APPENDIX B

Backfill Grain-Size Quality Assurance/Quality Control

BACKFILL QA/QC SUMMARY
Boeing DSOA CS2
Boeing Plant 2
Seattle/Tukwila, Washington

This document summarizes the Quality Assurance (QA) and Quality Control (QC) testing conducted for backfill placed during January 2013 through March 2014 at the Duwamish Sediment Other Area and Southwest Bank Corrective Measure and Habitat Project at Boeing Plant 2, Seattle/Tukwila, Washington. The testing was conducted in accordance Section 3.1.1 and Table 1 of the Final Construction Assurance Project Plan (CQAPP), dated December 2012 (AMEC et al. 2012).

Table 1 is a summary of the tests performed on the Sand/Gravel Mixture. The samples were tested for gradation and were compared to the specification Section 02484.2.01.C.2 Sand/Gravel Mixture. A total of approximately 54,625 tons of this material was delivered on 9 separate barges. This represents approximately 33,780 cubic yards (CY) of material. A total of 9 QA/QC samples (1 per 3,750 CY) were taken. This conformed to the minimum frequency of 1 per 5,000 cy as specified in Table 1 of the CQAPP.

Table 2 is a summary of the tests performed on the Fine Gravel Ballast. This material was delivered on 1 barge, for a total of 567 tons (approximately 355 cy). A total of one QA/QC sample (1 per 355 cy) was taken. This conformed to the minimum frequency of 1 per 5,000 CY as specified in Table 1 of the CQAPP. The fine Gravel Ballast gradation met the specified gradation.

In addition 1,481 tons (approximately 925 cy) of 2”-4” spalls were placed along the SW shoreline between approximate stations 26+50 and 32+75 starting at elevation +5’ MLLW and continuing downslope. Spalls were used for slope stabilization during dredging and for the central outfall. Spall gradation was visually verified in the field by QA/QC representatives.

Table 3 is a summary of the analytical results for samples taken from approved backfill sources.

Table 1: Sand and Gravel Mix Grain Size Analysis

Boeing Plant 2 DSOA CS2- QA/QC Summary

Seattle/Tukwila, Washington

Sample ID		Sample Date	SAND / GRAVEL MIX: Percent Passing by Dry Weight (ASTM D422)														
Project ID	Lab Job No.		5"	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
Specified Gradation				100		65-100		25-80		15-60	5-40	0-25	0-10			0-2	
DSOABF-011514-1	XU86	1/15/2014	100.0	100.0	100.0	97.8	70.8	70.8	52.3	46.5	35.5	3.0	0.8	0.6	0.5	0.5	0.4
DSOA-SG-012914-2	XW47	1/29/2014	100.0	100.0	100.0	100.0	81.4	70.2	60.6	55.8	**44.5**	3.3	0.2	0.2	0.0	0.0	0.0
DSOA-FGB-021114-4	XY80	2/11/2014	100.0	100.0	100.0	100.0	77.1	67.8	57.3	51.5	40.1	2.1	0.1	0.1	0.0	0.0	0.0
DSOA-SGB-021114-6	XZ58	2/14/2014	100.0	100.0	100.0	96.6	71.8	56.3	42.9	36.1	24.7	0.7	0.1	0.1	0.1	0.0	0.0
DSOA-SGB-021114-7	XZ98	2/19/2014	100.0	100.0	100.0	94.5	75.5	65.0	55.5	51.2	**41.3**	2.8	0.3	0.1	0.1	0.1	0.0
DSOA-SGB-021114-8	YA49	2/25/2014	100.0	100.0	100.0	100.0	74.7	66.2	55.8	51.1	**42.2**	5.9	1.9	0.9	0.5	0.3	0.3
DSOA-SGB-021114-9	YA95	2/28/2014	100.0	100.0	100.0	100.0	71.8	65.1	54.2	48.8	37.6	2.0	0.3	0.2	0.2	0.2	0.2
DSOA-SGB-021114-10	YB20	3/4/2014	100.0	100.0	100.0	100.0	80.0	74.7	61.9	55.3	**42.2**	3.2	0.7	0.4	0.3	0.3	0.2
DSOA-SGB-021114-11	YB65	3/7/2014	100.0	100.0	100.0	100.0	78.3	73.6	66.3	**60.5**	**46.7**	3.3	0.2	0.1	0.0	0.0	0.0

Percent passing individual sieve size reported by lab.

