MEMORANDUM

To:	National Oceanic and Atmospheric Administration – Fisheries and National Marine Fisheries Service
From:	Mark Storm, INCE Bd. Cert. (Acoustic Services Manager, Dudek); Nick Segovia (Dudek)
Subject:	WETA Alameda Main Street Terminal Refurbishment Project – Hydroacoustic Monitoring Assessment
Date:	February 9, 2024
cc:	Andrew Hatch, Biologist, Dudek
Attachment(s):	Figure 1 – Regional Setting Figure 2 – Project Features Attachment A – Hydroacoustic Monitoring Log Attachment B – Channel and Pile Driving Information Attachment C – Photographs of Pile Driving Activities and Hydroacoustic Monitoring Attachment D – One-Third Octave Band Spectrum and Power Spectral Density Plots Attachment E – Monitoring Data Calculations, LD-831c Summary Data Sheets, and Investigator Field Notes

Dudek is pleased to present the National Oceanic and Atmospheric Administration - Fisheries and National Marine Fisheries Service (NOAA-Fisheries/NMFS) with the following hydroacoustic monitoring results and corresponding data analyses for the Water Emergency Transportation Authority (WETA) Alameda Main Street Terminal Refurbishment Project (Project) located in the City of Alameda (City). This memorandum (memo) presents quantitative results of measured Project impact-type pile driving noise emission to the surrounding underwater sound environment. The potential for significant impacts from these Project construction activities on marine mammals species of concern is briefly discussed in accordance with guidelines provided by the California Department of Fish and Wildlife (CDFW) and NOAA-Fisheries/NMFS joined with Caltrans, with other regulatory agencies and researchers in the Fisheries Hydroacoustic Working Group (FHWG) and considers polices regarding the incidental harassment of marine mammals, authorized under section 1010(a)(5)(D) of the Marine Mammal Protection Act. The contents and organization of this memorandum are as follows: Executive Summary, Background, Assessment Framework, Hydroacoustic Monitoring, and References Cited.

1 Executive Summary

As analyzed herein, after completion of hydroacoustic monitoring and review of the collected data for the Alameda Main St Ferry Terminal Refurbishment Project, impact pile driving activities associated with the Project did not exceed the Level A or Level B Marine Mammal Protection Underwater thresholds established by NOAA-Fisheries.

2 Background

2.1 Project Description

The Alameda Main Street (AMS) Ferry Terminal Refurbishment Project (Project) was proposed by WETA to support its ferry operations within the Oakland Inner Harbor. Figure 1 illustrates the regional setting of the project; and Figure 2 summarizes the project site features located at 2990 Main Street in Alameda, California (City) and includes the existing AMS Ferry Terminal, which consists of a trestle, steel float structure, aluminum gangway, and bridge structure. The site is designated under the General and Maritime Industry land use and zoned as General Industrial (M-2). Much of the project site is within the Oakland Inner Harbor, with a portion of the bridge structure extending onto the landside of the City. The landside of the project site consists of various bay rocks, rip-rap, and dirt/sand. The project site is accessible by vehicle via Main Street and by ferry within the Oakland Inner Harbor. Specific project elements include the following:

- **Terminal Bridge and Foundation Replacement.** Project activities would involve demolition of the existing bridge/walkway and bridge foundation and replace them with a new aluminum truss bridge. Onshore and landside support would be installed, consisting of driving a 48-inch monopile and two 24-inch pipe piles with cap beams, respectively (in water).
- **Gangway Replacement.** The project would include removal of the existing sixty-foot-long gangway and replacement with an eighty-foot-long covered aluminum gangway.
- **Float Demolition/Replacement.** The existing terminal float would be removed and replaced-in-kind with a new steel float. Ramps that had been previously installed on the float would be removed, protected in place, and reused once the new float is installed. Float ramps would be shifted to the west to provide additional room for a longer gangway. The four existing thirty-inch guide piles would be removed and replaced with four new 36-inch guide piles. To achieve a more safe, efficient berthing capacity and enable ingress and egress in a timely manner, float demolition/replacement activities would also involve installation of two new 36-inch donut fender piles (in water).
- **Utility Upgrades.** Utility upgrades associated with the project would involve replacement of existing razor equipment, installation of electrical service for new lighting, ramp controls, and outlets, provision of new potable water as well as conduit for future upgrades on bridge, gangway, and float structures. No other utility improvements are planned.

2.2 Pile Installation

Vibratory pile driving technique was expected to be used for the majority of project pile installation with the possibility of using an impact hammer if piles hit refusal prior to the required tip elevation. Observed pile driving for the project was consistent with this expectation; hence, hydroacoustic monitoring was performed during the few occurrences of witnessed impact pile-driving per the Hydroacoustic Monitoring Plan (HMP) as required per Section 5(f) of the project's Incidental Harassment Authorization (IHA) and the Incidental Take Permit (NMFS 2023; CDFW 2023). The IHA does not require hydroacoustic monitoring during vibratory pile driving processes, and thus no hydroacoustic monitoring of pile extraction or installation involving vibratory means was planned.

Pile installation activities for the project included installation of a single 48-inch steel pipe monopile in water for the terminal bridge along with two 24-inch steel pipe piles with concrete cap beams on land. The project also involves removal of four existing 30-inch guide piles, installation of four 36-inch guide piles and two 36-inch donut fender piles in water for the terminal float. Vibratory pile driving techniques were used to install all 7 piles, and impact pile driving techniques were used to complete installation of two piles (one 36" steel pipe pile and one 48" steel pipe pile) as appearing in Table 1.

Table 1. Summary of Project Pile Locations, Durations, Quantities and Types

Pile Location (and project feature)	Measurement Duration and Blows per Pile	Piles	Pile Type
In Water - Installation			
• Terminal Bridge and Foundation Replacement • Float Replacement (Guide Piles and Donut Fender Piles)	27 minutes, 15 seconds 62 strikes (impact)	1	48-inch steel pipe
	45 minutes, 58 seconds 11 strikes (impact)	1	36-inch steel pipe

For both piles that were driven with an impact hammer, attenuation was applied with the use of a bubble curtain. This sound attenuation apparatus was required for the duration of impact driving for this project. There was no testing of attenuation effectiveness, and no piles were impact-driven without this properly functioning means of underwater sound attenuation.

3 Assessment Framework

3.1 Underwater Acoustical Fundamentals

The following subsections provide the reader a summary of underwater acoustical terminology and concepts that the foregoing analyses will use to evaluate potential noise and vibration impacts associated with the proposed Project. The summary provided is informed by a 2022 hydroacoustic assessment conducted by Illingworth & Rodkin, Inc., which was prepared for Dudek to predict the impacts of underwater impact pile driving during the construction of the Project.

3.1.1 Fundamentals of Underwater Noise

Underwater noise can be significantly amplified by the process of impact pile driving. The action of a pile-driving hammer hitting a pile generates a pulse that travels through the pile and emits sound into the surrounding water, ground, and air. This sound pressure pulse over time is known as a waveform. These sounds are characterized acoustically by their peak pressure, root-mean-square (RMS) pressure, and sound exposure level (SEL). The peak pressure is the maximum absolute value of the waveform, which can be either a negative or positive pressure peak. The RMS level of pile-driving pulses is calculated by analyzing the waveform and averaging the squared pressures over the time that encompasses the part of the waveform that contains the sound energy (Richardson et al. 1995; ISO 18406:2017(E).). In the field, the pulse RMS for pile-driving sounds is often estimated by measuring the signal with a precision sound level meter set to the "impulse" RMS setting, and it is commonly used to evaluate impacts on marine mammals. The sound energy of the pressure waveform is another way to describe the pulse. The total sound energy in the pulse is often referred to as the "total energy flux" (Finerran 2002). The "total energy flux" is the same as the un-weighted SEL for a plane wave propagating in a free field, a unit of sound energy frequently used in airborne acoustics to describe short-duration events. The unit used is decibels (dB) re 1 micropascal $(\mu Pa)^2$-second (sec). In this memo, peak pressure levels are expressed as the absolute maximum pressure of a pulse in dB re 1 μPa; however, in other literature, peak pressure levels can take varying forms, such as pascals or pounds per square inch. The total sound energy in an impulse accumulates over the duration of that pulse and the duration of a pile driving event.

SEL is an acoustic metric that provides an indication of the amount of acoustical energy contained in a sound event. For pile driving, the typical event can be one pile-driving pulse or many pulses, such as pile driving for one pile or for one day of pile driving. Typically, SEL is measured for a single strike and a cumulative condition. The cumulative SEL (cSEL) associated with the driving of a pile can be estimated using the single-strike SEL value and the number of pile strikes through the following equation:

$$SEL_{cumulative} = SEL_{single-strike} + 10log(\#of\ pile\ strikes)$$

For example, if a single-strike SEL for a pile is 165 dB, and it takes 1,000 strikes to drive the pile, the cumulative SEL is 195 dBA (165 dB + 30 dB = 195 dB), where 10 * $Log_{10}(1000)$ = 30.

Although this mathematical expression is recommended in technical guidance from the California Department of Transportation (Caltrans) as a "reasonable estimation" of cSEL for impact pile driving, it "assumes that all strikes have the same SEL value and that a fish would continuously be exposed to pulses with the same SEL. This is never actually the case since fish are migratory and move within and outside of the action area." (Caltrans 2020) Alternately, and comparable to a technique and supporting arguments proposed by Thalheimer, Poling, and Greene (2014), this memo also calculates cSEL with respect to the full measurement duration for an impact pile insertion.

3.1.2 Phocid and Otariid Hearing

Consistent with guidance described in Section 3.2 of the NMFS Manual for Optional User Spreadsheet Tool (version 2.2), Table 2 presents underwater auditory weighting adjustments at each indicated one-third octave band center frequency (1/3-OBCF) for the phocid and otariid hearing groups, which NMFS recommends application to unweighted measured sound levels (NMFS 2020).

Table 2. Marine Mammal Auditory Decibel Weightings (one-third octave [1/3-OBCF] bands)

Center frequency of 1/3-OBCF band (Hz)	Phocids (applied dB)	Otariids (applied dB)	Center frequency of 1/3-OBCF band (Hz)	Phocids (applied dB)	Otariids (applied dB)
8.0	-42.8	-82.2	500	-11.1	-12.5
10.0	-44.8	-78.3	630	-9.3	-9.5
12.5	-42.9	-74.4	800	-7.5	-6.9
16.0	-40.7	-70.1	1000	-5.9	-4.9
20.0	-38.8	-66.3	1250	-4.5	-3.3
25.0	-36.9	-62.4	1600	-3.1	-2.0
31.5	-34.9	-58.4	2000	-2.1	-1.2
40.0	-32.8	-54.2	2500	-1.3	-0.6
50.0	-30.9	-50.4	3150	-0.7	-0.2
63.0	-28.8	-46.4	4000	-0.3	-0.1
80.0	-26.8	-42.2	5000	-0.1	0.0
100	-24.8	-38.4	6300	0.0	-0.1
125	-22.9	-34.6	8000	-0.1	-0.3
160	-20.8	-30.4	10000	-0.3	-0.7
200	-18.9	-26.6	12500	-0.7	-1.4
250	-16.9	-23.0	16000	-1.5	-2.4
315	-15.0	-19.3	20000	-2.5	-3.7
400	-13.0	-15.7			

Source: NMFS 2020

3.2 Environmental Setting

3.2.1 Ambient Acoustic Contributors

The Project site, as shown in Figure 1, is within a developed area of the City and is bounded by the Oakland Inner Harbor to the north, industrial uses to the east, the San Francisco Bay Trail, AMS Ferry Terminal parking lot, and residential uses to the south, as well as the Main Street Dog Park and undeveloped land uses to the east. Consequently, acoustical contributors affecting underwater noise levels on the Project site and in its vicinity include sounds from the activity at the nearby Schnitzer Steel recycling center, SSA Terminals, the Oakland International Container Terminal, and the San Francisco Bay Ferry Terminal adjacent to Jack London Square. Contributing sounds from these sources to the Project site include the cargo loading of large container vessels and the passing of small and large boats, and the San Francisco Bay Ferry.

3.2.2 Affected Marine Mammals

Pre-construction surveys performed by Dudek observed California sea lions (*Zalophus californianus*) and harbor seals (*Phoca vitulina richardii*) within the Oakland Inner Harbor where pile driving occurred. Although bottlenose dolphins (*Tursiops truncatus*), harbor porpoises (*Phocoena phocoena*), and steller sea lions (*Eumetopias jubatus*) have also been observed within the channel, the IHA and hydroacoustic monitoring analysis within this memorandum focuses on the potential effects of impact pile driving on California sea lions (otariids) and harbor seals (phocids).

3.3 Regulatory Setting

3.3.1 Established Thresholds

In 2016, the National Oceanic and Atmospheric Administration – Fisheries and National Marine Fisheries Service (NOAA-Fisheries/NMFS) issued guidance on underwater thresholds for onset of permanent threshold shifts (PTS) or internal injury for marine mammals, which was updated and incorporated in the "2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0)". These underwater thresholds marine mammal protection are provided below in Table 3.

Table 3. NOAA-Fisheries Marine Mammal Protection Underwater "Level A" Thresholds

Hearing Group (Hearing Range/Weighting)	Accumulated SEL (cSEL) Threshold		Peak Threshold
	Impulsive[1]	Non-impulsive[2]	Impulsive[1]
Low-Frequency Cetaceans (LF 7 Hz. to 35 kHz.)	183 dB	199 dB	219 dB
Mid-Frequency Cetaceans (MF 150 Hz. to 160 kHz.)	185 dB	198 dB	230 dB
High-Frequency Cetaceans (HF 275 Hz. to 160 kHz.)	155 dB	173 dB	202 dB
Phocid Pinnipeds (PW 50 Hz. to 86kHz.)	185 dB	201 dB	218 dB
Otariid Pinnipeds (OW 60 Hz. 39 kHz.)	203 dB	219 dB	232 dB

Source: NOAA Fisheries 2018.
Notes: dB = decibel; cSEL = cumulative sound exposure level over a 24-hour period, with a reference value of $1\mu Pa^2s$; Peak = peak unweighted sound pressure level with reference to 1µPa
1 – Permanent Threshold Shift (PTS)/injury dual metric threshold for impulsive sources such as impact pile driving, use whichever metric results in the largest isopleth (e.g., seismic air guns, impact pile driving).
2 – Permanent Threshold Shift (PTS)/injury threshold for non-impulsive sources (e.g., vibratory pile driving, drilling).

NOAA-Fisheries indicates that marine mammals are likely to be behaviorally harasses in a manner that would qualify as Level B harassment when exposed to underwater noise levels above received levels of 120 dB 1µPa RMS for continuous sources (e.g., vibratory pile driving, drilling), and above received levels of 160 dB 1μPa RMS for non-explosive, impulsive sources (e.g., seismic air guns, impact pile driving) or intermittent sources (e.g., scientific, non-tactical sonar).

3.3.2 Marine Wildlife Protection Plan

The conditions under which incidental harassment of marine mammals is authorized under section 1010(a)(5)(D) of the Marine Mammal Protection Act. For this project, two marine mammals represent the subject of potential incidental take: harbor seal (*Phoca vitulina richardii);* and the California sea lion (*Zalophus californianus*). California sea lions (otariids), which range from California to Canada and are known to occur within the Project area, are not federally listed under the Endangered Species Act but receive protection under the Marine Mammal Protection Act. They. California sea lions. Harbor seals (phocids), which range from Mexico to Alaska and are known to occur within the Project area, are not federally listed under the Endangered Species Act but receive protection under the Marine Mammal Protection Act.

3.4 Incidental Harassment Authorization

With respect to hydroacoustic monitoring, Section 6(e) of the final IHA lists the following minimum requirements that were used to collect, analyze, and present data as appearing in this memo:

- Hydrophone equipment and methods: recording device, sampling rate, distance from the pile where recordings were made; depth of water at the pile location and recording device(s);
- Type and size of pile being driven, substrate type, method of driving during recordings (e.g., hammer model and energy), and total pile driving duration;
- For all impact driving, a detailed description of the sound attenuation device used and the duration of its use per pile;
- For impact pile driving (per pile): number of strikes and strike rate; depth of substrate to penetrate; pulse duration and mean, median, and maximum sound levels (dB re: 1 μPa): root mean square sound pressure level (SPLrms), cumulative sound exposure level (SELcum), peak sound pressure level (SPLpeak), and single-strike sound exposure level (SELs-s);
- One-third octave band spectrum and power spectral density plots (average per pile type or for each individual pile); and
- Sound measurement data shall be provided to NMFS in tabular spreadsheet format (Microsoft Excel or similar).

