

Date June 18, 2012

ENVIRON Project: 29-27143A

## MEMORANDUM

To: Nick Wobbrock, Brown and Caldwell  
From: Kristen Wallace, ENVIRON International Corporation  
Subject: Lake Oswego - Tigard Water Partnership (LOTWP)  
Noise Study and Summary of Potential Noise Mitigation for Willamette Boring  
Entrance Activities, West Linn, OR

---

ENVIRON International Corporation (ENVIRON) was asked to assess potential noise mitigation measures from horizontal directional drilling (HDD) activities at a portal site near West Linn's Mary Young Park. The HDD activities are associated with the Lake Oswego - Tigard Water Partnership Project. This memo provides a summary of our findings regarding construction equipment sound levels and potential mitigation measures.

In addition to assessing noise associated with the HDD activities near the park, ENVIRON was also asked to consider potential mitigation measures for noise from related nighttime construction activities along Highway 43. These assessments are considered separately below.

## HDD Noise Assessment

The following information is based on HDD equipment/layout provided by Staheli Trenchless (as shown in attached **Figure 1**). Although the equipment selection and layout have not been finalized, the available information is considered sufficiently representative of expected construction conditions for use in considering noise effects and possible mitigation.

### Equipment Sound Levels

Proposed equipment sound level limits are displayed in **Table 1**. Each piece of equipment listed in the table would be expected to operate at the HDD entrance site.

In addition to the equipment listed in **Table 1**, ENVIRON also considered the noise from the addition of trucks traveling on Mapleton Drive. Staheli Trenchless provided estimated truck volumes to ENVIRON for use in the noise assessment. During typical boring operations, 12 ADT would be expected during a 10-hour construction day, resulting in less than 2 trips per hour on average. During pullback, as many as 144 ADT could occur over a 24-hour period. Thus pullback would translate to up to about 6 trips (3 round trips) per hour on Mapleton Drive. Pullback would only occur for a 24 to 48 hour period, so the peak levels would be short-lived, and much of the time there would be far fewer trucks a day.

**Table 1. Equipment Sound Levels (dBA)**

Equipment	Sound Power Level (dBA)	Approx. Sound Pressure Level at 50 feet (dBA)	Approx. Distance to Nearest Residence (ft)
<b>Constant or Common Noise Sources</b>			
Quiet Drill Rig	104 <sup>(1)</sup>	69	65
Generator	103 <sup>(2)</sup>	68	85
Soil Separation Plant (SSP)	111 <sup>(2)</sup>	76	120
SSP Engine	99 <sup>(3)</sup>	64	120
Small Excavator/Loader	100 <sup>(6)(7)</sup>	62	110
Idling Dump Truck	102 <sup>(6)(7)</sup>	64	100
Mud Pumps (2)	104 <sup>(4)</sup>	69	100
Mud Sump Pump	100 <sup>(2)</sup>	66	80
Welders (2)	99 <sup>(5)</sup>	65	100
<b>Short-Term or Intermittent Equipment Noise</b>			
Crane	116 <sup>(6)</sup>	82	70
Vactor Truck	123 <sup>(6)</sup>	88	90
<b>Data Sources and Notes:</b>			
(1)	Based on sound level data for a Caterpillar C-15 engine as described in Section 4.5 of the <i>Whittier Main Oilfield Project Draft EIR</i> , October 2010. This sound level assumes use of a central generator type drilling rig, with the generator in a soundproofed enclosure with appropriate grade muffler system.		
(2)	Provided by Staheli Trenchless for typical equipment (memorandum attached).		
(3)	Based on sound level data for MQ Power's WhisperWatt 400 kVA (511 hp) generator		
(4)	Based on sound level data for mud pumps and a Caterpillar C-15 engine as described in Section 4.5 of the <i>Whittier Main Oilfield Project Draft EIR</i> , October 2010.		
(5)	Based on sound level data for Lincoln Vantage 400 or 500 welders available in Europe. If quiet welders are not available in this region, then temporary barriers can be used to achieve the recommended sound pressure levels at 50 feet.		
(6)	Based on ENVIRON archived equipment sound level data for typical equipment		
(7)	The excavator and idling truck are expected to operate less than 50% of the time.		

