Monthly Pile Driving Summary and Underwater Noise Monitoring Results

Pile Driving Period: October 02, 2016 – October 29, 2016
DOC Reference: TA_FHWA_03175_RPT_ENV
Revised: February 14, 2017 to add underwater noise monitoring results for the drilled shaft [redacted]

Summary:

No sturgeon were observed to have been severely injured or killed as a result of underwater noise from pile driving during this reporting period. This conclusion was reached based on the results of sturgeon monitoring by observers on the barge and vessel-based sturgeon monitoring conducted downstream of the piles being driven.

Based on an analysis using both empirical and modeled data, recoverable injuries caused by exposure to sub-lethal levels of underwater noise could not have been sustained by more than one sturgeon during this reporting period. This conclusion was reached by considering:

- the time required to drive each pile;
- the underwater area that experienced noise levels higher than a level that could potentially result in recoverable injury to the sturgeon (206 dB re 1 µPa peak sound pressure level); and
- the possible number of sturgeon that could have been in that area (number of gill nets x sturgeon encounter rate).

The potential number of sturgeon likely to have experienced recoverable injuries (described as "sturgeon take") is reported as the probability of a fish being affected by exposure to underwater noise from pile driving, as shown in the table below. If the sturgeon take is listed as 1, then 1 sturgeon was potentially exposed to recoverable noise levels. If sturgeon take is less than 1, then it is less likely that 1 sturgeon was affected. As shown at the bottom right of the table below, the sturgeon take for this reporting period was 0.08 sturgeon, which is less than the 0.17 sturgeon that was anticipated based on Table 8 of the 2016 NMFS Biological Opinion (NMFS BO).

In addition to impact pile driving during this reporting period, underwater noise monitoring was conducted during shaft drilling on October 27, 2016 [redacted] along the Westchester Approach. The peak SPL level did not exceed the threshold of 206 dB re: 1µPa for this criterion at a distance of 33 feet from the shaft. The 24-hr cSEL level did not exceed the threshold of 187 dB re: $1\mu Pa^2 \cdot s$ beyond a distance of 158 feet from the shaft.

Introduction:

As required under the NMFS BO, dated June 20, 2016, Reasonable & Prudent Measure #1 and Term & Conditions #1, underwater noise resulting from pile installation must be monitored. In addition, the Underwater Noise Monitoring Plan for the Project includes monitoring of underwater noise for one representative pile during shaft drilling along the Westchester Approach and the Rockland Trestle. According to the Plan:

One representative [redacted] from the Westchester Approach and the Rockland Approach will be monitored during installation via rock drilling (rock socketing) to establish the Peak SPL and the cSEL, if utilized. However, if the sound levels exceed the thresholds, the need for additional monitoring relative to the NMFS BO requirements will be reassessed.

The following is a summary of the installation and underwater noise monitoring of permanent piles and the results of noise measurements taken during shaft drilling [redacted] for the time period from October 2 through October 29, 2016.

As required under this condition, an estimate of sturgeon take for piles driven with an impact hammer during the most recent monthly monitoring period is included. The sturgeon take estimate has been calculated using the times required to drive each pile (impact hammer only) and an estimate of the diameter of the 206 dB peak SPL isopleth, which has been conservatively assumed to be equivalent to the largest isopleth measured for piles driven at the same pier (or other representative piles at nearby piers). The take estimate has been compared to that listed for the same piles in Table 8 of the NMFS BO to ensure that sturgeon take is not being exceeded. Sturgeon take summarized in Table 8 applies to both shortnose and Atlantic sturgeon (i.e., it is anticipated that 6 of each species will be exposed to underwater noise equal to 206 dB re 1µ Pa SPL_{peak} during pile driving).

This monthly report summarizes pile-driving activities for [redacted] production piles at the Rockland North trestle and shaft drilling activities along the Westchester Approach.

Pile Installation and Underwater Noise Monitoring:

During the monthly period from October 2 through October 29, 2016, [redacted] piles were driven. All of these were [redacted] piles driven at the Rockland North temporary trestle (bents 50 through 53). These [redacted] piles correspond to the scheduled pile-driving for weeks 38-43 of 2016 in Table 8. In addition, a [redacted] drilled shaft was constructed [redacted] along the Westchester Approach.

