

# BERWICK BANK WIND FARM OFFSHORE ENVIRONMENTAL IMPACT ASSESSMENT

## APPENDIX 10.1, ANNEX D: NOTE ON USE OF IMPULSIVE SOUND THRESHOLDS AT LARGE RANGES

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## CONTENTS

1. Discussion.....	1
2. References.....	1

## 1. DISCUSSION

1. For any sound of a given amplitude and frequency content, impulsive sound has a greater potential to cause auditory injury than a similar magnitude non-impulsive sound (Southall et al., 2007; 2019; NMFS, 2018). For highly impulsive sounds such as impact piling, unexploded ordnance (UXO) detonations and seismic source arrays, the interaction with the seafloor and the water column is complex. In these cases, due to a combination of dispersion (i.e., where the waveform elongates), multiple reflections from the sea surface and seafloor and molecular absorption of high frequency energy, the sound is unlikely to still be impulsive in character once it has propagated some distance (Hastie et al., 2019; Martin et al., 2020; B. L. Southall *et al.*, 2019; Southall, 2021). This transition in the acoustic characteristics therefore has implications with respect to which injury thresholds should be used (impulsive vs. non impulsive criteria) and, consequently, the potential range at which injury may occur.
2. This acoustic wave elongation effect is particularly pronounced at larger ranges of several kilometres and, in particular, it is considered highly unlikely that predicted permanent threshold shift (PTS) or temporary threshold shift (TTS) ranges for impulsive sound which are found to be in the tens of kilometres are realistic (Southall, 2021). However, the precise range at which the transition from impulsive to non-impulsive sound occurs is difficult to define precisely, not least because the transition also depends on the response of the marine mammals' ear. Consequently, there is currently no consensus as to the range at which this transition occurs or indeed the measure of impulsivity which can be used to determine which threshold should be applied (Southall, 2021) although evidence for impact pile driving and seismic source arrays does indicate that some measures of impulsivity change markedly within 10 km of the source (Hastie et al., 2019). Additionally, the draft NMFS (2018) guidance suggested 3 km as a transition range, but this was removed from the final document.
3. This is an area of ongoing research and in the meantime, it is considered that any predicted injury ranges in the tens of kilometres are almost certainly an overly precautionary interpretation of existing criteria (Southall, 2021).

## 2. REFERENCES

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