CRC TEST PILE PROJECT

Marine Mammal Monitoring Report

May 2011

Columbia River CROSSING

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ACRONYMS

ADA	Americans with Disabilities Act
CRC	Columbia River Crossing
NMFS	National Marine Fisheries Service
RM	river mile
RMS	root mean square
SPL	sound pressure level
USACE	U.S. Army Corps of Engineers

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1. Background

The existing Interstate 5 (I-5) Bridges span the Columbia River between Portland, Oregon, and Vancouver, Washington, at approximately River Mile (RM) 106.5. In February 2011, the I-5 Columbia River Crossing (CRC) Project conducted a geotechnical and sound propagation study within the Columbia River to evaluate the geotechnical and sound propagation characteristics of the project area, provide information necessary for a contractor to design pile installation activities for constructing the new bridges across the Columbia River, and test two types of bubble curtains for impact pile driving sound attenuation. The CRC test pile project installed and then removed a total of six steel piles at typical mid-channel depths of approximately 40 to 50 feet near two proposed pier locations for the new I-5 bridge structures. The test piles were installed and removed over an eight day period from a work barge temporarily anchored at each of the two test locations.

The National Marine Fisheries Service (NMFS) has established interim thresholds for noise exposure to marine mammals for both behavioral disturbance and injury. Pile installation and extraction produce noise levels over those thresholds. Small numbers of California sea lions (*Zalophus californianus*) and Steller sea lions (*Eumetopias jubatus*) were anticipated to be in the project area during installation and removal of the six test piles. CRC monitored the extent of the river determined to be within the underwater disturbance threshold for marine mammals before, during, and after pile installation and removal to comply with the requirements of the Marine Mammal Protection Act Letter of Concurrence (CRC 2010), which included:

- Avoiding disturbance to pinnipeds through visual monitoring of the identified disturbance zone and shut-down of pile installation or extraction prior to a pinniped entering the zone.
- Recording the number, species, and behavior of pinnipeds within or near the disturbance zones.

Hydroacoustic data were collected during the test pile project according to the hydroacoustic monitoring plan developed for the test pile study (CRC 2011a).

To avoid disturbance to seals or sea lions, monitoring zones based on the estimated extent of the disturbance threshold were established and visually monitored during pile installation and extraction. If a pinniped was seen approaching a monitoring zone, pile installation work was stopped and did not resume until the individual(s) passed through the area. This report summarizes the visual monitoring conducted during the installation and removal of the test piles. A detailed description of construction activities for the test pile project is included in the Request for Marine Mammal Protection Act Letter of Concurrence (CRC 2010).

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2. Methods

Methods for monitoring marine mammals were developed through coordination with NMFS and the design and environmental teams at the CRC Project (CRC 2010). A more detailed monitoring plan outlining specific monitoring locations was subsequently developed and provided as a field manual to monitoring biologists (CRC 2011b).

Monitoring biologists met the qualification standards outlined in the LOC (CRC 2010). All monitors attended a 3-hour marine mammal monitoring training session held on February 3, 2011 at Bonneville Dam or had prior sea lion monitoring experience.

To obtain an indication of the level of pinniped activity that might potentially occur during project activities, CRC contacted Robert Stansell (U.S. Army Corps of Engineers [USACE] Fisheries Field Unit) frequently during the project to obtain the numbers and species of sea lions at Bonneville Dam.

2.1 Monitoring Zones

The monitoring, or disturbance, zone consisted of the area where CRC calculated pile installation and extraction to be above the 160 dB disturbance threshold for impulse (impact driving) or the 120 dB disturbance threshold for continuous noise (vibratory installation and extraction). Prior to hydroacoustic data collection, disturbance zones were established based on the worst-case scenario for the extent of underwater sound modeled from impact driving of 24- and 48-inch steel pile using the Practical Spreading Loss Model (CRC 2010). The monitoring zones were adjusted (reduced) based on actual recorded sound pressure levels (SPLs) once the hydroacoustic monitoring data were available. Reduced monitoring zones were used for visual monitoring during the last four days of pile installation (February 16, 17, 18, and 21).

The initial and adjusted monitoring zone radii for the 160- and 120-dB thresholds for impact (impulse) and vibratory (continuous) driving and vibratory extraction, respectively, are shown in Table 2-1. Visual markers were used to mark the extent of monitoring zones. For example, CRC used the raft with hydroacoustic monitoring equipment, located approximately 800 meters up-river of the work barge, as a visual marker for the upstream extent of the adjusted 48-inch impact monitoring zone and the railroad bridge, located approximately 1,300 meters downriver, as a visual marker for the downstream extent. Appendix A provides maps of the initial modeled monitoring zones and the locations where monitoring occurred.