Anticipated Sturgeon Take from Table 8 of the NMFS BO

For the purposes of tracking take associated with the subset of piles from the groups of piles shown in Table 8[1] (i.e., Anticipated Sturgeon Take), total take for each time period was divided by the number of piles scheduled to be driven during the time period.

To calculate anticipated sturgeon take per pile from Table 8 for the [redacted] piles driven at the Rockland North trestle during this reporting period, the anticipated take of 1 sturgeon for the group containing piles at the Rockland North temporary trestle was divided by the [redacted] anticipated piles for this group and multiplied by the [redacted] piles actually driven during the reporting period. The result was an estimate of 0.014 sturgeon per pile for the Rockland North temporary trestle.

[1] Anticipated take was calculated in Table 8 of the NMFS BO as the product of the number of piles, number of hours to drive a pile, number of gill nets to span the 206 dB peak SPL isopleth, and the sturgeon encounter rate of 0.033 sturgeon per net per hour.

Based on these values:

- the anticipated take from Table 8 for the [redacted] piles driven at the Rockland North trestle from October 2 through October 29, was 0.17 sturgeon, which was calculated as:

  0.014 sturgeon per pile multiplied by [redacted] piles.

- the cumulative take associated with the [redacted] piles from Table 8 of the June 2016 NMFS BO driven thus far is the sum of the anticipated take values for all [redacted] piles, or 0.17 sturgeon.

Calculated Sturgeon Take for this reporting period

Following the same method used to estimate incidental sturgeon take for Table 8, the product of pile driving time, number of gill nets to span the width of the 206 dB isopleth, and sturgeon encounter rate of 0.033 sturgeon per net per hour was used to calculate sturgeon take for the piles driven during this reporting period (i.e., Calculated Sturgeon Take). For previous piles that have been monitored for underwater noise, the diameter of the 206 dB peak SPL isopleth was estimated based on the maximum peak SPL recorded during pile driving. For the unmonitored piles, the maximum recorded isopleth diameters was assigned based on noise monitoring from the test pile program or from noise monitoring of piles at each pier. Actual pile driving times for each of the piles were used in the calculations.

Impact pile driving has been completed for [redacted] production piles; none were driven during this reporting period.

For the [redacted] piles driven at the Rockland North trestle, pile-driving times ranged from 0.05 to 0.40 hours to install and averaged 0.17 hours per pile, which was the same as than the anticipated duration of 0.17 hours per pile reported in Table 8 of the NMFS BO. No underwater noise monitoring was conducted by TZC/JASCO/NYSTA during pile driving at the Rockland North temporary trestle. The Calculated Sturgeon Take for this reporting period was below the Anticipated Sturgeon Take from Table 8 of the NMFS BO.

Based on the recorded pile-driving times and isopleth widths:

- the incidental sturgeon take for the [redacted] piles driven during the monthly period from October 2 through October 29, 2016 was calculated as 0.08 sturgeon, which is less than the estimate of 0.17 sturgeon for the same [redacted] piles listed in Table 8,

- the cumulative incidental take for the [redacted] piles[1] driven as anticipated in Table 8 of the June 2016 NMFS BO was calculated as 0.87 sturgeon, which is less than the anticipated take of 3.25 sturgeon for the same [redacted] piles in Table 8.

[1] The [redacted] piles [redacted] were driven prior to the issuance of the June 2016 BO and were therefore included in previous monthly reports (April 17, 2016 – May 09, 2016 and May 15, 2016 – June 11, 2016) as part of the monthly and cumulative anticipated take calculations. Because those piles are also included in Table 8 of the June 2016 BO, the anticipated take for those piles will also be

During installation of the Rockland North temporary trestle, the size of the 206-dB peak SPL isopleth was estimated to be 148 feet, which exceeded the anticipated isopleth diameter of 100 feet. The total duration of impact pile driving for all piles driven during this reporting period was 2.09 hours, slightly more than the anticipated duration of 2.04 hours for these piles. The combination of drive times and maximum peak isopleth sizes measured to date for the Rockland trestle piles is slightly greater than those reported in Table 8 of the NMFS BO. However, the number of sturgeon potentially affected by pile driving noise for these piles is not likely to be greater than what was estimated in Table 8 of the June 2016 BO. Because of the conservatism used to estimate the anticipated sturgeon take in Table 8 (i.e., rounding 0.30 sturgeon to 1 sturgeon), the calculated sturgeon take did not exceed the anticipated take despite the slightly longer than anticipated duration of pile driving and the larger than anticipated isopleth size. The number of sturgeon potentially affected by pile driving was still less than or equal to 1 sturgeon. Therefore, incidental take for sturgeon was not exceeded during the most recent monthly reporting period for pile driving, nor has the cumulative sturgeon take been exceeded for all piles driven to date.

