USER SPREADSHEET INTRODUCTION

VERSION: 2.1 (2020)

Companion[+] User Spreadsheet to:

National Marine Fisheries Service (NMFS): 2018 Revision to: Technical Guidance For Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing: Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts (Version 2.0)

2018 Revised Technical Guidance web page

[+]For more information on the optional methodology provided within this User Spreadsheet, see Appendix D of Technical Guidance (2018)

DISCLAIMER: NMFS has provided this spreadsheet as an optional tool to provide estimated effect distances (i.e., isopleths) where PTS onset thresholds may be exceeded. Results provided by this spreadsheet do not represent the entirety of the comprehensive effects analysis, but rather serve as one tool to help evaluate the effects of a proposed action on marine mammal hearing and make findings required by NOAA's various statutes. Input values are the responsibility of the individual user.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance.

INSTRUCTIONS

STEP 1: Determine what spreadsheet is appropriate for activity

HOW TO DETERMINE WHICH TAB TO USE

1) Is the sound source NON-IMPULSIVE or IMPULSIVE? (If it is unclear which category describes your source, consult NOAA)

a) NON-IMPULSIVE (e.g., drilling, vibratory pile driving, tactical sonar): Go to Question 2	
b) IMPULSIVE (e.g., explosives, impact pile driving, seismic): Go to Question 5	

2) Is the NON-IMPULSIVE sound source STATIONARY or MOBILE?

a) STATIONARY: Go to Question 3
b) MOBILE: Go to Question 4

3) Is the NON-IMPULSIVE, STATIONARY source CONTINUOUS or INTERMITTENT↓?

a) CONTINUOUS: Use Tab A*	**RED BRICK**
*If source is vibratory pile driving: Use Tab A.1	
b) INTERMITTENT: Use Tab B	**YELLOW**

↓ A key distinction between continuous and intermittent sound sources is that intermittent sounds have a more regular (predictable) pattern of bursts of sounds and silent periods (i.e., duty cycle), which continuous sounds do not.

4) Is the NON-IMPULSIVE, MOBILE source CONTINUOUS or INTERMITTENT?

a) CONTINUOUS: Use Tab C ("safe distance" methodology from Sivle et al. 2014)	**BLUE**
b) INTERMITTENT: Use Tab D ("safe distance" methodology from Sivle et al. 2014)	**ORANGE**

5) Is the IMPULSIVE sound source STATIONARY or MOBILE?

a) STATIONARY: Use Tab E*	**GREEN EVRGRN**
*If source is impact pile driving: Use Tab E.1	
b) MOBILE: Use Tab F ("safe distance" methodology from Sivle et al. 2014)	**PURPLE**

STEP 2: Within the appropriate tab, fill-in: **SAGE CELLS** specific to the activity

a) Please provide information used to support values in provided sage boxes (e.g., surrogate data, direct measurements, etc.)
b) If information is unavailable to fill-out one or more of the sage boxes, please consult NMFS

STEP 3: Estimated PTS isopleths (meter) will be provided in: **SKY BLUE CELLS** by marine mammal hearing group

STEP 4: When using this spreadsheet to estimate marine mammal takes, please provide a copy of completed tab used to estimate isopleths

ASSUMPTIONS & ADDITIONAL INFORMATION

1) Marine mammals remain stationary during activity

2) Currently, recovery between intermittent sounds is not considered regardless of time between sounds (i.e., all sounds within the accumulation period are counted)

Suggested (Default*) Weighting Factor Adjustments (WFA) for Broadband Sources:

Source	WFA	Example Supporting Sources
Seismic airguns	1 kHz	Breitzke et al. 2008; Tashmukhambetov et al. 2008; Tolstoy et al. 2009
Impact pile driving hammers	2 kHz	Blackwell 2005; Reinhall and Dahl 2011
Vibratory pile driving hammers	2.5 kHz	Blackwell 2005; Dahl et al. 2015
Drill vessels/platforms	2 kHz	Greene 1987; Blackwell et al. 2004; Blackwell and Greene 2006

* NMFS acknowledges default WFAs are likely conservative

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW): true seals
Otariid pinnipeds (OW): sea lions and fur seals

Literature Cited

Blackwell, S.B. 2005. Underwater Measurements of Pile Driving Sounds during the Port MacKenzie Dock Modifications, 13-16 August 2004. Juneau, Alaska: Federal Highway Administration.

