Underwater Sound Levels Associated with Driving Steel Piles for the State Route 520 Bridge Replacement and HOV Project Pile Installation Test Program

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Airborne Noise Measurements

Sound from a single source (i.e., a "point" source) radiates uniformly outward in a spherical pattern as it travels away from the source. The sound level typically attenuates (or drops off) at a rate of six dBA for each doubling of distance.

Usually the noise path between the source and the observer is very close to the ground. Noise attenuation from ground absorption and reflective wave canceling adds to the rate of attenuation. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is done for simplification only; for distances of less than 300 feet, prediction results based on this scheme are sufficiently accurate. For acoustically "hard" sites (i.e., sites with a reflective surface, such as a parking lot or a smooth body of water, between the source and the receiver), no excess ground attenuation is assumed. For acoustically absorptive or "soft" sites (i.e., sites with an absorptive ground surface, such as soft dirt, grass, or scattered bushes and trees), an excess ground attenuation value of 1.5 dBA per doubling of distance is normally assumed.

Noises generated from construction activities are considered point sources, rather than a line source such as a freeway or roadway. The area around the Alviso Pedestrian Bridge is heavily vegetative and would be considered a "soft" site. The combination of these two creates a drop off rate of 6 to 7.5 dB per doubling distance. The formula for calculating the drop off is the source level plus $10*\text{Log}_{10}(D_1/D_2)$, where D_1 is the reference position and D_2 is the receiver position. For example if a impact pile driver has a reference level of 113 dBA at 50 feet the noise level at 500 feet would be calculated as follows for conditions where excess attenuation is not anticipated:

Received level = 113dBA +20Log$_{10}$*(50/500) dBA*

Received level =113+(-20) dBA

Received level = 93 dBA

Various descriptors are used to characterize noise levels, depending on the noise source and environment. The Department *Traffic Noise Analysis Protocol* (TNAP) and the *Technical Noise Supplement* (TeNS) contain explanations of the noise descriptors normally associated with traffic noise. Common descriptors used in environmental noise studies evaluating airborne noise are shown in Table 10.

The L_{eq} Noise descriptor is primarily used when the noise source is non-impulsive or a more steady noise. The $L_{eq(h),}$ the worst noise hour, is routinely used by the most State Departments of Transportation and the Federal Highway Administration to address impacts of highway noise on surrounding areas. The L_{max} noise descriptor is generally the most appropriate descriptor to use when discussing impulsive noise impacts, such as from pile driving. Construction noise is generally shorter in duration and the sound are more impulsive, such as with pile driving. The signal from pile driving is very short in duration and is not accurately characterized by averaging the source over a period of time. The L_{max} is the instantaneous highest level measured. Unlike the L_{eq} the Lmax does not have a time constant attached to it.