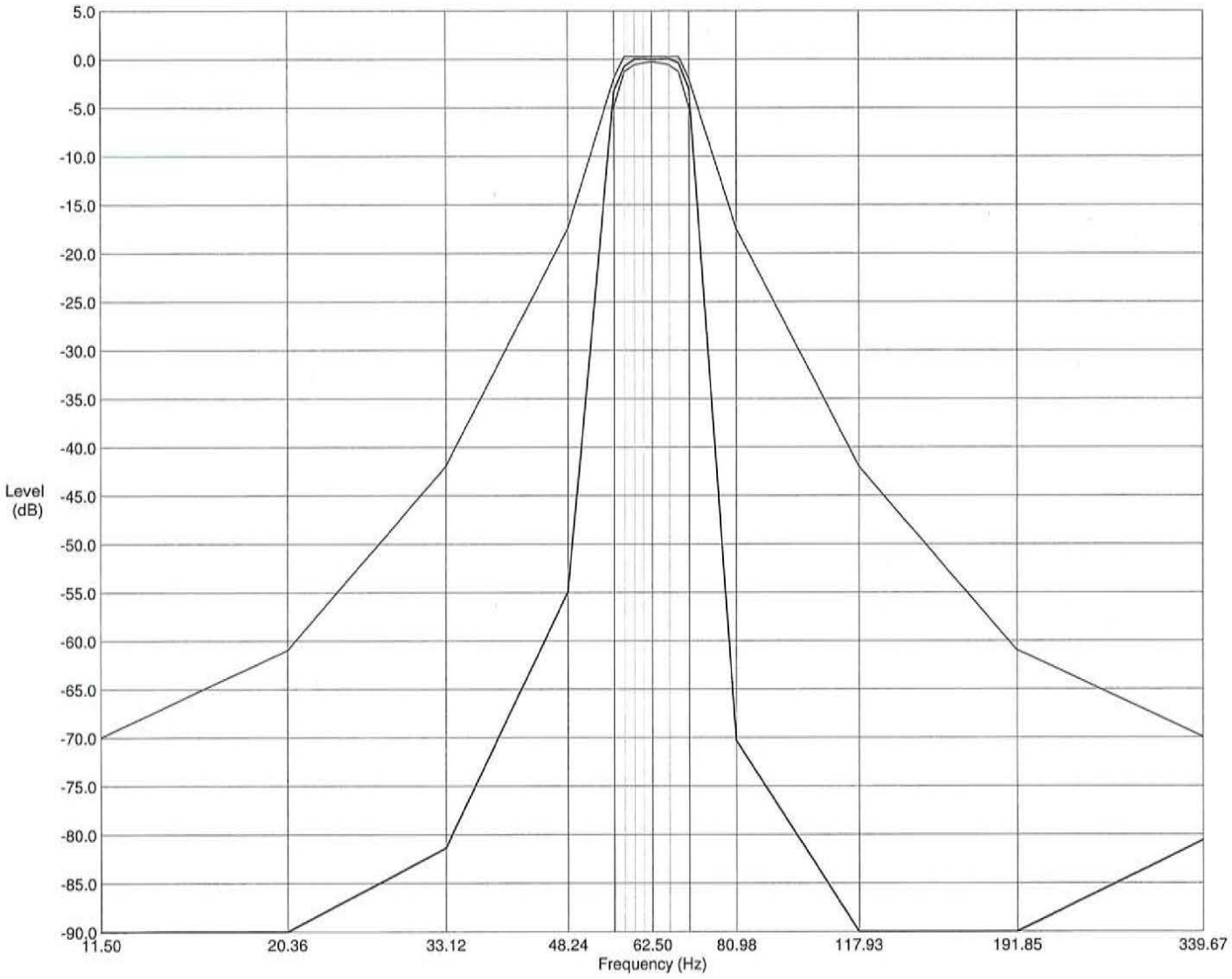
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 63 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 63 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
11.50	-100.82	0.10	-70.00,	-inf
20.36	-90.82	0.10	-61.00,	-inf
33.12	-81.40	0.10	-42.00,	-inf
48.24	-55.00	0.10	-17.50,	-inf
55.68	-3.36	0.10	-2.00,	-5.00
57.46	-0.75	0.10	0.30,	-1.30
59.19	0.02	0.10	0.30,	-0.60
60.87	0.04	0.10	0.30,	-0.40
62.50	-0.03	0.10	0.30,	-0.30
64.17	-0.01	0.10	0.30,	-0.40
66.00	0.06	0.10	0.30,	-0.60
67.99	-0.38	0.10	0.30,	-1.30
70.15	-3.07	0.10	-2.00,	-5.00
80.98	-70.36	0.10	-17.50,	-inf
117.93	-107.57	0.10	-42.00,	-inf
191.85	-99.14	0.10	-61.00,	-inf
339.67	-80.61	0.10	-70.00,	-inf

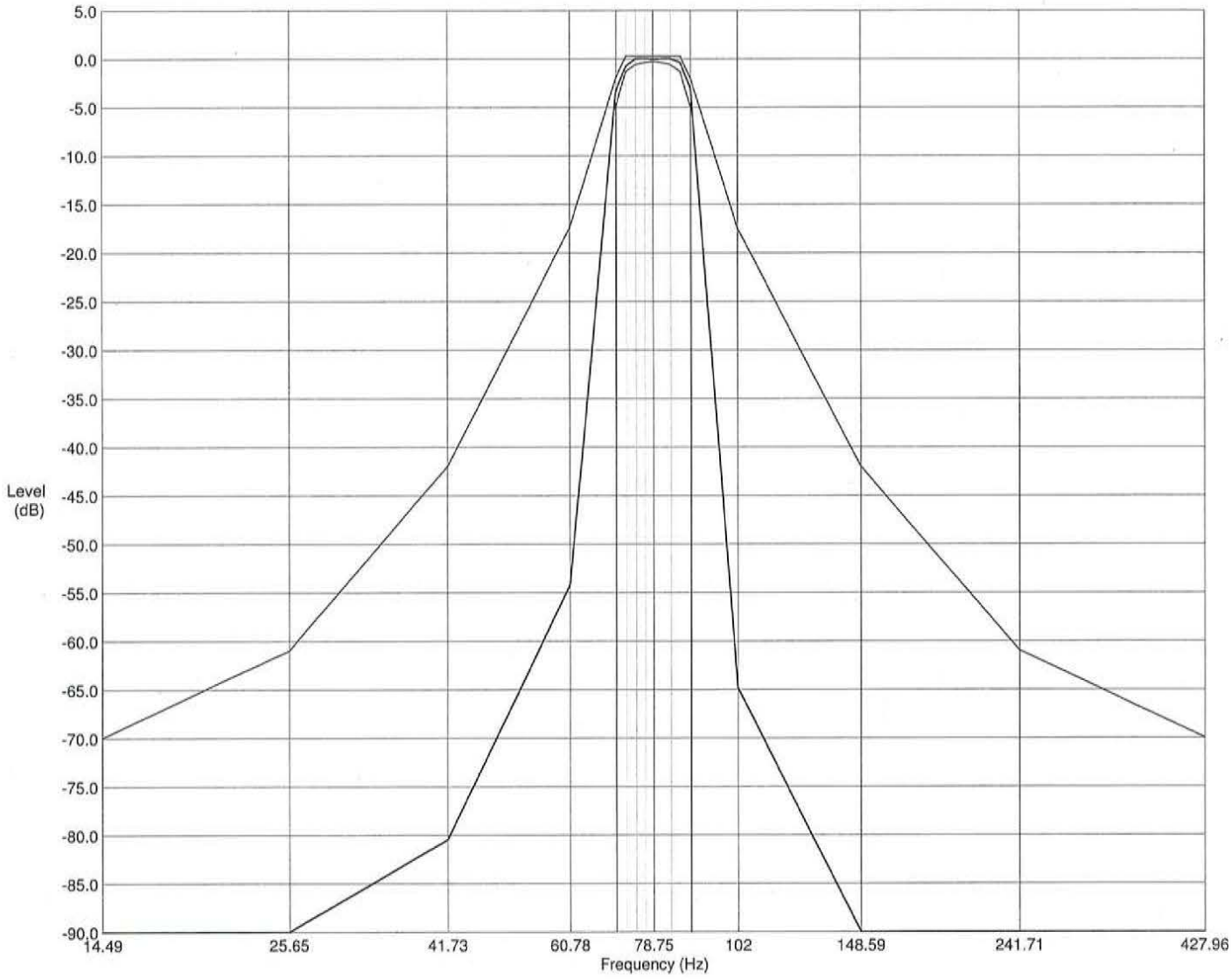
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 80 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 80 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
14.49	-101.18	0.10	-70.00,	-inf
25.65	-90.39	0.10	-61.00,	-inf
41.73	-80.51	0.10	-42.00,	-inf
60.78	-54.26	0.10	-17.50,	-inf
70.15	-3.39	0.10	-2.00,	-5.00
72.39	-0.75	0.10	0.30,	-1.30
74.57	-0.01	0.10	0.30,	-0.60
76.69	0.04	0.10	0.30,	-0.40
78.75	-0.03	0.10	0.30,	-0.30

Freq (Hz)	Measured	Uncertainty	Limits	
80.85	-0.01	0.10	0.30,	-0.40
83.15	0.04	0.10	0.30,	-0.60
85.66	-0.40	0.10	0.30,	-1.30
88.39	-3.04	0.10	-2.00,	-5.00
102.03	-64.87	0.10	-17.50,	-inf
148.59	-103.33	0.10	-42.00,	-inf
241.71	-97.08	0.10	-61.00,	-inf
427.96	-98.84	0.10	-70.00,	-inf

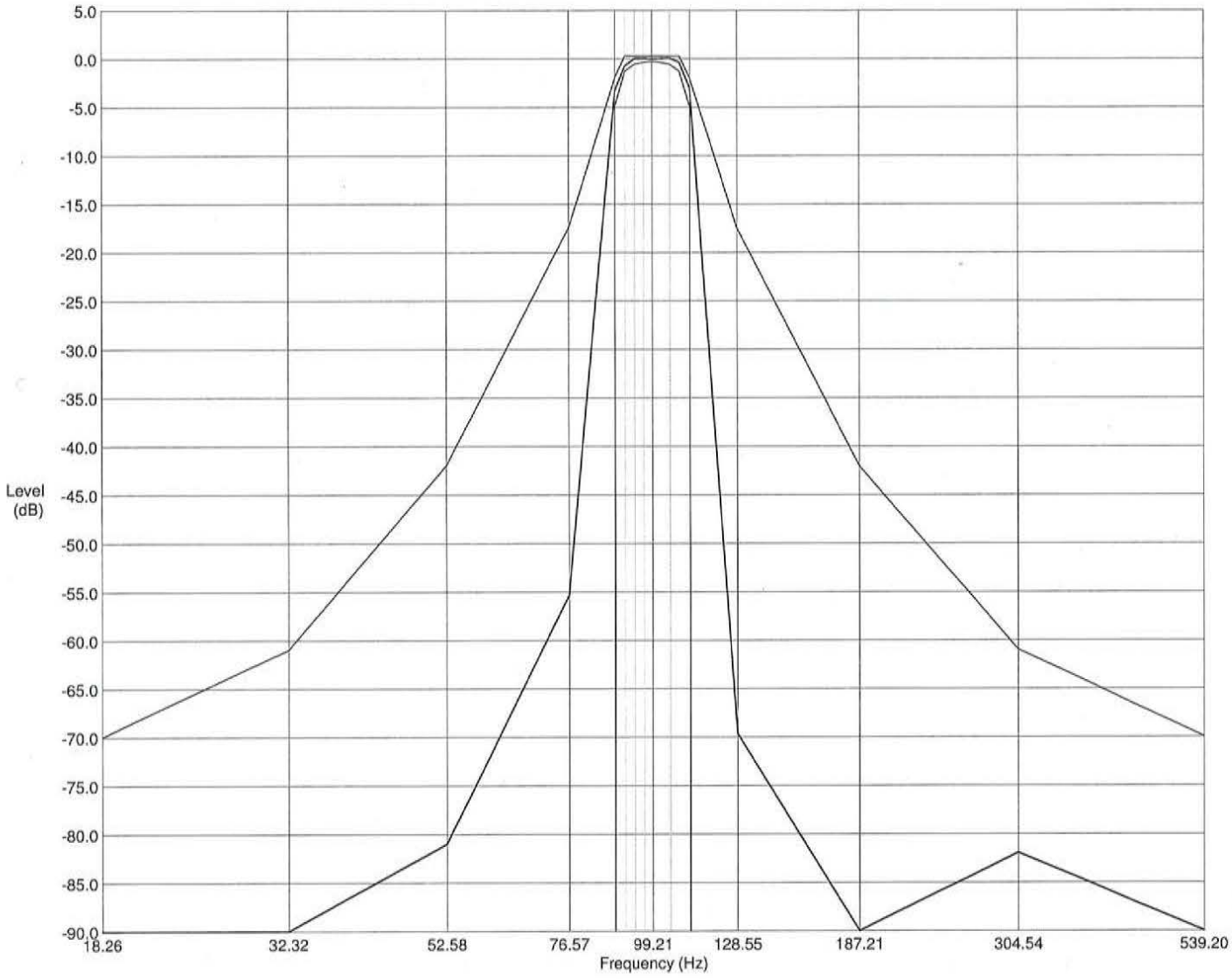
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 100 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 100 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
18.26	-102.73	0.10	-70.00,	-inf
32.32	-90.27	0.10	-61.00,	-inf
52.58	-81.03	0.10	-42.00,	-inf
76.57	-55.38	0.10	-17.50,	-inf
88.39	-3.36	0.10	-2.00,	-5.00
91.21	-0.75	0.10	0.30,	-1.30
93.96	0.02	0.10	0.30,	-0.60
96.63	0.04	0.10	0.30,	-0.40
99.21	-0.03	0.10	0.30,	-0.30
101.87	-0.01	0.10	0.30,	-0.40
104.76	0.06	0.10	0.30,	-0.60
107.92	-0.38	0.10	0.30,	-1.30
111.36	-3.07	0.10	-2.00,	-5.00
128.55	-69.67	0.10	-17.50,	-inf
187.21	-98.18	0.10	-42.00,	-inf
304.54	-81.95	0.10	-61.00,	-inf
539.20	-100.26	0.10	-70.00,	-inf

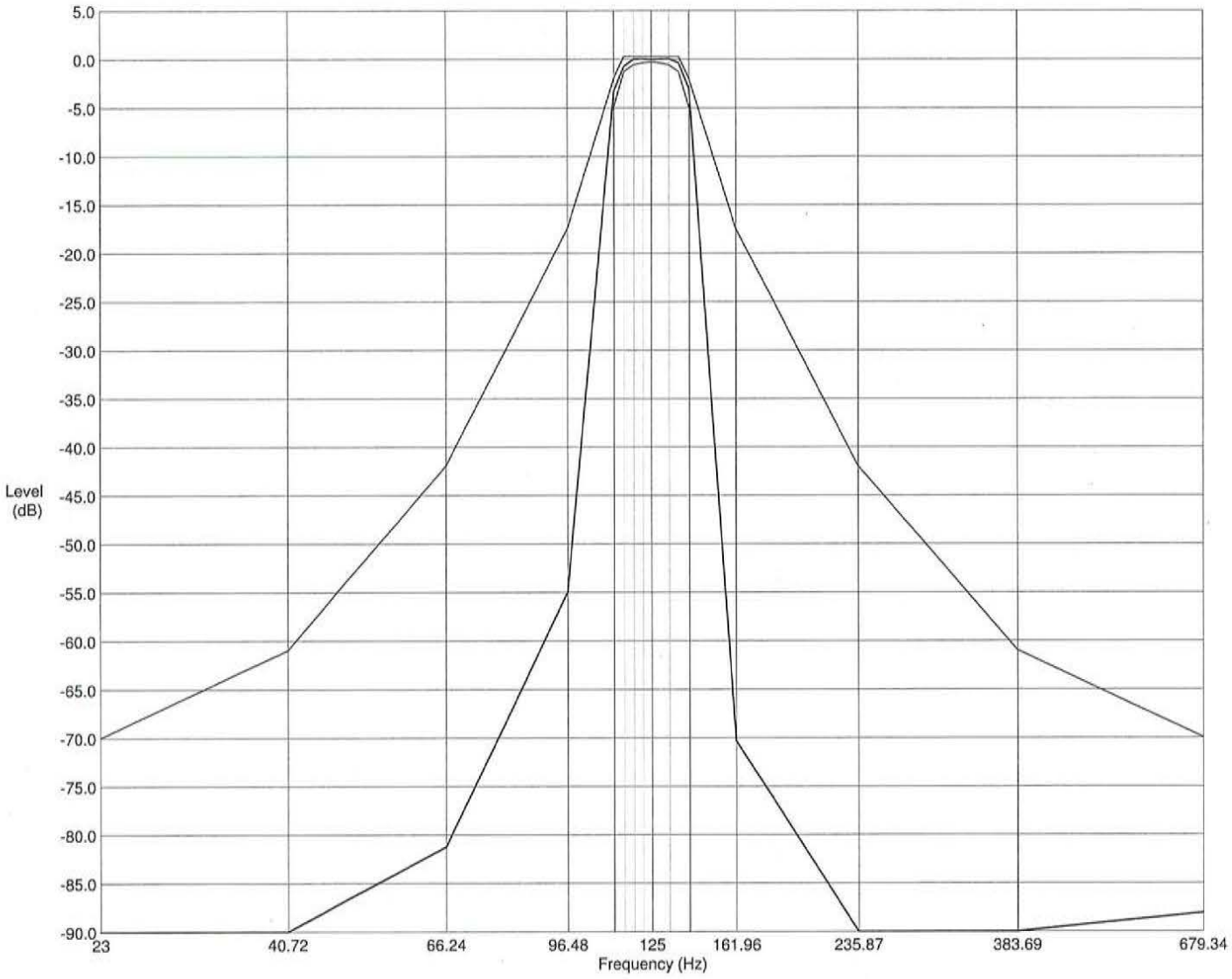
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 125 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 125 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
23.00	-101.62	0.10	-70.00,	-inf	128.34	-0.01	0.10	0.30,	-0.40
40.72	-91.66	0.10	-61.00,	-inf	131.99	0.06	0.10	0.30,	-0.60
66.24	-81.26	0.10	-42.00,	-inf	135.97	-0.38	0.10	0.30,	-1.30
96.48	-55.00	0.10	-17.50,	-inf	140.31	-3.07	0.10	-2.00,	-5.00
111.36	-3.36	0.10	-2.00,	-5.00	161.96	-70.36	0.10	-17.50,	-inf
114.91	-0.75	0.10	0.30,	-1.30	235.87	-103.51	0.10	-42.00,	-inf
118.38	0.02	0.10	0.30,	-0.60	383.69	-92.47	0.10	-61.00,	-inf
121.74	0.04	0.10	0.30,	-0.40	679.34	-88.08	0.10	-70.00,	-inf
125.00	-0.03	0.10	0.30,	-0.30					

