Errata to Final Environmental Impact Report

The purpose of this errata is to add a copy of Appendix A (*Memorandum Draft Re: National City Bayfront Projects & Plan Amendments – Potential Noise Effects on Fish and Marine Mammals*) to Appendix H (*National City Bayfront Projects Marine Biological Resources Report*) of the Final Environmental Impact Report (EIR) for the National City Bayfront Projects & Plan Amendments. Appendix A to Appendix H of the Final EIR was inadvertently omitted from the Final EIR that was made available to the public on Friday, September 30, 2022. That appendix to Appendix H, which was included in Volume III of the Draft EIR when the Draft EIR was released for public review on September 29, 2021, was not revised in the Final EIR. Therefore, providing this appendix to Appendix H does not constitute significant new information.

Appendix A

Memorandum Draft Re: National City Bayfront Projects & Plan Amendments – Potential Noise Effects on Fish and Marine Mammals

Draft Memorandum

To:	
From:	Jonathan Higginson, INCE-USA Senior Manager, Noise Analyst
Date:	January _, 2020
Re:	**National City Bayfront Projects & Plan Amendments – Potential Noise Effects on Fish and Marine Mammals**

Introduction

This memorandum is being prepared to inform the Environmental Impact Report (EIR) for the proposed National City Bayfront Projects & Plan Amendments (Project) regarding potential noise impacts to fish and marine mammals due to proposed in-water construction activities. Waterside construction activities including pile driving are proposed as part of the project in order to construct docks, gangways, and a pier platform. Pile driving will generate both underwater (hydroacoustic) noise and airborne (in-air acoustic) noise. Underwater noise may affect both fish and marine mammals. In addition, marine mammals may potentially be impacted by airborne noise while they are hauled out onto land (i.e., while they are in air rather than in water). During pile installation jetting would be used to the extent possible, but an impact pile driving hammer would also be required. While some pile details (assumed materials and sizes) have been established, the precise details of the construction process are not known at this time. Details such as the pile driver size and power rating, the number of pile strikes per pile, and the number of piles installed per day can all affect the underwater noise levels. As a result, underwater noise levels are estimated based, in part, on information for similar in-water construction in San Diego Bay. The project-specific underwater noise levels should be recalculated for each waterside project element when final construction details are available.

Introduction to Hydroacoustic Concepts

Fundamental concepts for in-air noise are covered in detail in the Noise section of the project EIR. The following discussion provides a brief introduction into the fundamental concepts and terminology used in underwater sound (hydroacoustic) analysis. Refer to the following documents for more detailed information:

- *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish* (Caltrans 2015)
- *Caltrans Engineering Technical Brief: Overview of the Evaluation of Pile Driving Impacts on Fish for the Permitting Process* (Caltrans 2018)

When a pile is struck with an impact hammer, the pile vibrates and radiates sound energy into the water. Figure 1 shows the pressure modulations associated with a single pile strike. The peak sound pressure occurs immediately after the pile is struck. The pile will then continue to ring for a few hundred milliseconds. One way to characterize the sound produced by the pile strike is to measure the peak sound pressure expressed in decibels relative to 1 micro-pascal. This is called the Peak Sound Pressure Level or L_{PEAK}.