The IHA also describes the shutdown and harassment zone boundaries for the marine mammal species of concern, based on pile type, as reproduced in Table 4 (NMFS 2023; CDFW 2023).

Table 4. Pile Driving Shutdown and Harassment Zones

Method	Pile Type	Pile Size (inches dia.)	Shutdown Zone for Phocids (meters)	Shutdown Zone for Otariids (meters)	Level B Harassment Zone (meters)
Impact, installation	steel	36	830	60	736
Impact, installation	steel	48	140	10	631

Vibratory, extraction*	steel	30	40	10	4,200 (west); 1,700 (east)
Vibratory, installation*	steel	36	40	10	4,200 (west); 1,700 (east)
Vibratory, installation*	steel	48	10	10	4,200 (west); 1,700 (east)

Source: IHA

Notes: Vibratory driving of 36-inch-diameter piles used as proxy for vibratory extraction of 30-inch piles.

* Constrained by bends in the Oakland Estuary and relatively shallow bathymetry near the shipping channel: 4,200 meters (13,780 feet) west; 1,700 meters (5,577 feet) east.

4 Hydroacoustic Monitoring

4.1 Approach and Methodology

4.1.1 Instrumentation and Equipment

Table 5 describes the equipment used to conduct the hydroacoustic monitoring.

Table 5. Equipment for Underwater Sound Monitoring

Item	Manufacturer and Model	Specifications	Usage
Hydrophone	RESON TC4013 hydrophone with 20-meter cable, LEMO termination, BNC adapter included	1 Hz-170 kHz, -211dB ±3dB re 1V/uPa	Detect underwater sound pressure levels and convert to voltages that can be recorded/analyzed by other equipment.
Calibrator (pistonphone-type) with Hydrophone Coupler/Adaptor	GRAS 42AA Pistonphone Calibrator and coupler	IEC 60942 Class 1, ANSI S1.10; 114 dB @ 250Hz	Calibration check of hydrophone in the field.
Sound Level Analyzer	Larson Davis Model 831C with LOG, OB3, SR, ELA, and 2GB options	IEC 61672-1:2013, ANSI S1.4-2014 Class 1; 51,200 Hz sampling rate; 30 micro-second peak rise	Analyzes and transfers digital data to laptop hard drive.
Laptop computer	Lenovo ThinkPad T16 (intel i5)	Compatible with sound level analyzer (runs Larson Davis G4 utility software)	Record digital data on hard drive
Flow shield	Protective cage for RESON TC4013 hydrophone, stainless steel construction, corrosion-resistant body	Open cell foam cover or functional equivalent	Protects hydrophone, eliminates flow noise contamination.

4.1.2 Selected Monitoring Distances

The hydrophone was positioned as practical within each of the two position ranges as outlined below:

- Position for the 48" steel pile. The hydrophone was positioned at approximately 600 meters from the pile being driven, consistent with the recommended 600 to 650-meter distance from the Hydroacoustic Monitoring Plan, with what appears in Table 3 for the evaluation of Level B marine mammal thresholds.

- Position for the 36" steel pile. The hydrophone recording system was positioned at approximately 710 meters from the pile being driven, consistent with the recommended 700 to 750-meter distance from the Hydroacoustic Monitoring Plan, with what appears in Table 3 for the evaluation of Level B marine mammal thresholds.

Exhibit A. Hydroacoustic Monitoring Measurement Locations

Source: Google 2022, Dudek 2023

4.1.3 Monitoring Procedure

Pre-monitoring Preparation

Prior to monitoring underwater sound levels, a weighted line recorded the channel depth before pile driving began. The hydrophone was attached to a nylon cord with an anchor, keeping the line at a set distance from the pile. The distance of the hydrophone location from the pile driving activities was measured using Google Earth Pro, and a direct line of acoustic transmission (direct line-of-sight) through the water column between the pile and the hydrophone was ensured.

The onsite inspector/contractor informed the acoustics specialist when pile driving would begin to ensure that the monitoring equipment was operational.

When collecting sound measurements in an area with strong currents (such as the Project area), appropriate measures were taken, when necessary, to ensure that the flow-induced noise at the hydrophone did not interfere with the recording and analysis of the relevant sounds (NMFS, 2012a, b, and c). As a rule, current speeds of 1.5 meters/second or greater are expected to generate significant flow-induced noise, which may interfere with the detection and analysis of low-level sounds such as the sounds from a distant pile driver. To reduce the flow-induced noise at the hydrophone, a flow shield was installed around the hydrophone to provide a barrier between the irregular, turbulent flow and the hydrophone.

Instrument Calibration Check

Calibration of measurement systems was established prior to use in the field each day. An acoustical pistonphone and hydrophone coupler was used along with manufacturer calibration certificates to calibrate the equipment. The volume correction of the coupler for each hydrophone or microphone was known so that the piston phone's produced known signal could be compared against the measurement system response. The response of the measurement system was noted in the field book and applied to all subsequent measurements. The hydrophone was calibrated to a calibration tone prior to use in the field.

Monitoring

Underwater sound levels were continuously monitored during the entire duration of each pile being driven at a one-third octave band center frequency resolution. The broadband instantaneous peak, SEL, and RMS values of each pile were monitored in real time during construction to help ensure that the observed impact pile driving associated with the Project does not exceed its authorized take level. Peak and RMS pressures are reported in dB re:1 μPa, and SEL is reported in dB re: 1 μPa^2-s.

Prior to and during the pile driving activity, environmental data was gathered, such as water depth, boat traffic, and other factors that could contribute to influencing the measurable underwater sound levels (e.g., boat passages, etc.). The start and stop time of each pile driving event was also recorded.

4.1.4 Data Analysis

Pile Driving Information Request

Information on the Project impact pile driving procedure conducted by the construction contractor was supplied after Dudek request. Requested details included the following to satisfy the aforementioned IHA Section 6(e) reporting requirements, and can be found in Attachment B: a description of the channel substrate composition, approximate depth of significant substrate layers, hammer model and size, hammer energy settings and any changes to those settings during the piles being monitored, depth pile driven, blows per foot for the piles monitored, and total number of strikes to drive each pile that is monitored (NMFS 2023; CDFW 2023).

Calculation of Metrics

After collection of data, Dudek analyzed the readings and performed calculations to either reproduce raw data or derive values appearing in Attachment A. Although not required by the IHA or ITP, Dudek has calculated cSEL values with two methods as alluded to in Section 3.1.1, with included application of appropriate phocid and otariid hearing group decibel adjustments as appearing in Table 3 of Section 3.1.2 (NMFS 2023; CDFW 2023).

4.2 Analysis Results

Analysis of the collected underwater sound level data from monitoring of the impact-driven piles as presented in Attachment A includes:

- Number of pile strikes per pile.
- For each pile monitored, and from the set of monitored pile strikes:
    - the maximum, minimum, and mean of the peak pressure values;
    - the maximum, minimum, and mean of the root-mean-square (RMS) values;
    - the maximum, minimum, and mean of the representative single-strike sound exposure level (SELss) values;
    - cumulative SEL (cSEL) for the entire set of monitored pile strikes, evaluated in two ways as follows—
        - representative single strike magnitude, plus 10*LOG(N) where N is the quantity of strikes,
        - aggregate SEL from all strikes, over the monitoring period for the indicated pile.
- For one approximate 1-hour ambient (no pile-driving) measurement period:
    - the maximum, minimum, and mean of the peak pressure values;
    - the maximum, minimum, and mean of the root-mean-square (RMS) values;
    - the maximum, minimum, and mean of the sound exposure level (SEL) values;
    - cumulative SEL (cSEL) for the entire set of monitored ambient levels.

Attachment D includes the following value plots, consistent with IHA requirements, for each of the piles monitored and with respect to the indicated monitoring period:

- One-third octave band center frequency (1/3-OBCF) cSEL and maximum sound levels, for the unweighted ("broadband") case and with dB weightings for phocid and otariid hearing groups; and

- Power spectral density of cSEL and maximum sound levels, between 20 and 20,000 Hz, for the unweighted ("broadband") case and with dB weightings for phocid and otariid hearing groups.

Because these above-listed plots that appear in Attachment D are for the entire measurement period associated with each pile, the cSEL they represent include the aggregate SEL from all strikes along with occasional contributions associated with other observed sources (see Attachment E) such as boat traffic on the channel. They thus represent the total underwater sound that the studied phocid and otariid would be exposed to in the vicinity of the monitoring location (NMFS 2023; CDFW 2023).

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Figure 1 – Regional Setting

Figure 2 – Project Features

Attachment A

Hydroacoustic Monitoring Log

Attachment A. Hydroacoustic Monitoring Log

Ambient Measurement Period

Date (mm/dd/yy) and Time (hh:mm)	Pile ID	Pile-driving Type (Impact, Vibratory) or Other	# Strikes or Vibratory Seconds	Distance to Pile from Hydrophone (m)	Depth of Hydrophone (m)	Water Depth (m)		Hearing Group	Peak (dB)			SEL (dB)					RMS (dB)			Notes
						At Pile	At H-phone		Max	Min	Mean	Max	Min	Mean	cSEL	cSEL*	Max	Min	Mean	
11/07/23 8:50 a.m. to 10:02 a.m.	N/A – Ambient measurement	N/A – Ambient measurement	N/A	700	10	13	15	Broadband	172.5	143.6	144.6	145.0	111.3	118.7	124.1	N/A	149.3	115.6	123.1	No observed pile driving this period.
								Phocid							116.6					
								Otariid							116.8					

Notes: cSEL represents the cumulative sound exposure level calculated from the "broadband" (mean) 1/3 octave band frequency spectrum for an entire measurement period, which considers existing ambient levels during a measurement period rather than solely capturing impact hammer strikes, providing a more accurate representation of receiving marine mammals. cSEL* represents the cumulative sound exposure level only corresponding to the number of strikes within the measurement period. N/A = not applicable.

Pile Driving Measurement Periods

Date (mm/dd/yy) and Time (hh:mm)	Pile ID	Pile-driving Type (Impact, Vibratory) or Other	# Strikes or Vibratory Seconds	Distance to Pile from Hydrophone (m)	Depth of Hydrophone (m)	Water Depth (m)		Hearing Group	Peak (dB)			SEL_{ss} (dB)					RMS_{ss} (dB)			Notes
						At Pile	At H-phone		Max	Min	Mean	Max	Min	Mean	cSEL	cSEL*	Max	Min	Mean	
11/07/23 10:33 a.m. to 11:19 a.m.	36" Steel Pipe Pile, 1" Thick	Impact	11 strikes	700	10	13	15	Broadband	160.6	150.6	157.7	139.6	130.1	136.0	121.6	146.4	144.0	134.5	140.4	Pulse duration (seconds) to calculate RMS: 0.363
								Phocid							116.1					
								Otariid							116.3					
11/07/23 1:40 p.m. to 2:07 p.m.	48" Steel Pipe Pile, 1" Thick	Impact	62 strikes	600	10	13	15	Broadband	147.3	134.6	139.4	121.4	112.8	116.6	133.6	134.5	133.0	124.4	128.2	Pulse duration (seconds) to calculate RMS: 0.0691
								Phocid							104.5					
								Otariid							100.3					

Notes: cSEL represents the cumulative sound exposure level calculated from the "broadband" (mean) 1/3 octave band frequency spectrum for an entire measurement period, which considers existing ambient levels during a measurement period rather than solely capturing impact hammer strikes, providing a more accurate representation of receiving marine mammals. cSEL* represents the cumulative sound exposure level only corresponding to the number of strikes within the measurement period. N/A = not applicable.

Attachment B

Channel and Pile Driving Information

2.5 SUBSURFACE CONDITIONS

Based on review of the available geotechnical exploration data and our understanding of the site history, the site can be divided into two generalized subsurface profiles – shore-side and offshore. As described in Section 2.1, numerous dredging and filling activities occurred throughout the history of the site, with material likely dredged from San Francisco Bay then placed as fill material on the existing marshland. Due to loading from fill placement shore-side, the underlying soil behaves differently from the same geologic unit offshore.

In general, the deposits encountered at the project site include, from youngest to oldest, (1) artificial fill, (2) Young Bay Mud deposits, and (3) San Antonio Formation. Offshore, artificial fill was not encountered in the explorations we reviewed. We provide additional generalized description of the deposits noted above, in the following sections. We provide an idealized geologic cross section through the project site in Figure 8.

ARTIFICIAL FILL

As a consequence of the land reclamation and prior construction activities at the project site, a heterogeneous surficial layer of fill material exists shore-side. The fill material comprises a mixture of sand, gravel, and clayey materials, much of which was likely dredged from San Francisco Bay and placed on an existing marshland.

At the project site, we estimate the artificial fill to vary between 10 and 20 feet in thickness. The fill consistency is generally loose to medium dense.

YOUNG BAY MUD

The explorations encountered Young Bay Mud (YBM) directly underneath the artificial fill. The YBM encountered consists of greenish gray to blue gray soft, plastic clay and silt as well as clayey and silty sand. YBM is highly compressible and typically very soft with strength increasing with depth.

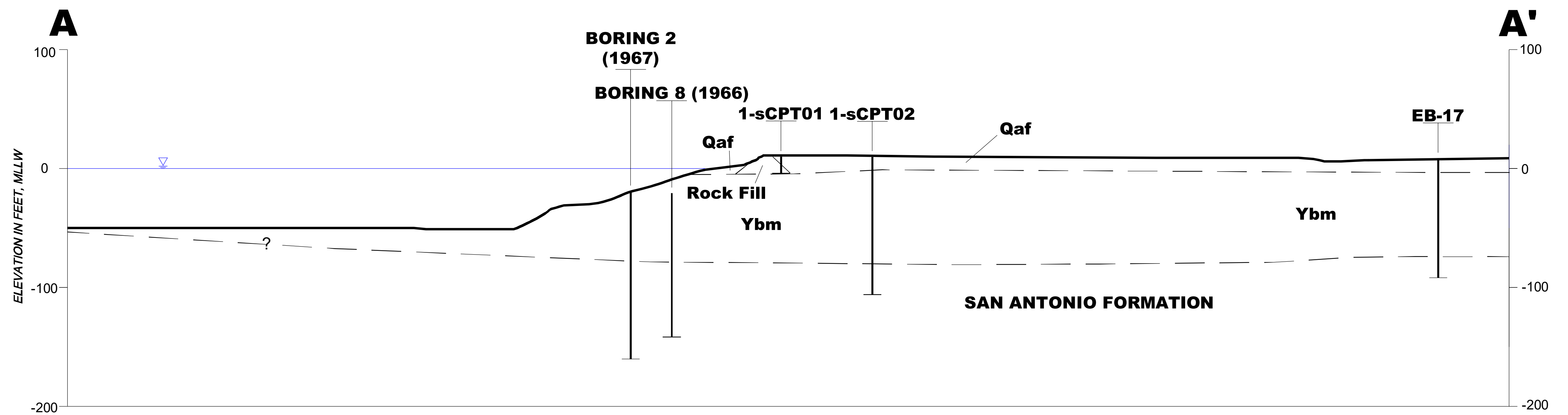
The YBM shore-side differs from the YBM offshore. Due to the placement of fill many years ago, the YBM shore-side is stiffer and has already experienced some amount of compression. The YBM offshore is typically softer, with strength increasing more slowly with depth as compared to the YBM shore-side. At the project site, we estimate the YBM to be approximately 70 feet in thickness.

SAN ANTONIO FORMATION

The San Antonio formation is composed of alluvium deposited in environments ranging from alluvial fans and flood plains to lakes and beaches, and is sometimes interbedded with YBM or Old Bay Clay. This unit is generally moderately dense to very dense sand and stiff to hard silt and clay. At the project site, we do not have explorations that penetrate beyond the San Antonio Formation.