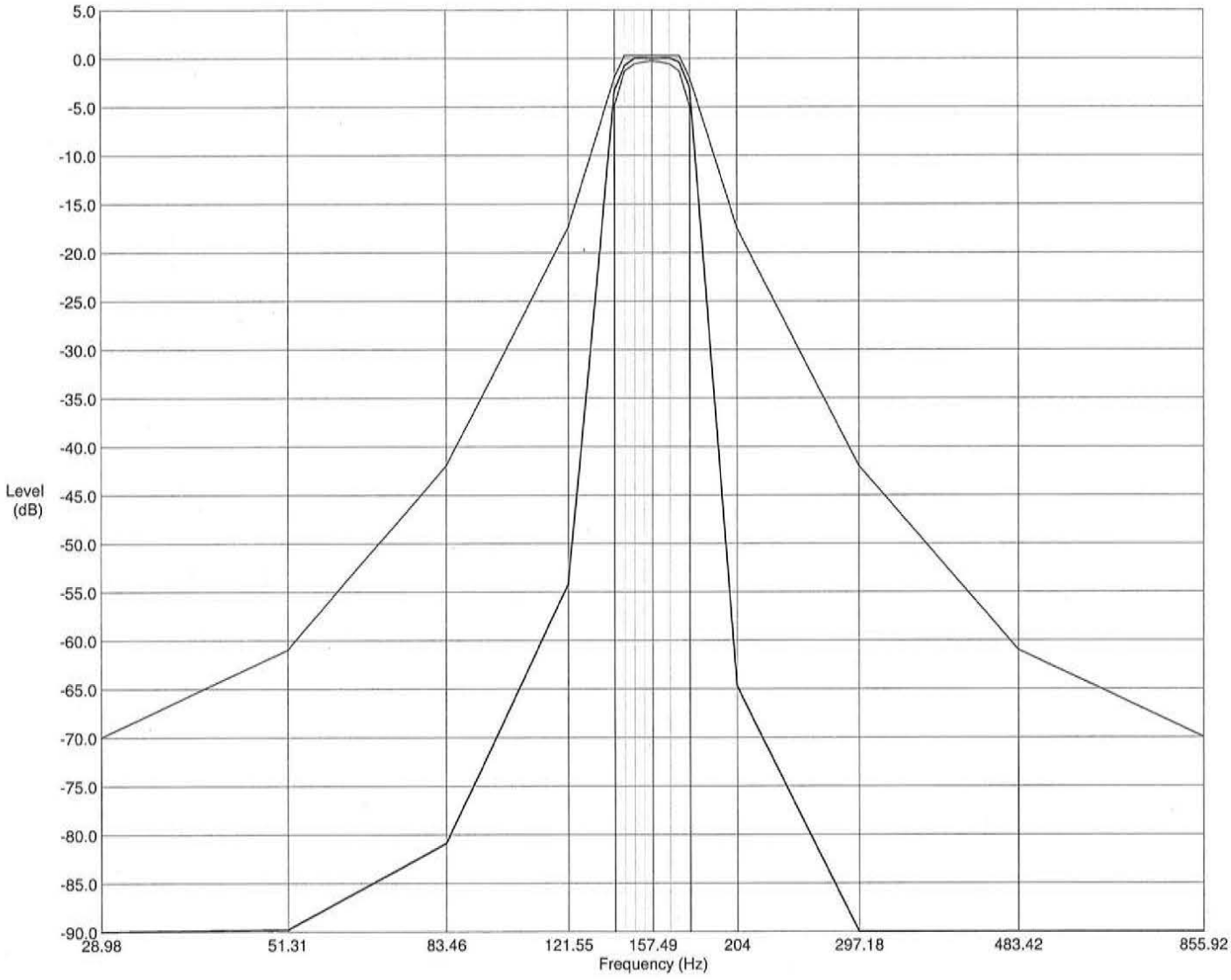
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 160 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 160 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
28.98	-100.09	0.10	-70.00,	-inf
51.31	-89.81	0.10	-61.00,	-inf
83.46	-80.90	0.10	-42.00,	-inf
121.55	-54.26	0.10	-17.50,	-inf
140.31	-3.39	0.10	-2.00,	-5.00
144.78	-0.75	0.10	0.30,	-1.30
149.15	-0.01	0.10	0.30,	-0.60
153.39	0.04	0.10	0.30,	-0.40
157.49	-0.03	0.10	0.30,	-0.30
161.70	-0.01	0.10	0.30,	-0.40
166.30	0.04	0.10	0.30,	-0.60
171.31	-0.40	0.10	0.30,	-1.30
176.78	-3.04	0.10	-2.00,	-5.00
204.05	-64.72	0.10	-17.50,	-inf
297.18	-98.14	0.10	-42.00,	-inf
483.42	-91.75	0.10	-61.00,	-inf
855.92	-103.89	0.10	-70.00,	-inf

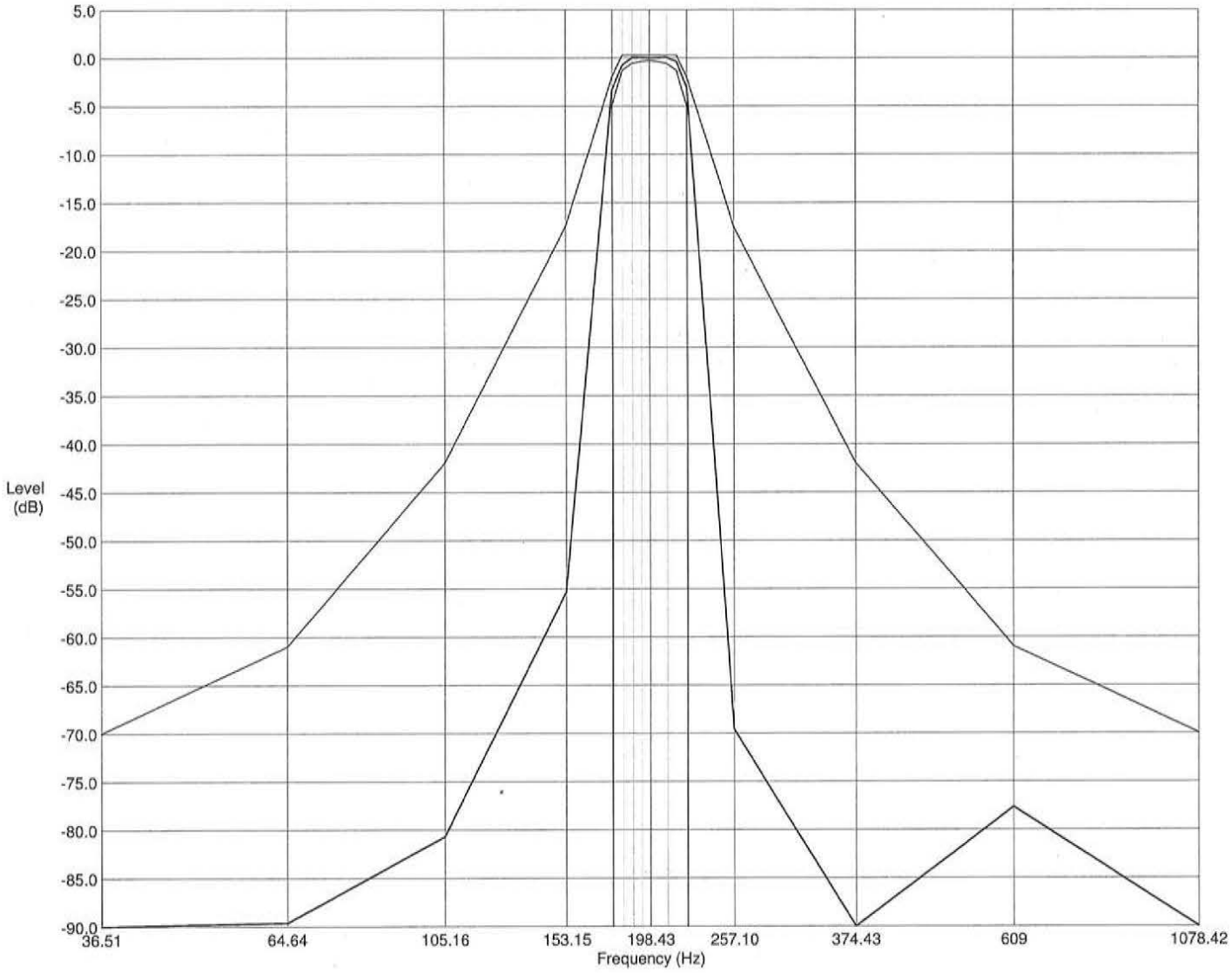
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 200 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 200 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
36.51	-100.35	0.10	-70.00,	-inf
64.64	-89.64	0.10	-61.00,	-inf
105.16	-80.69	0.10	-42.00,	-inf
153.15	-55.35	0.10	-17.50,	-inf
176.78	-3.36	0.10	-2.00,	-5.00
182.42	-0.75	0.10	0.30,	-1.30
187.92	0.02	0.10	0.30,	-0.60
193.26	0.04	0.10	0.30,	-0.40
198.43	-0.03	0.10	0.30,	-0.30

Freq (Hz)	Measured	Uncertainty	Limits	
203.74	-0.01	0.10	0.30,	-0.40
209.53	0.06	0.10	0.30,	-0.60
215.84	-0.38	0.10	0.30,	-1.30
222.73	-3.07	0.10	-2.00,	-5.00
257.10	-69.61	0.10	-17.50,	-inf
374.43	-93.70	0.10	-42.00,	-inf
609.09	-77.68	0.10	-61.00,	-inf
1078.42	-101.57	0.10	-70.00,	-inf

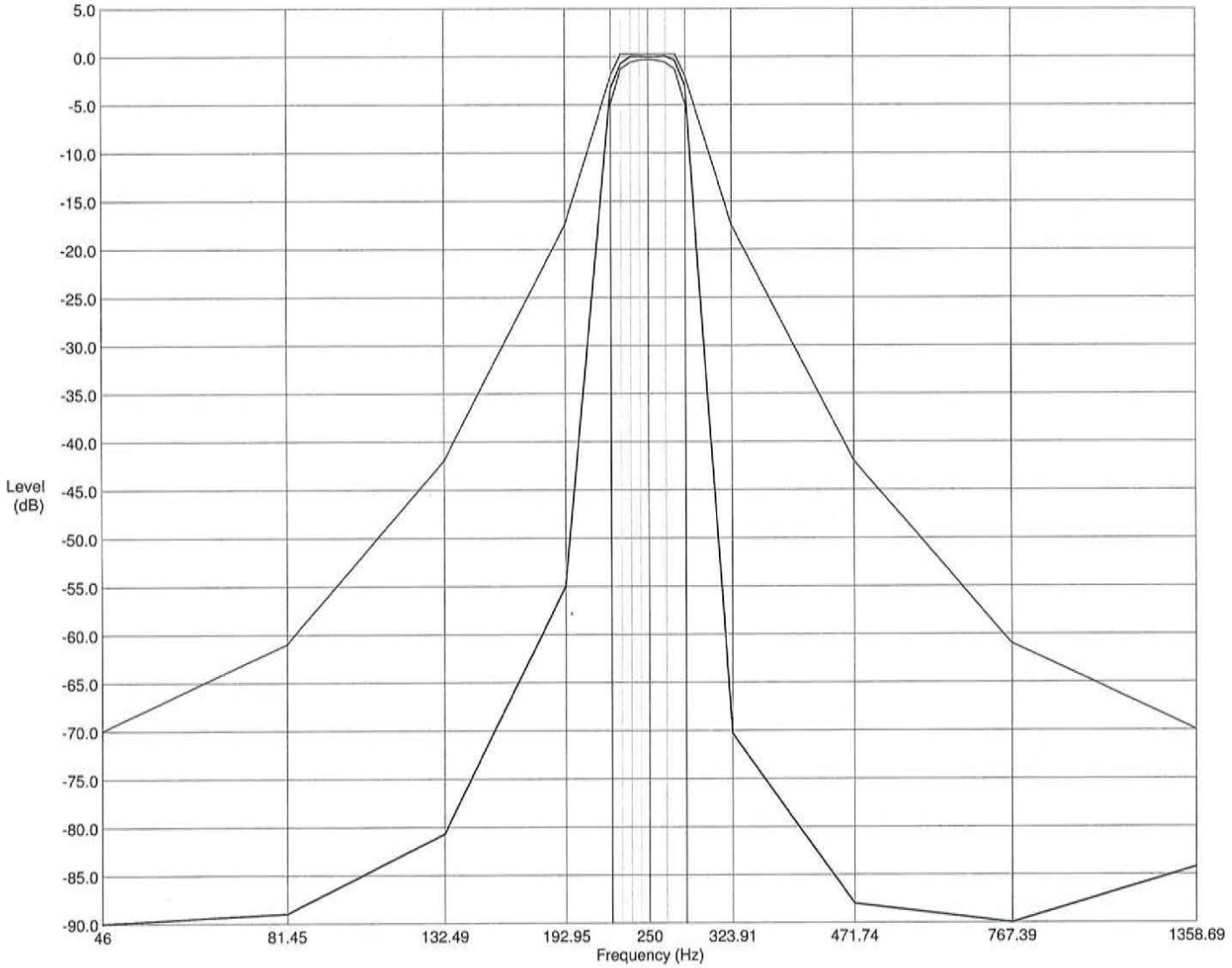
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 250 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 250 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
46.00	-99.23	0.10	-70.00,	-inf
81.45	-89.02	0.10	-61.00,	-inf
132.49	-80.69	0.10	-42.00,	-inf
192.95	-55.00	0.10	-17.50,	-inf
222.72	-3.36	0.10	-2.00,	-5.00
229.83	-0.75	0.10	0.30,	-1.30
236.76	0.02	0.10	0.30,	-0.60
243.48	0.04	0.10	0.30,	-0.40
250.00	-0.03	0.10	0.30,	-0.30

Freq (Hz)	Measured	Uncertainty	Limits	
256.69	-0.01	0.10	0.30,	-0.40
263.98	0.06	0.10	0.30,	-0.60
271.94	-0.38	0.10	0.30,	-1.30
280.62	-3.07	0.10	-2.00,	-5.00
323.91	-70.34	0.10	-17.50,	-inf
471.74	-88.02	0.10	-42.00,	-inf
767.39	-97.58	0.10	-61.00,	-inf
1358.69	-84.25	0.10	-70.00,	-inf