**Predicted Levels at Nearest Residences**

ENVIRON estimated construction noise levels near the Mary Young Park portal at the nearest residences using the CadnaA noise model. CadnaA is a sophisticated computerized noise modeling tool that calculates sound levels at distant locations using sound propagation factors as adopted by ISO 9613.<sup>(1)</sup> Factors considered include the effects of distance, topography, intervening buildings, atmospheric conditions, vegetation, and ground types.

ENVIRON also considered noise from trucks traveling on Mapleton Drive using the CadnaA TNM module, which applies the same algorithms and vehicle noise emission data used by the FHWA Traffic Noise Model (TNM), a standard vehicle noise modeling tool.

<sup>(1)</sup> ISO is the International Standards Organization that has established numerous standard calculational procedures for things such as conducting noise measurements as well as computing noise attenuation through the atmosphere.

Using the equipment sound levels displayed in **Table 1**, the noise modeling considered both constant and intermittent construction noise sources as described below.

**Constant Noise Sources** – With the constant and/or common noise sources (including average truck trips), the model-estimated sound levels at the three nearest residences north of the portal range from 63 to 68 dBA (Figure 1, attached). The dominant facility noise sources at these residences are the drill rig power unit, the generator, and the SSP.

The model-estimated sound levels at the two nearest residences west of the portal are 61 and 69 dBA, with the SSP as the dominant noise source.

Although construction noise is exempt from the noise limits during daytime hours, residents would be exposed to the fairly constant construction noise levels for several months. Therefore, several mitigation measures were considered.

**Short-term/Intermittent Noise Sources** – Short-term and/or intermittent noise sources include the crane and vactor truck. The crane would operate for brief periods approximately 12 times a day or less when lifting a new pipe onto the drill rig or moving items around the site. The vactor truck would be used minimally, and mostly to respond to emergency situations. It is expected that the vactor might be used less than once a week for an hour.<sup>2</sup>

The model-calculated sound levels at the nearest residences north of the portal range from 62 to 79 dBA due to the crane, and from 66 to 77 dBA due to the vactor truck. At the residences west of the portal, the modeled sound levels range from 61 to 67 dBA due to the crane, and 68 to 76 dBA due to the vactor truck.

**Pullback Noise Sources** – During pullback, the same noise sources identified above for constant noise sources would be used. The number of truck trips, however, could be as high as 6 trips an hour (3 round trips per hour), and the activities would continue during nighttime hours. Even with the higher number of truck trips, the model-calculated sound levels at the nearest residences remain virtually the same as under the constant noise scenario above. This occurs because HDD-related sources other than trucks would dominate the overall sound levels.

### **Potential Mitigation Measures**

To limit the potential effect of construction-related noise at the residences near the HDD portal site, ENVIRON considered several noise mitigation measures. The first three mitigation measures listed below were included in the noise modeling. The other mitigation measures listed can be considered part of a best management practice plan.

- Constructing a 16-foot tall noise wall around the perimeter of the portal site. The truck/equipment entrance on the west side of the site would not require a barrier.
- Enclosing the soils separation plant (SSP) to the extent feasible. This would likely entail an enclosure lined with sound absorbent material, with a small opening for material to drop into the muck bucket. In addition, the screens should be constructed of resilient materials. Examples of resilient screens include Flowmax, Screentek, or Norris polyurethane screens. Because rock falling into the muck buckets and dump trucks could also produce noise, consideration should be given to the feasibility of using HDPE

---

<sup>2</sup> Usage information provided by Staheli Trenchless.

muck buckets/dumpsters (and possibly HDPE dump truck beds) to reduce the sound of rock-on-metal impact noise.