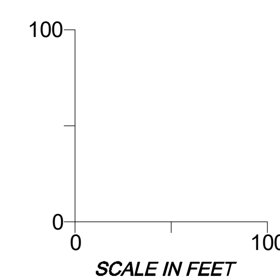
2.6 GROUNDWATER CONDITIONS

During our exploration, we performed pore-pressure dissipation testing in our CPT explorations. At 1-sCPT1, the pore-pressure dissipation testing indicated groundwater approximately 6½ feet



SECTION A-A'

1"= 100'



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

Qaf	ARTIFICIAL FILL
Ybm	YOUNG BAY MUD
1-sCPT02	CONE PENETRATION TEST
285.GB29	BORING

ENGEO Expect Excellence	CROSS SECTION A-A' ALAMEDA MAIN STREET FERRY TERMINAL REFURBISHMENT ALAMEDA, CALIFORNIA	PROJECT NO.: 19542.000.001 SCALE: AS SHOWN DRAWN BY: JV CHECKED BY: TMK	FIGURE NO. 8

Attachment B. Summary of Pile Driving Equipment (Vibratory and Impact Hammer)

Hammer Model	Hammer Size/Self-Weight (lbs)	Hammer Energy Setting
APE Model 400 Vibratory Hammer (Water)	31,570	
APE Model D80-42 Single Acting Diesel Impact Hammer (Land)	38,434	#4

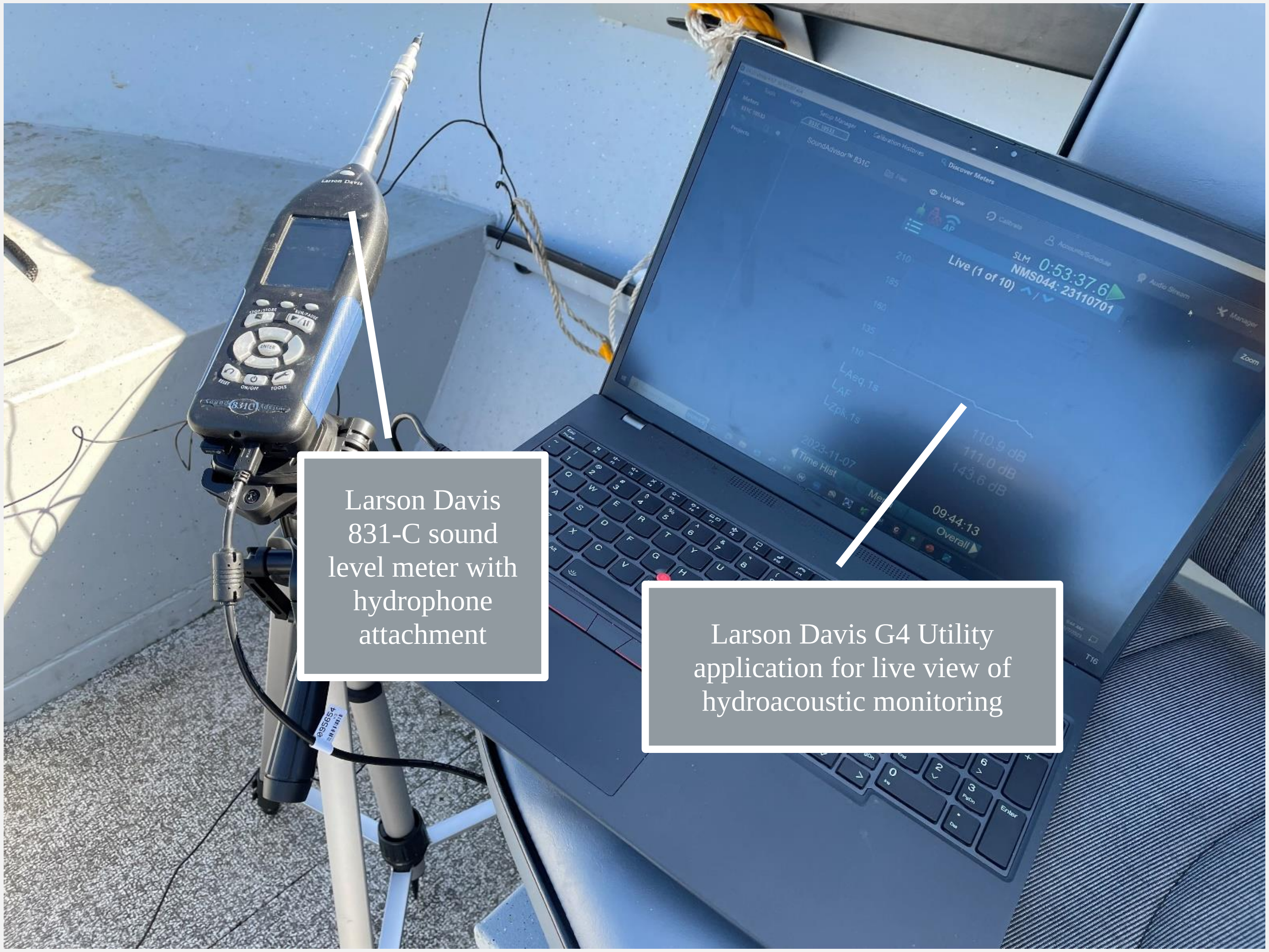
Attachment B. Summary of Pile Driving Activities

Pile Location (and project feature)	Pile Type (Quantity)	Pile Identification	Duration/Blows per Pile	Depth of Pile Driven (feet)
Terminal Bridge and Foundation Replacement	48-inch steel pipe, 1" Thick (1)		36 minutes (vibrate)	152
			62 strikes (impact)	1
Float Replacement (Guide Piles and Donut Fender Piles)	36-inch steel pipe, 1" Thick (4)	NW	122 minutes (vibrate)	137
			11 strikes (impact)	0.5
		NE	49 minutes (vibrate)	137
		SW	163 minutes (vibrate)	137
		SE	64 minutes (vibrate)	137
	36-inch steel pipe, 1 ¼" Thick (2)	East	97 minutes (vibrate)	132
		West	55 minutes (vibrate)	132

Attachment C

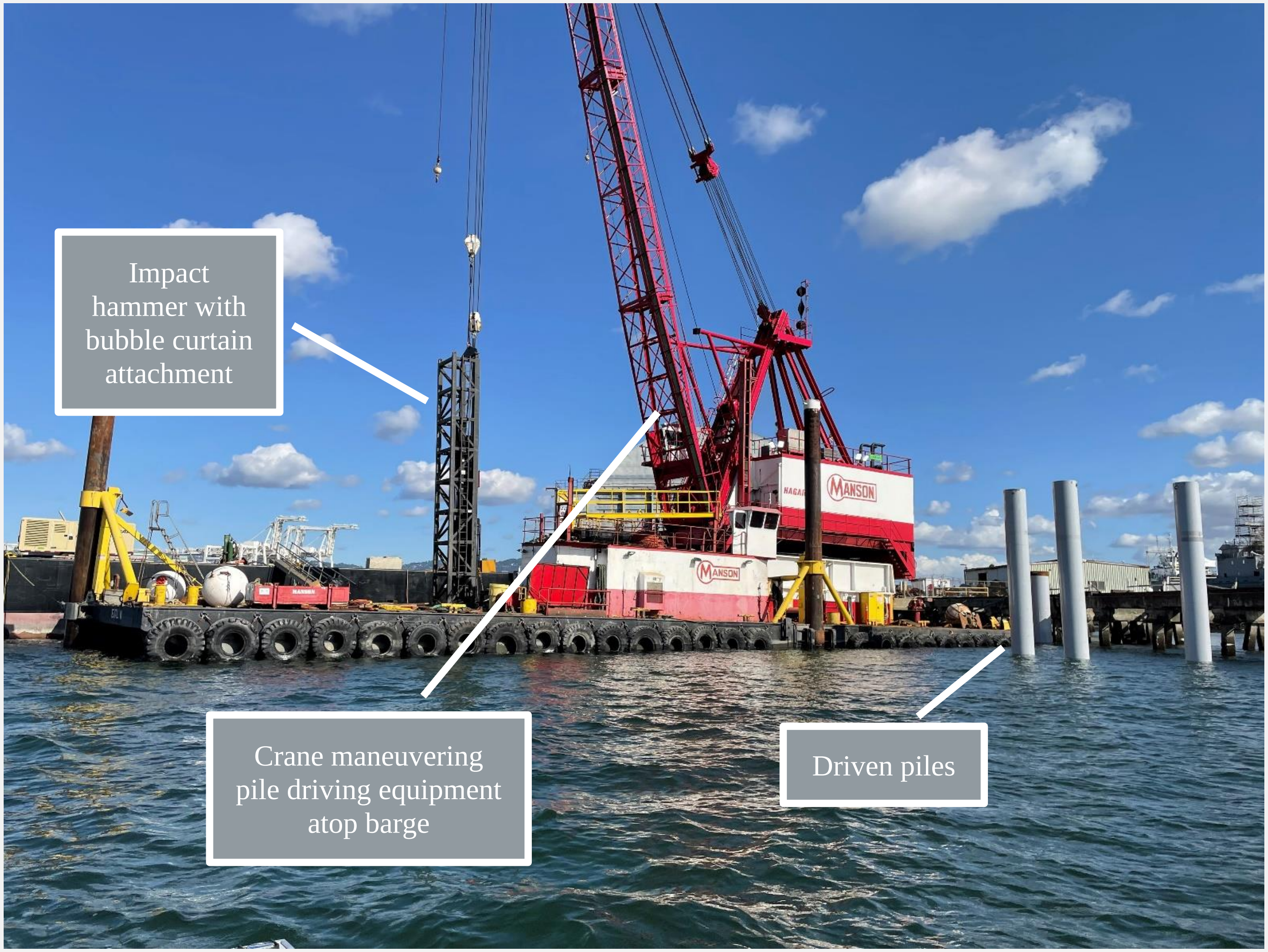
Photographs of Pile Driving Activities and Hydroacoustic Monitoring

Attachment C. Hydroacoustic Monitoring Measurement Setup



Source: Dudek 2023

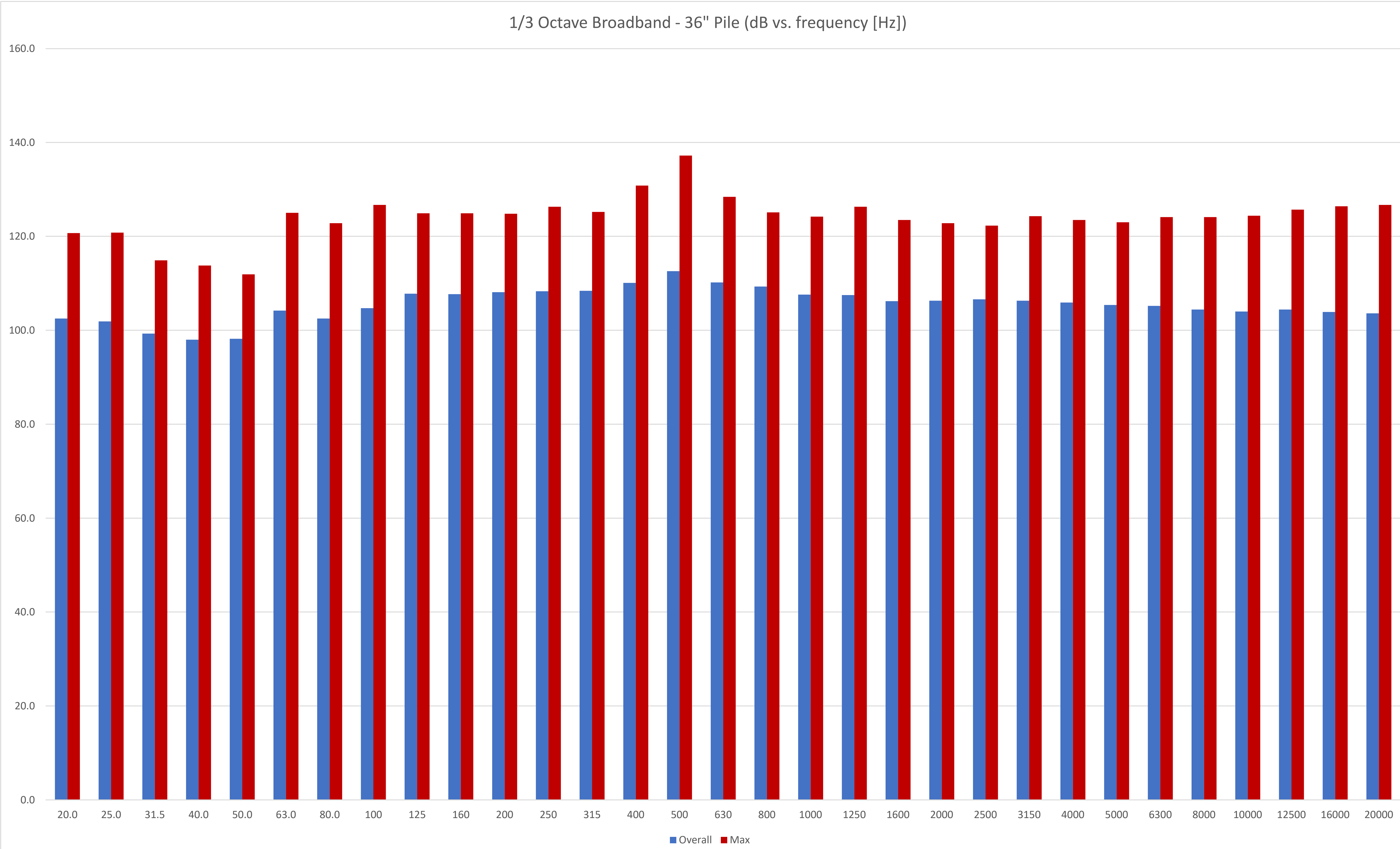
Attachment C. Impact Pile Driving Activities