Table 2-1. Initial Radii and Adjusted Radii (in Bold) for Monitoring Zones (meters)

Activity type	Driver type	160 dB (impulse)	120 dB (continuous)
Pile removal	Vibratory	N/A	1,600
24-in steel pipe installation	Impact	858 431[b]	N/A
48-in steel pipe installation	Impact	5,412 746[c] (upstream) 1,113 (downstream)	N/A
24-in and 48-in steel pipe[a] installation	Vibratory	N/A	20,166 (upstream) 8,851 (downstream)

a Sound encountered landforms in both directions before reaching calculated distances. Distances presented are distances to landforms.

b Distances were adjusted based on data from the last 5 re-strikes from a 24-inch steel pile at Location A on the Oregon side of river on 2/14/2011 (Lesnikowski 2011). The re-strikes did not include a bubble curtain or confinement sleeve for noise attenuation. At 431 meters downstream, the noise from impact re-strikes of the 24-inch pile attenuated to 158 dB root mean square (RMS). No data were available for the same location upstream (e.g. no hydrophone was placed at the same distance upstream); however, sound levels measured at the hydrophone 751 meters upstream indicated a higher transmission. To be conservative, 431 meters was used as the adjusted distance both upstream and downstream.

c Distances were adjusted based on first 5 restrikes from 48-inch steel pile at Location A on the Oregon side of river on 2/14/2011 (Lesnikowski 2011). The re-strikes did not include a bubble curtain or confinement sleeve for noise attenuation. At 855 meters downstream, the noise from the re-strikes of the 48-inch pile attenuated to 162.5 dB RMS. Using the 10 meter RMS source value of 190.7 dB and the practical spreading loss model, noise was calculated to attenuate to the 160 dB threshold by 1,113 meters. At 746 meters upstream, the noise from the re-strikes attenuated to 158.9 dB RMS, just below the threshold level.

2.2 Visual Marine Mammal Monitoring

Qualified monitoring biologists were stationed at designated monitoring locations (Appendix A). Monitoring began 30 minutes prior to, during, and 20 minutes following impact or vibratory installation or vibratory removal. At least one monitor was stationed at either end of the relevant disturbance zone and the other monitors were distributed throughout the zone. During vibratory pile driving, there were at least 13 monitors on duty. On the first two days of vibratory pile installation (February 11 and 12, 2011), a biologist monitored the upper extent of the disturbance zone from a boat. After the first two days, the upper extent did not need to be monitored because vibratory installation was complete and the disturbance zones were smaller, so the boat was no longer necessary. During impact pile driving and vibratory removal, where the disturbance zones were smaller, there were at least seven monitors. One monitor was always stationed on the construction barge.

All monitoring occurred during daylight hours when the opposite river bank was visible from each location. Prior to the start of pile installation or extraction, the construction inspector was notified by the lead biologist that no pinnipeds were observed and the 30-minute pre-driving/extraction monitoring period had concluded. When a pinniped was observed approaching the disturbance zone, corresponding to the 160- or 120-dB thresholds, as appropriate, work was delayed until the animal was observed leaving the disturbance zone.

Biologists monitored by scanning the water surface within line of sight using high-quality binoculars (8 or 10 power magnification) and spotting scopes. Monitoring biologists were also equipped with the CRC Test Pile Project Marine Mammal Monitoring Field Manual, data forms and daily monitoring maps (on Rite In The Rain® paper), and a radio and back-up cell phone for maintaining contact with other monitors and the lead biologist.

2.3 Shutdown Procedure

Pile driving and removal shutdown was required if any marine mammal entered or approached the disturbance zones corresponding to the 160- and 120-dB thresholds. Activities did not resume until the lead biologist advised the construction inspector that the animal had moved beyond the disturbance zone radius, either through sightings by the monitoring team or waiting the required time period to allow the animal to move beyond the disturbance zone. If visual contact with a pinniped in or near the disturbance zone was lost, the lead biologist allowed for the specified time period to elapse before alerting construction personnel that the animal had likely left the zone. Based on the type of pile installation and removal that was conducted, required elapsed times from last sighting varied as follows:

- For impact pile driving of 24-in piles, elapsed time required was 11 minutes;
- For impact pile driving of 48-in piles, elapsed time required was 67 minutes;
- For vibratory installation of all piles, elapsed time required was 180 minutes; and
- For vibratory removal of any piles, elapsed time required was 20 minutes.