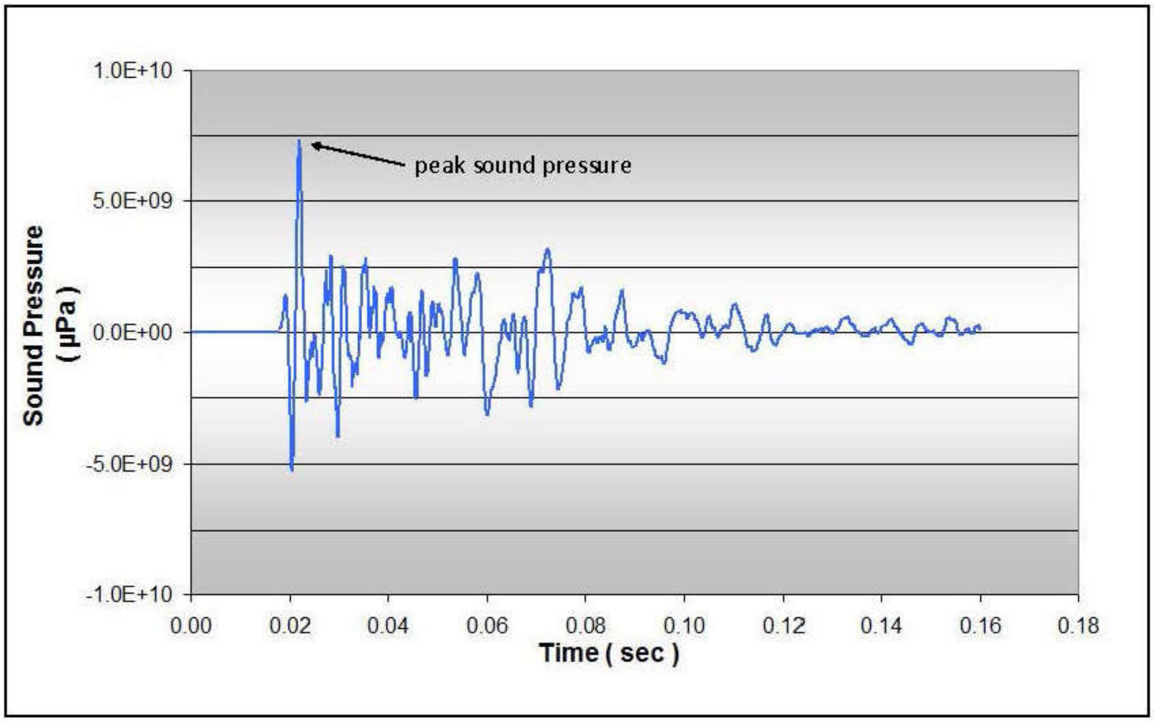

Figure 1. Sound Pressure Resulting from Pile Strike

Another way to quantify the sound associated with a pile strike is to measure the total energy associated with the pile strike. This is commonly expressed as the Sound Exposure Level or SEL. The total sound energy associated with the pile strike is summed and normalized to 1 second. Figure 2 shows how sound energy from a single strike accumulates over time to reach a maximum value. For a given pile and pile strike, the SEL value is typically 25 dB less than the peak level.