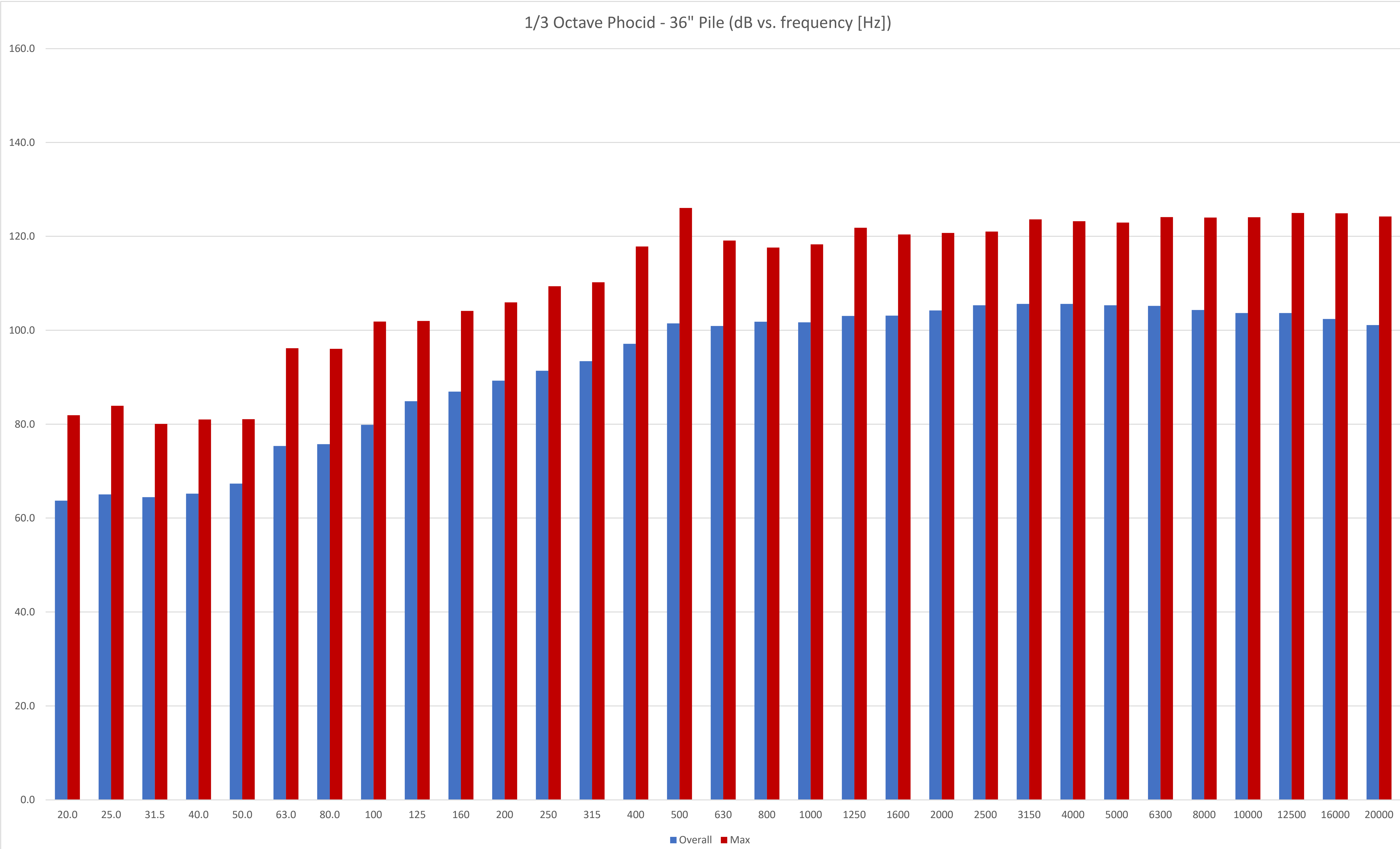


Source: Dudek 2023

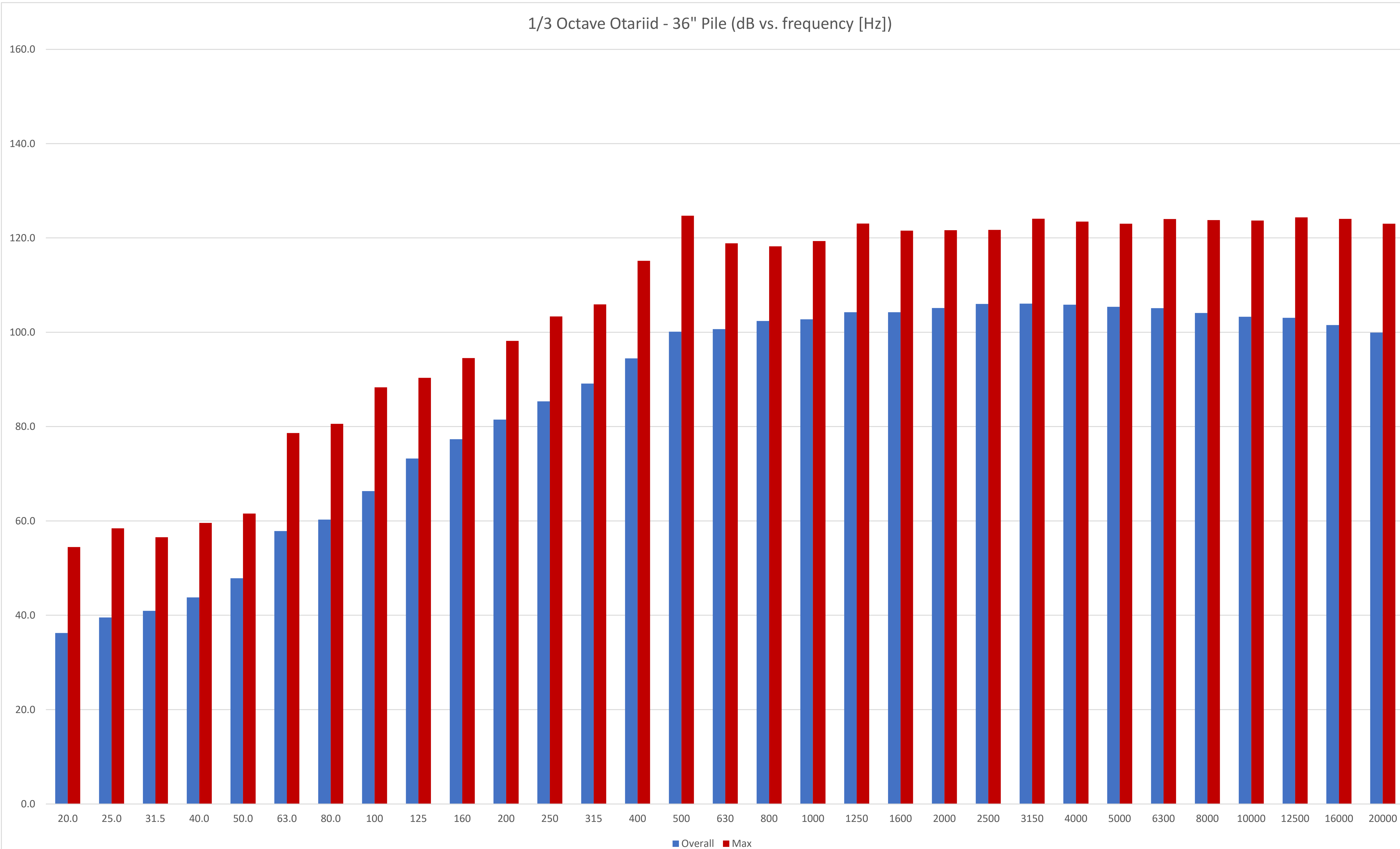
Attachment D

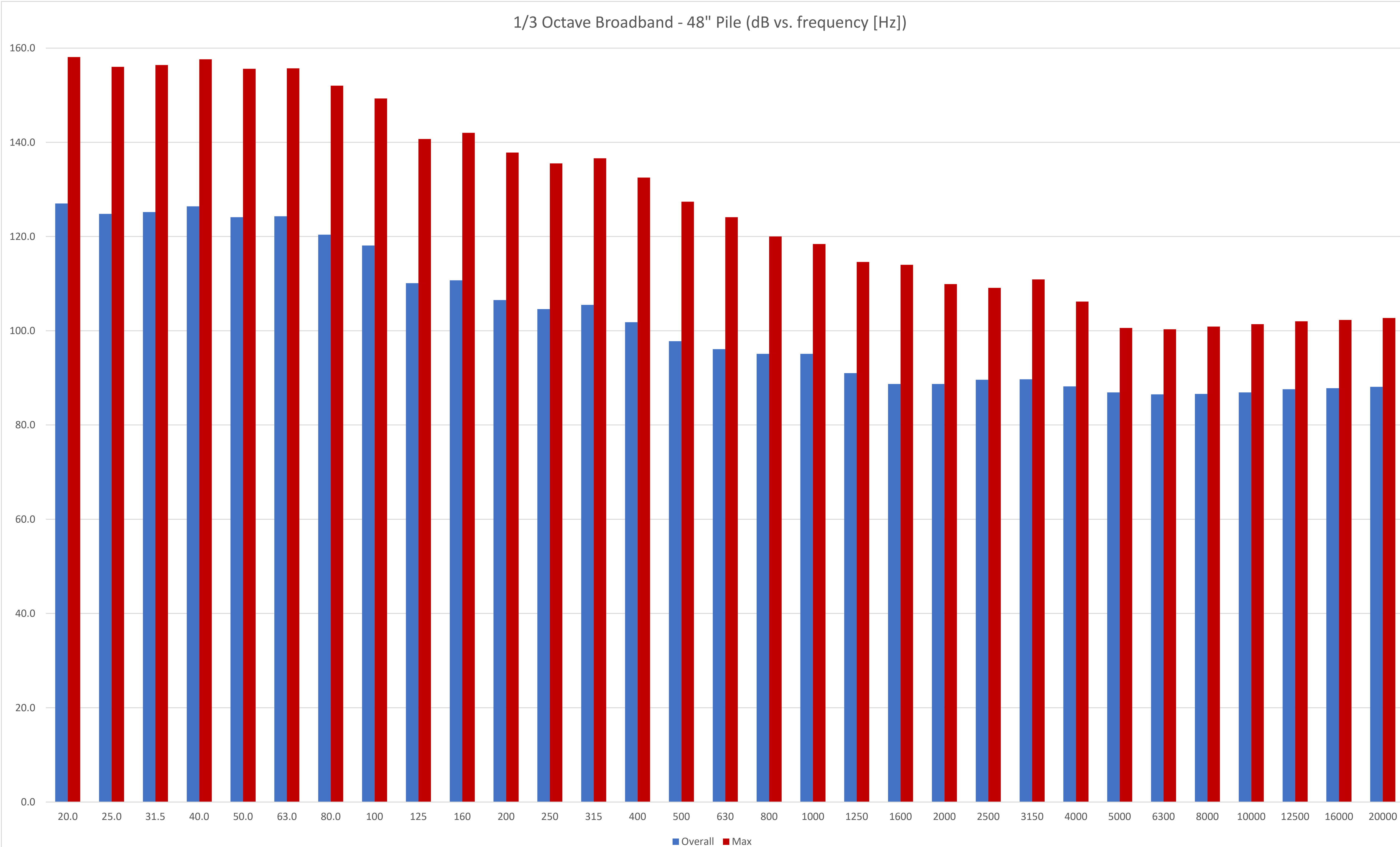
One-Third Octave Band Spectrum and Power Spectral Density Plots

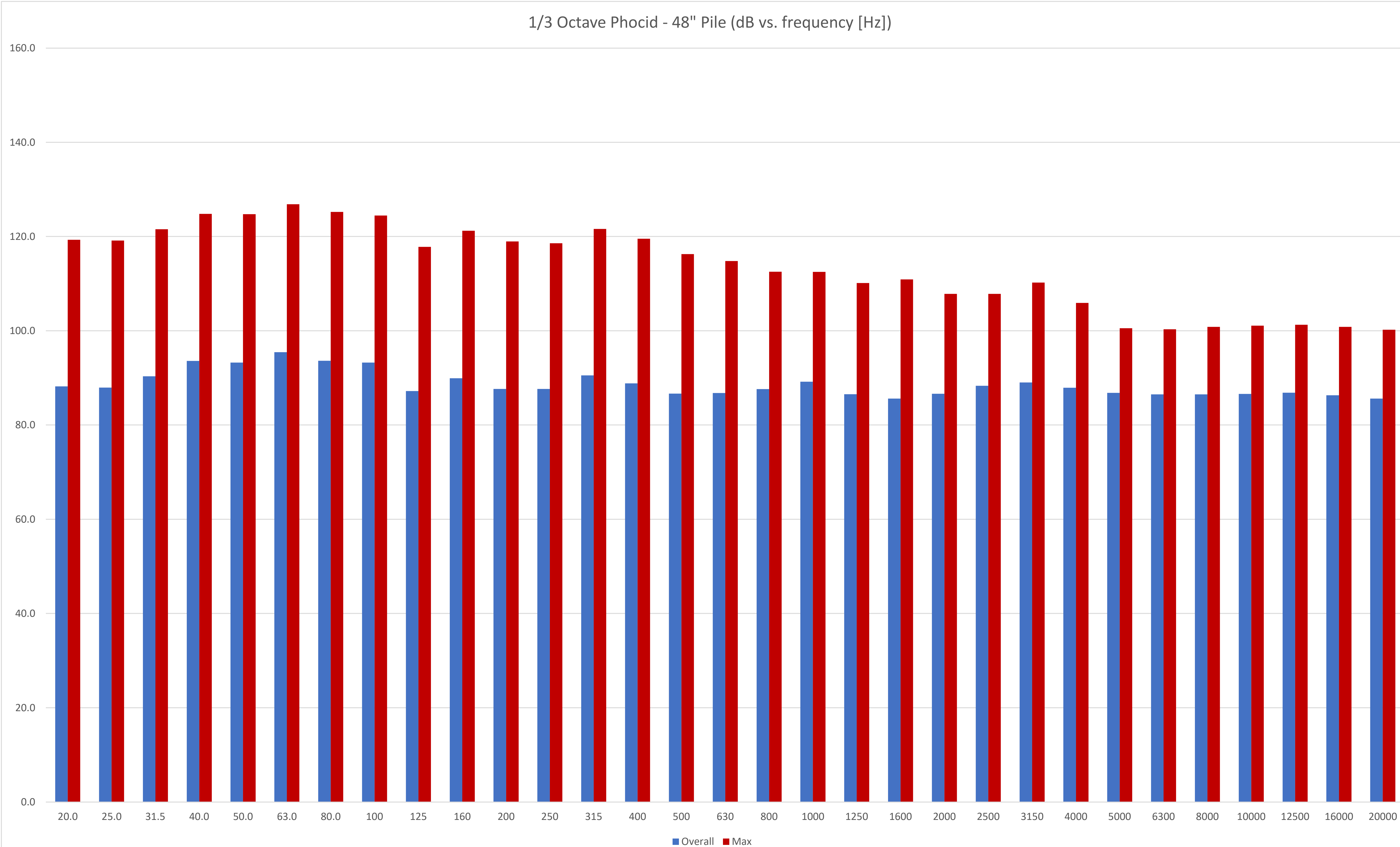

1/3 Octave Broadband - 36" Pile (dB vs. frequency [Hz])
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20.0 25.0 31.5 40.0 50.0 63.0 80.0 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000 10000 12500 16000 20000
Overall
Max



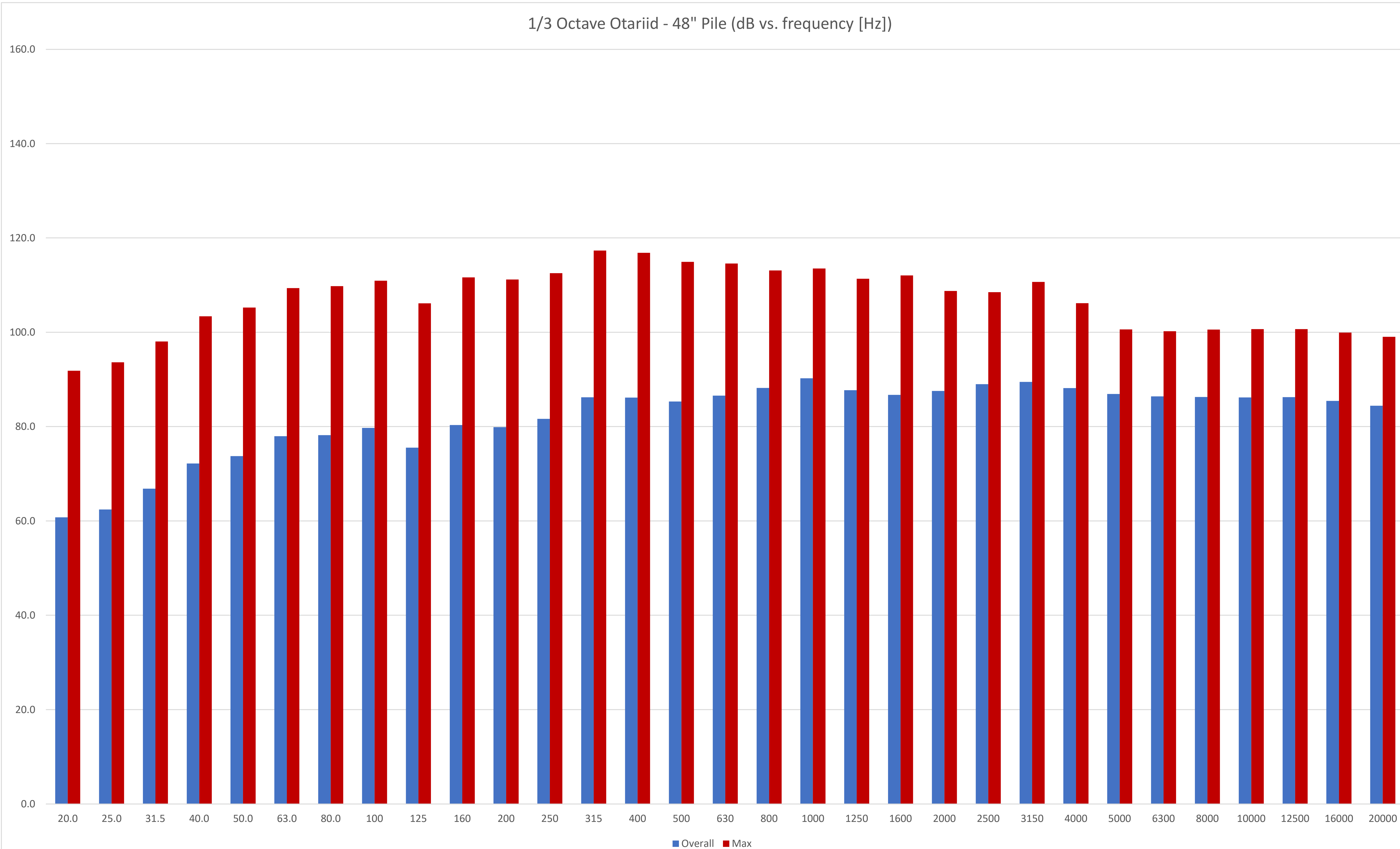
1/3 Octave Phocid - 36" Pile (dB vs. frequency [Hz])
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
Overall
Max