These elapsed times were based on a calculation of the likely transit speed of 6 miles per hour, which is the approximate average speed of sea lions tracked between Bonneville Dam and Astoria, OR, over the past several years. Likely speeds through the project area may have been faster or slower depending on individual pinnipeds and river currents at the project site.

2.4 Data Recording

CRC conducted marine mammal monitoring on February 11, 12, 14, 15, 16, 17, 18, and 21, 2011. Start and end times varied daily with the construction contractor's schedule.

Each monitor recorded general observations and pinniped sightings on a data form and daily monitoring map. When a pinniped was spotted, monitors recorded the time of the sighting, the location of the sighting, pinniped species (if possible), behavior, direction of pinniped travel, and whether pile driving/extraction was occurring or if the sighting occurred in the pre- or post-monitoring period. A record was also kept of the type of construction that was occurring at the time of the sighting and the time that pile installation or removal began and ended throughout the monitoring period.

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3. Results

A total of approximately 5 hours and 24 minutes of pile installation and extraction occurred over an eight day work period during the test pile project (Table 3-1). Five marine mammals were observed on three different days during the monitoring periods over the course of the test pile study. Two unidentified pinnipeds were observed during a post-monitoring period and two sea lions were observed after a post-monitoring period concluded. One sea lion was observed swimming upriver toward the monitoring zone during pile extraction. Extraction was suspended until this pinniped swam through and out of the monitoring zone. A summary of pile installation and extraction activities, observations of seals or sea lions during the monitoring periods, and work shut-downs is provided in Table 3-2. Details of all sea lions monitored are described subsequently.

Table 3-1. Total Time for Vibratory and Impact Installation and Vibratory Extraction

Pile Size	Activity	Driver Type	Time hours: minutes: seconds
24-in and 48-in	Pile removal	Vibratory	02:04:35
24-in	Impact drive[a]	Impact	00:40:39
48-in	Impact drive[a]	Impact	01:52:43
24-in and 48-in	Vibratory install	Vibratory	00:45:45
	Total Time		5:23:42

a Includes all strikes with or without a confined bubble curtain.

Table 3-2. Summary of Visual Marine Mammal Observations for Each Activity[a]

Date	Pile # /Diam	Activity	Time for Test[c]		Duration Min:Sec	# Marine Mammal Monitors	# Pinnipeds In or Approaching Monitoring Zone			Shut-Down	Animal(s) Entered Monitoring Zone During Activity
			Start	End			30 Minute Pre-Activity	During Activity	20 Minute Post-Activity		
11-Feb	A-1, 24-in	Vibe	12:20	12:30	10:00	15	0	0	2	No	No
		Proof	16:42	16:56	8:28	15	0	0	0	---	
12-Feb	A-4, 48-in	Vibe	9:40	9:50	10:00	13	0	0	0	---	
		Proof	13:05	13:43	31:49	13	0	0	0	---	
14-Feb	A-2, 24-in	Vibe[b]	10:35	10:40	5:00	9	0	0	0	---	
		Impact	12:25	12:35	10:52	9	0	0	0	---	
		Proof	13:35	13:45	10:20	9	0	0	0	---	
	A-1, 24-in	Re-strike	8:55	8:55	0:32	9	0	0	0	---	
		Extract	10:20	10:35	15:00	9	0	0	0	---	
15-Feb	A-4, 48-in	Re-strike	8:40	8:40	0:45	9	0	0	0	---	
		Extract	9:25	11:00	95:00	9	0	0	0	---	
	A-3, 48-in	Vibe[b]	12:40	12:50	10:15	9	0	0	0	---	
		Impact	14:09	14:40	31:02	9	0	0	0	---	
		Proof	15:00	15:10	10:00	9	0	0	0	---	
16-Feb	B-2, 48-in	Vibe[b]	9:50	9:55	5:30	9	0	0	0	---	
		Impact	11:00	11:15	15:41	9	0	0	0	---	
		Proof	11:50	11:59	9:00	9	0	0	0	---	
17-Feb	B-1, 24-in	Vibe[b]	8:30	8:35	5:00	7	0	0	0	---	
		Impact	9:44	10:46	11:26	7	0	0	0	---	
		Proof	10:40	10:50	10:00	7	0	0	0	---	
	A-2, 24-in	Re-strike	13:20	13:20	0:20	7	0	0	0	---	
		Extract	13:40	13:44	4:00	7	0	0	0	---	
18-Feb	A-3, 48-in	Re-strike	8:35	8:35	0:40	7	0	0	0	---	
		Extract	9:43	10:40	57:00	7	0	0	0	---	
	A-4, 48-in	Extract	11:30	11:50	20:00	7	0	0	0	---	
		Re-strike	12:50	12:51	0:57	7	0	0	0	---	
		Extract	13:15	15:15	120:00	7	0	1	0	Yes	No
21-Feb	B-2, 48-in	Re-strike	8:45	8:46	0:45	7	0	0	0	---	
		Extract	9:05	9:25	20:00	7	0	0	0	---	
	B-1, 24-in	Re-strike	10:30	10:30	0:45	7	0	0	0	---	
		Extract	10:50	10:55	5:00	7	0	0	0	---	