Blackwell, S.B., C.R. Greene, Jr., and W.J. Richardson. 2004. Drilling and operational sounds from an oil production island in the ice-covered Beaufort Sea. Journal of the Acoustical Society of America 116: 3199-3211.

Blackwell, S.B., and C.R. Green, Jr. 2006. Sounds from an oil production island in the Beaufort Sea in summer: Characteristics and contribution of vessels. Journal of the Acoustical Society of America 119: 182-196.

Breitzke, M., O. Boebel, S. El Naggar, W. Jokat, and B. Werner. 2008 Broad-band calibration of marine seismic sources used by R/V Polarstern for academic research in polar regions. Geophysical Journal International 174: 505-524.

Dahl, P.H., D.R. Dall'Osto, and D.M. Farrell. 2015. The underwater sound field from vibratory pile driving. Journal of the Acoustical Society of America 137: 3544–3554.

Madsen, P.T. 2005. Marine mammals and noise: Problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117:3952–3957.

Greene, R. 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. Journal of the Acoustical Society of America 82: 1315-1324.

Reinhall, P.G., and P.H. Dahl. 2011. Underwater Mach wave radiation from impact pile driving: Theory and observation. Journal of the Acoustical Society of America 130: 1209–1216.

Sivle, L.D., P.H. Kvadsheim, and M.A. Ainslie. 2014. Potential for population-level disturbance by active sonar in herring. ICES Journal of Marine Science 72: 558-567.

Tashmukhambetov, A.M., G.E. Ioup, J.W. Ioup, N.A. Sidorovskaia, and J.J. Newcomb. 2008. Three-dimensional seismic array characterization study: Experiment and modeling. Journal of the Acoustical Society of America 123:4094–4108.

Tolstoy, M., J. Diebold, L. Doermann, S. Nooner, S.C. Webb, D.R. Bohnenstiehl, T.J. Crone, and R.C. Holmes. 2009. Broadband calibration of the R/V Marcus G. Langseth four-string seismic sources. Geochemistry Geophysics Geosystems 10: 1-15.

Technical questions or suggestion on User Spreadsheet: Please contact Amy Scholik-Schlomer (amy.scholik@noaa.gov)

UPDATES (will be posted when change results in the need to recalculate an isopleth; other non-substantive changes may be made periodically but will not result in a version number change)

Original Version	Updated Version	Change	Date posted
1.0	1.1	Sheet A, error with formula for phocid pinniped	Aug. 22, 2016
1.1	2.0	Corresponds to 2.0 version of Revised Technical Guidance (2018). Added sheet specific to vibratory pile driving and explosives and added capabilities to calculate peak sound pressure level isopleths for impulsive sources	July 2018
2.0	2.1	Updated version based on comments from 2018 public comment period.	March 2020

A: STATIONARY SOURCE: Non-Impulsive, Continuous

VERSION 2.1: 2020
KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE

PROJECT/SOURCE INFORMATION

Please include any assumptions

PROJECT CONTACT

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value.

Weighting Factor Adjustment (kHz)¥

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 47), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	
Duration of Sound Production (hours) within 24-h period	
Duration of Sound Production (seconds)	0
10 Log (duration of sound production)	#NUM!
Propagation loss	

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL$_{cum}$ Threshold	199	168	173	201	219
PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

$$W(f) = C + 10\log_{10}\left\{ \frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b} \right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.1: 2020
KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE

PROJECT/SOURCE INFORMATION

Please include any assumptions

PROJECT CONTACT

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	
Number of piles within 24-h period	
Duration to drive a single pile (minutes)	
Duration of Sound Production within 24-h period (seconds)	0
10 Log (duration of sound production)	#NUM!
Transmission loss	
Distance of sound pressure level measurement (meters)	

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL$_{cum}$ Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b}\right\}$$

B: STATIONARY SOURCE: Non-Impulsive, Intermittent

VERSION 2.1: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE

PROJECT/SOURCE INFORMATION

Please include any assumptions

PROJECT CONTACT

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 64), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either B1 OR B2 method to calculate isopleths (not required to fill in sage boxes for both)

B1: METHOD USING RMS SPL SOURCE LEVEL

Source Level (L_{rms})	
Activity Duration (hours) within 24-h period	
Pulse duration (seconds)	
1/Repetition rate˚ (seconds)	
Duty cycle	#DIV/0!
Duration of Sound Production (seconds)	#DIV/0!
10 Log (duration of sound production)	#DIV/0!
Propagation loss	