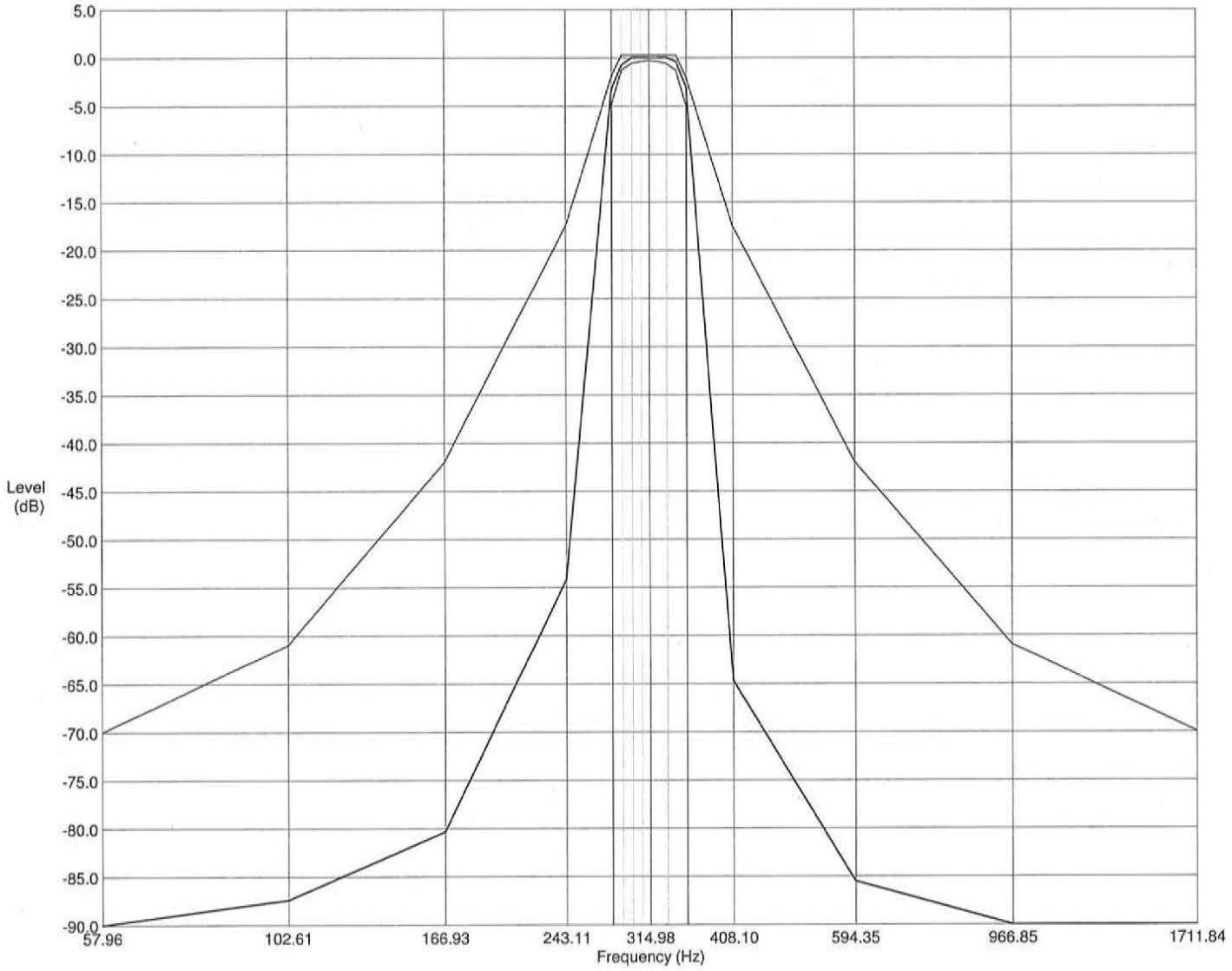
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 315 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 315 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
57.96	-99.05	0.10	-70.00,	-inf
102.61	-87.43	0.10	-61.00,	-inf
166.93	-80.35	0.10	-42.00,	-inf
243.11	-54.24	0.10	-17.50,	-inf
280.62	-3.36	0.10	-2.00,	-5.00
289.57	-0.75	0.10	0.30,	-1.30
298.29	0.02	0.10	0.30,	-0.60
306.77	0.04	0.10	0.30,	-0.40
314.98	-0.01	0.10	0.30,	-0.30
323.41	-0.01	0.10	0.30,	-0.40
332.60	0.04	0.10	0.30,	-0.60
342.62	-0.40	0.10	0.30,	-1.30
353.55	-3.04	0.10	-2.00,	-5.00
408.10	-64.72	0.10	-17.50,	-inf
594.35	-85.54	0.10	-42.00,	-inf
966.85	-94.73	0.10	-61.00,	-inf
1711.84	-92.93	0.10	-70.00,	-inf

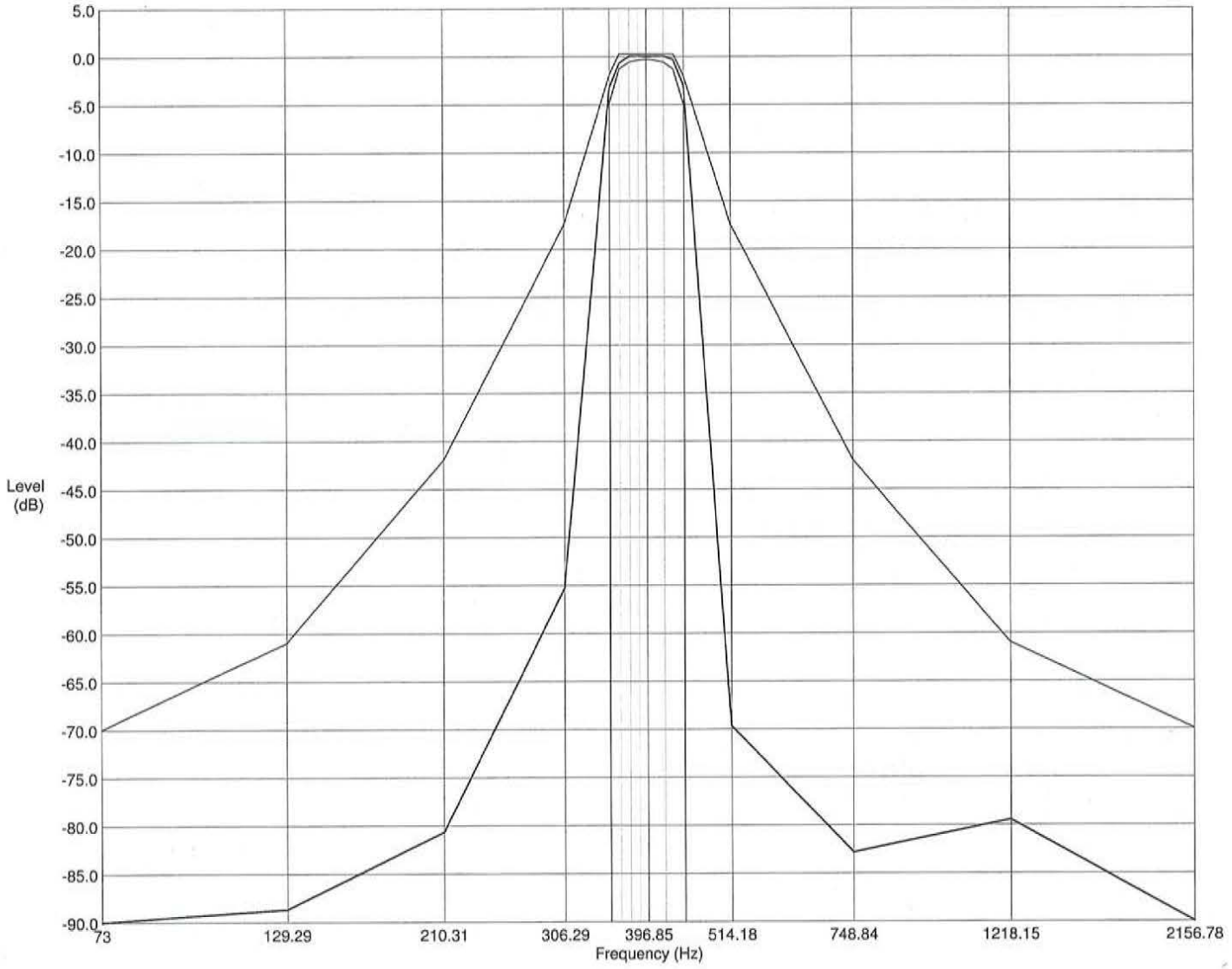
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 400 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 400 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
73.02	-98.65	0.10	-70.00,	-inf
129.29	-88.68	0.10	-61.00,	-inf
210.31	-80.67	0.10	-42.00,	-inf
306.29	-55.35	0.10	-17.50,	-inf
353.55	-3.34	0.10	-2.00,	-5.00
364.83	-0.70	0.10	0.30,	-1.30
375.83	0.04	0.10	0.30,	-0.60
386.51	0.06	0.10	0.30,	-0.40
396.85	0.02	0.10	0.30,	-0.30
407.47	0.04	0.10	0.30,	-0.40
419.05	0.08	0.10	0.30,	-0.60
431.68	-0.32	0.10	0.30,	-1.30
445.45	-3.02	0.10	-2.00,	-5.00
514.18	-69.69	0.10	-17.50,	-inf
748.84	-82.82	0.10	-42.00,	-inf
1218.15	-79.46	0.10	-61.00,	-inf
2156.78	-100.53	0.10	-70.00,	-inf

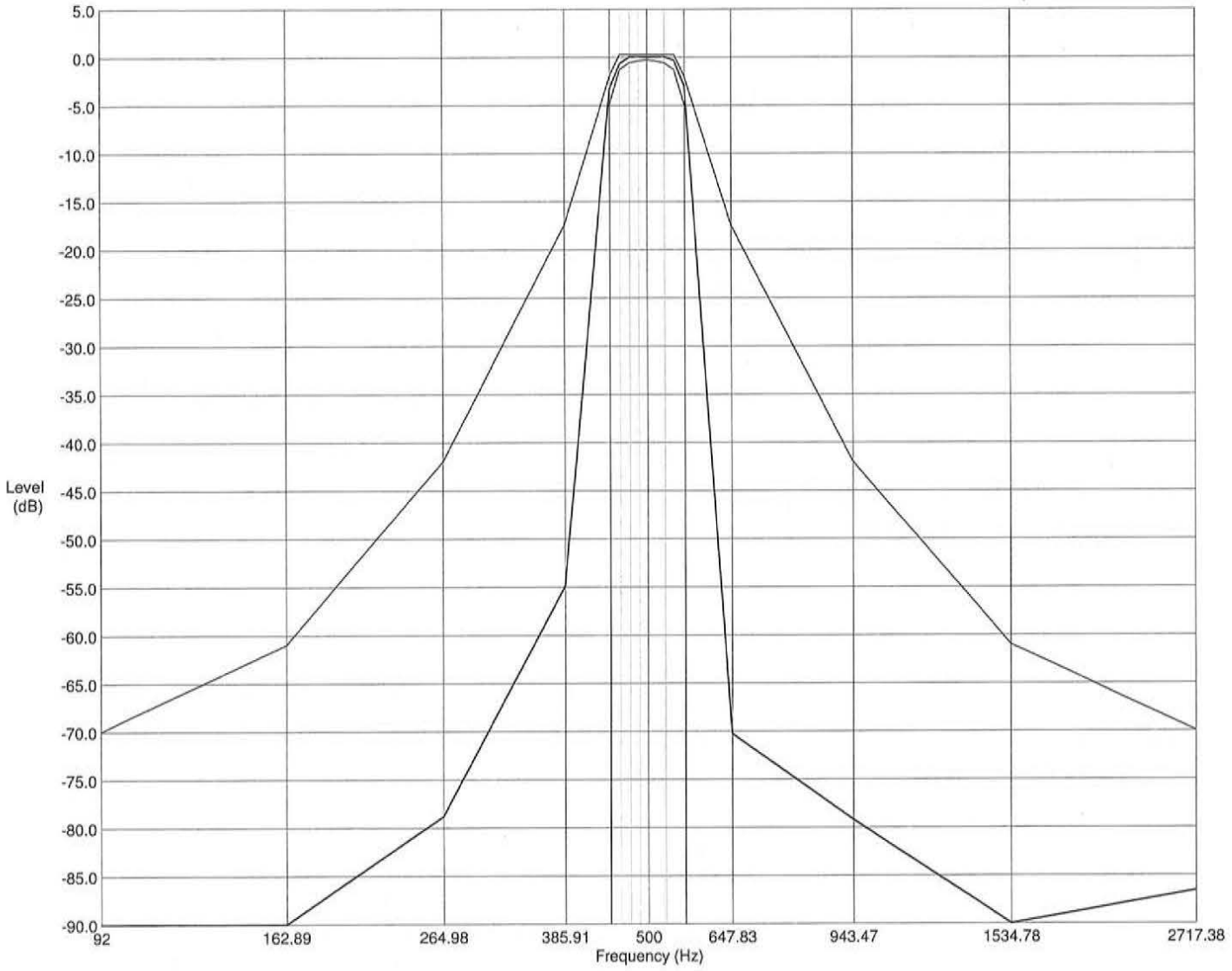
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 500 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 500 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
92.00	-96.53	0.10	-70.00,	-inf
162.89	-90.74	0.10	-61.00,	-inf
264.98	-78.85	0.10	-42.00,	-inf
385.91	-54.93	0.10	-17.50,	-inf
445.45	-3.34	0.10	-2.00,	-5.00
459.66	-0.70	0.10	0.30,	-1.30
473.51	0.04	0.10	0.30,	-0.60
486.97	0.06	0.10	0.30,	-0.40
500.00	0.02	0.10	0.30,	-0.30
513.38	0.04	0.10	0.30,	-0.40
527.97	0.08	0.10	0.30,	-0.60
543.88	-0.32	0.10	0.30,	-1.30
561.23	-3.02	0.10	-2.00,	-5.00
647.83	-70.28	0.10	-17.50,	-inf
943.47	-79.22	0.10	-42.00,	-inf
1534.78	-93.21	0.10	-61.00,	-inf
2717.38	-86.59	0.10	-70.00,	-inf

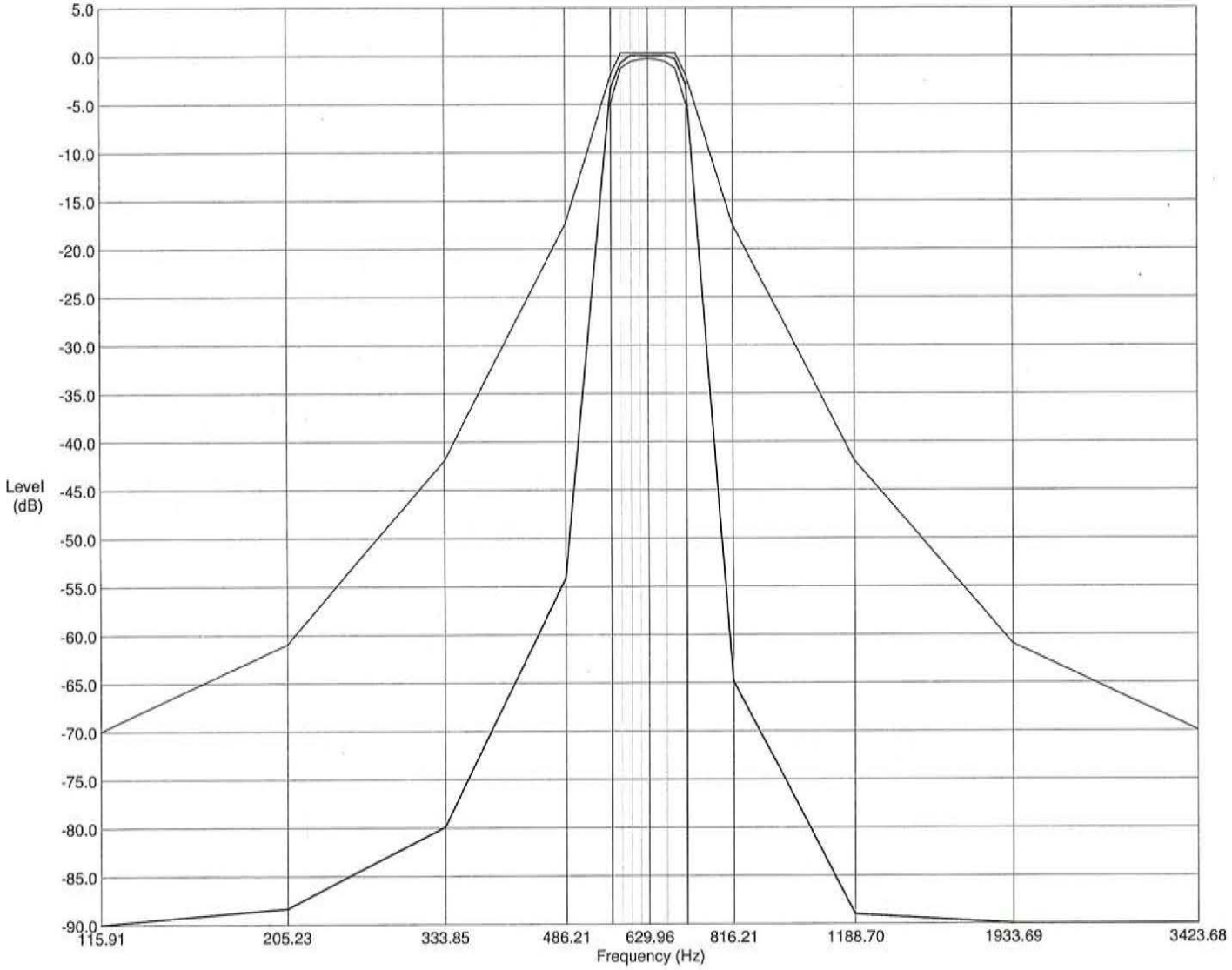
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 630 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 630 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
115.91	-99.90	0.10	-70.00,	-inf
205.23	-88.37	0.10	-61.00,	-inf
333.85	-79.94	0.10	-42.00,	-inf
486.21	-54.14	0.10	-17.50,	-inf
561.23	-3.34	0.10	-2.00,	-5.00
579.13	-0.72	0.10	0.30,	-1.30
596.59	0.04	0.10	0.30,	-0.60
613.54	0.08	0.10	0.30,	-0.40
629.96	0.02	0.10	0.30,	-0.30
646.82	0.04	0.10	0.30,	-0.40
665.20	0.08	0.10	0.30,	-0.60
685.25	-0.35	0.10	0.30,	-1.30
707.11	-3.00	0.10	-2.00,	-5.00
816.21	-64.87	0.10	-17.50,	-inf
1188.70	-89.03	0.10	-42.00,	-inf
1933.69	-94.13	0.10	-61.00,	-inf
3423.68	-90.04	0.10	-70.00,	-inf