a Pile proofing and re-strikes used an impact hammer and no attenuation. Proofing is defined here as driving the pile the last few feet into the substrate to determine the capacity of the pile. Capacity was measured by a Pile Dynamic Analyzer (PDA) placed on each pile. Capacity was verified by counting the number of blows per inch to verify resistance. Piles were restruck at least 48 hours after installation and are identified in this report as “re-strike”. The purpose of the re-strikes was to test structural capacity after the substrate was allowed to reconsolidate after being displaced and disturbed by the pile driving.

b Vibratory hammer used only to set pile in substrate prior to impact driving.

c Start and end times for impact driving are from the Dynamic Pile Measurements and CAPWAP Analysis Report by Robert Miner Dynamic Testing. Start time and end time for vibratory extraction covers the duration of time to physically remove the pile from the riverbed and includes times when vibratory extraction was stopped.

On February 11, 2011, one Steller sea lion, one unidentified sea lion, and one unidentified pinniped were observed. A monitor in the boat observed a Steller sea lion at RM 119 during the post-activity monitoring period at 12:40 p.m. (10 minutes after vibratory pile installation ended) within the vibratory monitoring zone at the zone's farthest upstream extent near Government Island. The direction of travel of this sea lion was not determined and it was not seen again within the monitoring zone. The sea lion appeared to be foraging on a sturgeon. At 12:40 p.m., 10 minutes after vibratory pile installation ended, a second marine mammal was spotted approximately 150 feet upstream of the project barge at RM 106.5 (downstream of the bridges), swimming parallel to I-5 towards the Oregon shore. This animal was confirmed by the monitor on the barge to be a pinniped. The visual observation of this pinniped was not clear enough to make a positive identification to the species level; however, based on the physical description of the animal (approximately 100 pounds, 3 to 4 feet long, dark blue/black in color), it was determined to be too small to be a sea lion and too large to be a river otter or other aquatic mammal, and was therefore conservatively assumed to be a harbor seal. At 1:40 p.m., a third marine mammal (tentatively identified as a sea lion) was spotted from the barge at RM 106.5 immediately downstream of the I-5 bridges, where it appeared to be foraging in the hydraulic shadow of a southbound bridge pier. The third sighting was verified as a marine mammal by another monitor, but positive species identification was not made. This sighting occurred after the post-activity monitoring period and prior to the next pre-activity monitoring period. Therefore, this sighting is not included in Table 3-2. Vibratory installation was not suspended for these sightings because the sightings occurred during or after the 20-minute post-activity monitoring period.

On February 18, 2011, at 2:18 p.m., a Steller sea lion was observed swimming upstream towards the monitoring zone during vibratory extraction. The sea lion was observed at RM 105.3 as it was approaching the downstream edge of the monitoring zone. Vibratory extraction was immediately shut-down. The animal entered the monitoring zone, was observed by each subsequent monitor upstream, and was visually tracked as it swam through the monitoring area. A small project boat also tracked it at an appropriate distance to maintain visual contact. Pile extraction was suspended for 50 minutes between 2:18 pm and 3:08 pm, at which point the sea lion was confirmed leaving the monitoring zone and continuing upstream.