Results of underwater noise monitoring during shaft drilling

As outlined in the Underwater Noise Monitoring Plan, the peak SPL and cSEL levels were monitored for a drilled shaft along the Westchester Approach. The results of this noise monitoring are summarized in Attachment A.

During this activity, the maximum peak SPL level recorded at a distance of 33 feet during monitoring was 166 dB re: 1µPa, which did not exceed the threshold of 206 dB re: 1µPa for this criterion. The 24-hr cSEL level measured at the same location was estimated to be 195 dB re: $1\mu Pa^2 \cdot s$ at a distance of 33 feet, 176 dB re: $1\mu Pa^2 \cdot s$ at a distance of 158 feet, and 178 dB re: $1\mu Pa^2 \cdot s$ at a distance of 367 feet (Attachment A). Based on these measurements, the threshold of 187 dB re: $1\mu Pa^2 \cdot s$ was estimated to occur at a distance of less than 367 feet from the shaft. The 187 dB isopleth in this case would have been less than 734 feet in diameter and would not have extended into the river channel, which was located approximately 2,500 feet from the drilling operation.

included as part of the cumulative take estimates reported in future monthly reports. The incidental take associated [redacted] has therefore essentially been "counted twice."

Report Period: 10/2/2016 to 10/29/2016

Date	Year	Week	[redacted]	Net Impact Pile Driving Duration (hrs/pile)	Pile driving time from Table 8 of the NMFS BO (hrs/pile)	Average width of isopleth for 206-dB peak SPL (feet)	Maximum width of isopleth for 206-dB peak SPL (feet)	Number of gill nets to span the 206-dB peak SPL isopleth	Sturgeon encounter rate (fish/net/hour)	Sturgeon take
10/3/2014	2016	41		0.08	0.17	Not measured	148	1.18	0.033	0.0031
10/3/2014	2016	41		0.22	0.17	Not measured	148	1.18	0.033	0.0086
10/3/2014	2016	41		0.20	0.17	Not measured	148	1.18	0.033	0.0078
10/3/2014	2016	41		0.08	0.17	Not measured	148	1.18	0.033	0.0031
10/3/2014	2016	41		0.22	0.17	Not measured	148	1.18	0.033	0.0086
10/3/2014	2016	41		0.28	0.17	Not measured	148	1.18	0.033	0.0109
10/3/2014	2016	41		0.30	0.17	Not measured	148	1.18	0.033	0.0117
10/3/2014	2016	41		0.40	0.17	Not measured	148	1.18	0.033	0.0156
10/4/2016	2016	41		0.12	0.17	Not measured	148	1.18	0.033	0.0047
10/4/2016	2016	41		0.07	0.17	Not measured	148	1.18	0.033	0.0027
10/4/2016	2016	41		0.07	0.17	Not measured	148	1.18	0.033	0.0027
10/4/2016	2016	41		0.05	0.17	Not measured	148	1.18	0.033	0.0020
Monthly sturgeon take (Calculated based on pile-driving data/Anticipated from Table 8 of the September 2016 NMFS BO)										**0.08/0.17**
Cumulative sturgeon take to date (Calculated based on pile-driving data/Anticipated from Table 8 of the September 2016 NMFS BO)*										**0.87/3.25**

* As of the September 2014 NMFS BO, the exempted incidental take for sturgeon as a result of exposure to underwater noise during impact pile driving was 37 Atlantic sturgeon and 37 shortnose sturgeon. With the issuance of the June 2016 BO, the exempted take was reduced to 6 Atlantic sturgeon and 6 shortnose sturgeon in order to reflect the anticipated incidental take for the remaining piles that will be installed (i.e., the piles associated with the first 31 sturgeon had been driven, and the take accounted for, as of the issuance of the June 2016 BO). To allow tracking of incidental take with respect to Table 8 of the June 2016 BO, the cumulative take reported in the table above will be with reference to 6 sturgeon. Note that previous monthly reports submitted prior to the issuance of the June 2016 BO accounted for estimates of anticipated sturgeon take for piles driven [redacted] April 17, 2016 – May 09, 2016 [redacted] May 15, 2016 – June 11, 2016 [redacted]. Because the piles [redacted] are also included in Table 8 of the June 2016 BO, the anticipated take for those piles will also be included as part of the cumulative take estimate reported in future monthly reports.