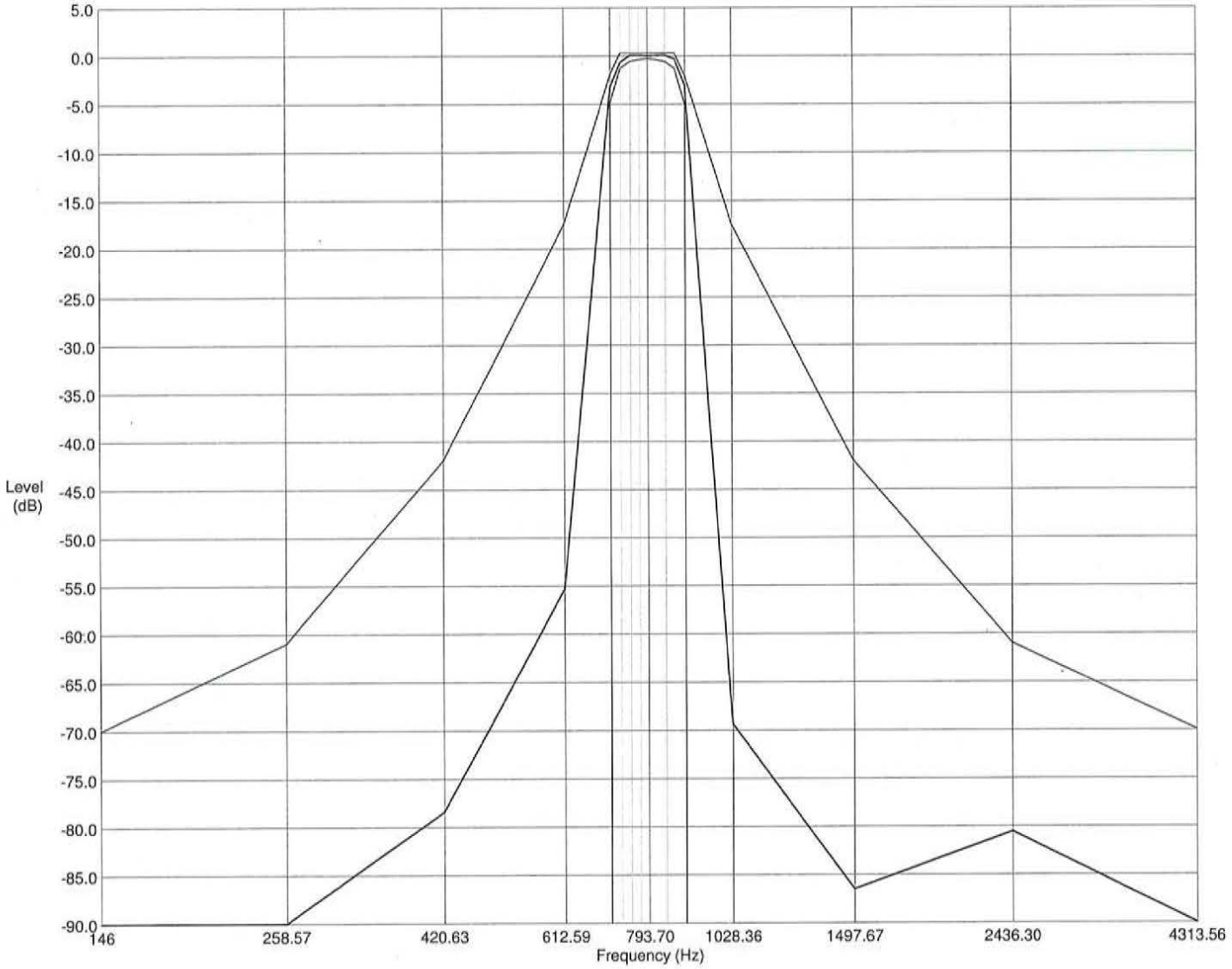
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 800 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 800 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
146.04	-99.82	0.10	-70.00,	-inf
258.57	-90.25	0.10	-61.00,	-inf
420.63	-78.44	0.10	-42.00,	-inf
612.59	-55.32	0.10	-17.50,	-inf
707.11	-3.31	0.10	-2.00,	-5.00
729.66	-0.70	0.10	0.30,	-1.30
751.65	0.06	0.10	0.30,	-0.60
773.02	0.08	0.10	0.30,	-0.40
793.70	0.02	0.10	0.30,	-0.30
814.94	0.04	0.10	0.30,	-0.40
838.10	0.11	0.10	0.30,	-0.60
863.36	-0.32	0.10	0.30,	-1.30
890.90	-3.02	0.10	-2.00,	-5.00
1028.36	-69.36	0.10	-17.50,	-inf
1497.67	-86.51	0.10	-42.00,	-inf
2436.30	-80.57	0.10	-61.00,	-inf
4313.56	-92.46	0.10	-70.00,	-inf

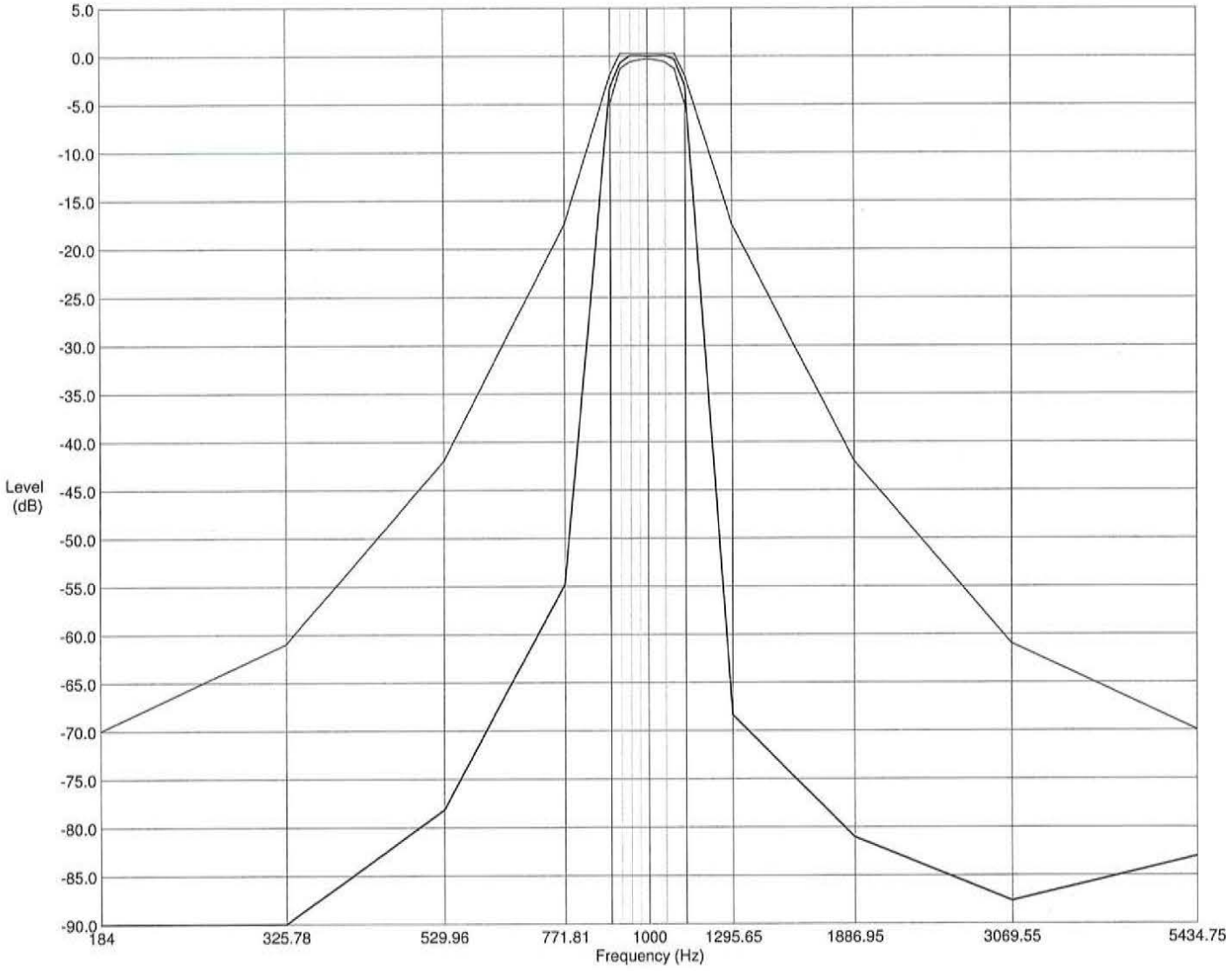
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 1000 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 1000 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
184.00	-97.93	0.10	-70.00,	-inf
325.78	-90.15	0.10	-61.00,	-inf
529.96	-78.18	0.10	-42.00,	-inf
771.81	-54.85	0.10	-17.50,	-inf
890.90	-3.31	0.10	-2.00,	-5.00
919.32	-0.70	0.10	0.30,	-1.30
947.02	0.06	0.10	0.30,	-0.60
973.94	0.08	0.10	0.30,	-0.40
1000.00	0.02	0.10	0.30,	-0.30
1026.76	0.04	0.10	0.30,	-0.40
1055.94	0.11	0.10	0.30,	-0.60
1087.76	-0.32	0.10	0.30,	-1.30
1122.46	-3.02	0.10	-2.00,	-5.00
1295.65	-68.41	0.10	-17.50,	-inf
1886.95	-81.06	0.10	-42.00,	-inf
3069.55	-87.65	0.10	-61.00,	-inf
5434.75	-83.07	0.10	-70.00,	-inf

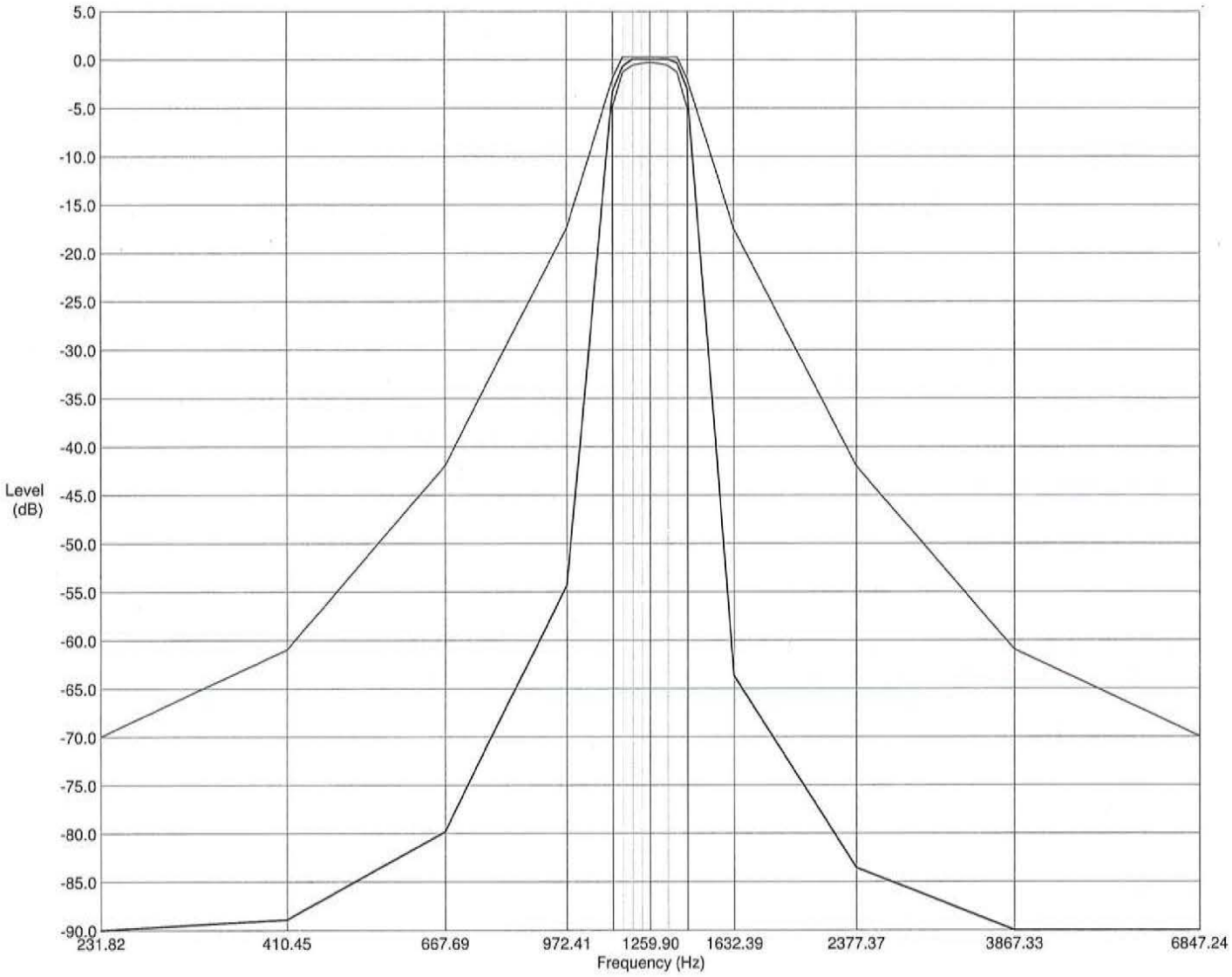
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 1250 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 1250 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
231.82	-99.28	0.10	-70.00,	-inf	1293.61	0.04	0.10	0.30,	-0.40
410.45	-88.92	0.10	-61.00,	-inf	1330.38	0.11	0.10	0.30,	-0.60
667.69	-79.84	0.10	-42.00,	-inf	1370.47	-0.35	0.10	0.30,	-1.30
972.41	-54.36	0.10	-17.50,	-inf	1414.19	-3.00	0.10	-2.00,	-5.00
1122.44	-3.34	0.10	-2.00,	-5.00	1632.39	-63.70	0.10	-17.50,	-inf
1158.25	-0.70	0.10	0.30,	-1.30	2377.37	-83.58	0.10	-42.00,	-inf
1193.16	0.06	0.10	0.30,	-0.60	3867.33	-91.50	0.10	-61.00,	-inf
1227.07	0.08	0.10	0.30,	-0.40	6847.24	-90.61	0.10	-70.00,	-inf
1259.90	0.04	0.10	0.30,	-0.30					

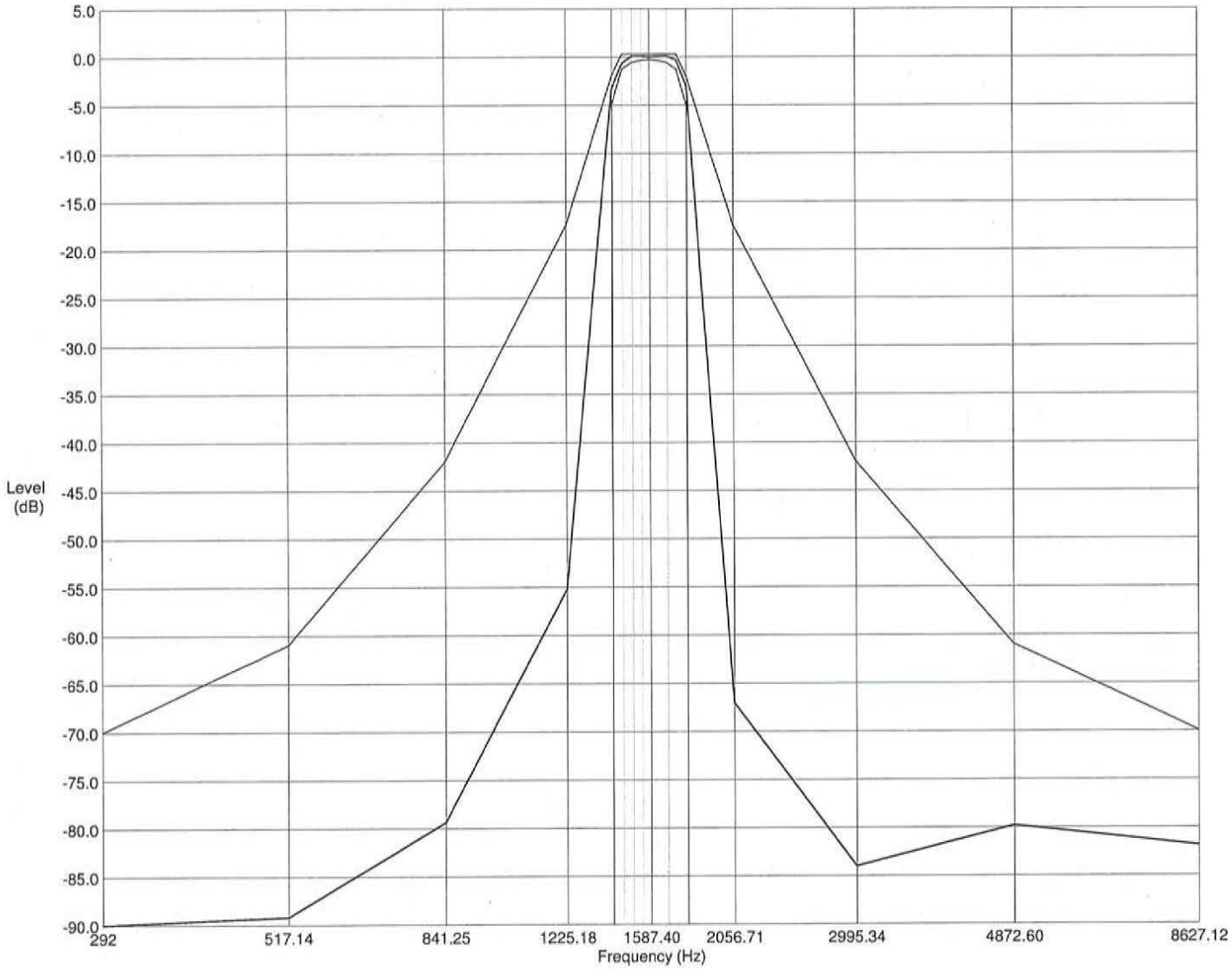
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 1600 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 1600 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
292.08	-98.36	0.10	-70.00,	-inf
517.14	-89.20	0.10	-61.00,	-inf
841.25	-79.37	0.10	-42.00,	-inf
1225.18	-55.25	0.10	-17.50,	-inf
1414.21	-3.31	0.10	-2.00,	-5.00
1459.33	-0.70	0.10	0.30,	-1.30
1503.31	0.06	0.10	0.30,	-0.60
1546.03	0.08	0.10	0.30,	-0.40
1587.40	0.02	0.10	0.30,	-0.30
1629.88	0.04	0.10	0.30,	-0.40
1676.20	0.11	0.10	0.30,	-0.60
1726.71	-0.32	0.10	0.30,	-1.30
1781.80	-3.02	0.10	-2.00,	-5.00
2056.71	-67.09	0.10	-17.50,	-inf
2995.34	-84.02	0.10	-42.00,	-inf
4872.60	-79.81	0.10	-61.00,	-inf
8627.12	-81.89	0.10	-70.00,	-inf