1/3 Octave Otariid - 36" Pile (dB vs. frequency [Hz])
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
Overall
Max

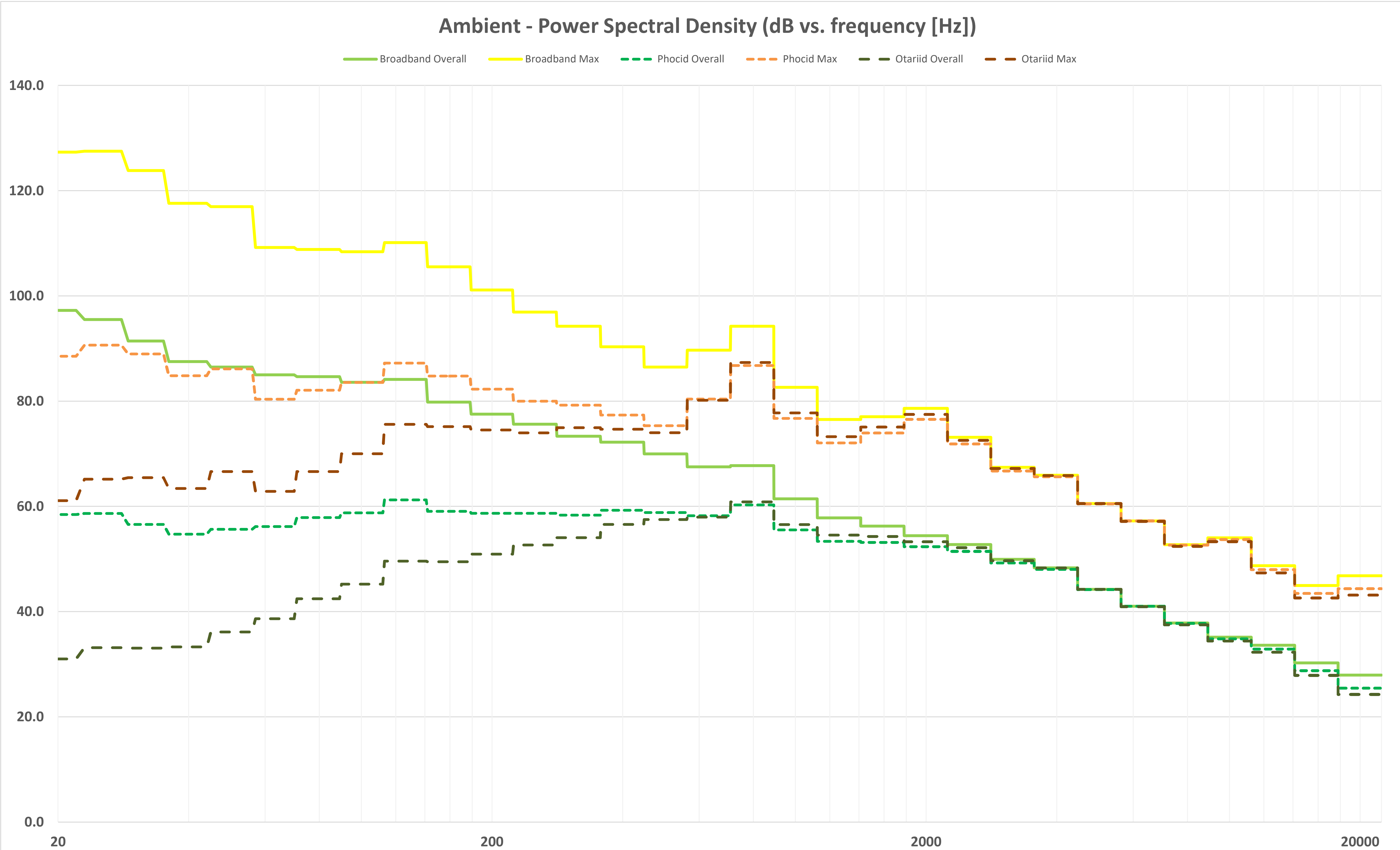

1/3 Octave Broadband - 48" Pile (dB vs. frequency [Hz])
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
Overall
Max

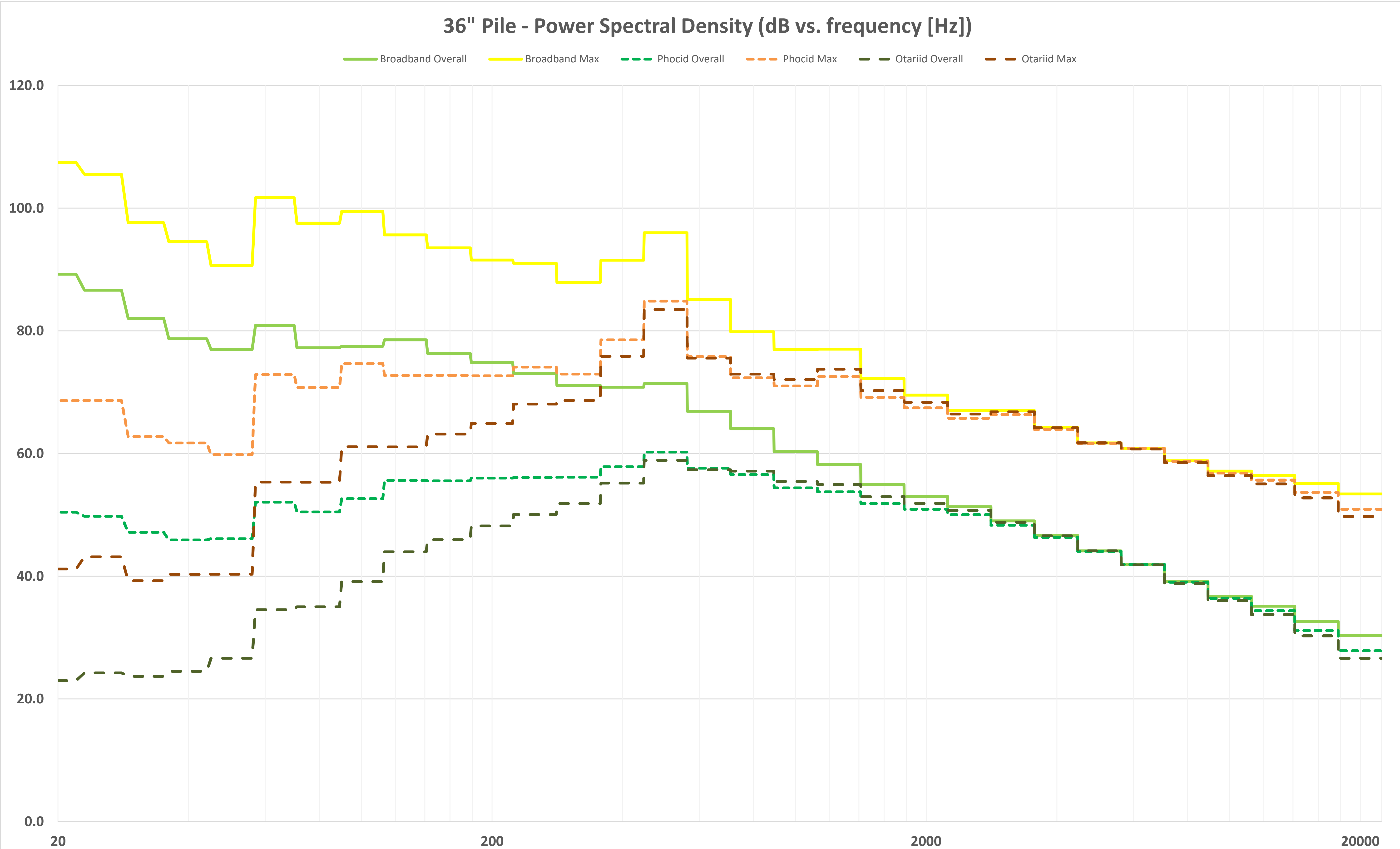


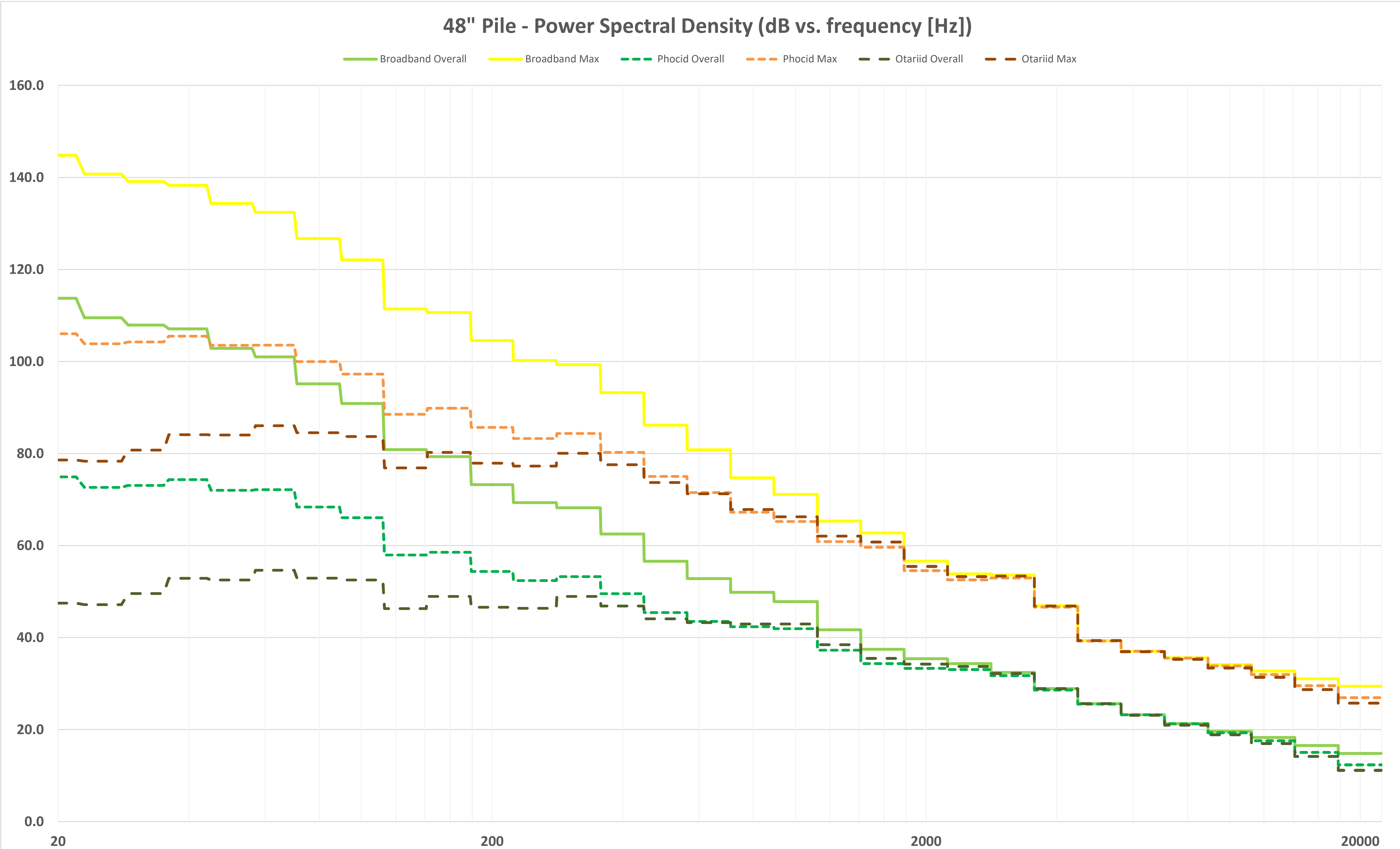
1/3 Octave Phocid - 48" Pile (dB vs. frequency [Hz])
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
Overall
Max



1/3 Octave Otariid - 48" Pile (dB vs. frequency [Hz])
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20.0
25.0
31.5
40.0
50.0
63.0
80.0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
4000
5000
6300
8000
10000
12500
16000
20000
Overall
Max


Ambient - Power Spectral Density (dB vs. frequency [Hz])
Broadband Overall
Broadband Max
Phocid Overall
Phocid Max
Otariid Overall
Otariid Max
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20
200
2000
20000


36" Pile - Power Spectral Density (dB vs. frequency [Hz])
Broadband Overall
Broadband Max
Phocid Overall
Phocid Max
Otariid Overall
Otariid Max
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20
200
2000
20000



48" Pile - Power Spectral Density (dB vs. frequency [Hz])
Broadband Overall
Broadband Max
Phocid Overall
Phocid Max
Otariid Overall
Otariid Max
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
20
200
2000
20000

Attachment E

Monitoring Data Calculations, LD-831c Summary Data Sheets, and Investigator Field Notes

Ambient monitoring data calculcations

Ambient levels (Oakland Inner Harbor)

Timestamp	LAeq	LCeq	LCpk	LZpk
8:50:36	132.3	134.3	143.7	148.4
8:50:37	133.9	135.6	143.7	143.6
8:50:38	133.8	135.8	143.7	143.6
8:50:39	132.8	134.9	143.7	148.4
8:50:40	130.2	131.9	143.7	143.6
8:50:41	129.9	131.6	143.7	143.6
8:50:42	127.1	128.5	143.7	143.6
8:50:43	125.9	127.8	143.7	143.6
8:50:44	127.7	129.6	143.7	143.6
8:50:45	125.2	127.4	143.7	143.6
8:50:46	125.9	128.1	143.7	143.6
8:50:47	126.7	128.7	143.7	143.6
8:50:48	124.8	126.9	143.7	143.6
8:50:49	124.3	126.8	143.7	143.6
8:50:50	124.9	127.6	143.7	149.6
8:50:51	126.2	128.9	143.7	143.6
8:50:52	124.8	127.5	143.7	143.6
8:50:53	122.9	125.7	143.7	143.6
8:50:54	121.8	124.5	143.7	143.6
8:50:55	120.2	123.0	143.7	143.6
8:50:56	118.7	122.2	143.7	146.6
8:50:57	118.5	122.5	143.7	143.6
8:50:58	116.5	124.1	143.7	161.5
8:50:59	120.0	128.6	143.7	148.4
8:51:00	117.4	125.1	143.7	161.5
8:51:01	116.4	123.4	143.7	152.1
8:51:02	117.2	125.0	143.7	158.8
8:51:03	116.2	122.1	143.7	164.1
8:51:04	114.3	121.7	143.7	157.6
8:51:05	114.3	119.0	143.7	152.1
8:51:06	114.1	120.2	143.7	143.6
8:51:07	114.8	119.2	143.7	153.2
8:51:08	114.5	118.7	143.7	148.4
8:51:09	114.0	117.9	143.7	148.4
8:51:10	114.6	119.2	143.7	154.4
8:51:11	114.5	119.3	143.7	154.0
8:51:12	111.1	115.3	143.7	143.6
8:51:13	111.6	117.1	143.7	152.1
8:51:14	110.5	117.4	143.7	153.2
8:51:15	110.8	118.6	143.7	154.0
8:51:16	109.7	115.8	143.7	150.6
8:51:17	108.8	112.9	143.7	143.6

	Peak			SEL					RMS		
	max	min	mean	max	min	mean	cSEL	cSEL*	max	min	mean
Broadband	172.5	143.6	144.6	145.0	111.3	118.7	124.1		149.3	115.6	123.0
Phocid							116.6				
Otariid							116.8				