˚Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

	Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
	SEL$_{cum}$ Threshold	199	198	173	201	219
	PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

B2: ALTERNATIVE METHOD (SINGLE PING/PULSE EQUIVALENT)

Source Level ($L_{E,p, \text{single ping/pulse}}$)	
Activity Duration (hours) within 24-h period	
Number pulses in 1-h period	
Number of pulses in 24-h	0
10 Log (number of pulses)	#NUM!
Propagation loss	

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

	Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
	SEL$_{cum}$ Threshold	199	198	173	201	219
	PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b}\right\}$$

C: MOBILE SOURCE: Non-Impulsive, Continuous ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.1: 2020
KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE

PROJECT/SOURCE INFORMATION

Please include any assumptions

PROJECT CONTACT

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 45), and enter the new value directly.
However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION‡

Source Level (L_{rms})	
Source Velocity (meters/second)	
Duty cycle	1
Source Factor	1

‡Methodology assumes propagation loss of 20 log R; Activity duration (time) independent

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

$$W(f) = C + 10\log_{10}\left\{ \frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b} \right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.1: 2020

KEY

	Action Proponent Provided Information	
	NMFS Provided Information (Technical Guidance)	
	Resultant Isopleth	

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE

PROJECT/SOURCE INFORMATION

Please include any assumptions

PROJECT CONTACT

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directly.
However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (L_{rms})		
Source Velocity (meters/second)		
Pulse Duration (seconds)		
1/Repetition rate^ (seconds)		
Duty Cycle	#DIV/0!	
Source Factor	#DIV/0!	

‡Methodology assumes propagation loss of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

D2: ALTERNATIVE METHOD† (SINGLE PING/PULSE EQUIVALENT)

Source Level ($L_{E,p, single ping/pulse}$)		
Source Velocity (meters/second)		
1/Repetition rate^ (seconds)		
Source Factor	#DIV/0!	

†Methodology assumes propagation loss of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f₁	0.2	8.8	12	1.9	0.94
f₂	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b}\right\}$$

E: STATIONARY SOURCE: Impulsive, Intermittent

KEY

Action Proponent Provided Information			
NMFS Provided Information (Technical Guidance)			
Resultant Isopleth			

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE

PROJECT/SOURCE INFORMATION

Please include any assumptions

PROJECT CONTACT

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)ᵛ

ᵛ Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 72), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either E1 OR E2 method to calculate isopleths (not required to fill in sage boxes for both)

E1: METHOD TO CALCULATE PK AND SELcum (USING RMS SPL SOURCE LEVEL)

SELcum		PK	
Source Level (L_{rms})		Source Level ($L_{p,0-pk}$)	
Activity Duration (hours) within 24-h period			
Pulse Duration△ (seconds)			
1/Repetition rate^ (seconds)			
Duty cycle	#DIV/0!		
Duration of Sound Production (seconds)	#DIV/0!		
10 Log (duration of sound production)	#DIV/0!		
Propagation loss			

△Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005
^Time between onset of successive pulses.

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RESULTANT ISOPLETHS* | *Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SELcum Threshold	183	185	155	185	203
PTS SELcum Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	NA	NA	NA	NA	NA

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

E2: ALTERNATIVE METHOD TO CALCULATE PK AND SELcum (SHOT/PULSE EQUIVALENT)

SELcum		PK	
Source Level ($L_{E,p,single\ ping/pulse/shot}$)		Source Level ($L_{p,0-pk}$)	
Activity Duration (hours) within 24-h period			
Number of pulses in 1-h period			
Propagation loss			
Number of pulses in 24-h period	0		
10 log (number of pulses)	#NUM!		

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS* | *Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SELcum Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	NA	NA	NA	NA	NA

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent)

VERSION 2.1: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE

PROJECT/SOURCE INFORMATION

Please include any assumptions

PROJECT CONTACT

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

**Weighting Factor Adjustment (kHz)*

* Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 75), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either E1-1 OR E.1-2 method to calculate isopleths (not required to fill in sage boxes for both)

E.1-1: METHOD TO CALCULATE PK AND SEL$_{cum}$ (USING RMS SPL SOURCE LEVEL)

SEL$_{cum}$			PK	
Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B35)			$L_{p,0-pk}$ specified at "x" meters (Cell G29)	
Number of piles per day			Distance of $L_{p,0-pk}$ measurement (meters)	
Strike (pulse) Duration^A (seconds)			$L_{p,0-pk}$ Source level	#NUM!
Number of strikes per pile				
Duration of Sound Production (seconds)	0			
10 Log (duration of sound production)	#NUM!			
Transmission loss				
Distance of sound pressure level measurement (meters)				