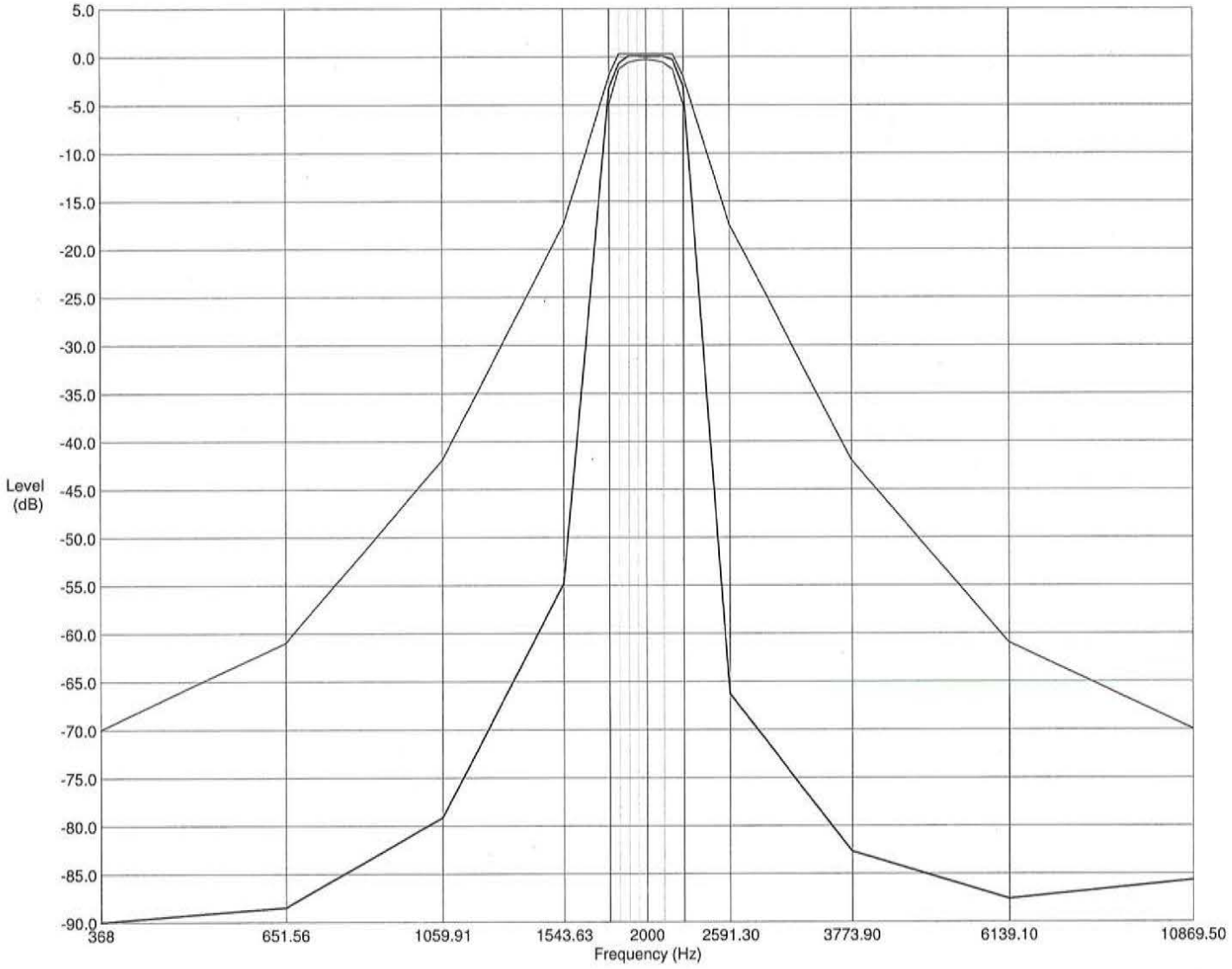
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 2000 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 2000 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
368.00	-98.90	0.10	-70.00,	-inf
651.56	-88.49	0.10	-61.00,	-inf
1059.91	-79.16	0.10	-42.00,	-inf
1543.63	-54.85	0.10	-17.50,	-inf
1781.80	-3.31	0.10	-2.00,	-5.00
1838.64	-0.70	0.10	0.30,	-1.30
1894.05	0.06	0.10	0.30,	-0.60
1947.88	0.08	0.10	0.30,	-0.40
2000.00	0.02	0.10	0.30,	-0.30

Freq (Hz)	Measured	Uncertainty	Limits	
2053.52	0.04	0.10	0.30,	-0.40
2111.88	0.08	0.10	0.30,	-0.60
2175.52	-0.32	0.10	0.30,	-1.30
2244.92	-3.02	0.10	-2.00,	-5.00
2591.30	-66.35	0.10	-17.50,	-inf
3773.90	-82.69	0.10	-42.00,	-inf
6139.10	-87.62	0.10	-61.00,	-inf
10869.50	-85.70	0.12	-70.00,	-inf

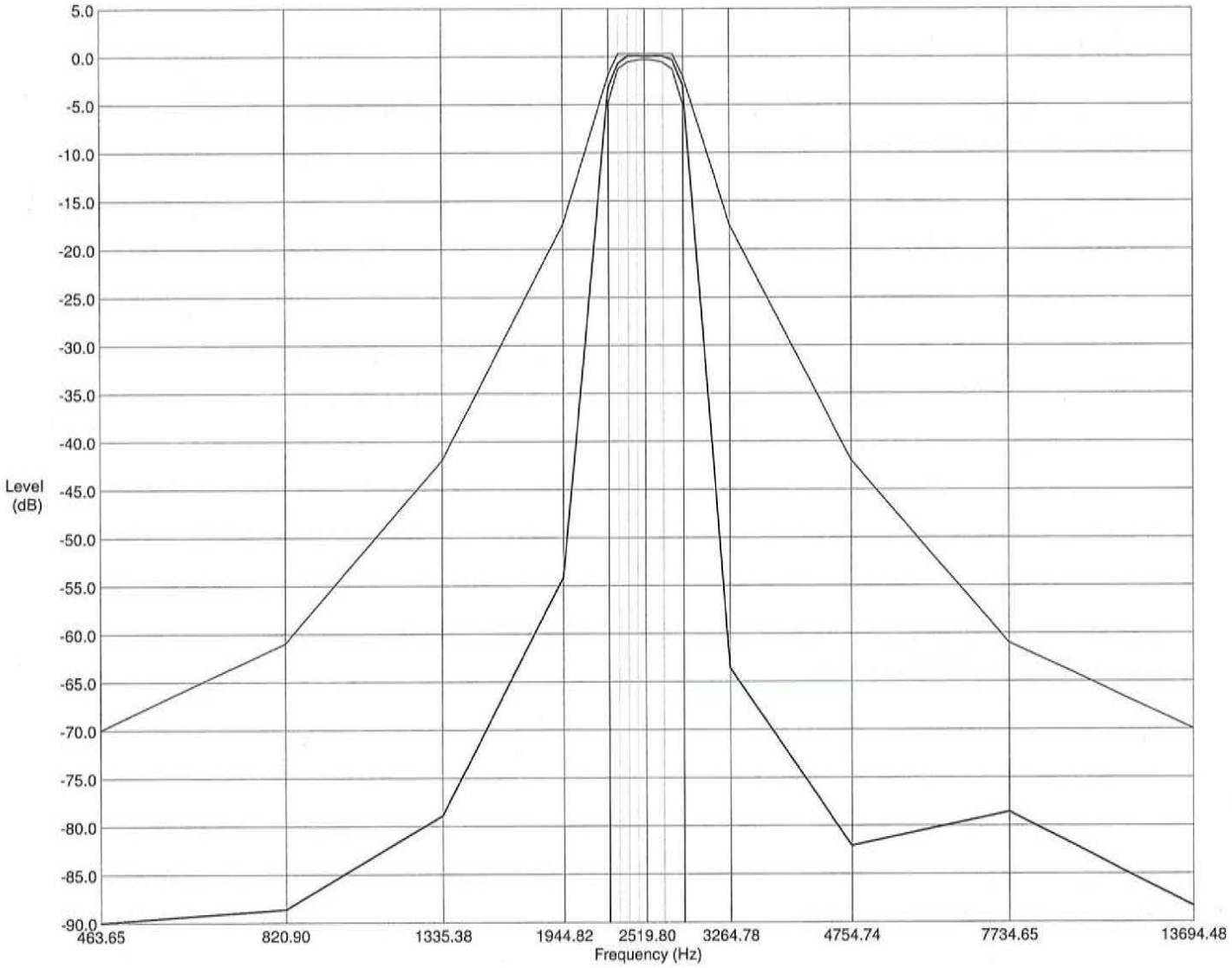
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 2500 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 2500 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
463.65	-97.55	0.10	-70.00,	-inf
820.90	-88.64	0.10	-61.00,	-inf
1335.38	-78.93	0.10	-42.00,	-inf
1944.82	-54.19	0.10	-17.50,	-inf
2244.89	-3.34	0.10	-2.00,	-5.00
2316.50	-0.72	0.10	0.30,	-1.30
2386.31	0.04	0.10	0.30,	-0.60
2454.13	0.08	0.10	0.30,	-0.40
2519.80	0.02	0.10	0.30,	-0.30
2587.23	0.04	0.10	0.30,	-0.40
2660.76	0.08	0.10	0.30,	-0.60
2740.94	-0.35	0.10	0.30,	-1.30
2828.38	-3.00	0.10	-2.00,	-5.00
3264.78	-63.64	0.10	-17.50,	-inf
4754.74	-82.11	0.10	-42.00,	-inf
7734.65	-78.60	0.10	-61.00,	-inf
13694.48	-88.40	0.12	-70.00,	-inf

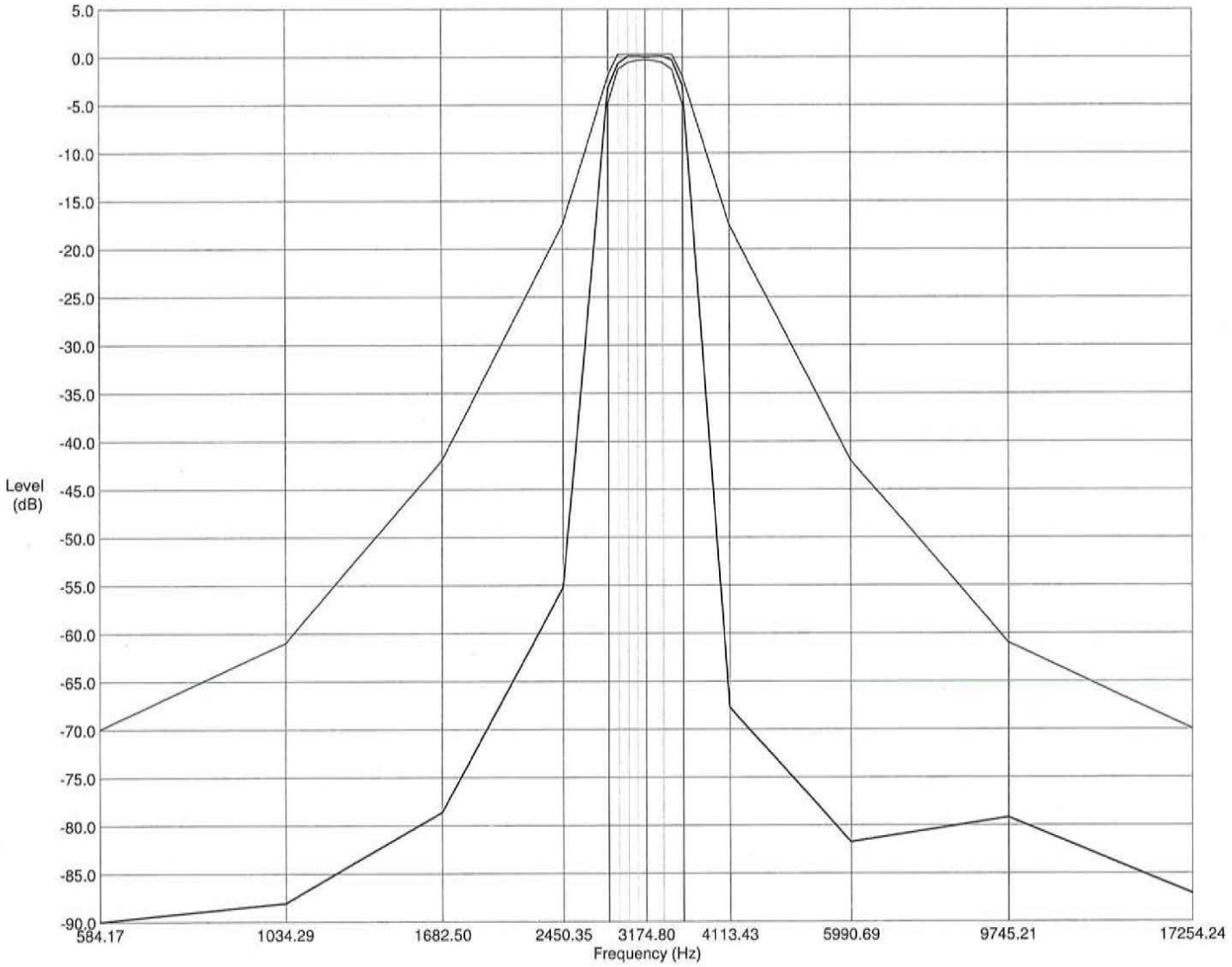
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 3150 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 3150 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
584.17	-97.52	0.10	-70.00,	-inf
1034.29	-88.08	0.10	-61.00,	-inf
1682.50	-78.64	0.10	-42.00,	-inf
2450.35	-55.22	0.10	-17.50,	-inf
2828.42	-3.31	0.10	-2.00,	-5.00
2918.66	-0.70	0.10	0.30,	-1.30
3006.61	0.06	0.10	0.30,	-0.60
3092.06	0.08	0.10	0.30,	-0.40
3174.80	0.02	0.10	0.30,	-0.30
3259.75	0.04	0.10	0.30,	-0.40
3352.40	0.11	0.10	0.30,	-0.60
3453.42	-0.32	0.10	0.30,	-1.30
3563.59	-3.00	0.10	-2.00,	-5.00
4113.43	-67.74	0.10	-17.50,	-inf
5990.69	-81.76	0.10	-42.00,	-inf
9745.21	-79.22	0.10	-61.00,	-inf
17254.24	-87.12	0.12	-70.00,	-inf