Attachment A

Drilled Shaft Underwater Noise Log

Monthly Summary of Pile Driving Activities
New NY Bridge Project
10/2/2016 - 10/29/2016
Revision 2

TAPPAN ZEE
CONSTRUCTORS, LLC

Reporting Period 10/2/2016 - 10/29/2016

No. of Piles Impact Driven	12	
No. of Piles Monitored for Underwater Noise	0	
No. of Sturgeon Observed	0	
187 cSEL Acoustic Corridor Maintained at All Times	Yes	(If no, provide detail)
150 rms SPL Acoustic Corridor Maintained at All Times	Yes	(If no, provide detail)

Date (mm/dd/yyyy)	Year (yyyy)	Week	[redacted]	Start Time (24:00)	End Time (24:00)	Net Impact Pile Driving Duration (hrs/pile)	Pile Monitored for Underwater Noise (Yes or No)	Diameter of 206 dB re 1 µPa peak SPL Isopleth (feet)[a]	Diameter of 187 dB re 1 µPa^2•s cSEL Isopleth (feet)[a]	Diameter of 150 dB re 1 µPa rms SPL Isopleth (feet)[a]	Pile Driving Duration Longer than Anticipated in Table 12 of NMFS BO? (Yes / No)	Diameter of 206 dB re 1 µPa Peak SPL Isopleth Greater than Anticipated in Table 12 of the NMFS BO?[b] (Yes, No, N/A)	Estimated Extent of <187-dB cSEL Acoustic Corridor[c] (feet)	Estimated Extent of <150-dB rms SPL Acoustic Corridor[c] (feet)
10/3/2016	2016	41		10:11	10:16	0.08	No	N/A	N/A	N/A	No	N/A	14662	13228
10/3/2016	2016	41		10:20	10:33	0.22	No	N/A	N/A	N/A	No	N/A	14662	13228
10/3/2016	2016	41		10:36	10:48	0.20	No	N/A	N/A	N/A	No	N/A	14662	13228
10/3/2016	2016	41		11:27	11:32	0.08	No	N/A	N/A	N/A	No	N/A	14662	13228
10/3/2016	2016	41		11:35	11:48	0.22	No	N/A	N/A	N/A	No	N/A	14662	13228
10/3/2016	2016	41		11:51	12:08	0.28	No	N/A	N/A	N/A	No	N/A	14662	13228
10/3/2016	2016	41		12:35	13:08	0.30	No	N/A	N/A	N/A	No	N/A	14662	13228
10/3/2016	2016	41		13:13	13:37	0.40	No	N/A	N/A	N/A	Yes	N/A	14662	13228
10/4/2016	2016	41		12:00	12:07	0.12	No	N/A	N/A	N/A	No	N/A	14662	13228
10/4/2016	2016	41		12:12	12:16	0.07	No	N/A	N/A	N/A	No	N/A	14662	13228
10/4/2016	2016	41		12:20	12:24	0.07	No	N/A	N/A	N/A	No	N/A	14662	13228
10/4/2016	2016	41		12:28	12:31	0.05	No	N/A	N/A	N/A	No	N/A	14662	13228

Note: Start Time and End Time reflect overall pile driving activity and does not reflect Net Impact Pile Driving Duration. Impact pile driving information presented after the completion of a given pile.

[a] Estimated width of the isopleth is only provided if underwater noise measurements are collected.

[b] Comparison with NMFS BO Geographic Threshold is only provided if underwater noise measurements are collected and is based on the 206-dB mean peak SPL isopleth for monitored piles only.

[c] See Table 1 for assumed 187-dB cSEL and 150-dB rms SPL values for estimation of Acoustic Corridors for non-monitored piles.