On February 17, a California sea lion was observed swimming upriver toward the monitoring zone (431 meters for impact installation of 24-inch pile) at approximately RM 106 near the railroad bridges as the post-driving monitoring period ended (11:06 a.m.). It swam upstream through the project area and stopped to eat an unidentified fish upriver of the I-5 bridges at RM 106.5. Approximately 69 minutes later at 12:15 p.m., the same sea lion was observed upriver of the monitoring zone at RM 107.5 eating a Chinook salmon. As it ate the salmon, it floated downstream back toward the I-5 bridges. Even though it was outside the monitoring zone, it was monitored to ensure it did not swim back downstream into the monitoring zone for the impact driving (re-strike) that began at 1:20 pm. At 12:40 p.m. near RM 106.7, it finished the salmon, disappeared from view prior to the start of the next pre-activity monitoring period, and was not seen again. Impact pile driving began at 1:20 p.m. following the 30-minute pre-pile driving

monitoring. No sea lions were seen during the pre-monitoring period. It was assumed that the sea lion had continued to swim upstream out of the monitoring zone.

No fish kill associated with construction activities was observed during the course of the test pile work. Monitoring was conducted according to the procedures that had been developed and no gear or other equipment malfunctions occurred. Weather conditions varied from light sun to heavy rain, but did not obscure sight distance or delay monitoring. Wind varied between light and moderate, never exceeding 18 miles per hour (Beaufort Scale 4) during monitoring activities. See Appendix B for project photos.

4. Discussion

4.1 Monitoring Zones

CRC used the disturbance zones originally modeled for the test pile work for the first four days of monitoring. These disturbance zones are described in Section 2.1 and illustrated in Appendix A. However, a limited amount of hydroacoustic data gathered during these first days of test pile work allowed the monitoring zone to be reduced for impact installation of a 48-inch pile on the fifth day (February 15) and a 24-inch pile on the sixth day (February 17), as well as re-strikes that occurred on the last 4 days of work (February 16, 17, 18, and 21). Reducing the monitoring zone allowed monitoring biologists to be stationed directly on the I-5 bridges and improved monitoring efficiency at the project site itself during impact driving. Evaluation of hydroacoustic monitoring data did not support reducing the size of the vibratory installation monitoring zones. No monitoring data were available for extraction; therefore, the size of these zones was not changed.

4.2 Visual Marine Mammal Monitoring

Test pile work was suspended only for the Steller sea lion observed on February 18. Shut-down occurred prior to the Steller sea lion entering the work area and continued until the animal left the monitoring zone. Observation times and locations of the other marine mammals did not necessitate suspending impact driving or vibratory installation or removal. The animal identified as a harbor seal, observed near the work barge at 12:40 p.m. on February 11, was observed swimming in the area approximately 10 minutes after vibratory pile installation had been completed. It is possible that this individual may have been within the disturbance zone, undetected, during vibratory installation. However, monitoring procedures were followed closely at all times.

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5. References

CRC (Columbia River Crossing). 2010. Request for Marine Mammal Protection Act Letter of Concurrence. Prepared by Columbia River Crossing and Parametrix. Portland, Oregon. December 2010.

CRC. 2011a. Columbia River Crossing Test Pile Project Underwater Noise Monitoring Plan. Final plan submitted to the National Marine Fisheries Service. January, 2011.

CRC. 2011b. Interstate 5 Columbia River Crossing 2011 Marine Mammal Monitoring Field Manual. February 2011.

Lesnikowski, N. 2011. Electronic communications from Nicholas Lesnikowski, Lead Hydrographer with David Evans and Associates, to Steve Morrow, CRC Environmental Coordinator. February 13 and 16, 2011.

Miner, R. 2011. Dynamic Pile Measurements and CAPWAP Analysis. Robert Miner Dynamic Testing, Inc. March 23, 2011.