- If a crane is used instead of a quieter truck hoist, equip the crane with a "residential" or "critical" grade silencer on the exhaust and ensure all doors to engines be kept intact and closed. This could achieve approximately 5-dBA of noise reduction from the crane.
- Using acoustical blankets, pads, and/or boards to control metal-on-metal clanging noise that can occur while picking up drill pipe or casing and setting on racks; moving the drill pipe or casing from pipe racks, and making up the drill pipe or casing.
- Where feasible, any additional generators, engines, and pumps not identified in **Table 1** should be specified as having a sound level of 85 dBA or less at 3 feet. This level of control would likely require the equipment be provided or housed in enclosures, that the enclosure doors be kept closed during operation, and also could necessitate use of "residential" or "critical" grade stack silencers. Where this is not feasible, or where additional noise reduction is warranted, use portable noise barriers around smaller pieces of equipment (e.g., pumps, generators).
- Give advance notice to nearby residents of the time periods when particularly noisy work will be occurring. Particularly noisy work could include the installation of the conductor casing and installation of a "deadman" anchor. Installation of the conductor casing is expected to be the noisiest short-term activity and would entail use of a pneumatic hammer. The crew would drive the casing with the hammer for one hour and then weld for six hours. The casing installation is expected to take up to three days.
- Notify the public of upcoming nighttime construction activities (e.g., pullback).
- Potentially offer to relocate the nearest residents during nights when construction activities would occur (e.g., during pullback) or during days with particularly noisy daytime activities (e.g., casing installation).
- Install broadband, ambient-sensing backup alarms on all on-site equipment requiring backup indicators.

### **Modeled Sound Levels With Noise Mitigation**

**Constant Noise Sources** – With the first two mitigation measures identified above, the model-calculated sound levels of constant noise sources at the three nearest residences north of the portal site range from 55 to 61 dBA, a reduction of 7 to 9 dBA from the levels modeled with no mitigation. This reduction is primarily due to the 16-foot tall perimeter noise wall.

With the same two mitigation measures as above, the model-calculated levels at the two nearest residences west of the portal site range from 58 to 66 dBA, a reduction of 3 dBA from the levels modeled with no mitigation. The mitigation is less effective at locations west of the portal site because the primary noise source is the SSP, and the perimeter noise wall would not be effective at reducing the levels of the SSP west of the site.

With the proposed layout, a noise wall just west of the SSP would not be possible, due to the need for regular access with a small excavator to empty the muck buckets located on the west side of the SSP. The SSP would have to be moved to an alternate location (e.g., onto West Linn's pump station site) in order to be able to more effectively mitigate the noise from it (i.e., construct a noise wall on the west side of it). Relocating the SSP was *not* considered in this assessment because it is uncertain if it is a feasible option. If the City requested this option be considered and it was deemed feasible, however, ENVIRON would recommend relocating the

SSP to the West Linn pump station site to allow for effective noise mitigation to be implemented for this source.

**Short-term/Intermittent Noise Sources** – Construction of a 16-foot high perimeter noise wall and installation of a silencer on the crane's exhaust stack would reduce noise from the intermittent sources.

At residences north of the portal site with the mitigation identified above, the model-calculated sound levels of the crane range from 51 to 60 dBA and of the vactor truck range from 62 to 68 dBA. The model-calculated reductions in crane noise levels exceed 10 dBA with the mitigation identified, which would be considered a substantial reduction. The reductions in vactor noise, would range from 5 to 6 dBA, a noticeable reduction in noise.

At residences west of the portal site, the model-calculated sound levels of the crane range from 56 to 62 dBA, a reduction of 5 dBA due to the installation of an exhaust stack silencer. The perimeter wall is not effective at reducing this source at receivers on the hillside west of the site. Model-calculated levels of the vactor truck range from 65 to 72 dBA, a moderate reduction of 3 to 4 dBA due to the perimeter wall.

**Pullback Noise Sources** – Sound levels during pullback, with implementation of the mitigation measures identified above, would be virtually the same as identified for constant noise sources. However, pullback activities would occur during both daytime and nighttime hours over a period of one or two days. To reduce the potential for sleep disturbance, the project owner could offer to temporarily move the nearest residents to a hotel during this activity.

## Highway 43 Nighttime Construction Noise

As part of the project, pipe will need to be installed in Highway 43. This activity will be conducted during nighttime hours (i.e., between 8 PM and 5 AM) to avoid conflicts with traffic on the state highway.