Table 1. Estimated Extents of Non-Monitored Production and Temporary Piles for the 187 dB re 1µPa^2 •s cSEL and the 150 dB re 1µPa rms SPL Acoustic Corridors

Design Unit		cSEL Isopleth Diameter (feet)				rms SPL Isopleth Diameter (feet)			
		2-foot	3-foot	4-foot	6-foot	2-foot	3-foot	4-foot	6-foot
Rockland Trestle		--	338[a]	--	--	--	1772[a]	--	--
Design Unit 2		--	418[a]	204	--	--	1772[a]	616	--
Design Unit 3		--	--	204	--	--	--	616	--
Design Unit 4		--	--	290	--	--	--	546	--
Design Unit 5		--	--	240	--	--	--	1130	--
Design Unit 6		--	--	146	--	--	--	572	--
Design Unit 7		--	--	140	400	--	--	572	6996
Main Span		--	--	NA	400	--	--	NA	6996
Design Unit 8		--	--	460	190	--	--	1853	924
Design Unit 9		--	418[a]	--	--	--	1772[a]	--	--
Westchester Trestle		248[a]	--	--	--	1192[a]	--	--	--

Note: Values provided represent the maximum extent of the 187 dB re 1 1µPa^2•s cSEL and the 150 dB re 1µPa rms SPL Isopleths from applicable *Description of Underwater Noise Attenuation System* Report. See *Underwater Noise Monitoring Plan, Rev 4* for more information.

[a]Values provided in Table 11 of the NMFS BO (NER-2014-11317).

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Underwater Acoustic Monitoring Log: [redacted]

Drilled Shaft Underwater Noise Log

Acoustic Engineer: Caitlin O'Neill Date: 27/10/2016

Part 1: Shaft Information

[redacted]

Drilling Method:	Reverse Circulation

Drill Model:	Wirth PBA 933
Water Depth:	16.5 ft
Tidal Stage:	Ebb

Start of Drilling:	26/10/2016 16:20
End of Drilling:	2/11/2016 9:14
Net Drilling Time:	24:02

Part 2: Hydrophone Information

AMAR ID:	Device Name	Location	Distance to Shaft (feet)	Peak SPL [1] (dB re 1 µPa)[2]		cSEL (24 hr)[3] (dB re 1 µPa^2·s)[4]
				Median	Max	
AMAR-RT	OSM-016	Cross-current	33	158	166	195
AMAR-Primary	AMAR-215	Cross-current	158	144	158	176
AMAR-Secondary	AMAR-298	Cross-current	367	144	155	178

[1] Sound Pressure Level

[2] Peak Sound Pressure Level calculated over a 1 second average with 50% overlap

[3] Cumulative Sound Exposure Level

[4] rms SPL calculated over a 1 second average with 50% overlap.