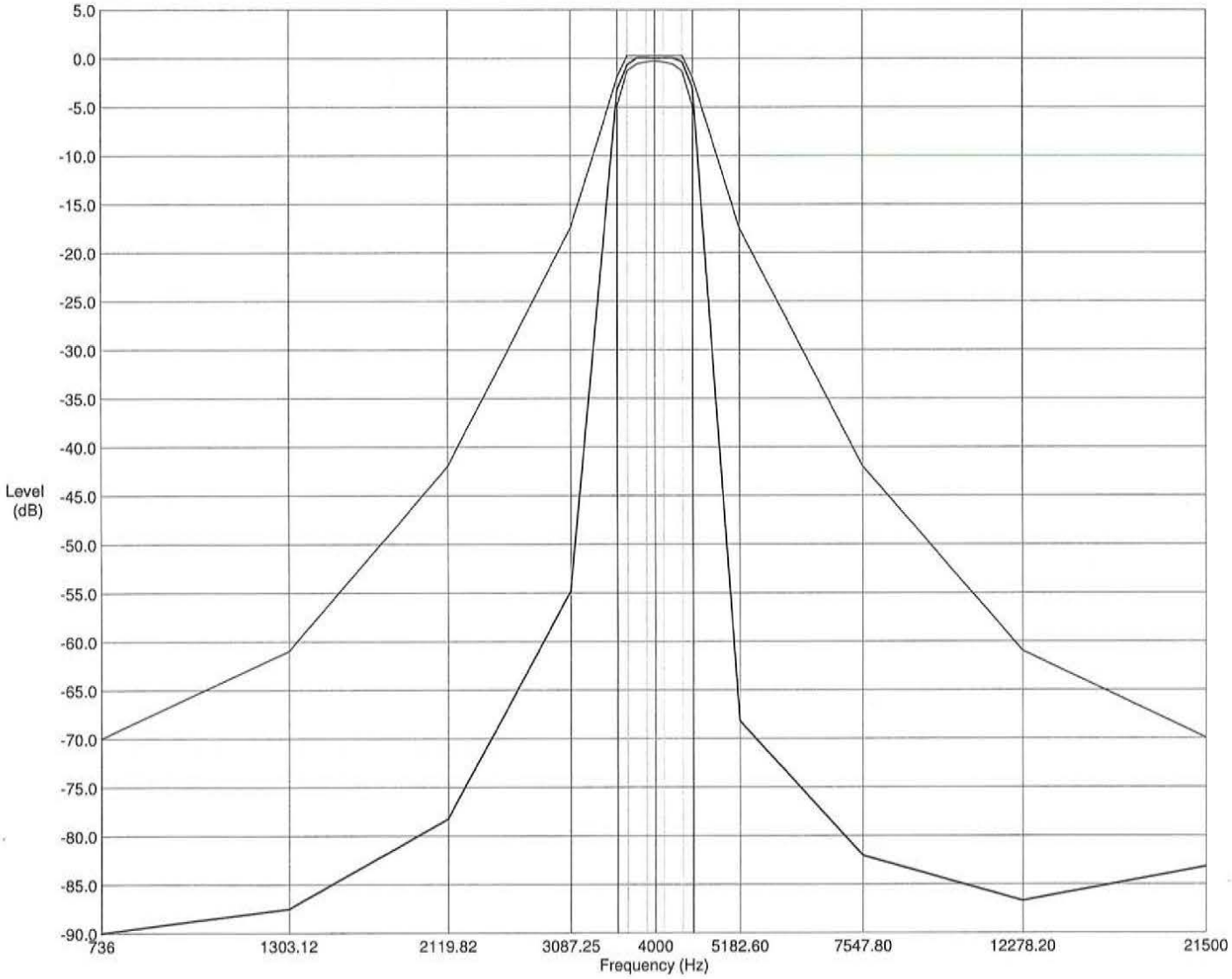
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 4000 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 4000 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
736.00	-96.76	0.10	-70.00,	-inf
1303.12	-87.53	0.10	-61.00,	-inf
2119.82	-78.25	0.10	-42.00,	-inf
3087.25	-54.80	0.10	-17.50,	-inf
3563.59	-3.31	0.10	-2.00,	-5.00
3677.28	-0.70	0.10	0.30,	-1.30
3788.10	0.06	0.10	0.30,	-0.60
3895.76	0.08	0.10	0.30,	-0.40
4000.00	0.02	0.10	0.30,	-0.30
4107.03	0.04	0.10	0.30,	-0.40
4223.76	0.08	0.10	0.30,	-0.60
4351.04	-0.35	0.10	0.30,	-1.30
4489.85	-3.02	0.10	-2.00,	-5.00
5182.60	-68.22	0.10	-17.50,	-inf
7547.80	-82.06	0.10	-42.00,	-inf
12278.20	-86.73	0.12	-61.00,	-inf
21500.00	-83.21	0.12	-69.83,	-inf

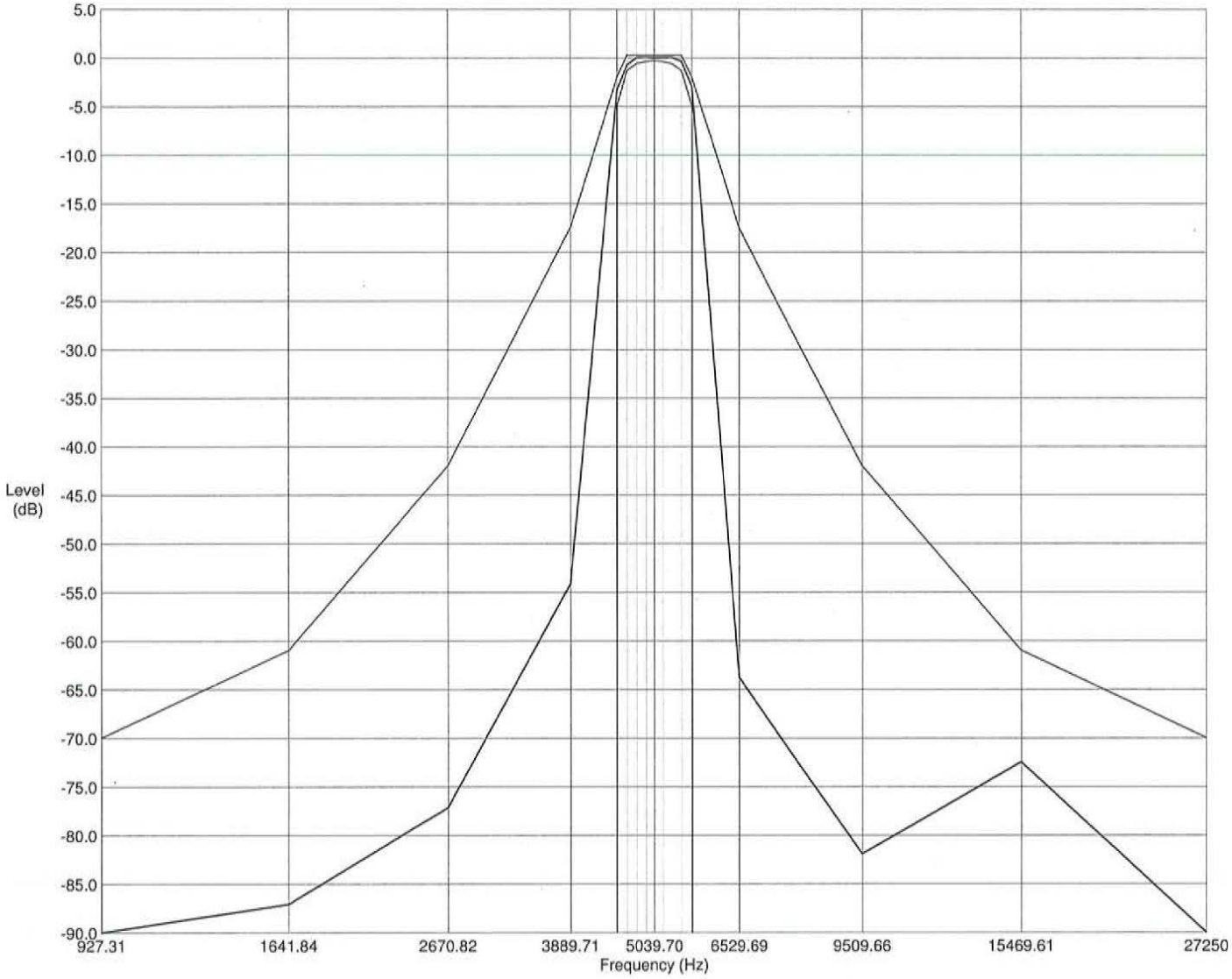
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 5000 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 5000 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
927.31	-96.27	0.10	-70.00,	-inf	5174.56	0.04	0.10	0.30,	-0.40
1641.84	-87.12	0.10	-61.00,	-inf	5321.62	0.08	0.10	0.30,	-0.60
2670.82	-77.14	0.10	-42.00,	-inf	5481.99	-0.35	0.10	0.30,	-1.30
3889.71	-54.17	0.10	-17.50,	-inf	5656.87	-3.00	0.10	-2.00,	-5.00
4489.86	-3.34	0.10	-2.00,	-5.00	6529.69	-63.78	0.10	-17.50,	-inf
4633.10	-0.72	0.10	0.30,	-1.30	9509.66	-81.95	0.10	-42.00,	-inf
4772.72	0.04	0.10	0.30,	-0.60	15469.61	-72.47	0.12	-61.00,	-inf
4908.36	0.06	0.10	0.30,	-0.40	27250.00	-90.41	0.12	-69.92,	-inf
5039.70	0.02	0.10	0.30,	-0.30					

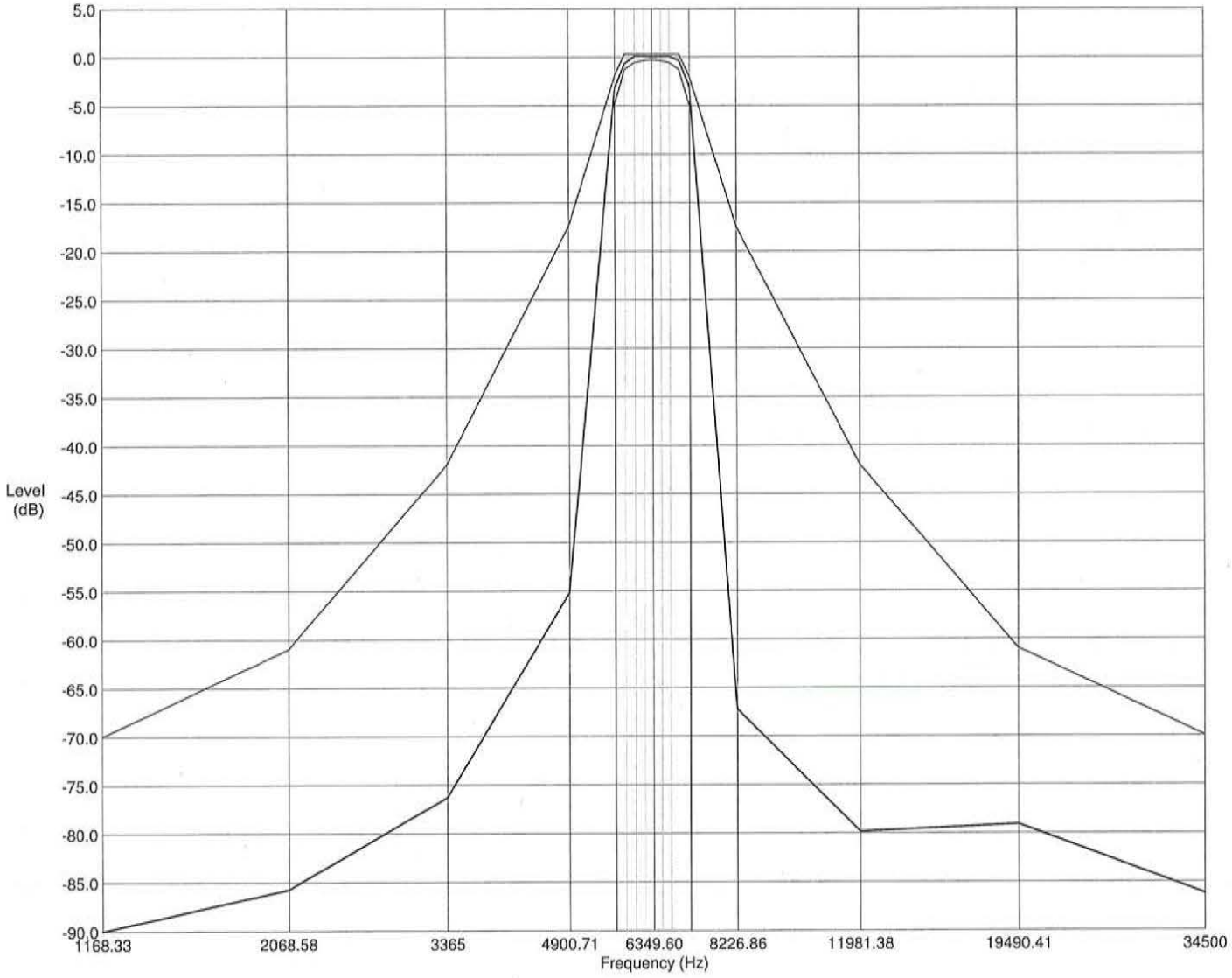
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 6300 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 6300 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
1168.33	-95.75	0.10	-70.00,	-inf
2068.58	-85.76	0.10	-61.00,	-inf
3365.01	-76.32	0.10	-42.00,	-inf
4900.71	-55.25	0.10	-17.50,	-inf
5656.85	-3.31	0.10	-2.00,	-5.00
5837.31	-0.70	0.10	0.30,	-1.30
6013.23	0.06	0.10	0.30,	-0.60
6184.12	0.08	0.10	0.30,	-0.40
6349.60	0.02	0.10	0.30,	-0.30
6519.51	0.04	0.10	0.30,	-0.40
6704.79	0.08	0.10	0.30,	-0.60
6906.84	-0.35	0.10	0.30,	-1.30
7127.19	-3.02	0.10	-2.00,	-5.00
8226.86	-67.24	0.10	-17.50,	-inf
11981.38	-79.87	0.12	-42.00,	-inf
19490.41	-79.13	0.12	-61.00,	-inf
34500.00	-86.21	0.12	-70.00,	-inf

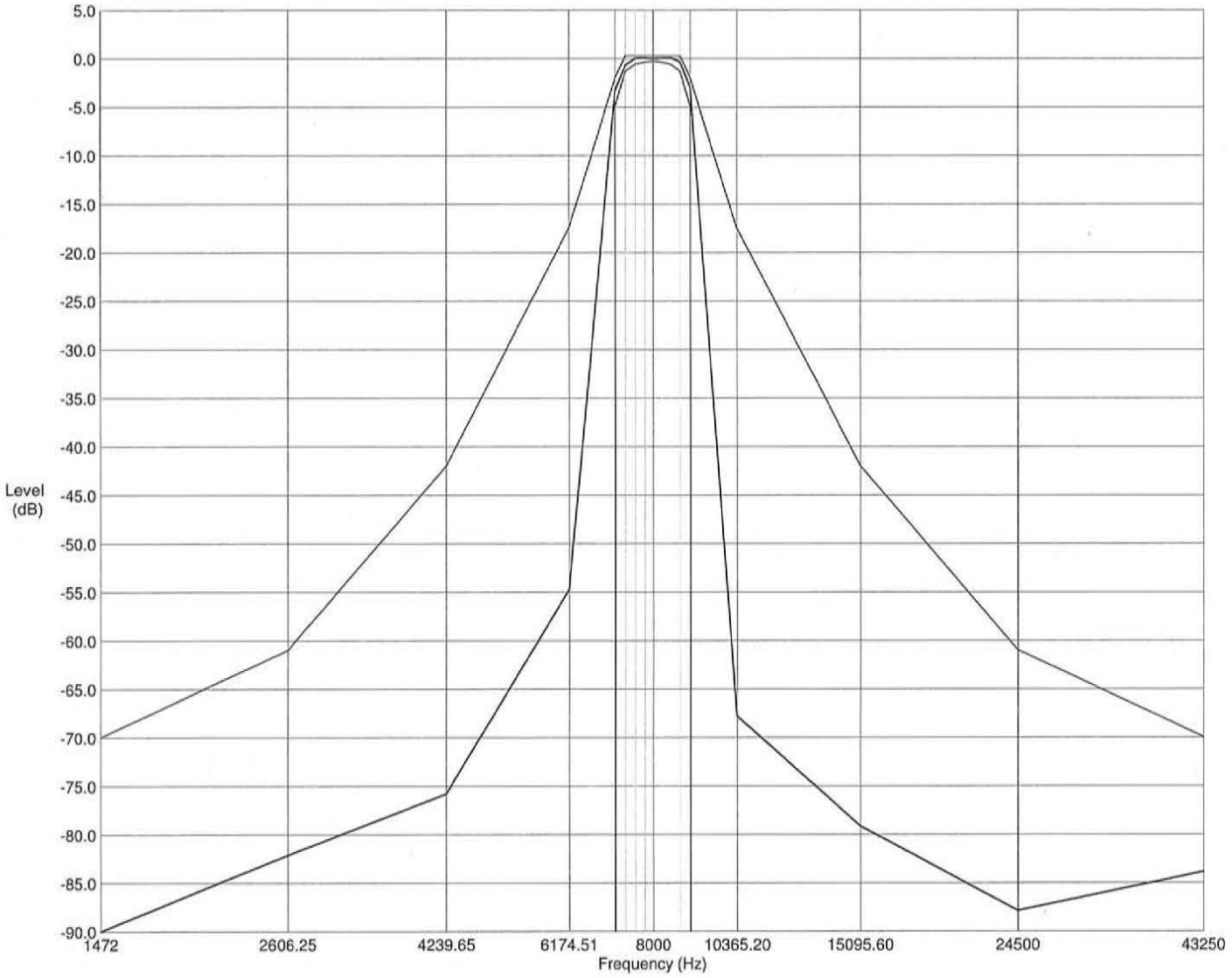
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 8000 Hz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 8000 Hz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
1472.01	-90.74	0.10	-70.00,	-inf	8214.07	0.04	0.10	0.30,	-0.40
2606.25	-82.14	0.10	-61.00,	-inf	8447.51	0.11	0.10	0.30,	-0.60
4239.65	-75.82	0.10	-42.00,	-inf	8702.08	-0.35	0.10	0.30,	-1.30
6174.51	-54.77	0.10	-17.50,	-inf	8979.70	-3.02	0.10	-2.00,	-5.00
7127.19	-3.34	0.10	-2.00,	-5.00	10365.20	-67.81	0.12	-17.50,	-inf
7354.56	-0.70	0.10	0.30,	-1.30	15095.60	-79.16	0.12	-42.00,	-inf
7576.19	0.04	0.10	0.30,	-0.60	24500.00	-87.89	0.12	-60.91,	-inf
7791.51	0.08	0.10	0.30,	-0.40	43250.00	-83.87	0.12	-69.92,	-inf
8000.00	0.02	0.10	0.30,	-0.30					