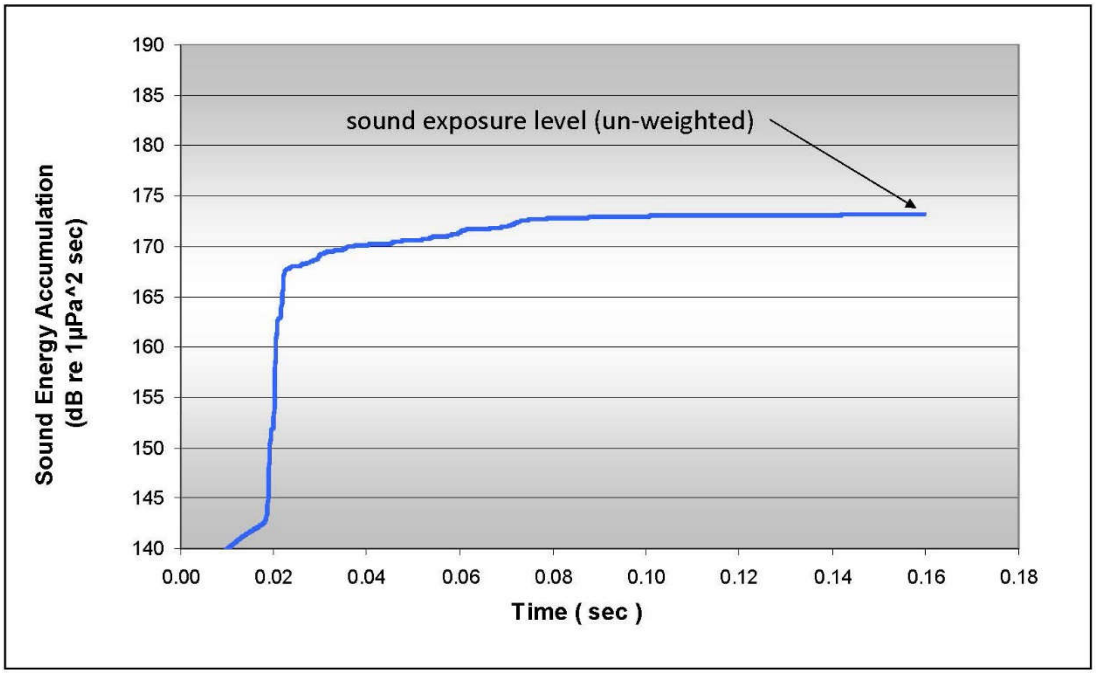

Figure 6. Sound Energy Accumulation Resulting from Pile Strike

Note: This is an "unweighted" sound energy scale and does not use the A-weighting scale normally applied to human hearing.

Because impact pile driving involves a series of pile strikes throughout the day, the cumulative sound energy associated with the pile strikes that occur in 1 day is also used. The cumulative SEL or $SEL_{CUMULATIVE}$ is determined by adding up the sound energy associated with all pile strikes that occur over a given day. If the single strikes SEL and the number of daily strikes are known, the cumulative SEL can be calculated with the following equation:

$$SEL_{CUMULATIVE} = SEL_{SINGLESTRIKE} + 10\text{Log (number of strikes)}$$

A final metric that is used to characterize pile driving sound is the root-mean-square (RMS) level. As discussed above, this is essentially an average of the sound energy associated with a single strike.

Underwater sound generated by vibratory driving and rotational pile installation is similar to impact pile driving with the exception that sound pressure is continuous rather than intermittent over the driving period. With vibratory driving, SEL and RMS values are equal. The calculation of cumulative SEL is also different:

$$SEL_{CUMULATIVE} = SEL + 10\text{Log (duration of driving in seconds)}$$

Sound levels diminish over distance as a result of many complex factors. For the purposes of this analysis, a simplified approach is taken. Sound is assumed to diminish at a rate of 4.5 dB per doubling of distance. This is generally a conservative approach and should be used unless there is site-specific information indicating that a different attenuation rate is appropriate. Attenuation is calculated with the following equation:

$$dB_2 = dB_1 - F*\log(D_2/D_1)$$

where: dB_1 is the sound level at a distance of D_1 from the pile
dB_2 is the sound level at a distance of D_2 from the pile
F = attenuation factor (attenuation is 4.5 dB per doubling of distance where F = 15)

Potential impacts are typically identified in terms of the distance from construction activity at which various thresholds would be exceeded. The term "isopleth" is used to describe a line (for instance that could be drawn on a map) connecting points having equal sound levels. Underwater isopleths are analogous to "noise contours" that are often described for in-air noise. It is important to note that the convention for describing distances in association with hydroacoustic impacts is to state all distances in meters rather than feet. While results can easily be converted to feet for reporting purposes, it is important to be mindful of the calculated distances and to ensure the appropriate unit (meters or feet) is clearly identified.

Interim Injury Criteria

In-water Noise

Fish

Acoustic criteria intended to protect fish from harm and mortality caused by pile driving activities were adopted by the California Department of Transportation (Caltrans), the Federal Highway Administration (FHWA), the California Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, and the NOAA Fisheries Northwest and Southwest Regions in 2008. These "interim injury criteria" are now routinely used to evaluate the effects of impact pile driving sound on fish. These criteria do not apply to vibratory pile driving. Vibratory pile driving is considered to be an avoidance and minimization measure for reducing effects on fish from impact pile driving and is not assessed for potential injury to fish. The same line of thinking is also applied to pile drilling. (Vibratory driving and pile drilling, however, may affect marine mammals, and so vibratory driving and pile drilling must be considered when marine mammals are present, as described in the following sections of the memorandum). Table 1 summarizes the adopted interim criteria for fish.

Table 1. Interim Level A Injury Criteria for Fish

Interim Injury Criteria	Agreement in Principal
Peak	206 dB
Cumulative SEL	187 dB – for fish size of two grams or greater 183 dB – for fish size of less than two grams

dB = decibels; SEL = Sound Exposure Level.

Additional guidance provided by NOAA Fisheries states that a level of 150 dB_{RMS} should be used to assess potential behavioral effects on fish. The accumulation period for the cumulative SEL is 1 day of activity. In other words, the accumulative energy resets each day.