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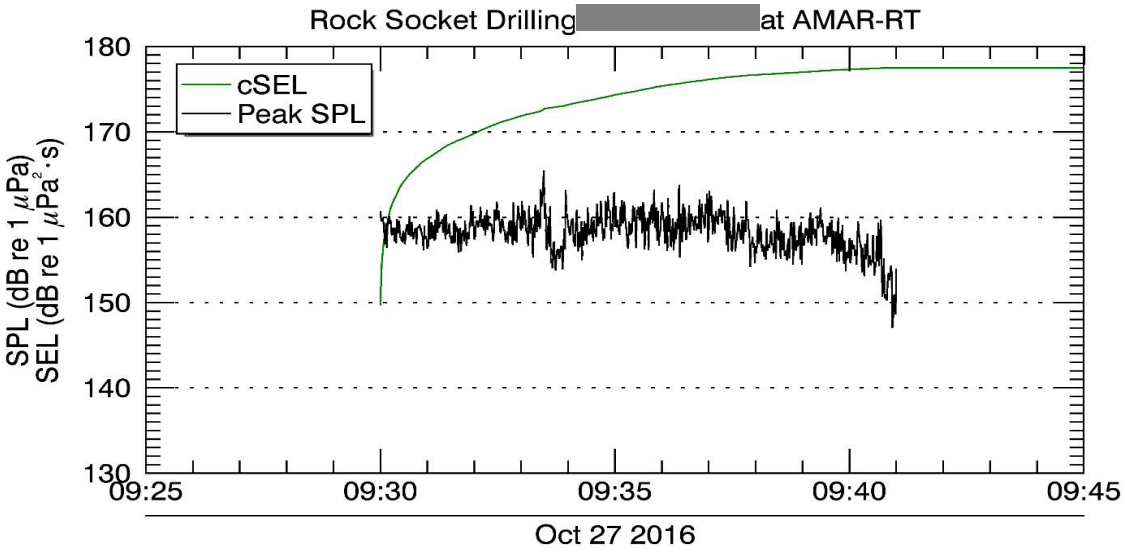
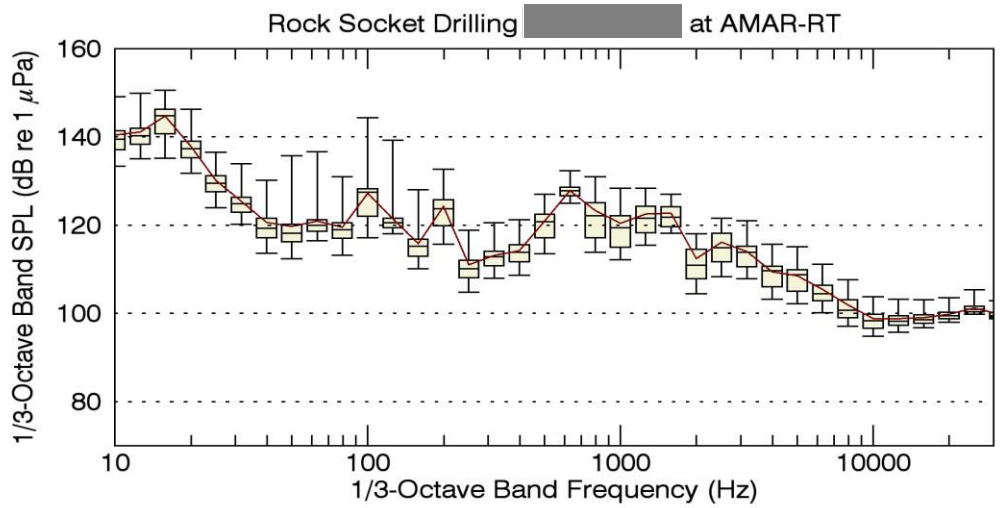
Underwater Acoustic Monitoring Log: [redacted]

Acoustic Engineer: Caitlin O'Neill Date: 27/10/2016

Part 3: AMAR-RT Additional Figures



Drilled Shaft: Peak SPL and cSEL versus time (EDT) for the drilled shaft P42EB-01 measured 33 ft from the shaft using AMAR-RT.



Distribution of 1/3-Octave SPL for drilled shaft P42EB-01 measured 33 ft from the pile using AMAR-RT. Beige bars indicate the first, second, and third quartiles (L25, L50, and L75). Upper error-bars indicate the maximum levels (Lmax). Lower error bars indicate the 95% exceedance percentiles (L95). The maroon line indicates the arithmetic mean (Lmean).