^{A}Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS* *Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

	Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
	SEL$_{cum}$ Threshold	183	160	155	185	203
	PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
"NA": PK source level is < to the threshold for that marine mammal hearing group.	PK Threshold	219	214	202	218	232
	PTS PK Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

E.1-2: ALTERNATIVE METHOD TO CALCULATE PK AND SEL$_{cum}$ (SINGLE STRIKE EQUIVALENT)

Unweighted SEL$_{cum}$ (at measured distance) = SEL$_{ss}$ + 10 Log (# strikes)	#NUM!			

SEL$_{cum}$			PK	
Single Strike SEL$_{ss}$ ($L_{E,p, single strike}$) specified at "x" meters (Cell B55)			$L_{p,0-pk}$ specified at "x" meters (Cell G52)	
Number of strikes per pile			Distance of $L_{p,0-pk}$ measurement (meters)	
Number of piles per day			$L_{p,0-pk}$ Source level	#NUM!
Transmission loss				
Distance of single strike SEL$_{ss}$ ($L_{E,p, single strike}$) measurement (meters)				

RESULTANT ISOPLETHS* *Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

	Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
	SEL$_{cum}$ Threshold	183	185	155	185	203
	PTS Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
"NA": PK source level is < to the threshold for that marine mammal hearing group.	PK Threshold	219	230	202	218	232
	PTS PK Isopleth to threshold (meters)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

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KEY

	Action Proponent Provided Information	
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STEP 1: GENERAL PROJECT INFORMATION

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Please include any assumptions

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STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)*

* Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 71), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either F1 OR F2 method to calculate isopleths (not required to fill in sage boxes for both)

F1: METHOD‡ TO CALCULATE PK and SEL$_{cum}$ (USING RMS SPL SOURCE LEVEL)

SEL$_{cum}$			PK	
Source Level (L_{rms})			Source Level ($L_{p,0-pk}$)	
Source Velocity (meters/second)				
Pulse Duration^ (seconds)				
1/Repetition rate^ (seconds)			NOTE: The User Spreadsheet tool provides a means to estimates distances associated with	
Duty Cycle	#DIV/0!		the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements	
Source Factor	#DIV/0!		associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered	
‡Methodology assumes propagation loss of 20 log R; Activity duration (time) independent			Species Act (ESA) consultation or permit are independent management decisions made in the	
^Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005			context of the proposed activity and comprehensive effects analysis, and are beyond the scope	
^Time between onset of successive pulses.			of the Technical Guidance and the User Spreadsheet tool.	

RESULTANT ISOPLETHS* — *Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

	Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
	SEL$_{cum}$ Threshold	183	185	155	185	203
	PTS SEL$_{cum}$ Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
"NA": PK source level is < to the threshold for that marine mammal hearing group.	PK Threshold	219	230	202	218	232
	PTS PK Isopleth to threshold (meters)	NA	NA	NA	NA	NA

F2: ALTERNATIVE METHOD† TO CALCULATE PK and SEL$_{cum}$ (SINGLE SHOT/PULSE EQUIVALENT)

SEL$_{cum}$			PK	
Source Level ($L_{E,p, single ping/pulse/shot}$)			Source Level ($L_{p,0-pk}$)	
Source Velocity (meters/second)				
1/Repetition rate^ (seconds)			NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the	
Source Factor	#DIV/0!		Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated	
†Methodology assumes propagation loss of 20 log R; Activity duration (time) independent			with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA)	
^Time between onset of successive pulses.			consultation or permit are independent management decisions made in the context of the proposed	
			activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance	
			and the User Spreadsheet tool.	

RESULTANT ISOPLETHS* — *Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

	Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
	SEL$_{cum}$ Threshold	183	185	155	185	203
	PTS SEL$_{cum}$ Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
"NA": PK source level is < to the threshold for that marine mammal hearing group.	PK Threshold	219	230	202	218	232
	PTS PK Isopleth to threshold (meters)	NA	NA	NA	NA	NA

WEIGHTING FUNCTION CALCULATIONS

	Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
	a	1	1.6	1.8	1	2
	b	2	2	2	2	2
	f_1	0.2	8.8	12	1.9	0.94
	f_2	19	110	140	30	25
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	Adjustment (-dB)†	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$