	LAeq	LCeq	LCpk	LZpk
max	142.5	146.9	170.6	172.5
min	107.8	111.4	143.7	143.6
mean	114.3	118.1	143.9	144.6

LAIeq	124.4
LAeq	120.1
LAIeq - LAe	4.3

1/3 Octave (Broadband)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	117.0	115.9	114.9	112.7	109.7	110.5	110.8	108.7	106.8	107.7	108.3	109.9	110.8	113.4	111.2	110.8	110.9	110.6	111.5	111.2	110.8	113.0	108.7	107.1	107.5	107.7	108.0	107.2	107.6	105.5	104.3	103.1	102.4	102.9	101.5	101.2
Max 1/3 Spectra	141.9	142.8	143.1	138.6	136.0	140.6	142.8	141.1	136.9	138.2	132.5	134.1	135.6	139.4	136.9	134.4	132.2	131.5	129.6	127.7	133.0	139.5	129.9	125.8	128.3	131.9	128.4	124.7	125.2	121.8	120.5	118.0	121.3	118.0	116.2	120.1
Min 1/3 Spectra	94.4	93.0	93.3	93.2	91.9	92.9	92.1	91.4	91.4	91.3	91.2	91.7	95.9	99.3	96.5	94.7	98.4	98.3	99.8	99.4	100.5	97.4	94.8	92.0	91.8	92.7	93.2	92.6	92.4	91.9	92.0	92.3	93.1	93.7	94.6	95.5
L(20-200Hz)	120.7																																			

cSEL (Broadband) [20-20000 Hz]	
Overall	124.1
Max	150.0
Min	110.3

1/3 Octave (Phocid)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	-	73.1	70.1	69.8	69.0	71.7	73.9	73.8	74.0	76.9	79.5	83.1	86.0	90.5	90.4	92.0	94.0	95.6	98.5	100.1	101.5	105.5	102.8	102.6	104.4	105.6	106.7	106.5	107.3	105.4	104.3	103.0	102.1	102.2	100.0	98.7
Max 1/3 Spectra	-	100.0	98.3	95.7	95.3	101.8	105.9	106.2	104.1	107.4	103.7	107.3	110.8	116.5	116.1	115.6	115.3	116.5	116.6	116.6	123.7	132.0	124.0	121.3	125.2	129.8	127.1	124.0	124.9	121.7	120.5	117.9	121.0	117.3	114.7	117.6
Min 1/3 Spectra	-	50.2	48.5	50.3	51.2	54.1	55.2	56.5	58.6	60.5	62.4	64.9	71.1	76.4	75.7	75.9	81.5	83.3	86.8	88.3	91.2	89.9	88.9	87.5	88.7	90.6	91.9	91.9	92.1	91.8	92.0	92.2	92.8	93.0	93.1	93.0

cSEL (Phocid) [20-20000 Hz]	
Overall	116.6
Max	137.4
Min	103.9

1/3 Octave (Otariid)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	-	33.7	36.6	38.3	39.6	44.3	48.4	50.3	52.6	57.4	62.0	67.7	72.4	78.8	80.8	84.2	87.9	91.3	95.9	98.7	101.3	106.1	103.8	103.8	105.5	106.6	107.4	107.0	107.6	105.5	104.2	102.8	101.7	101.6	99.1	97.5
Max 1/3 Spectra	-	60.6	64.8	64.2	65.9	74.4	80.4	82.7	82.7	87.9	86.2	91.9	97.2	104.8	106.5	107.8	109.2	112.2	114.0	115.2	123.5	132.6	125.0	122.5	126.3	130.8	127.8	124.5	125.2	121.8	120.4	117.7	120.6	116.7	113.8	116.4
Min 1/3 Spectra	-	10.8	15.0	18.8	21.8	26.7	29.7	33.0	37.2	41.0	44.9	49.5	57.5	64.7	66.1	68.1	75.4	79.0	84.2	86.9	91.0	90.5	89.9	88.7	89.8	91.6	92.6	92.4	92.4	91.9	91.9	92.0	92.4	92.4	92.2	91.8

cSEL (Otarrid) [20-20000 Hz]	
Overall	116.8
Max	137.8
Min	103.8

Phocid Adjustment Values																																			
Frequency (Hz)	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Adjustment	-42.8	-44.8	-42.9	-40.7	-38.8	-36.9	-34.9	-32.8	-30.9	-28.8	-26.8	-24.8	-22.9	-20.8	-18.9	-16.9	-15.0	-13.0	-11.1	-9.3	-7.5	-5.9	-4.5	-3.1	-2.1	-1.3	-0.7	-0.3	-0.1	0.0	-0.1	-0.3	-0.7	-1.5	-2.5
Overall 1/3 Spectra*	115.9	114.9	112.7	109.7	110.5	110.8	108.7	106.8	107.7	108.3	109.9	110.8	113.4	111.2	110.8	110.9	110.6	111.5	111.2	110.8	113.0	108.7	107.1	107.5	107.7	108.0	107.2	107.6	105.5	104.3	103.1	102.4	102.9	101.5	101.2
Max 1/3 Spectra*	142.8	143.1	138.6	136.0	140.6	142.8	141.1	136.9	138.2	132.5	134.1	135.6	139.4	136.9	134.4	132.2	131.5	129.6	127.7	133.0	139.5	129.9	125.8	128.3	131.9	128.4	124.7	125.2	121.8	120.5	118.0	121.3	118.0	116.2	120.1
Min 1/3 Spectra*	93.0	93.3	93.2	91.9	92.9	92.1	91.4	91.4	91.3	91.2	91.7	95.9	99.3	96.5	94.7	98.4	98.3	99.8	99.4	100.5	97.4	94.8	92.0	91.8	92.7	93.2	92.6	92.4	91.9	92.0	92.3	93.1	93.7	94.6	95.5

Otariid Adjustment Values																																			
Frequency (Hz)	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Adjustment	-82.2	-78.3	-74.4	-70.1	-66.3	-62.4	-58.4	-54.2	-50.4	-46.4	-42.2	-38.4	-34.6	-30.4	-26.6	-23.0	-19.3	-15.7	-12.5	-9.5	-6.9	-4.9	-3.3	-2.0	-1.2	-0.6	-0.2	-0.1	0.0	-0.1	-0.3	-0.7	-1.4	-2.4	-3.7
Overall 1/3 Spectra*	115.9	114.9	112.7	109.7	110.5	110.8	108.7	106.8	107.7	108.3	109.9	110.8	113.4	111.2	110.8	110.9	110.6	111.5	111.2	110.8	113.0	108.7	107.1	107.5	107.7	108.0	107.2	107.6	105.5	104.3	103.1	102.4	102.9	101.5	101.2
Max 1/3 Spectra*	142.8	143.1	138.6	136.0	140.6	142.8	141.1	136.9	138.2	132.5	134.1	135.6	139.4	136.9	134.4	132.2	131.5	129.6	127.7	133.0	139.5	129.9	125.8	128.3	131.9	128.4	124.7	125.2	121.8	120.5	118.0	121.3	118.0	116.2	120.1
Min 1/3 Spectra*	93.0	93.3	93.2	91.9	92.9	92.1	91.4	91.4	91.3	91.2	91.7	95.9	99.3	96.5	94.7	98.4	98.3	99.8	99.4	100.5	97.4	94.8	92.0	91.8	92.7	93.2	92.6	92.4	91.9	92.0	92.3	93.1	93.7	94.6	95.5

***unadjusted OB values**

Impact pile driving monitoring data calculcations

36" Pile, 11 strikes/6" of drive

Timestamp	LAeq	LCeq	LCpk	LZpk	[redacted]
11:11:42	128.0	131.6	153.7	154.0	
11:11:45	124.3	127.9	148.4	150.6	
11:11:47	135.1	138.5	160.0	159.9	
11:11:48	131.2	134.8	156.4	156.6	
11:13:46	129.9	133.2	154.1	154.8	
11:13:48	136.4	139.6	160.6	160.6	
11:13:50	135.2	138.2	159.7	160.0	
11:13:51	135.1	138.2	160.1	160.5	
11:13:53	134.0	137.0	159.3	159.3	
11:13:54	133.9	136.7	159.6	159.3	
11:13:56	133.2	136.2	159.3	159.5	

	Peak			SEL					RMS		
	max	min	mean	max	min	mean	cSEL	cSEL*	max	min	mean
Broadband	160.6	150.6	157.7	139.6	130.1	136.0	121.6	146.4	144.0	134.5	140.4
Phocid							116.1				
Otariid							116.3				

	LAeq	LCeq	LCpk	LZpk
max	136.4	139.6	160.6	160.6
min	124.3	127.9	148.4	150.6
mean	132.4	135.6	157.4	157.7

LAIeq	123.5
LAeq	119.1
LAIeq - LAe	4.4

		Pulse Duration
144.0	-4.40093	0.363

1/3 Octave (Broadband)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	112.2	107.0	104.9	106.1	105.1	102.5	101.9	99.3	98.0	98.2	104.2	102.5	104.7	107.8	107.7	108.1	108.3	108.4	110.1	112.6	110.2	109.3	107.6	107.5	106.2	106.3	106.6	106.3	105.9	105.4	105.2	104.4	104.0	104.4	103.9	103.6
Max 1/3 Spectra	130.5	126.6	120.6	125.5	124.0	120.7	120.8	114.9	113.8	111.9	125.0	122.8	126.7	124.9	124.9	124.8	126.3	125.2	130.8	137.2	128.4	125.1	124.2	126.3	123.5	122.8	122.3	124.3	123.5	123.0	124.1	124.1	124.4	125.7	126.4	126.7
Min 1/3 Spectra	94.6	95.5	94.6	94.4	94.2	93.6	92.5	91.7	91.6	90.9	92.2	92.6	93.9	94.1	94.6	95.1	95.3	96.9	97.5	98.5	98.3	95.1	92.8	90.2	89.0	90.4	91.3	92.0	91.3	91.3	91.7	92.2	92.9	93.7	94.6	95.6
L(20-200Hz)	114.9																																			

cSEL (Broadband) [20-20000 Hz]	
Overall	121.6
Max	141.6
Min	108.9

1/3 Octave (Phocid)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	-	64.2	60.1	63.2	64.4	63.7	65.0	64.4	65.2	67.4	75.4	75.7	79.9	84.9	86.9	89.3	91.4	93.4	97.1	101.5	100.9	101.8	101.7	103.0	103.1	104.2	105.3	105.6	105.6	105.3	105.2	104.3	103.7	103.7	102.4	101.1
Max 1/3 Spectra	-	83.8	75.8	82.6	83.3	81.9	83.9	80.0	81.0	81.1	96.2	96.0	101.9	102.0	104.1	106.0	109.4	110.2	117.8	126.1	119.1	117.6	118.3	121.8	120.4	120.7	121.0	123.6	123.2	122.9	124.1	124.0	124.1	125.0	124.9	124.2
Min 1/3 Spectra	-	52.7	49.8	51.5	53.5	54.8	55.6	56.8	58.8	60.1	63.4	65.8	69.1	71.2	73.8	76.3	78.4	81.9	84.5	87.4	89.0	87.6	86.9	85.7	85.9	88.3	90.0	91.3	91.0	91.2	91.7	92.1	92.6	93.0	93.1	93.1

cSEL (Phocid) [20-20000 Hz]	
Overall	116.1
Max	135.4
Min	103.1

1/3 Octave (Otariid)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	-	24.8	26.6	31.7	35.0	36.3	39.5	40.9	43.8	47.9	57.9	60.3	66.3	73.2	77.3	81.5	85.3	89.1	94.5	100.1	100.7	102.4	102.7	104.2	104.2	105.2	106.0	106.1	105.9	105.4	105.1	104.1	103.3	103.1	101.5	99.9
Max 1/3 Spectra	-	44.4	42.3	51.1	53.9	54.5	58.4	56.5	59.6	61.6	78.7	80.6	88.3	90.3	94.5	98.2	103.3	105.9	115.2	124.7	118.9	118.2	119.3	123.0	121.5	121.7	121.7	124.1	123.5	123.0	124.0	123.8	123.7	124.4	124.0	123.0
Min 1/3 Spectra	-	13.3	16.3	20.0	24.1	27.4	30.1	33.3	37.4	40.6	45.9	50.4	55.5	59.5	64.2	68.5	72.3	77.6	81.9	86.0	88.8	88.2	87.9	86.9	87.0	89.3	90.7	91.8	91.3	91.3	91.6	91.9	92.2	92.4	92.2	91.9

cSEL (Otarrid) [20-20000 Hz]	
Overall	116.3
Max	135.2
Min	102.9

Phocid Adjustment Values																																				
Frequency (Hz)		**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Adjustment		-42.8	-44.8	-42.9	-40.7	-38.8	-36.9	-34.9	-32.8	-30.9	-28.8	-26.8	-24.8	-22.9	-20.8	-18.9	-16.9	-15.0	-13.0	-11.1	-9.3	-7.5	-5.9	-4.5	-3.1	-2.1	-1.3	-0.7	-0.3	-0.1	0.0	-0.1	-0.3	-0.7	-1.5	-2.5
Overall 1/3 Spectra*		107.0	104.9	106.1	105.1	102.5	101.9	99.3	98.0	98.2	104.2	102.5	104.7	107.8	107.7	108.1	108.3	108.4	110.1	112.6	110.2	109.3	107.6	107.5	106.2	106.3	106.6	106.3	105.9	105.4	105.2	104.4	104.0	104.4	103.9	103.6
Max 1/3 Spectra*		126.6	120.6	125.5	124.0	120.7	120.8	114.9	113.8	111.9	125.0	122.8	126.7	124.9	124.9	124.8	126.3	125.2	130.8	137.2	128.4	125.1	124.2	126.3	123.5	122.8	122.3	124.3	123.5	123.0	124.1	124.1	124.4	125.7	126.4	126.7
Min 1/3 Spectra*		95.5	94.6	94.4	94.2	93.6	92.5	91.7	91.6	90.9	92.2	92.6	93.9	94.1	94.6	95.1	95.3	96.9	97.5	98.5	98.3	95.1	92.8	90.2	89.0	90.4	91.3	92.0	91.3	91.3	91.7	92.2	92.9	93.7	94.6	95.6

Otariid Adjustment Values																																				
Frequency (Hz)		**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Adjustment		-82.2	-78.3	-74.4	-70.1	-66.3	-62.4	-58.4	-54.2	-50.4	-46.4	-42.2	-38.4	-34.6	-30.4	-26.6	-23.0	-19.3	-15.7	-12.5	-9.5	-6.9	-4.9	-3.3	-2.0	-1.2	-0.6	-0.2	-0.1	0.0	-0.1	-0.3	-0.7	-1.4	-2.4	-3.7
Overall 1/3 Spectra*		107.0	104.9	106.1	105.1	102.5	101.9	99.3	98.0	98.2	104.2	102.5	104.7	107.8	107.7	108.1	108.3	108.4	110.1	112.6	110.2	109.3	107.6	107.5	106.2	106.3	106.6	106.3	105.9	105.4	105.2	104.4	104.0	104.4	103.9	103.6
Max 1/3 Spectra*		126.6	120.6	125.5	124.0	120.7	120.8	114.9	113.8	111.9	125.0	122.8	126.7	124.9	124.9	124.8	126.3	125.2	130.8	137.2	128.4	125.1	124.2	126.3	123.5	122.8	122.3	124.3	123.5	123.0	124.1	124.1	124.4	125.7	126.4	126.7
Min 1/3 Spectra*		95.5	94.6	94.4	94.2	93.6	92.5	91.7	91.6	90.9	92.2	92.6	93.9	94.1	94.6	95.1	95.3	96.9	97.5	98.5	98.3	95.1	92.8	90.2	89.0	90.4	91.3	92.0	91.3	91.3	91.7	92.2	92.9	93.7	94.6	95.6