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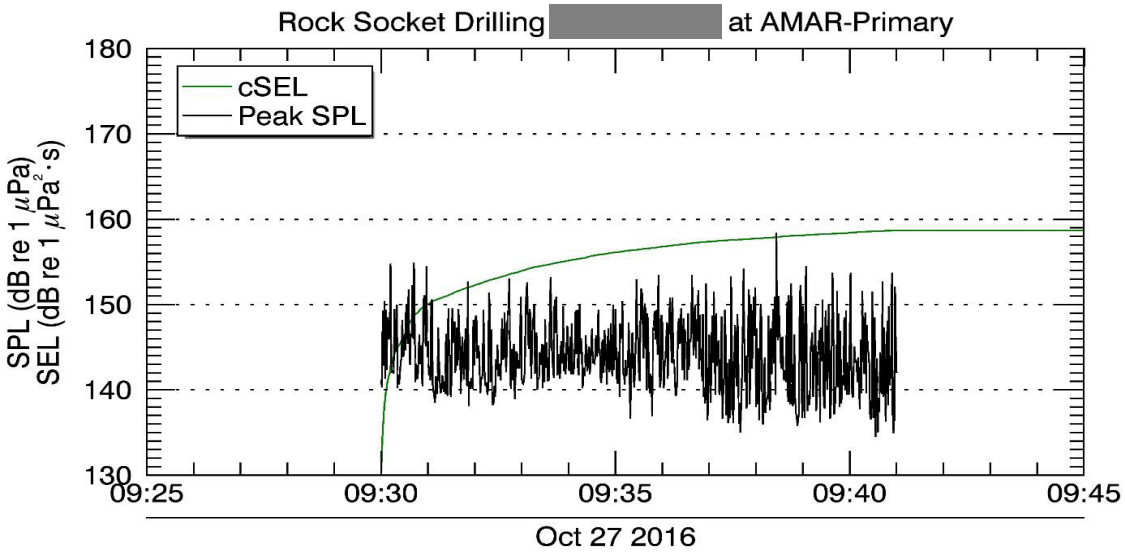
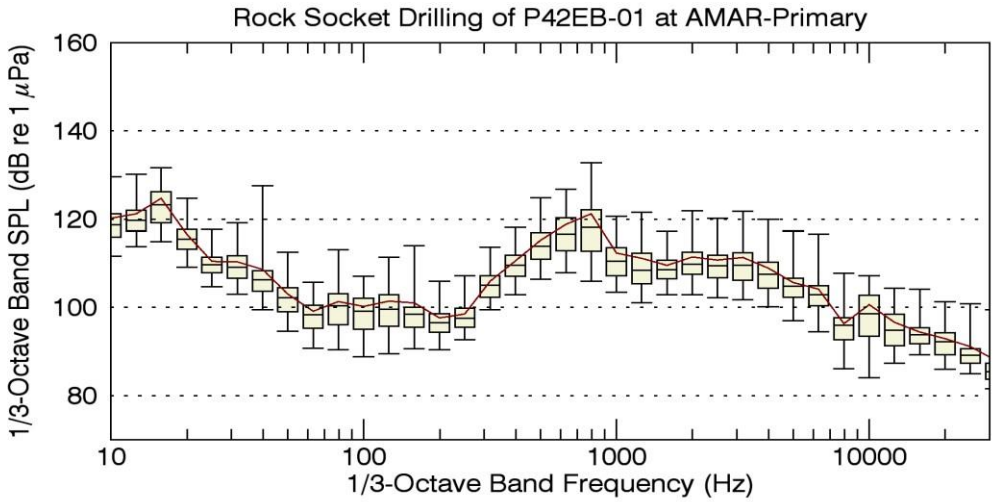
Underwater Acoustic Monitoring Log: [redacted]

Acoustic Engineer: Caitlin O'Neill Date: 27/10/2016

Part 4: AMAR-Primary Additional Figures



Drilled Shaft: Peak SPL and cSEL versus time (EDT) for the drilled shaft P42EB-01 measured 158 ft from the shaft using AMAR-Primary.



Distribution of 1/3-Octave SPL for the drilled shaft [redacted] measured 158 ft from the shaft using AMAR-Primary. Beige bars indicate the first, second, and third quartiles (L25, L50, and L75). Upper error-bars indicate the maximum levels (Lmax). Lower error bars indicate the 95% exceedance percentiles (L95). The maroon line indicates the arithmetic mean (Lmean).

