Washington State Department of Transportation

Memorandum

January 3, 2011

TO: Rick Huey

FROM: Jim Laughlin
(206) 440-4643

SUBJECT: Port Townsend Dolphin Timber Pile Removal – Vibratory Pile Monitoring Technical Memorandum.

Underwater Noise Levels

This memo summarizes the vibratory pile removal results measured at the Port Townsend Dolphin project in an effort to collect additional data on underwater noise levels for timber piles. Data was collected during vibratory pile removal at the Port Townsend Ferry Terminal facility on the Olympic Peninsula during the month of December 2010.

Three 12-inch diameter wooden piles were monitored as they were removed as part of the dolphin removal project using and ICE 416 vibratory hammer. No frequency weighting (*e.g.*, A-weighting or C-weighting) was applied to the underwater acoustic measurements presented in this report. Underwater sound levels quoted in this report are in decibels relative to the standard underwater acoustic reference pressure of 1 µPa.

Continuous sounds occur for extended periods with a vibratory hammer. Continuous sounds may disturb whales when they exceed a criterion level of 120 dB RMS, according to current NMFS standards (Southall et al., 2007). The 120 dB RMS criterion has been adopted in the present analysis.

Near Field Measurements

- Underwater noise measurements were collected 16 meters from the piles.
- Three piles were extracted simultaneously with the vibratory hammer.
- Table 1 summarizes the results of the near field measurement location.
- No noise mitigation was used during these vibratory measurements.
- Broadband Root Mean Square (RMS) noise levels are reported in terms of the 30-second average continuous sound level and have been computed from the Fourier transform of pressure waveforms in 30-second time intervals.
- Average RMS values ranged from 149 to 152 dB RMS with an overall average RMS value of 150 dB RMS.

Figure 1: Location of the noise monitoring and pile locations at the Port Townsend Ferry Terminal.

Table 1: Summary Table of Underwater Monitoring Results.

Pile #	Hydrophone Depth	Distance To Pile (feet)	Absolute Peak (dB)	Average RMS Value (dB)
1	17 feet (midwater)	52	164	150

The results of Table 1 shows average RMS values around 150 dB RMS. Average RMS values are appropriate for continuous sounds generated during vibratory driving.

Comparison of Wood versus Steel Pile Waveforms

Figures 2 and 3 show the relative differences between the frequencies generated while vibratory driving a 30-inch steel pile into the substrate versus vibratory removal of a 12-inch wood pile. As Figure 2 indicates, there does not appear to be a substantial difference between the frequency content from the two pile types. Figure 3 indicates that the dominant frequencies for both pile types are between 20 Hz and 25 Hz, which is consistent with measurements recorded in other locations (Burgess and Blackewell, 2003). The amplitude of the frequencies above 80 Hz are generally driving the steel pile higher than the frequencies from the removal of the wood pile. However, these differences are not considered significant.

The higher frequencies above 80 Hz contribute to the overall sound levels for driving the steel pile which are 25 to 30 dB higher than for the removal of the wood pile.