***unadjusted OB values**

Impact pile driving monitoring data calculcations

48" Pile, 62 strikes/1' of drive

Timestamp	LAeq	LCeq	LCpk	LZpk
14:03:10	113.7	114.4	140.7	140.8
14:03:12	115.7	117.3	141.4	141.4
14:03:13	116.2	117.3	141.9	142.9
14:03:14	110.0	114.5	136.4	136.6
14:03:15	119.1	120.5	145.8	146.2
14:03:17	117.6	119.3	144.3	145.3
14:03:18	117.6	118.2	146.0	146.2
14:03:19	111.0	114.7	135.0	134.6
14:03:20	118.2	119.5	144.5	144.9
14:03:21	116.3	117.1	145.3	145.3
14:03:22	112.8	115.7	135.0	135.6
14:03:23	118.7	119.9	145.0	145.0
14:03:25	119.8	120.6	146.7	147.3
14:03:26	119.5	120.6	144.4	144.3
14:03:28	119.7	120.8	145.9	146.2
14:03:29	116.1	117.1	140.6	140.6
14:03:31	117.9	119.1	145.5	145.6
14:03:32	114.4	115.8	142.0	141.8
14:03:34	115.8	117.5	142.0	142.5
14:03:35	113.3	114.9	139.8	139.8
14:03:37	112.6	115.6	140.9	140.3
14:03:40	111.3	115.1	135.9	136.3
14:03:41	109.6	113.7	137.1	138.6
14:03:43	111.7	115.4	139.8	139.8
14:03:44	110.6	114.4	138.3	138.7
14:03:46	110.9	114.8	136.6	137.4
14:03:47	110.5	114.4	137.6	137.9
14:03:49	111.0	114.7	137.3	137.6
14:03:50	110.2	114.4	137.6	137.0
14:03:52	111.4	115.2	137.6	139.0
14:03:53	111.0	115.2	137.8	137.4
14:03:55	111.3	115.4	135.9	137.0
14:03:56	110.3	114.1	135.0	134.9
14:03:58	111.5	115.1	135.6	136.1
14:03:59	110.7	114.2	135.6	138.3
14:04:01	111.7	115.7	136.1	138.3
14:04:04	112.4	116.3	138.2	138.6
14:04:05	109.7	113.2	136.4	137.9
14:04:07	112.2	116.4	138.2	140.5
14:04:10	112.2	116.6	139.4	139.4
14:04:12	111.9	115.8	137.6	136.3
14:04:13	111.7	116.0	138.5	138.8

	Peak			SEL					RMS		
[redacted]	max	min	mean	max	min	mean	cSEL	cSEL*	max	min	mean
Broadband	147.3	134.6	139.4	121.4	112.8	116.6	133.6	134.5	133.0	124.4	128.2
Phocid							104.5				
Otariid							100.3				

	LAeq	LCeq	LCpk	LZpk
max	119.8	120.8	146.7	147.3
min	109.6	113.2	135.0	134.6
mean	112.7	116.1	138.9	139.4

LAI_{eq}	120.9
LA_{eq}	109.3
LAI_{eq} - LA_{e}	11.6

Pulse Duration

133.0	-11.6052	0.0691

1/3 Octave (Broadband)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	132.0	128.1	133.8	130.1	131.8	127.0	124.8	125.2	126.4	124.1	124.3	120.4	118.1	110.1	110.7	106.5	104.6	105.5	101.8	97.8	96.1	95.1	95.1	91.0	88.7	88.7	89.6	89.7	88.2	86.9	86.5	86.6	86.9	87.6	87.8	88.1
Max 1/3 Spectra	162.3	158.8	164.6	161.0	162.6	158.1	156.0	156.4	157.6	155.6	155.7	152.0	149.3	140.7	142.0	137.8	135.5	136.6	132.5	127.4	124.1	120.0	118.4	114.6	114.0	109.9	109.1	110.9	106.2	100.6	100.3	100.9	101.4	102.0	102.3	102.7
Min 1/3 Spectra	78.3	77.2	76.7	78.3	77.5	78.0	76.3	75.4	74.5	74.9	74.5	75.9	76.6	77.8	77.0	75.1	77.1	78.6	80.4	79.4	79.4	79.1	73.8	70.1	69.2	70.2	72.1	73.1	72.4	71.9	71.9	72.3	73.1	73.8	74.7	75.8
L(20-200Hz)	133.6																																			

cSEL (Broadband) [20-20000 Hz]	
Overall	133.6
Max	164.9
Min	90.8

1/3 Octave (Phocid)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	-	85.3	89.0	87.2	91.1	88.2	87.9	90.3	93.6	93.3	95.5	93.6	93.3	87.2	89.9	87.7	87.7	90.5	88.8	86.7	86.8	87.6	89.2	86.5	85.6	86.6	88.3	89.0	87.9	86.8	86.5	86.5	86.6	86.9	86.3	85.6
Max 1/3 Spectra	-	116.0	119.8	118.1	121.9	119.3	119.1	121.5	124.8	124.8	126.9	125.2	124.5	117.8	121.2	119.0	118.6	121.6	119.5	116.3	114.8	112.5	112.5	110.1	110.9	107.8	107.8	110.2	105.9	100.5	100.3	100.8	101.1	101.3	100.8	100.2
Min 1/3 Spectra	-	34.4	31.9	35.4	36.8	39.2	39.4	40.5	41.7	44.1	45.7	49.1	51.8	54.9	56.2	56.3	60.2	63.6	67.4	68.3	70.1	71.6	67.9	65.6	66.1	68.1	70.8	72.4	72.1	71.8	71.9	72.2	72.8	73.1	73.2	73.3

cSEL (Phocid) [20-20000 Hz]	
Overall	104.5
Max	134.4
Min	83.7

1/3 Octave (Otariid)																																				
Frequency (Hz)	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Overall 1/3 Spectra	-	45.9	55.5	55.7	61.7	60.8	62.4	66.8	72.2	73.8	78.0	78.2	79.7	75.5	80.3	79.9	81.6	86.2	86.2	85.3	86.6	88.2	90.2	87.7	86.7	87.6	89.0	89.5	88.2	86.9	86.4	86.3	86.2	86.3	85.4	84.4
Max 1/3 Spectra	-	76.6	86.3	86.6	92.5	91.9	93.6	98.0	103.4	105.3	109.4	109.8	110.9	106.1	111.6	111.2	112.5	117.3	116.9	114.9	114.6	113.1	113.5	111.3	112.0	108.8	108.5	110.7	106.2	100.6	100.2	100.6	100.7	100.7	99.9	99.0
Min 1/3 Spectra	-	-5.0	-1.6	3.9	7.4	11.8	13.9	17.0	20.3	24.6	28.2	33.7	38.2	43.2	46.6	48.5	54.1	59.3	64.8	66.9	69.9	72.2	68.9	66.8	67.2	69.1	71.5	72.9	72.4	71.9	71.8	72.0	72.4	72.5	72.3	72.1

cSEL (Otarrid) [20-20000 Hz]	
Overall	100.3
Max	125.6
Min	83.6

Phocid Adjustment Values																																				
Frequency (Hz)		**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Adjustment		-42.8	-44.8	-42.9	-40.7	-38.8	-36.9	-34.9	-32.8	-30.9	-28.8	-26.8	-24.8	-22.9	-20.8	-18.9	-16.9	-15.0	-13.0	-11.1	-9.3	-7.5	-5.9	-4.5	-3.1	-2.1	-1.3	-0.7	-0.3	-0.1	0.0	-0.1	-0.3	-0.7	-1.5	-2.5
Overall 1/3 Spectra*		128.1	133.8	130.1	131.8	127.0	124.8	125.2	126.4	124.1	124.3	120.4	118.1	110.1	110.7	106.5	104.6	105.5	101.8	97.8	96.1	95.1	95.1	91.0	88.7	88.7	89.6	89.7	88.2	86.9	86.5	86.6	86.9	87.6	87.8	88.1
Max 1/3 Spectra*		158.8	164.6	161.0	162.6	158.1	156.0	156.4	157.6	155.6	155.7	152.0	149.3	140.7	142.0	137.8	135.5	136.6	132.5	127.4	124.1	120.0	118.4	114.6	114.0	109.9	109.1	110.9	106.2	100.6	100.3	100.9	101.4	102.0	102.3	102.7
Min 1/3 Spectra*		77.2	76.7	78.3	77.5	78.0	76.3	75.4	74.5	74.9	74.5	75.9	76.6	77.8	77.0	75.1	77.1	78.6	80.4	79.4	79.4	79.1	73.8	70.1	69.2	70.2	72.1	73.1	72.4	71.9	71.9	72.3	73.1	73.8	74.7	75.8

Otariid Adjustment Values																																				
Frequency (Hz)		**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
Adjustment		-82.2	-78.3	-74.4	-70.1	-66.3	-62.4	-58.4	-54.2	-50.4	-46.4	-42.2	-38.4	-34.6	-30.4	-26.6	-23.0	-19.3	-15.7	-12.5	-9.5	-6.9	-4.9	-3.3	-2.0	-1.2	-0.6	-0.2	-0.1	0.0	-0.1	-0.3	-0.7	-1.4	-2.4	-3.7
Overall 1/3 Spectra*		128.1	133.8	130.1	131.8	127.0	124.8	125.2	126.4	124.1	124.3	120.4	118.1	110.1	110.7	106.5	104.6	105.5	101.8	97.8	96.1	95.1	95.1	91.0	88.7	88.7	89.6	89.7	88.2	86.9	86.5	86.6	86.9	87.6	87.8	88.1
Max 1/3 Spectra*		158.8	164.6	161.0	162.6	158.1	156.0	156.4	157.6	155.6	155.7	152.0	149.3	140.7	142.0	137.8	135.5	136.6	132.5	127.4	124.1	120.0	118.4	114.6	114.0	109.9	109.1	110.9	106.2	100.6	100.3	100.9	101.4	102.0	102.3	102.7
Min 1/3 Spectra*		77.2	76.7	78.3	77.5	78.0	76.3	75.4	74.5	74.9	74.5	75.9	76.6	77.8	77.0	75.1	77.1	78.6	80.4	79.4	79.4	79.1	73.8	70.1	69.2	70.2	72.1	73.1	72.4	71.9	71.9	72.3	73.1	73.8	74.7	75.8

***unadjusted OB values**

Measurement Report

Report Summary

Meter's File Name	23110701.LD0.s	Computer's File Name	831C_10533-20231107 085036-23110701.LD0.ldbin
Meter	831C 10533	Firmware	04.9.0R59
User		Location	
Job Description			
Note			

Start Time	2023-11-07 08:50:36	Duration	1:12:08.4		
End Time	2023-11-07 10:02:44	Run Time	1:12:08.4	Pause Time	0:00:00.0
Pre-Calibration	2023-11-07 08:03:03	Post-Calibration	None	Calibration Deviation	---

Results

Overall Metrics

LA_{eq}	120.1 dB		
LAE	156.5 dB	SEA	184.4 dB
EA	492.1 Pa²h	LAFTM5	125.2 dB
LZ_{peak}	172.5 dB	2023-11-07 09:17:02	
LAS_{max}	141.4 dB	2023-11-07 09:15:58	
LAS_{min}	107.9 dB	2023-11-07 08:55:14	
LA_{eq}	120.1 dB		
LC_{eq}	123.5 dB	LC_{eq} - LA_{eq}	3.4 dB
LAI_{eq}	124.4 dB	LAI_{eq} - LA_{eq}	4.3 dB

Exceedances	Count	Duration
LAS > 65.0 dB	1	1:12:10.3
LAS > 85.0 dB	1	1:12:10.3
LZpk > 135.0 dB	1	1:12:10.3
LZpk > 137.0 dB	1	1:12:10.3
LZpk > 140.0 dB	1	1:12:10.3

Community Noise	LDN	LDay	LNight	
	120.1 dB	120.1 dB	0.0 dB	
	LDEN	LDay	LEve	LNight
	120.1 dB	120.1 dB	--- dB	--- dB

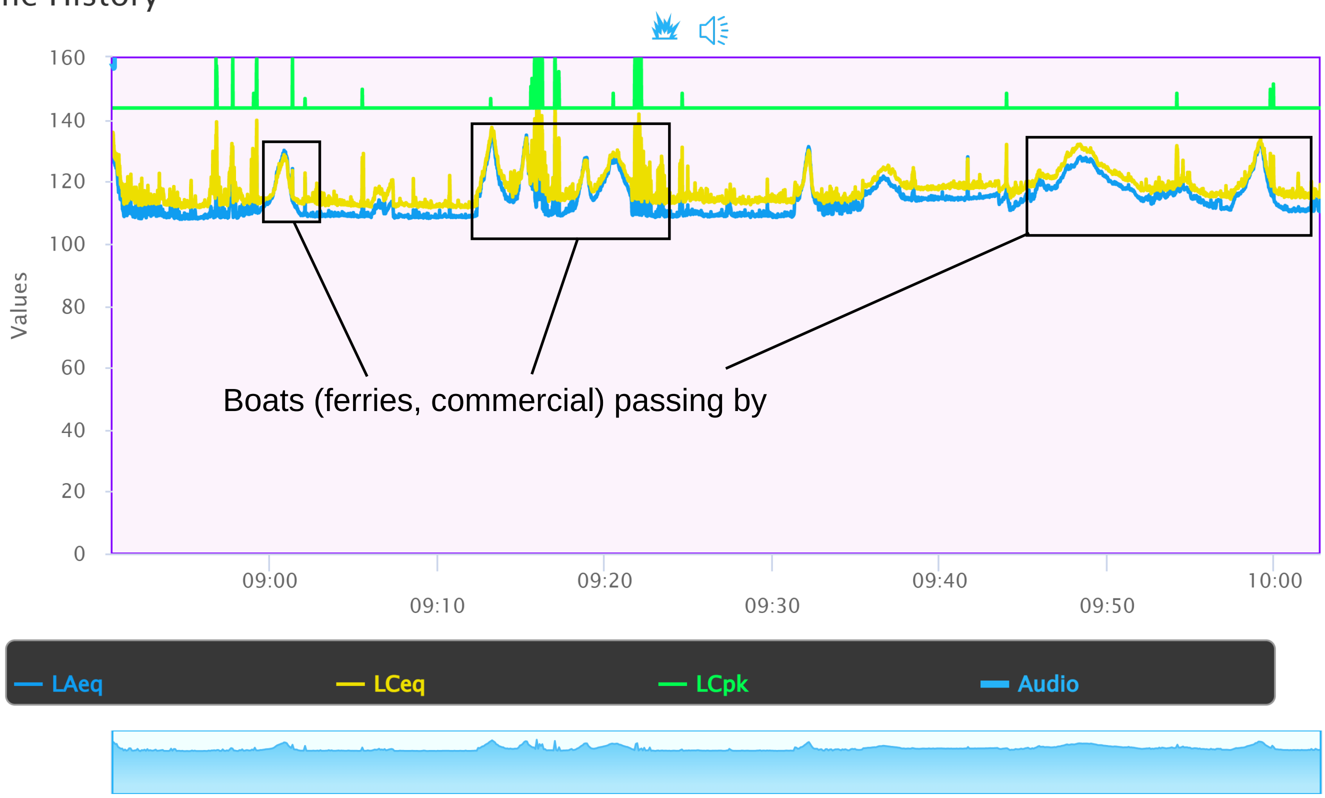
Any Data	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	120.1 dB		123.5 dB		139.6 dB	
$Ls_{(max)}$	141.4 dB	2023-11-07 09:15:58	146.0 dB	2023-11-07 09:15:58	158.5 dB	2023-11-07 09:16:16
$LF_{(max)}$	145.5 dB	2023-11-07 09:15:58	153.1 dB	2023-11-07 09:17:02	162.7 dB	2023-11-07 09:16:16
$LI_{(max)}$	148.2 dB	2023-11-07 09:15:58	157.4 dB	2023-11-07 09:17:02	164.3 dB	2023-11-07 09:16:16
$LS_{(min)}$	107.9 dB	2023-11-07 08:55:14	111.5 dB	2023-11-07 09:09:36	120.2 dB	2023-11-07 09:11:14
$LF_{(min)}$	106.9 dB	2023-11-07 08:52:17	110.8 dB	2023-11-07 08:54:51	113.8 dB	2023-11-07 09:11:14
$LI_{(min)}$	107.6 dB	2023-11-07 08:55:43	111.3 dB	2023-11-07 09:09:36	121.9 dB	2023-11-07 09:06:19
$L_{Peak(max)}$	167.8 dB	2023-11-07 09:17:01	170.6 dB	2023-11-07 09:17:01	172.5 dB	2023-11-07 09:17:02