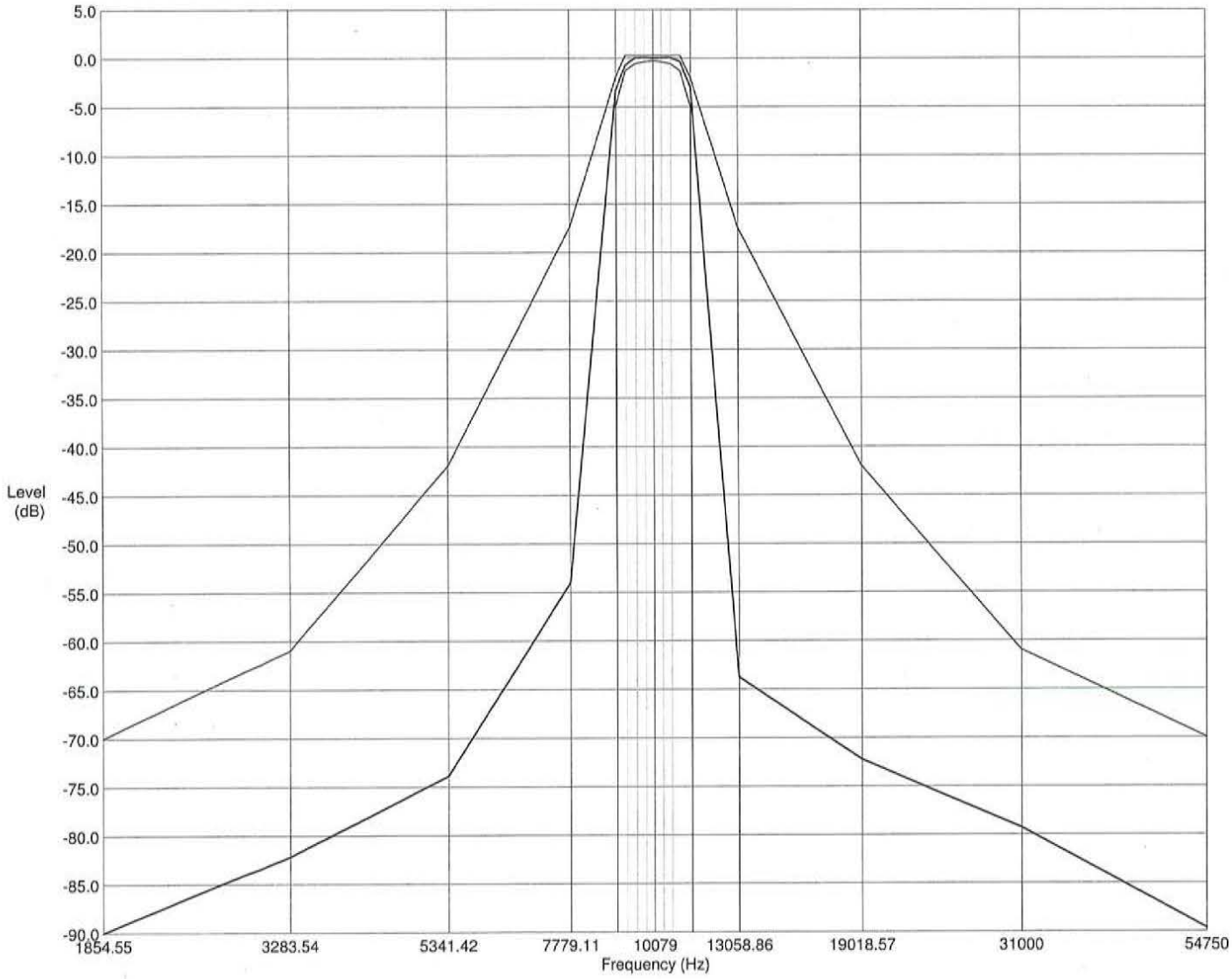
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 10 KHz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 10 KHz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
1854.55	-92.84	0.10	-70.00,	-inf
3283.54	-82.20	0.10	-61.00,	-inf
5341.42	-73.93	0.10	-42.00,	-inf
7779.11	-54.03	0.10	-17.50,	-inf
8979.37	-3.34	0.10	-2.00,	-5.00
9265.83	-0.72	0.10	0.30,	-1.30
9545.06	0.04	0.10	0.30,	-0.60
9816.33	0.06	0.10	0.30,	-0.40
10079.00	0.02	0.12	0.30,	-0.30
10348.70	0.04	0.12	0.30,	-0.40
10642.81	0.08	0.12	0.30,	-0.60
10963.54	-0.35	0.12	0.30,	-1.30
11313.30	-3.00	0.12	-2.00,	-5.00
13058.86	-63.78	0.12	-17.50,	-inf
19018.57	-72.25	0.12	-42.00,	-inf
31000.00	-79.31	0.12	-61.08,	-inf
54750.00	-89.68	0.17	-69.99,	-inf

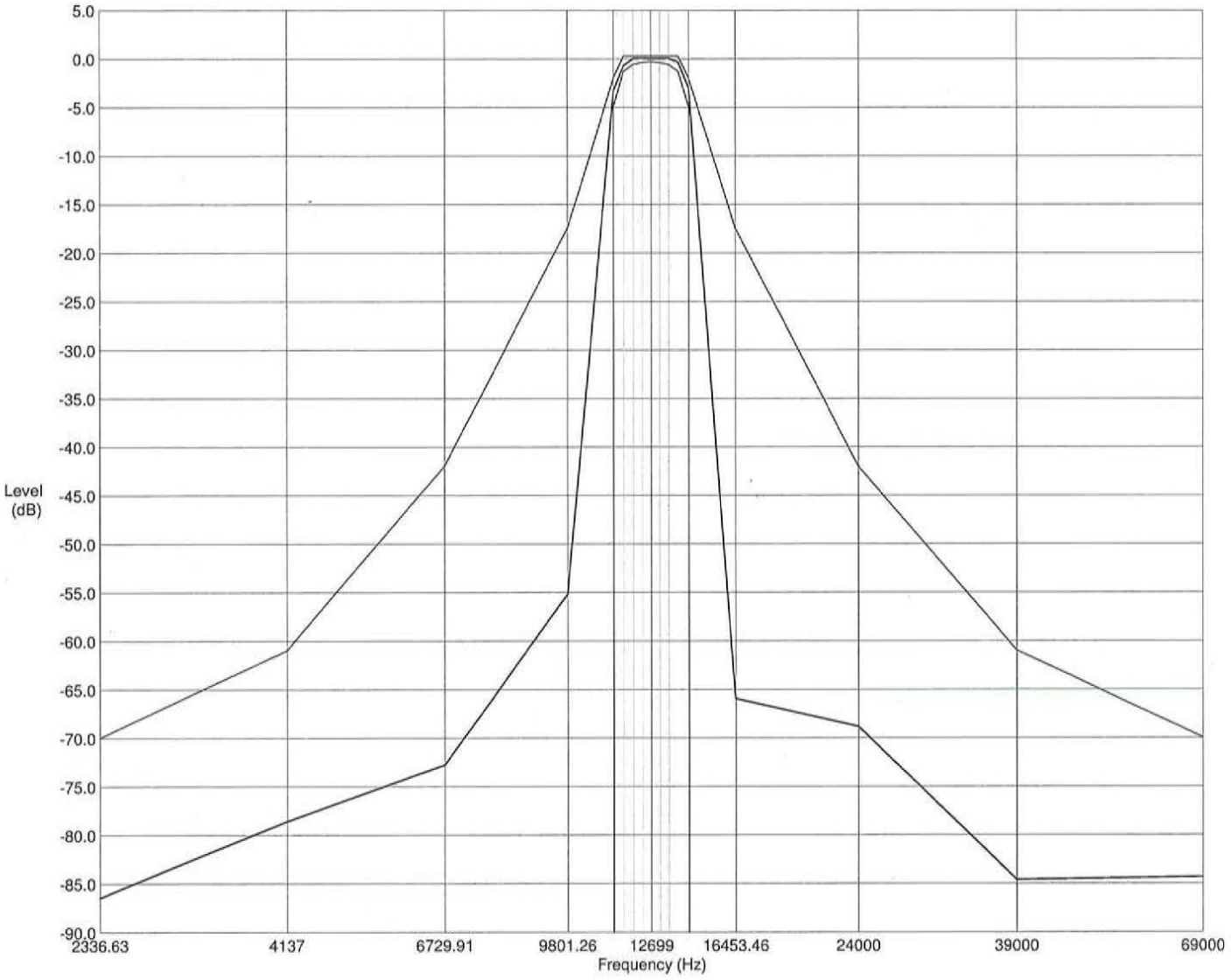
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 12.5 KHz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 12.5 KHz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
2336.63	-86.49	0.10	-70.00,	-inf
4137.09	-78.62	0.10	-61.00,	-inf
6729.91	-72.78	0.10	-42.00,	-inf
9801.26	-55.22	0.10	-17.50,	-inf
11313.52	-3.34	0.12	-2.00,	-5.00
11674.44	-0.72	0.12	0.30,	-1.30
12026.26	0.04	0.12	0.30,	-0.60
12368.05	0.08	0.12	0.30,	-0.40
12699.00	0.02	0.12	0.30,	-0.30

Freq (Hz)	Measured	Uncertainty	Limits	
13038.81	0.04	0.12	0.30,	-0.40
13409.37	0.08	0.12	0.30,	-0.60
13813.47	-0.35	0.12	0.30,	-1.30
14254.15	-3.02	0.12	-2.00,	-5.00
16453.46	-65.96	0.12	-17.50,	-inf
24000.00	-68.84	0.12	-42.10,	-inf
39000.00	-84.64	0.12	-61.02,	-inf
69000.00	-84.35	0.17	-70.00,	-inf

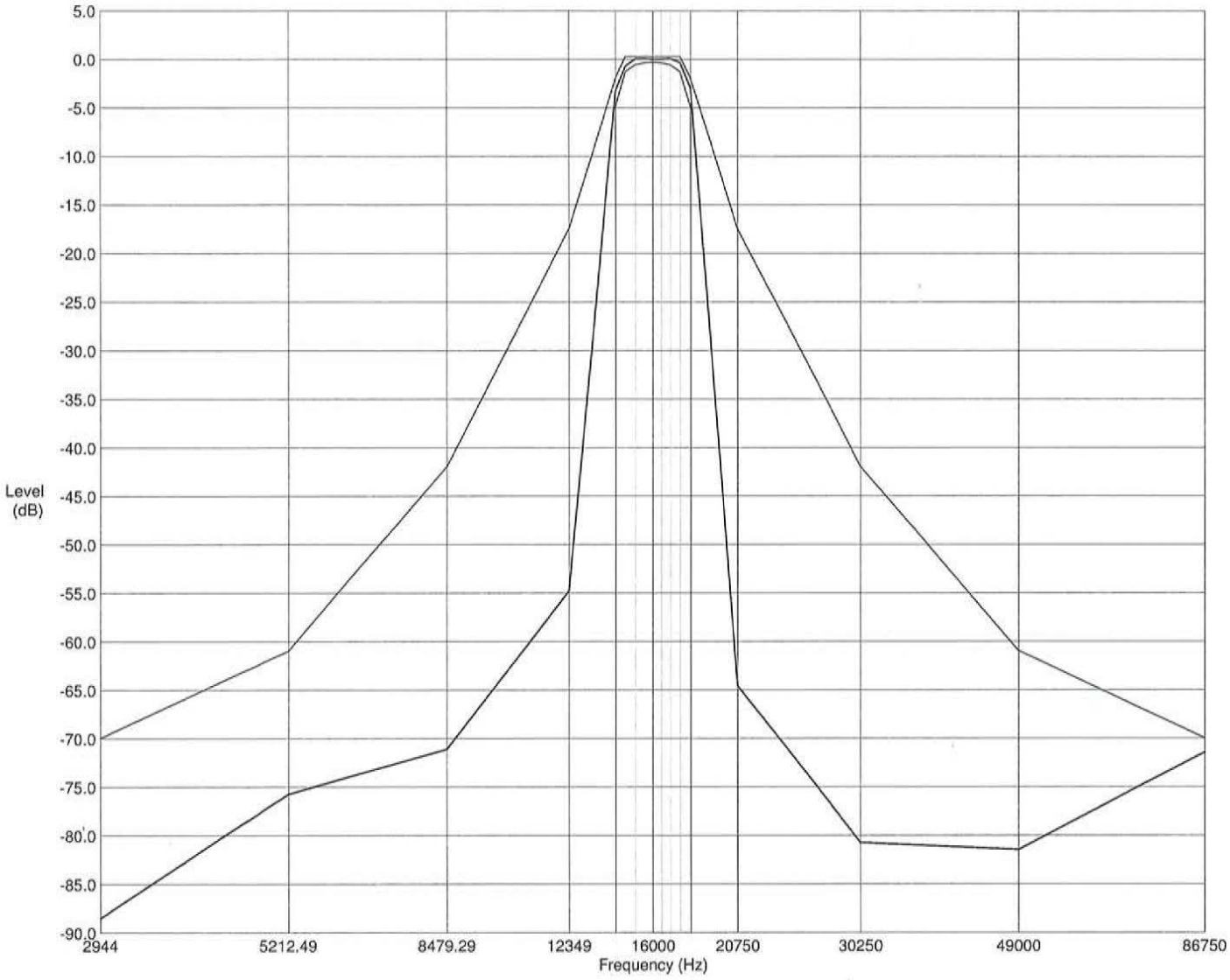
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 16 KHz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 16 KHz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits	
2944.02	-88.55	0.10	-70.00,	-inf
5212.49	-75.76	0.10	-61.00,	-inf
8479.29	-71.14	0.10	-42.00,	-inf
12349.01	-54.85	0.12	-17.50,	-inf
14254.38	-3.34	0.12	-2.00,	-5.00
14709.12	-0.72	0.12	0.30,	-1.30
15152.39	0.04	0.12	0.30,	-0.60
15583.02	0.06	0.12	0.30,	-0.40
16000.00	-0.01	0.12	0.30,	-0.30

Freq (Hz)	Measured	Uncertainty	Limits	
16428.14	0.02	0.12	0.30,	-0.40
16895.03	0.08	0.12	0.30,	-0.60
17404.17	-0.35	0.12	0.30,	-1.30
17959.40	-3.04	0.12	-2.00,	-5.00
20750.00	-64.57	0.12	-17.60,	-inf
30250.00	-80.75	0.12	-42.13,	-inf
49000.00	-81.48	0.12	-60.91,	-inf
86750.00	-71.46	0.17	-69.96,	-inf

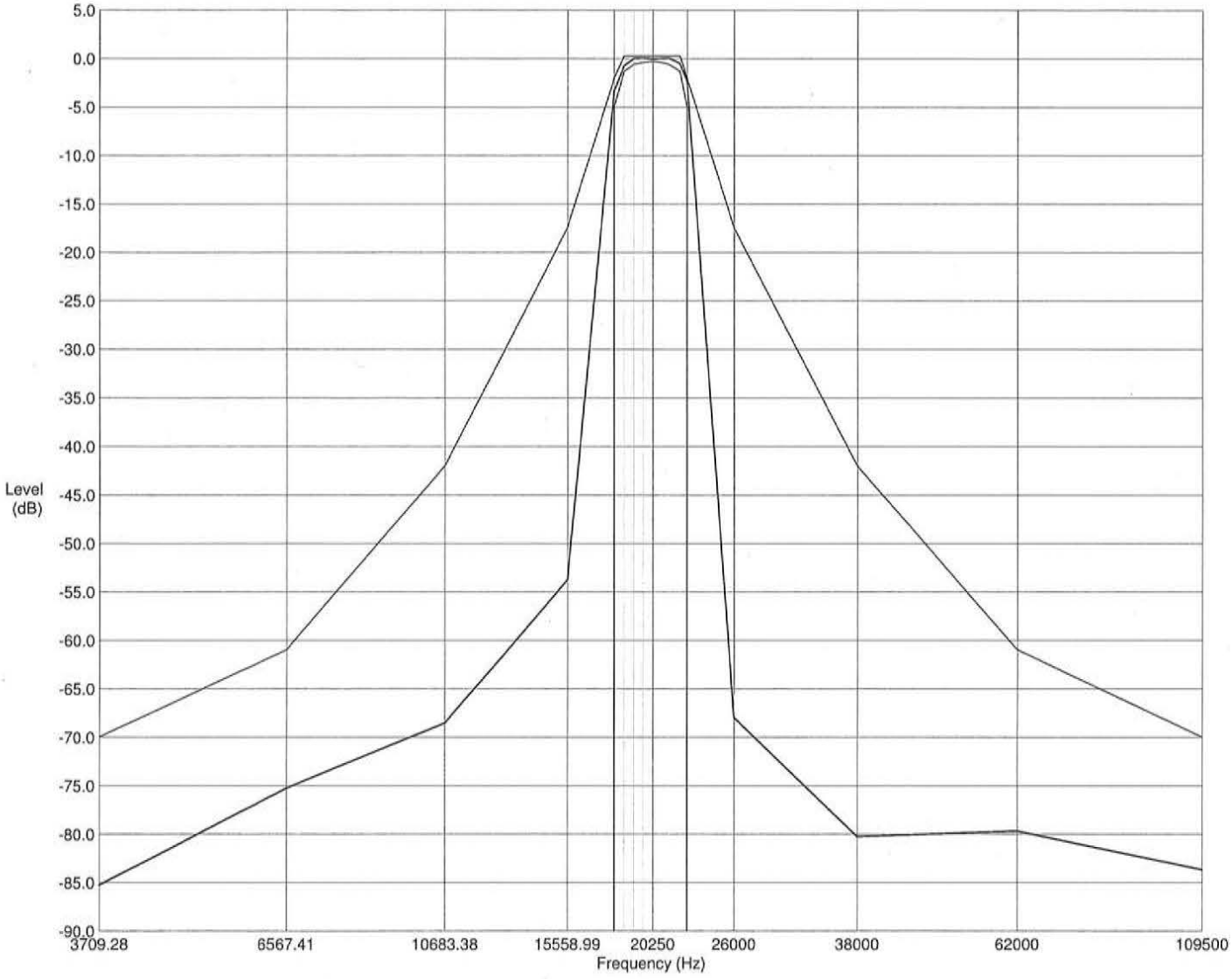
Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Certificate of 20 KHz Third Octave Filter Shape

This Type 1 Sound Level Meter (including attached PRM902 preamplifier and ADP005 18 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0 dBSPL. The instrument's 20 KHz filter response was then electrically tested using a 127.20 dBSPL sinewave at selected frequencies as specified in IEC 61260-am1 (2001-09).