Marine Mammals

In 2018, NOAA Fisheries published criteria for assessing in-water impacts on marine mammals from pile driving and other construction sources (NOAA 2018). These thresholds relate to the onset of permanent hearing threshold shift (PTS) and have frequency weighting functions that are applied to overall measured unweighted sound levels based on the type of activity (e.g., drilling, pile driving) and the potentially effected species. Background and details on these criteria can be found here:

https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance

In-water acoustic thresholds for behavioral disruption were previously reported on the NOAA Fisheries Westcoast Region website at:

https://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

Tables 2 and 3 summarize these various criteria. As with fish, the accumulation period for the cumulative SEL is 1 day of activity and the accumulative energy resets each day.

Table 2. NOAA Fisheries In-water Level A Acoustic Thresholds (PTS Onset)

Criterion	PTS Onset (Received Sound Level)	
Level A Hearing Groups	Impulsive Sound Source	Non-Impulsive Sound Source
Low-frequency Cetaceans (LF) *(baleen whales)*	Peak: 219 dB_{LF} SEL_{CUM}: 183 dB_{LF}	SEL_{CUM}: 199 dB_{LF}
Mid-frequency Cetaceans (MF) *(dolphins, toothed whales, beaked whales, bottlenose whales)*	Peak: 230 dB_{MF} SEL_{CUM}: 185 dB_{MF}	SEL_{CUM}: 198 dB_{MF}
High-frequency Cetaceans (HF) *(true porpoises, Kogia, river dolphins, cephalorhynchid, Lagenorhynchous cruciger and australis)*	Peak: 202 dB_{HF} SEL_{CUM}: 155 dB_{HF}	SEL_{CUM}: 173 dB_{HF}
Phocid Pinnipeds (PW) *(true seals)*	Peak: 218 dB_{HF} SEL_{CUM}: 185 dB_{HF}	SEL_{CUM}: 201 dB_{HF}
Otariid Pinnipeds (OW) *(sea lions and fur seals)*	Peak: 232 dB_{HF} SEL_{CUM}: 203 dB_{HF}	SEL_{CUM}: 219 dB_{HF}

Notes: Dual Thresholds (impulsive): Use one resulting in largest effect distance (isopleth); SEL thresholds incorporate frequency weighting functions; all decibels referenced to 1 micro-pascal (re: 1uPa); the recommended accumulation period is 24 hours.

dB = decibels; PTS = permanent hearing threshold shift SEL_{CUM} = cumulative Sound Exposure Level.

Table 3. NOAA Fisheries In-Water Level B Acoustic Thresholds (Behavioral Disruption)

Criterion	Criterion Definition	Threshold
Level B	Behavioral disruption for impulsive noise	160 dB_{RMS}
Level B	Behavioral disruption for continuous noise	120 dB_{RMS}[a]

Note: All decibels referenced to 1 micro-pascal (re: 1uPa).
[a] The 120 dB threshold may be slightly adjusted if background noise levels are at or above this level.
dB_{RMS} = decibels root-mean-squared.

In-Air Noise (Marine Mammals Only)

In-air acoustic thresholds for marine mammals were previously reported on the NOAA Fisheries Westcoast Region website at:

> https://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

These thresholds are summarized in Table 4. It is noted that thresholds are currently only provided for Level B take (behavioral disruption) and that no threshold is currently established for Level A take (injury). Because injury is a more severe effect than behavioral disruption it follows that Level A take would occur at higher noise levels than those associated with Level B take. Therefore, although no specific threshold has been established for Level A take (injury) it can be concluded that avoidance of Level B take would also avoid Level A take. It is noted that the thresholds in Table 1 are all established using unweighted decibels (dB) (also sometimes referred to as “flat” or “Z” weighted), as opposed to A-weighted decibels (dBA) which are typically used for assessing environmental noise impacts on humans. When a sound is measured using both unweighted decibels and A-weighted decibels, the values are rarely the same. For most environmental sound sources the unweighted (dB) level will be higher than the A-weighted (dBA) level. The difference between the two values depends on the frequency content (spectrum) of the sound.