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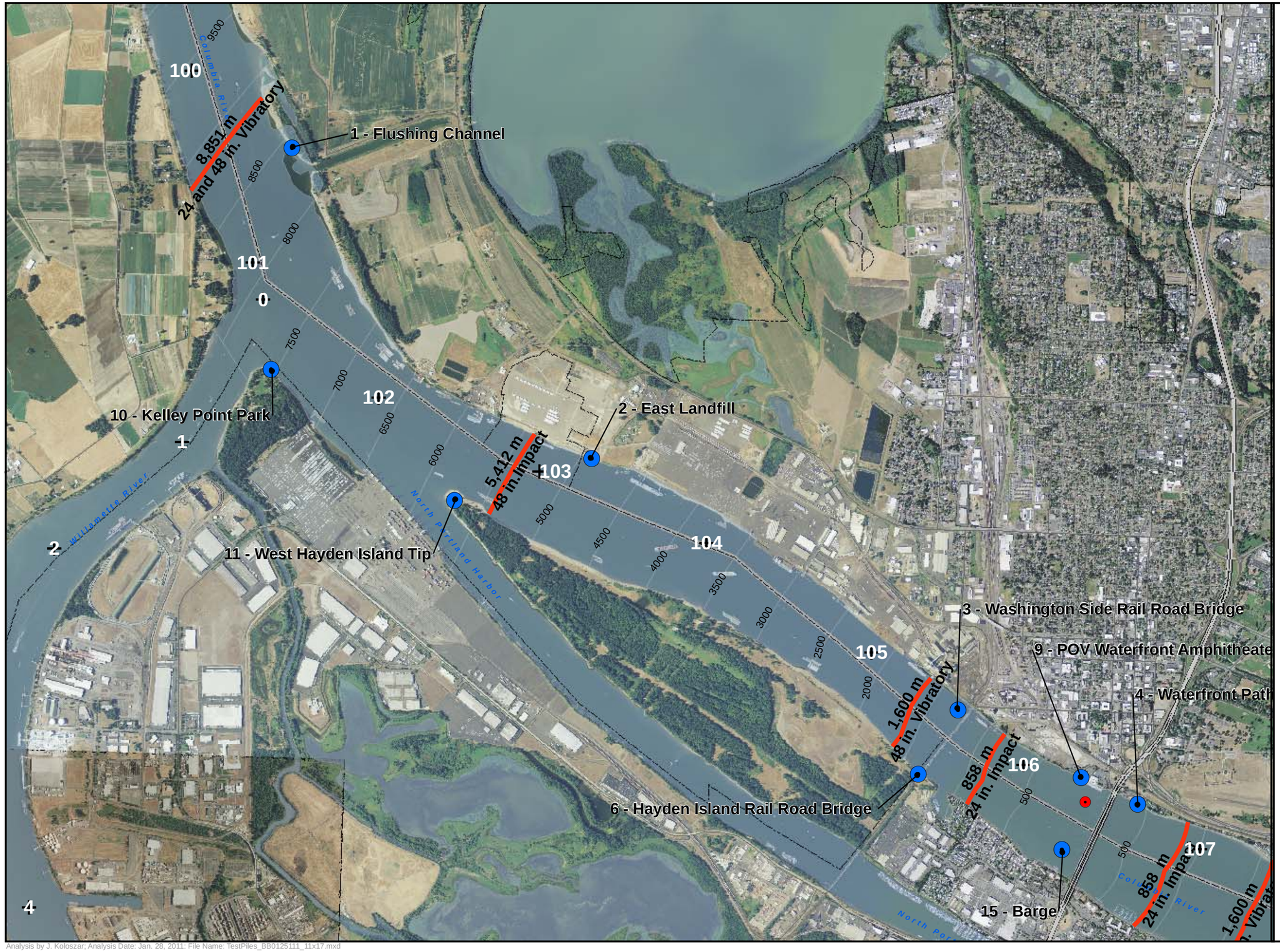
APPENDIX A

Maps

Columbia River Test Pile Project Monitoring Areas



Test Pile Isolines

River Miles

Monitoring Location

Approximate Test Pile Location

500m Isopleths

N

W E

S

0 0.5 1

Miles

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: Jan. 28, 2011: File Name: TestPiles_BB0125111_11x17.mxd

Columbia River Test Pile Project Monitoring Areas

5 - McMenamins'

7 - Marine Park

14 - Government Island Tip

12 - Columbia River Yacht Club

13 - Marine Drive Levee

8 - Columbia Land Trust

17 - Lady Island

16 - Boat

5,412 m 48 in. Impact

20,166 m 24 and 48 in. Vibratory

Columbia River

Test Pile Isolines

River Miles

Monitoring Location

Approximate Test Pile Location

500m Isopleths

N

W E

S

0 1 2

Miles

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: Jan. 28, 2011: File Name: TestPiles_BB0125111_11x17.mxd

APPENDIX B

Monitoring Photos

Photograph 1. Typical view from the I-5 bridge facing downstream toward test pile activities.

Photograph 2. Monitor (shown in yellow) on the work barge scans for marine mammals during vibratory pile activities.

Photograph 3. Boat utilized during marine mammal monitoring.

Photograph 4. Typical view from monitoring point at McMenamins's restaurant (Vancouver), looking downstream towards the I-5 bridge.

Photograph 5. Heightened bird activity while California sea lion feeds on a Chinook salmon on February 17, 2011.

Photograph 6. River otter observed and identified during monitoring activities.

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