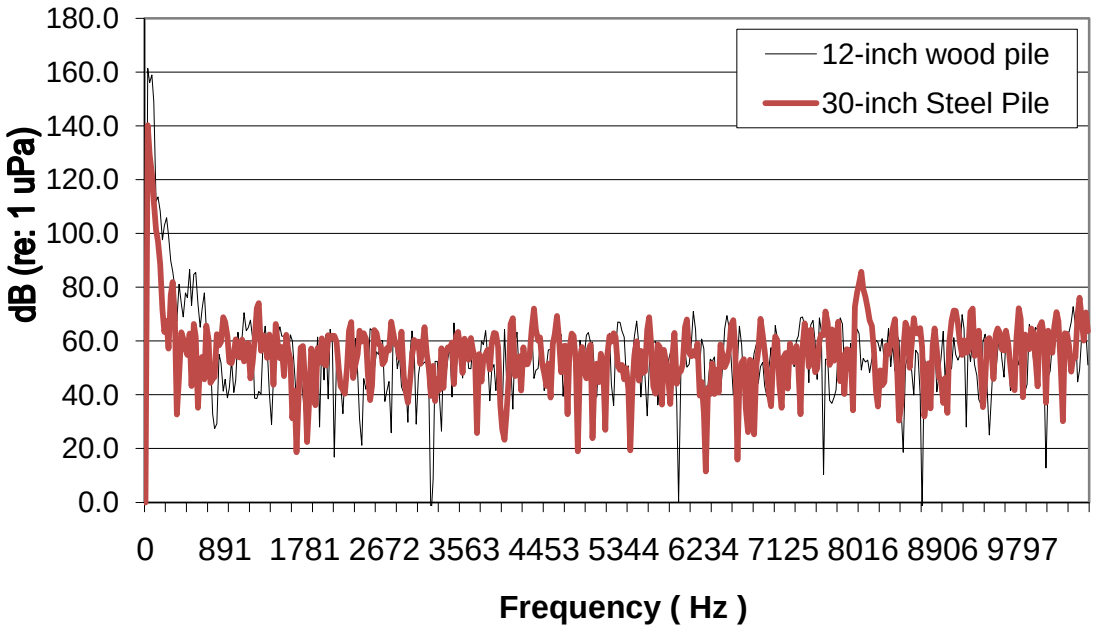

Figure 2: Comparison of Spectral Density Plot for 30-inch vibratory driving of 30-inch steel pile versus a 12-inch wood pile being vibed out.

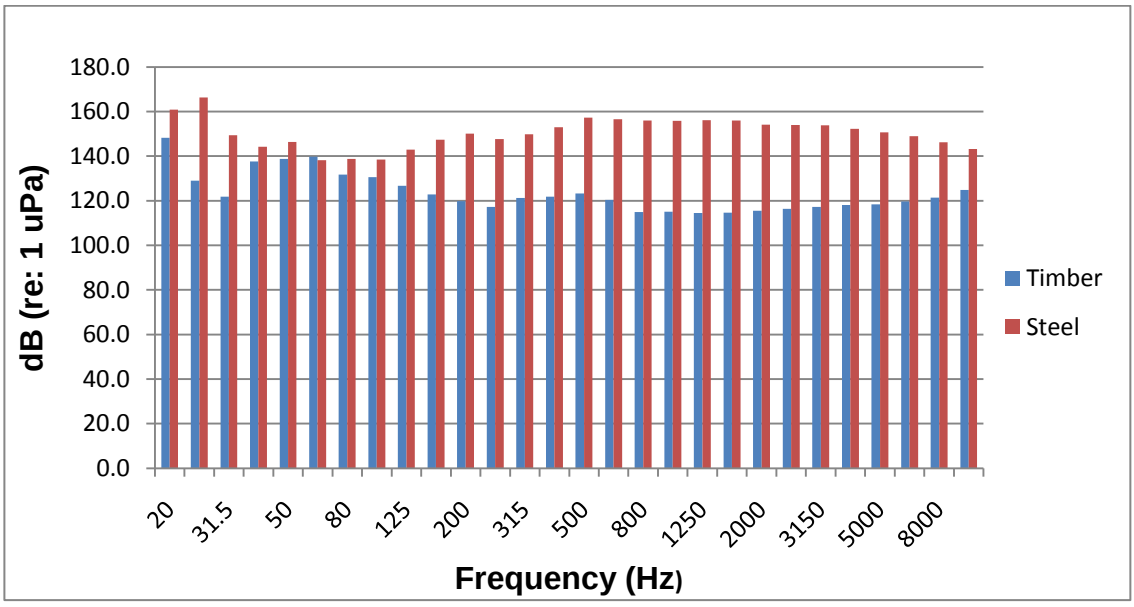

Figure 3: Comparison of vibratory sound levels from vibrating a steel pile in versus vibrating a timber pile out.

Conclusions

Near field measurements were taken at the Port Townsend Ferry terminal during vibratory removal of wood piles. Average RMS values for vibratory removal of the wood piles

measured at the near field location were 150 dB RMS re: 1 uPa, which is considerably lower than for vibratory driving of steel piles.

1/3rd octave band frequency analysis indicates that the dominant frequency for both wood and steel piles are between 20 Hz and 25 Hz.

If you have any questions please call me at (206) 440-4643.

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Attachments
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Literature Cited

Burgess, William C. and Susanna B. Blackwell. 2003. Acoustic Monitoring of Barrier Wall Installation at the Former Rhone-Poulenc Site, Tukwila, Washington. Greeneridge Report 290-1.

Southall, Brandon L., Ann E. Bowles, William T. Ellison, James J. Finneran, Roger L. Gentry, Charles R. Greene Jr., David Kastak, Darlene R. Ketten, James H. Miller, Paul E. Nachtigal, W. John Richardson, Jeanette A. Thomas, and Peter L. Tyak. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, Volume 33(4).