Table 4. NOAA National Marine Fisheries Service Current In-Air Acoustic Thresholds

Criterion	Criterion Definition	Threshold
Level A	PTS (injury) conservatively based on TTS	None established
Level B	Behavioral disruption for harbor seals	90 dB_{RMS}
Level B	Behavioral disruption for non-harbor seal pinnipeds	100 dB_{RMS}

PTS = permanent hearing threshold shift
TTS = temporary hearing threshold shift
dB = decibels referenced to 20 micro Pascals (re: 20 μPa)
RMS = root mean square

Analysis Methods

Fish

NOAA Fisheries has published a Microsoft Excel spreadsheet that facilities the assessment of underwater sound impacts from pile driving on fish. Data inputs to the spreadsheet include sound source levels for the pile being evaluated, the number of pile strikes per day, and the sound attenuation rate (typically 4.5 dB per doubling of distance). Source levels are typically taken from the database of pile driving sound levels reported in Caltrans 2015. This is commonly referred to as the pile driving "compendium." The spreadsheet determines the distances within which the various injury criteria are exceeded. These distances are often referred to as "injury isopleths".

An important concept related to the analysis of underwater sound impacts on fish is the concept of "effective quiet." The concept of effective quiet relates to the calculation of cumulative SEL. As discussed above, the cumulative SEL value is calculated using the single strike SEL value and the anticipated number of daily pile strikes. The sound level generated by pile driving diminishes with distance from the pile. At a certain distance, the pile driving sound level is so low that it is no longer expected to result in injury to fish even when the energy is accumulated from multiple pile strikes. The area beyond this distance is called the area of "effective quiet" and is considered to be located at the point where the single strike SEL value drops to 150 decibels or less. Accordingly, the distance at which the single strike SEL drops to less than 150 dB is the maximum distance within which injury is assumed to result. This means that at about 5,000 strikes, the injury isopleth relative to the 187 dB criterion does not increase. This occurs at about 2,000 strikes relative to the 183 dB criterion.

Marine Mammals

Underwater Sound

NOAA Fisheries has also published a Microsoft Excel spreadsheet that facilitates the assessment of underwater sound impacts on marine mammals from non-impulsive sources (e.g. drilling, vibratory pile driving, and tactical sonar) and impulsive sources (e.g. impact pile driving, explosives, seismic exploration). The spreadsheet provides default Weight Factor Adjustments (WFAs) to account for variations in hearing responses from the various marine mammal hearing groups. The default WFAs are used if the frequency spectrum from the source is not available. For most typical analyses, source levels are taken from the compendium of pile driving source levels in the Caltrans 2015. Because spectra are not available for these source levels, the default WFAs are used.

The analysis process assumes that marine mammals remain stationary during the sound generating activity. In addition, recovery between intermittent sounds is not considered for sound energy that occurs with the accumulation period of 24 hours. The spreadsheet uses inputs that are similar to the fish spreadsheet and calculates the distance within which the PTS threshold is predicted to be exceeded. This distance is called the "PTS isopleth."

The concept of effective quiet is not applied to marine mammal analysis.

Airborne Sound

There are no specific guidelines or required methodologies for the analysis of airborne sound. The propagation of airborne sound can be analyzed using the same techniques that are typically applied to the analysis of environmental noise impacts on humans. The simplest commonly-used approach assumes geometric spreading from a point source, with noise attenuation at a rate of 6 dB per doubling of distance from source. The primary difference between the analysis for marine mammals versus humans is that (as noted previously) the noise levels considered for marine mammal impacts are unweighted sound pressure levels (dB) as opposed to the A-weighted sound pressure levels (dBA) typically used to assess potential impacts to humans. (A-weighting is a frequency modification based on how humans hear sound). To make a construction noise assessment relative to the unweighted criteria, unweighted construction noise source levels are needed. The FHWA Roadway Construction Noise Model (RCNM) is a commonly accepted reference for noise levels generated by construction equipment. These reference sound levels, however, are A-weighted. The unweighted sound levels can be estimated from these A-weighted sound levels with conversion factors developed from measured sound level spectra. RCNM data indicate maximum A-weighted noise levels (rms) of approximately 101 dBA at 50 feet from impact pile driving. A review conducted by ICF of available pile driving sound spectra (i.e., frequency) data indicates that unweighted noise levels for impact pile driving are up to 6 dB higher than A-weighted noise levels. Adjusting the A-weighted noise source levels accordingly results in unweighted noise levels (rms) of approximately 107 dB at 50 feet.