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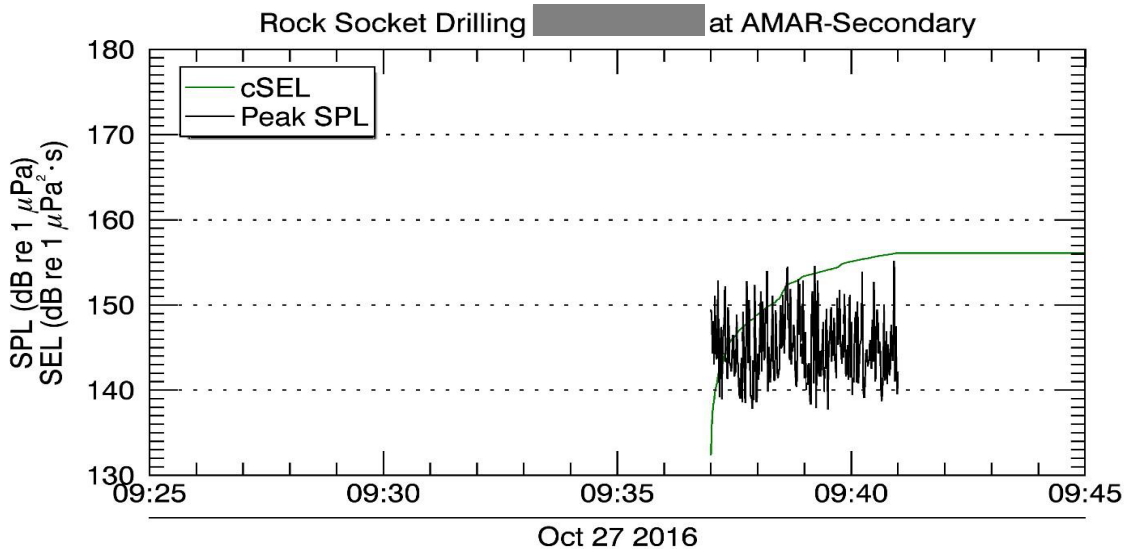
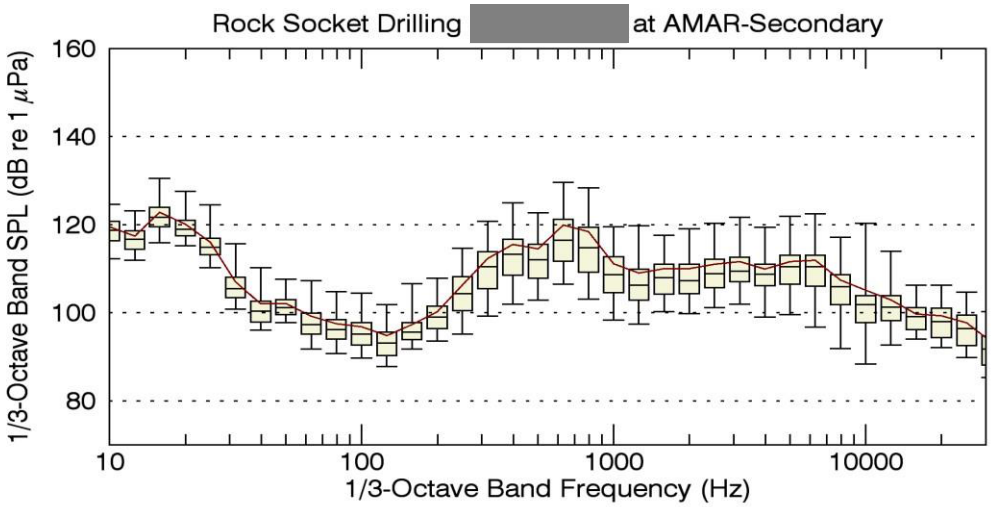
Underwater Acoustic Monitoring Log: [redacted]

Acoustic Engineer: Caitlin O'Neill Date: 27/10/2016

Part 5: AMAR-Secondary Additional Figures



Drilled Shaft: Peak SPL and cSEL versus time (EDT) for the drilled shaft P42EB-01 measured 367 ft from the shaft using AMAR-Secondary.



Distribution of 1/3-Octave SPL for the drilled shaft [redacted] measured 367 ft from the shaft using AMAR-Secondary. Beige bars indicate the first, second, and third quartiles (L25, L50, and L75). Upper error-bars indicate the maximum levels (Lmax). Lower error bars indicate the 95% exceedance percentiles (L95). The maroon line indicates the arithmetic mean (Lmean).

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Underwater Acoustic Monitoring Log: [redacted]

Acoustic Engineer: Caitlin O'Neill Date: 27/10/2016

Part 6: Comments

L50 (median) values were used instead of mean to remove vessel activity near primary and secondary AMARs. Data where vessel activity saturated the AMARs were removed. There was auger drilling near the AMAR-Secondary, which may have caused higher received levels at this location. Total drilling time reported includes all drilling times for shaft during October 26, 27, 31, and November 1 and 2. cSEL was calculated from the day with the greatest total drilling time, which was 10 hours and 30 minutes on November 1, 2016. 1/3-Octave SPL is presented instead of SELss because SELss is not used for continuous sounds like rock socket drilling.