Overloads	Count	Duration	OBA Count	OBA Duration
	0	0:00:00.0	0	0:00:00.0

Statistics

LAS 5.0	126.7 dB
LAS 10.0	123.5 dB
LAS 33.3	115.2 dB
LAS 50.0	113.1 dB
LAS 66.6	110.4 dB
LAS 90.0	108.8 dB

Time History



Measurement Report

Report Summary

Meter's File Name	23110702.LD0.s	Computer's File Name	831C_10533-20231107 103320-23110702.LD0.ldbin
Meter	831C 10533	Firmware	04.9.0R59
User		Location	
Job Description			
Note			

Start Time	2023-11-07 10:33:20	Duration	0:45:58.0		
End Time	2023-11-07 11:19:18	Run Time	0:45:58.0	Pause Time	0:00:00.0
Pre-Calibration	2023-11-07 08:03:03	Post-Calibration	None	Calibration Deviation	---

Results

Overall Metrics

LA_{eq}	119.1 dB		
LAE	153.5 dB	SEA	179.5 dB
EA	249.1 Pa²h	LAFTM5	124.0 dB
LZ_{peak}	163.4 dB	2023-11-07 11:18:31	
LAS_{max}	135.8 dB	2023-11-07 11:13:48	
LAS_{min}	106.1 dB	2023-11-07 11:11:01	
LA_{eq}	119.1 dB		
LC_{eq}	121.1 dB	LC_{eq} - LA_{eq}	2.0 dB
LAI_{eq}	123.5 dB	LAI_{eq} - LA_{eq}	4.4 dB

Exceedances	Count	Duration
LAS > 65.0 dB	1	0:45:58.3
LAS > 85.0 dB	1	0:45:58.3
LZpk > 135.0 dB	1	0:45:58.3
LZpk > 137.0 dB	1	0:45:58.3
LZpk > 140.0 dB	1	0:45:58.3

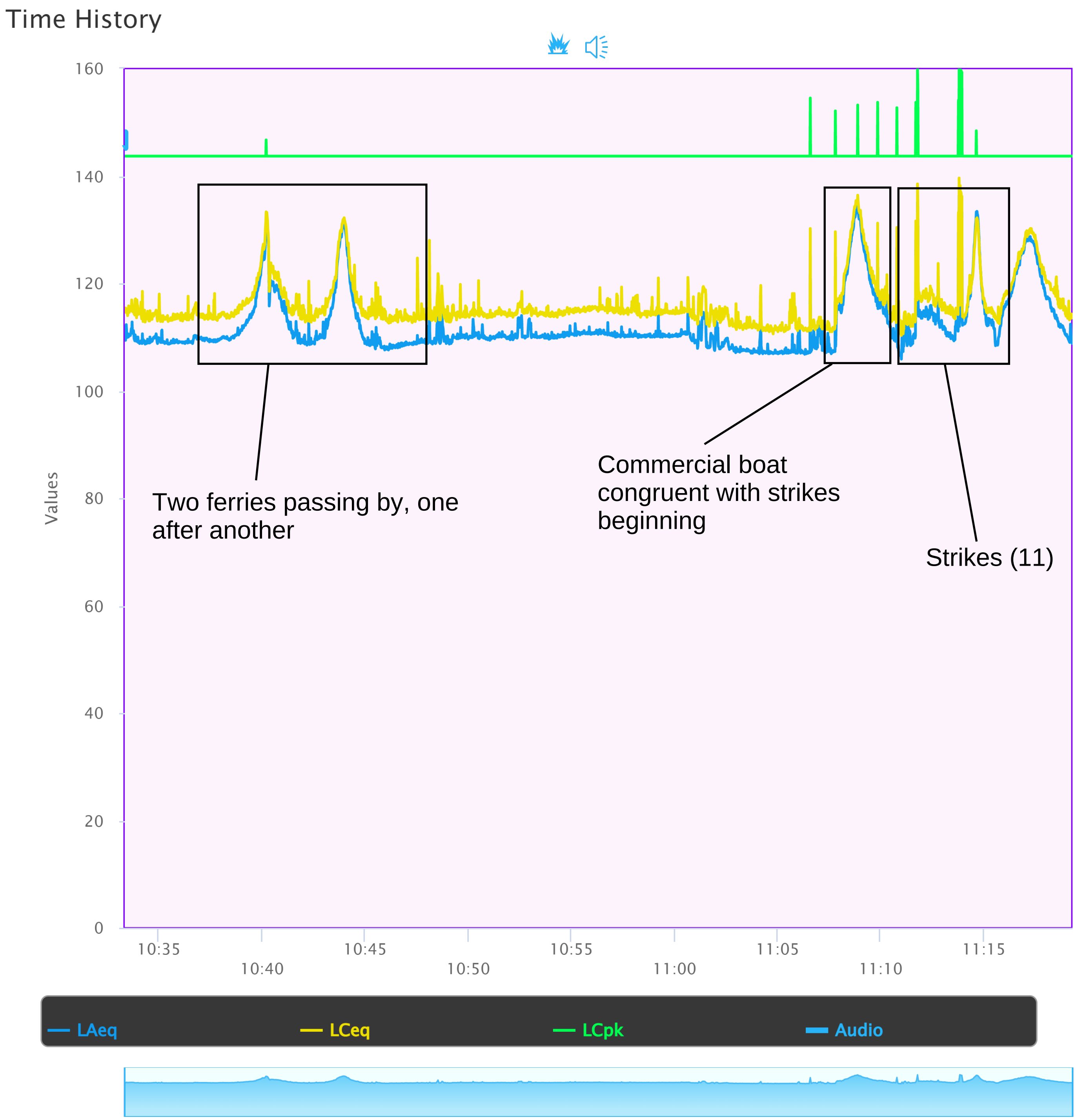
Community Noise	LDN	LDay	LNight	
	119.1 dB	119.1 dB	0.0 dB	
	LDEN	LDay	LEve	LNight
	119.1 dB	119.1 dB	--- dB	--- dB

Any Data	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	119.1 dB		121.1 dB		135.4 dB	
$L_{S(max)}$	135.8 dB	2023-11-07 11:13:48	138.9 dB	2023-11-07 11:13:48	155.9 dB	2023-11-07 11:18:31
$L_{F(max)}$	143.8 dB	2023-11-07 11:13:48	146.9 dB	2023-11-07 11:13:48	160.4 dB	2023-11-07 11:18:31
$L_{I(max)}$	147.9 dB	2023-11-07 11:13:48	151.0 dB	2023-11-07 11:13:48	162.5 dB	2023-11-07 11:18:31
$L_{S(min)}$	106.1 dB	2023-11-07 11:11:01	110.7 dB	2023-11-07 11:11:01	121.0 dB	2023-11-07 11:06:08
$L_{F(min)}$	105.3 dB	2023-11-07 11:11:00	109.9 dB	2023-11-07 11:11:00	115.0 dB	2023-11-07 11:04:43
$L_{I(min)}$	105.9 dB	2023-11-07 11:11:00	110.4 dB	2023-11-07 11:11:00	123.3 dB	2023-11-07 11:06:06
$L_{Peak(max)}$	157.5 dB	2023-11-07 11:13:48	160.6 dB	2023-11-07 11:13:48	163.4 dB	2023-11-07 11:18:31

Overloads	Count	Duration	OBA Count	OBA Duration
	0	0:00:00.0	0	0:00:00.0

Statistics

LAS 5.0	126.5 dB
LAS 10.0	120.6 dB
LAS 33.3	111.2 dB
LAS 50.0	110.2 dB
LAS 66.6	109.8 dB
LAS 90.0	108.1 dB



Time History
160
140
120
100
80
60
40
20
0
Values
Two ferries passing by, one after another
Commercial boat congruent with strikes beginning
Strikes (11)
10:35
10:40
10:45
10:50
10:55
11:00
11:05
11:10
11:15
LAeq
LCeq
LCpk
Audio

Measurement Report

Report Summary

Meter's File Name	23110704.LD0.s	Computer's File Name	831C_10533-20231107 134017-23110704.LD0.ldbin
Meter	831C 10533	Firmware	04.9.0R59
User		Location	
Job Description			
Note			

Start Time	2023-11-07 13:40:17	Duration	0:27:14.8		
End Time	2023-11-07 14:07:32	Run Time	0:27:14.8	Pause Time	0:00:00.0
Pre-Calibration	2023-11-07 13:30:50	Post-Calibration	None	Calibration Deviation	---

Results

Overall Metrics

LA_{eq}	109.3 dB		
LAE	141.4 dB	SEA	188.5 dB
EA	15.5 Pa²h	LAFTM5	121.5 dB
LZ_{peak}	188.5 dB	2023-11-07 13:57:34	
LAS_{max}	139.8 dB	2023-11-07 13:57:34	
LAS_{min}	87.5 dB	2023-11-07 14:06:52	
LA_{eq}	109.3 dB		
LC_{eq}	133.0 dB	LC_{eq} - LA_{eq}	23.7 dB
LAI_{eq}	120.9 dB	LAI_{eq} - LA_{eq}	11.6 dB

Exceedances	Count	Duration
LAS > 65.0 dB	1	0:27:14.5
LAS > 85.0 dB	1	0:27:14.5
LZpk > 135.0 dB	223	0:00:51.9
LZpk > 137.0 dB	152	0:00:32.8
LZpk > 140.0 dB	43	0:00:10.0

Community Noise	LDN	LDay	LNight	
	109.3 dB	109.3 dB	0.0 dB	
	LDEN	LDay	LEve	LNight
	109.3 dB	109.3 dB	--- dB	--- dB

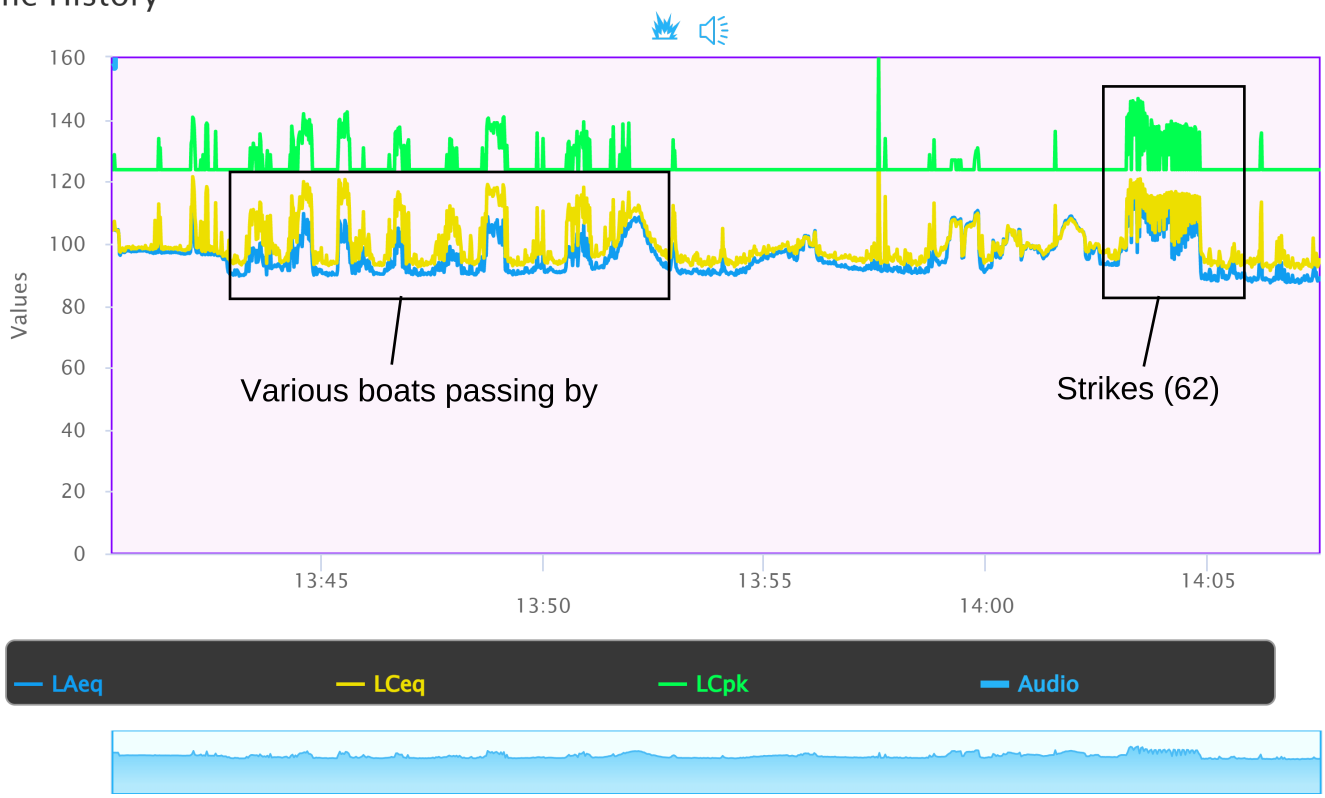
Any Data	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	109.3 dB		133.0 dB		141.2 dB	
$LS_{(max)}$	139.8 dB	2023-11-07 13:57:34	164.4 dB	2023-11-07 13:57:34	172.5 dB	2023-11-07 13:57:34
$LF_{(max)}$	146.2 dB	2023-11-07 13:57:34	171.0 dB	2023-11-07 13:57:34	179.3 dB	2023-11-07 13:57:34
$LI_{(max)}$	150.3 dB	2023-11-07 13:57:34	175.2 dB	2023-11-07 13:57:34	182.3 dB	2023-11-07 13:57:34
$LS_{(min)}$	87.5 dB	2023-11-07 14:06:52	91.9 dB	2023-11-07 14:06:25	103.7 dB	2023-11-07 13:50:27
$LF_{(min)}$	86.6 dB	2023-11-07 14:05:07	90.8 dB	2023-11-07 14:06:24	97.1 dB	2023-11-07 13:46:21
$LI_{(min)}$	87.3 dB	2023-11-07 14:06:57	92.0 dB	2023-11-07 14:05:25	105.8 dB	2023-11-07 13:44:11
$L_{Peak(max)}$	162.2 dB	2023-11-07 13:57:34	183.6 dB	2023-11-07 13:57:34	188.5 dB	2023-11-07 13:57:34

Overloads	Count	Duration	OBA Count	OBA Duration
	0	0:00:00.0	1	0:00:02.2

Statistics

LAS 5.0	108.9 dB
LAS 10.0	106.7 dB
LAS 33.3	97.5 dB
LAS 50.0	94.8 dB
LAS 66.6	92.2 dB
LAS 90.0	90.2 dB

Time History



Attachment E. Investigator Field Notes (11/7/23)

11/7/2023

Impact Hammer, hydrophone at ~700 m, 36” pile

Measurement begin: 8:50 AM

- Ferry passes by when measurement began
- Adjusted monitor at around 7 min
- Boat approaching at 9 min 50 sec increases levels
- 22 min 20 sec = another example of a boat pass-by, large ferry
- No impact hammer
- Measurement stopped at 1:12:08

Measurement begin: 10:33 AM – 11 strikes, 6” of drive

- Hydrophone depth at 10m, channel depth at 15m
- Impact hammer starting soon as of measurement start
- Hydrophone depth at 10m, channel depth at 12-15m
- Ferry pass by from 6’30” to 7’30”
- Ferry pass by from 11’ to 12’
- 10:50 HASE moving West (500 m)
- Strike at 33’30? 34’40”?
- Boat with strike at 34’40” until 36’
- Strike at 36’33”, levels up to 128 dB for 1 second
- Strike at 37’40”
- Strike at 38’25”, levels up to 130 dB for 1 second, 38’45” levels up to 135 and remained for a couple seconds (multiple strikes? 5 peaks)
- Lots of strikes starting at 40’40”, Boats approaching at 40’50”
- Large boat 43’10” (Miss Tammy)
- Hammer off at 45’ min.

Impact Hammer, hydrophone at ~600 m, 48” pile – 62 strikes, 1’ of drive

Measurement begin: 1:40 PM

- Hydrophone depth at 10m, channel depth at 15m
- Early peak of 145 dB was a result of tripod moving
- Impact starting at 2:00 PM
- Levels increased by 10-20 dB for a few seconds after each impact
- Multiple strikes going from 22’50” to 24’40”