Analysis and Estimated Impact Distances

Due to the programmatic nature of the Project, the full details of the required pile driving activity are not known at this time. The piles are anticipated to include the following.

- For the Floating Dock: 21 concrete piles, each 18 inches in diameter and 50 feet in length. It is anticipated that these piles would be jetted into place.
- For the Dock: 16 concrete piles, each 18 inches in diameter and 50 feet in length.

- For the Pier Platform: 42 concrete piles, each 24 inches in diameter and 40 feet in length. 29 piles would be installed on the landside and 13 on the waterside.

A key variable that is currently unknown is the total number of impact hammer strikes that will occur in a 24-hour period. This total will be a product of the number of strikes required to install each pile and the number of piles that will be installed each day. The number is important because it will affect the cumulative SEL. Where pile jetting is used, the number of strikes per pile will be reduced (possibly to zero), but an impact hammer may still be needed to achieve the required final depth. To make a preliminary analysis possible, the number of pile strikes was assumed based on data for the proposed marina expansion that was analyzed as part of the Fifth Avenue Landing Project. This data indicated up to 75 strikes per pile and 10 piles per day, for a total of 750 strikes per day.

In-Water Noise

Fish

Table 5 summarizes the results of the hydroacoustic assessment for potential impacts on fish.

Table 5. Pile Driving Hydroacoustic Assessment for Fish

	Distance to Injury Isopleth for Fish, meters (feet)			Distance to Disturbance Threshold (feet) (all fish)
Pile Type	Peak (all fish)	Cumulative SEL (fish > 2 grams)	Cumulative SEL (fish < 2 grams)	
Concrete, 18 inch	1 (4)	21 (68)	38 (126)	631 (2,070)
Concrete, 24 inch	1 (4)	33 (108)	61 (199)	541 (1,775)

dB= decibels; SEL = Sound Exposure Level.

Marine Mammals

Table 6 summarizes the results of the hydroacoustic assessment for potential impacts on marine mammals. For Level A impacts, the Cumulative SEL impact distances are all larger than the corresponding Peak impact distances, and therefore the Cumulative SEL distances would be used in determining impacts and establishing any required mitigation.

Table 6. Pile Driving Hydroacoustic Assessment for Marine Mammals

Pile Type	Distance to Level A Impacts for Marine Mammals, meters (feet)					Distance to Level B Threshold for Impulsive Sound, meters (feet)
	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds	
Concrete, 18 inch	Cumulative SEL					136 (446)
	38 (126)	1.4 (4)	46 (150)	21 (67)	1.5 (5)	
	Peak					
	N/A	N/A	2.2 (7)	N/A	N/A	
Concrete, 24 inch	Cumulative SEL					117 (383)
	61 (199)	2.2 (7)	72 (237)	33 (106)	2.4 (8)	
	Peak					
	N/A	N/A	2.2 (7)	N/A	N/A	

dB= decibels; SEL = Sound Exposure Level; N/A = impact distance is negligible (less than 1 meter).

In-Air Noise (Marine Mammals Only)

Table 7 summarizes the results of the in-air noise assessment for potential impacts on marine mammals.

Table 7. Pile Driving In-Air Noise Assessment for Marine Mammals

Criterion	Criterion Definition	Threshold	Distance from Impact Pile Driving, meters (feet)	Distance from Vibratory Pile Driving or Extraction, meters (feet)
Level B	Behavioral disruption for harbor seals	90 dB_{rms}	108 m (354 ft)	161 m (530 ft)
Level B	Behavioral disruption for non-harbor seal pinnipeds	100 dB_{rms}	34 m (112 ft)	51 m (167 ft)

dB = decibels referenced to 20 micro Pascals (re: 20uPa)
rms = root mean square

References Cited

Caltrans. 2015. *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish*. Sacramento, CA.

Caltrans. 2018. *Caltrans Engineering Technical Brief: Overview of the Evaluation of Pile Driving Impacts on Fish for the Permitting Process*. Sacramento, CA.

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