Equipment expected to be used as part of the nighttime construction includes the following:

- Excavator with backup alarms
- Jackhammer (if necessary to remove remnant concrete panels)
- Dump truck with backup alarms
- Welder
- Compactor with backup alarms
- Paver with backup alarms
- Generator
- Compressor
- Construction Lighting (with generators)

The equipment identified above would not all operate simultaneously. For example, the excavator would first dig a trench and fill a waiting dump truck. If necessary, a jackhammer might occasionally be needed to break up remnants of old concrete panels under the asphalt. Next, the excavator would lift and place the pipe in the open trench, which would then be welded. Finally, a compactor and paver would be used to repave the highway. A generator, compressor, and construction lights also might need to run fairly continuously throughout much of the construction. These activities and equipment would advance approximately 50 to 100 feet along the highway during each night of construction.

The houses nearest the nighttime construction are approximately 50 feet from the proposed activities and equipment. However, these locations would not be that close to the construction activities for more than one or two nights after construction activities would have advanced further down the highway, and construction noise levels would substantially decrease.

Regardless, even one or two nights of exposure to the nearest construction activities could affect the nearest residences, and noise mitigation measures should be considered and applied. Therefore, the following list of noise mitigation measures is suggested, where feasible:

- Use ambient-sensing, broadband backup alarms in lieu of pure tone, single-level alarms. Or use flaggers/observers in lieu of backup alarms.
- Restrict the dumping of materials onto the ground, especially metallic or other hard materials. When possible, move/place materials with a crane or excavator rather than by dumping. This restriction does not apply to the dumping of dirt into dump trucks.
- Minimize banging tailgates, pipe noise, etc. with procedural methods or with the use of rubber gaskets.
- Conduct jackhammer usage within a noise tent.
- Minimize idling of heavy mobile equipment and dump trucks. Turn off trucks or equipment when not in active use.
- Place stationary equipment as far from affected residences as possible.
- Use portable noise barriers or enclosures around discrete, stationary equipment. Any barrier or enclosure will need to be designed based on the specific equipment and the placement of the equipment for which noise is to be controlled. However in general terms, barriers should be constructed of materials with a mass of at least 4 pounds per square foot. Typical materials for temporary barriers/enclosures include plywood, lead-weighted curtains or blankets, or acoustic panels. To achieve the required density using plywood it might be necessary to use two sheets attached together. However, something as simple as a properly situated, single-sheet sided plywood box could be effective at reducing noise and could be easily installed. A lead-weighted vinyl blanket could be installed on a structure (e.g., a chain link fence) or draped on equipment to form a noise barrier. Acoustic panels are typically constructed of two metal sheets, one perforated, filled with acoustically absorbent material. No matter what material is used, there should be no gaps in the barrier from ground to top, and any walls should be at least a couple of feet taller than the noise-generating part of the equipment being shielded. A full enclosure could reduce noise from an individual source by 20 dBA or more. A partial barrier would be less effective, with reductions more typically in the 5 to 15 dBA range.
- Notify the public of upcoming nighttime construction activities.

### Typical Sound Levels in the Environment and Industry

Thresholds/ Noise Sources	Noise Level (dBA)	Subjective Evaluations	Possible Effects on Humans
Human Threshold of Pain Carrier jet takeoff (50 ft)	140	Deafening  Very Loud  Loud  Moderate  Faint  Very Faint	Continuous exposure to levels above 70 can cause hearing loss in majority of population  Speech Interference  Sleep Interference
Siren (100 ft) Loud rock band	130		
Jet takeoff (200 ft) Auto horn (3 ft)	120		
Chain saw Noisy snowmobile	110		
Lawn mower (3 ft) Noisy motorcycle (50 feet)	100		
Heavy truck (50 feet)	90		
Pneumatic drill (50 feet) Busy urban street, daytime	80		
Normal automobile at 50 mph Vacuum cleaner (3 ft)	70		
Large air conditioning unit (20 feet) Conversation (3 feet)	60		
Quiet residential area Light auto traffic (100 ft)	50		
Library Quiet home	40		
Soft whisper	30		
Slight rustling of leaves	20		
Broadcasting Studio	10		
Threshold of Human Hearing	0		
Note that both the subjective evaluations and the physiological responses are continuous without true threshold boundaries. Consequently, there are overlaps among categories of response that depend on the sensitivity of the noise receivers.			