Freq (Hz)	Measured	Uncertainty	Limits		Freq (Hz)	Measured	Uncertainty	Limits	
3709.28	-85.27	0.10	-70.00,	-inf	20750.00	0.02	0.12	0.30,	-0.41
6567.41	-75.27	0.10	-61.00,	-inf	21250.00	0.08	0.12	0.30,	-0.59
10683.38	-68.55	0.12	-42.00,	-inf	22000.00	-0.50	0.12	0.30,	-1.38
15558.99	-53.77	0.12	-17.50,	-inf	22500.00	-2.32	0.12	-1.59,	-4.33
17959.63	-3.36	0.12	-2.00,	-5.00	26000.00	-67.98	0.12	-17.01,	-inf
18532.57	-0.72	0.12	0.30,	-1.30	38000.00	-80.26	0.12	-41.93,	-inf
19091.06	0.04	0.12	0.30,	-0.60	62000.00	-79.71	0.17	-61.08,	-inf
19633.63	0.06	0.12	0.30,	-0.40	109500.00	-83.68	0.23	-69.99,	-inf
20250.00	-0.03	0.12	0.30,	-0.28					

Uncertainties are given as expanded uncertainty at ~95% confidence interval (k = 2).

This instrument is in compliance with IEC 61260-am1 (2001-09) (Class 1) and ANSI S1.11-1986 (Order 3, Type 1-D).

Technician: Sean Childs Test Date: 22FEB2017

Sound Level Meter Model: 824 Serial Number: A0988
Summary Test Data

dB Offset (added to dBuV readings for dBSPL): 1.0
NoiseFloor: 9.1 (10.1 SPL)
LogLin Reference: 113.1 (114.1 SPL)
Weighted Peak Reference: 116.1 (117.1 SPL)
Overload: 127.2 (128.2 SPL)
LowerRange (max (noisefloor, w/in limits, w/in diff linearity)): 18.0 (19.0 SPL)
UpperRange (min (overload, w/in limits, w/in diff linearity)): 127.1 (128.1 SPL)
UpperLimit (Overload - 0.1): 127.1 (128.1 SPL)
Primary indicator range: 109.1 dB (Minimum Allowed: 105.0)
Dynamic range: 118.0 dB (Minimum Allowed: 110.0)
Gain stages measured at input level 70.00 dBuV:
  Gain + 0 reference: 70.05
  Gain + 10, Value: 70.04, Error: -0.01, Passed
  Gain + 20, Value: 70.07, Error: 0.02, Passed
  Gain + 30, Value: 70.06, Error: 0.01, Passed
  Gain + 40, Value: 70.05, Error: 0.00, Passed
  Gain + 50, Value: 70.00, Error: -0.05, Passed

LogLin Test Run Date: Wed Feb 22 12:21:27 2017. Passed
A Weight Test Run Date: Wed Feb 22 12:35:24 2017. Passed
C Weight Test Run Date: Wed Feb 22 12:37:33 2017. Passed
F Weight Test Run Date: Wed Feb 22 12:39:25 2017. Passed
Crest Test Run Date: Wed Feb 22 13:14:06 2017. Passed
Burst Test Run Date: Wed Feb 22 13:19:16 2017. Passed
Detector Test Run Date: Wed Feb 22 13:22:56 2017. Passed
Frequency Counter Test Run Date: Wed Feb 22 13:27:49 2017. Passed

This 824 has the following purchased options:
Logging SLM - Real-Time Spectrum Analyzer -

PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2017-204799

Instrument Model PRM902, Serial Number 1462, was calibrated on 22 Feb 2017. The instrument meets factory specifications per Procedure D0001.8126.

Instrument found to be in calibration as received: YES
Date Calibrated: 22 Feb 2017
Calibration due: 22 Feb 2019

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0662/0114	12 Months	8 Dec 2017	2016-204417
Agilent Technologies	34401A	MY41038589	12 Months	6 Jan 2018	2017000125

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 24 ° Centigrade

Relative Humidity: 25 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"As received" data is the same as shipped data.

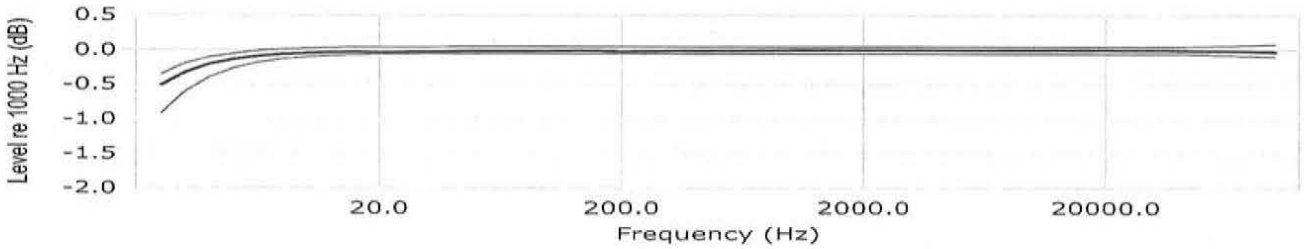
Signed [redacted]

Technician: Sean Childs

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

Preamplifier Model: PRM902 Serial Number: 1462
Frequency Response Test Report

Frequency response electrically tested at 120.0 dBµV using a 18 pF capacitor to simulate microphone capacitance.



Frequency (Hz)	Relative Level (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Relative Level (dB)	Uncertainty (dB)	Limits (dB)
2.5	-0.51	0.08	-0.35,-0.91	631.0	-0.00	0.02	0.05,-0.05
3.2	-0.32	0.06	-0.19,-0.59	794.3	-0.00	0.02	0.05,-0.05
4.0	-0.20	0.06	-0.10,-0.39	1000.0	0.00	0.02	0.05,-0.05
5.0	-0.13	0.04	-0.05,-0.26	1258.9	0.00	0.02	0.05,-0.05
6.3	-0.09	0.04	-0.01,-0.18	1584.9	0.00	0.02	0.05,-0.05
7.9	-0.06	0.04	0.01,-0.13	1995.3	0.00	0.02	0.05,-0.05
10.0	-0.04	0.02	0.02,-0.10	2511.9	0.00	0.02	0.05,-0.05
12.6	-0.03	0.02	0.03,-0.08	3162.3	0.00	0.02	0.05,-0.05
15.8	-0.03	0.02	0.04,-0.07	3981.1	0.01	0.02	0.05,-0.05
20.0	-0.04	0.02	0.04,-0.06	5011.9	0.00	0.02	0.05,-0.05
25.1	-0.03	0.02	0.04,-0.06	6309.6	0.00	0.02	0.05,-0.05
31.6	-0.02	0.02	0.04,-0.05	7943.3	0.00	0.02	0.05,-0.05
39.8	-0.02	0.02	0.05,-0.05	10000.0	0.00	0.02	0.05,-0.05
50.1	-0.02	0.02	0.05,-0.05	12589.3	0.01	0.02	0.05,-0.05
63.1	-0.01	0.02	0.05,-0.05	15848.9	0.00	0.02	0.05,-0.05
79.4	-0.01	0.02	0.05,-0.05	19952.6	0.01	0.02	0.05,-0.05
100.0	-0.01	0.02	0.05,-0.05	25118.9	0.00	0.02	0.05,-0.05
125.9	-0.01	0.02	0.05,-0.05	31622.8	0.00	0.02	0.05,-0.05
158.5	-0.01	0.02	0.05,-0.05	39810.7	-0.00	0.02	0.05,-0.05
199.5	-0.02	0.02	0.05,-0.05	50118.7	-0.00	0.02	0.06,-0.06
251.2	-0.01	0.02	0.05,-0.05	63095.7	-0.01	0.05	0.07,-0.07
316.2	-0.01	0.02	0.05,-0.05	79432.8	-0.01	0.05	0.08,-0.08
398.1	-0.01	0.02	0.05,-0.05	100000.0	-0.02	0.05	0.09,-0.09
501.2	-0.01	0.02	0.05,-0.05				

1000 Hz measured level: 119.711 dBµV, -0.289 dB re input (0.033 dB uncertainty; -0.483 dB to -0.017 dB limit)
1 kHz (1/3 Octave) Noise Floor : 0.62 µV, -4.10 dBµV (0.47 dB uncertainty; -4.00 dB limit)
Flat (20 Hz - 20 kHz) Noise Floor : 4.33 µV, 12.73 dBµV (0.47 dB uncertainty; 15.00 dB limit)
A-weight Noise Floor : 2.54 µV, 8.11 dBµV (0.46 dB uncertainty; 10.00 dB limit)
Environmental conditions: 23.6 °C, 25.5 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainties are given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: D0001.8126 with PRM902 (SMD).xml
This frequency response is in compliance with manufacturers specification for the item tested.
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Technician: Sean Childs Test Date: 22 Feb 2017 07:54:59

Test Location: Larson Davis, a division of PCB Piezotronics, Inc.
1681 West 820 North, Provo, Utah 84601
Tel: 716 684-0001 www.LarsonDavis.com

CERTIFICATE of CALIBRATION

Make :	Larson Davis	Reference # :	147080
Model :	2559	Customer :	Rowan Williams Davies & Irwin Inc Guelph, ON
Descr. :	Microphone 1/2" random		
Serial # :	2356	P. Order :	NOI-01-01-KAMH
Asset # :	NAN		

Cal. status : Received in spec's, no adjustment made.

Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.

Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.

Our calibration system complies with the requirements of ISO-17025 standard, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.

Calibrated : Mar 09, 2017 By [redacted]

Cal. Due : Mar 09, 2019 J. Raposo

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-163 J-216 J-282 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7 http: // www.navair.com

Phone : 905 565 1584 Fax: 905 565 8325 e-Mail: service @ navair.com

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6375 Dixie Rd Unit# 7,
Mississauga, ON L5T 2E7
Tel: (905)565-1583
Fax: (905)565-8325

Form:LSD2559	Approved By:JR Mar/17	Ver1.0

Calibration Report for Certificate: **147080**

Make	Model	Serial	Asset
Larson Davis	2559	2356	nan

Test	Reading

Open circuit sensitivity

251.2Hz
99.7kPa
23.2 °C
RH 26%

	dB re 1V/Pa
Nom -37.8dB	-39.2
	mV/Pa
Nom 12.9mV/Pa	11.02
	dB
Ko ref to 12.9mV/Pa	-1.4

ATTACHMENT 2

Government of Canada / Gouvernement du Canada

Hourly Data Report for December 12, 2018

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

THOMPSON A
MANITOBA
Current Station Operator: NAVCAN

Latitude:	55°48'17.000" N
Longitude:	97°51'45.000" W
Elevation:	224.00 m
Climate ID:	5062921
WMO ID:	71079
TC ID:	YTH

	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
TIME										
00:00	-8.7	-9.9	91	18	7	8.1	97.40		-13	Snow,Fog
01:00	-8.4	-9.6	91	19	6	3.2	97.37		-12	Snow,Fog
02:00	-8.4	-9.6	91	21	8	9.7	97.34		-13	Snow,Fog
03:00	-10.5	-11.8	90	17	4	24.1	97.34		-13	Mainly Clear
04:00	-12.1	-13.5	89	16	4	24.1	97.29		-15	NA
05:00	-12.8	-14.4	88	16	5	24.1	97.27		-16	NA
06:00	-13.4	-15.1	88	14	5	24.1	97.25		-17	Clear
07:00	-13.9	-15.7	87	12	6	24.1	97.19		-18	NA
08:00	-14.8	-16.7	86	36	3	24.1	97.15		-17	NA
09:00	-14.5	-16.3	86	14	4	24.1	97.13		-17	Mainly Clear
10:00	-13.7	-15.4	87	11	3	24.1	97.08		-16	NA
11:00	-11.4	-13.0	88	15	5	24.1	97.07		-15	NA
12:00	-8.9	-10.2	90	15	9	24.1	96.98		-14	Mainly Clear
13:00	-7.4	-8.6	91	15	6	24.1	96.94		-11	NA

	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
14:00	-7.0	-8.1	92	15	6	24.1	96.91		-10	NA
15:00	-7.0	-8.0	92	16	9	24.1	96.95		-11	Mostly Cloudy
16:00	-7.2	-8.2	92	16	8	24.1	96.94		-11	NA
17:00	-6.9	-7.9	92	18	10	16.1	96.99		-12	Snow
18:00	-6.7	-7.7	93	17	9	24.1	97.02		-11	Snow
19:00	-6.3	-7.3	93	17	10	9.7	97.01		-11	Snow
20:00	-6.0	-6.9	93	18	9	24.1	97.04		-10	Snow
21:00	-5.8	-6.7	93	20	14	24.1	97.06		-11	Snow
22:00	-5.8	-6.6	94	21	13	24.1	97.06		-11	Snow
23:00	-5.7	-6.5	94	21	9	24.1	97.07		-10	Snow

Legend

- E = Estimated
- M = Missing
- NA = Not Available

Date modified:
2018-07-20

Government of Canada / Gouvernement du Canada

Hourly Data Report for December 13, 2018

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

THOMPSON A
MANITOBA
Current Station Operator: NAVCAN

Latitude:	55°48'17.000" N
Longitude:	97°51'45.000" W
Elevation:	224.00 m
Climate ID:	5062921
WMO ID:	71079
TC ID:	YTH

TIME	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
00:00	-5.7	-6.5	94	21	9	19.3	97.07		-10	Snow
01:00	-5.3	-6.1	94	20	11	19.3	97.09		-10	Snow
02:00	-4.9	-5.7	94	19	10	19.3	97.10		-9	Snow
03:00	-4.6	-5.4	94	22	10	19.3	97.17		-9	Snow
04:00	-5.5	-6.2	94	20	9	24.1	97.21		-10	NA
05:00	-6.5	-7.4	94	20	8	24.1	97.23		-10	NA
06:00	-7.6	-8.5	93	18	8	24.1	97.26		-12	Clear
07:00	-9.8	-11.0	91	20	7	24.1	97.27		-14	NA
08:00	-9.8	-11.0	91	17	3	24.1	97.31		-12	NA
09:00	-10.0	-11.3	90	36	1	24.1	97.35		-11	Mainly Clear
10:00	-9.9	-11.2	90	21	6	24.1	97.38		-13	NA
11:00	-7.7	-8.9	91	22	10	24.1	97.40		-13	NA
12:00	-6.4	-7.5	92	22	10	24.1	97.34		-11	Clear
13:00	-5.5	-6.5	93	22	14	24.1	97.35		-11	NA

	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
14:00	-5.0	-5.9	93	21	9	24.1	97.33		-9	NA
15:00	-5.2	-6.1	94	20	9	24.1	97.31		-9	Clear
16:00	-5.9	-6.7	94	19	7	24.1	97.33		-9	NA
17:00	-7.3	-8.2	93	17	5	24.1	97.33		-10	NA
18:00	-7.7	-8.7	93	18	4	24.1	97.30		-10	Mainly Clear
19:00	-7.6	-8.5	93	18	5	24.1	97.23		-10	NA
20:00	-6.6	-7.6	93	17	8	24.1	97.12		-10	NA
21:00	-6.6	-7.5	93	18	5	24.1	97.09		-9	Cloudy
22:00	-6.6	-7.5	93	18	4	24.1	97.07		-9	NA
23:00	-6.1	-7.0	93	20	7	24.1	97.04		-9	Snow

Legend

- E = Estimated
- M = Missing
- NA = Not Available

Date modified:
2018-07-20