Sieve required by specifications

Did not meet specification (Approved by Engineer)

Table 2: Fine Gravel Ballast Grain Size Analysis

Boeing Plant 2 DSOA CS2- QA/QC Summary

Seattle/Tukwila, Washington

Sample ID		Sample Date		Fine Gravel Ballast: Percent Passing by Dry Weight (ASTM D422)														
Project ID	Lab Job No.		CY	5"	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
Specified Gradation							100		40-80			5 max.					0-2	
DSOA-FGB-020414-3	XW99	2/4/2014	0-5k	100.0	100.0	100.0	100.0	87.2	42.1	8.9	2.8	0.6	0.6	0.5	0.4	0.4	0.3	0.3

Percent passing individual sieve size reported by lab.

Sieve required by specifications

Table 3

Analytical Results from Backfill Sources Approved for Use in the DSOA Corrective Measure in 2013[1,2]

Analyte	CAS Number	Units	DP-QDU1-13 12/9/2013	JPM-QDU1-13 12/9/2013	Table 3.1 Criteria[3]	Are results below Table 3.1 Criteria?
Polychlorinated Biphenyls (PCBs) by SW8082A						
Aroclor 1016	12674-11-2	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
Aroclor 1242	53469-21-9	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
Aroclor 1248	12672-29-6	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
Aroclor 1254	11097-69-1	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
Aroclor 1260	11096-82-5	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
Aroclor 1221	11104-28-2	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
Aroclor 1232	11141-16-5	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
Aroclor 1262	37324-23-5	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
Aroclor 1268	11100-14-4	µg/kg dry weight	3.9 U	3.9 U	--	Not applicable.
PCBs (Total Aroclors)	1336-36-3	µg/kg dry weight	3.9 U	3.9 U	30	Yes.
Organochlorine Pesticides by 8081B						
Hexachlorobenzene	118-74-1	µg/kg dry weight	0.96 U	0.97 U	22	Yes.
Hexachlorobutadiene	87-68-3	µg/kg dry weight	0.96 U	0.97 U	11	Yes.
Semivolatile Organic Compounds (SVOCs) by 8270D						
Phenol	108-95-2	µg/kg dry weight	18 U	18 U	420	Yes.
1,3-Dichlorobenzene	541-73-1	µg/kg dry weight	18 U	18 U	--	Not applicable.
1,4-Dichlorobenzene	106-46-7	µg/kg dry weight	18 U	18 U	110	Yes.
Benzyl Alcohol	100-51-6	µg/kg dry weight	18 U	18 U	57	Yes.
1,2-Dichlorobenzene	95-50-1	µg/kg dry weight	18 U	18 U	35	Yes.
2-Methylphenol	95-48-7	µg/kg dry weight	18 U	18 U	63	Yes.
4-Methylphenol	106-44-5	µg/kg dry weight	18 U	36	670	Yes.
Hexachloroethane	67-72-1	µg/kg dry weight	18 U	18 U	--	Not applicable.
2,4-Dimethylphenol	105-67-9	µg/kg dry weight	91 U	91 U	29	Yes; use result by 8270DSIM.
Benzoic Acid	65-85-0	µg/kg dry weight	180 U	180 U	650	Yes.
1,2,4-Trichlorobenzene	120-82-1	µg/kg dry weight	18 U	18 U	31	Yes.
Naphthalene	91-20-3	µg/kg dry weight	18 U	18 U	2,100	Yes.
Hexachlorobutadiene	87-68-3	µg/kg dry weight	18 U	18 U	11	Yes; use result by 8081.
2-Methylnaphthalene	91-57-6	µg/kg dry weight	18 U	18 U	670	Yes.
Dimethylphthalate	131-11-3	µg/kg dry weight	18 U	18 U	71	Yes.
Acenaphthylene	208-96-8	µg/kg dry weight	18 U	18 U	1,300	Yes.
Acenaphthene	83-32-9	µg/kg dry weight	18 U	18 U	500	Yes.
Dibenzofuran	132-64-9	µg/kg dry weight	18 U	18 U	540	Yes.
Diethylphthalate	84-66-2	µg/kg dry weight	18 U	18 U	200	Yes.
Fluorene	86-73-7	µg/kg dry weight	18 U	18 U	540	Yes.
N-Nitrosodiphenylamine	86-30-6	µg/kg dry weight	18 U	18 U	28	Yes.
Hexachlorobenzene	118-74-1	µg/kg dry weight	18 U	18 U	22	Yes.
Pentachlorophenol	87-86-5	µg/kg dry weight	91 U	91 U	360	Yes.
Phenanthrene	85-01-8	µg/kg dry weight	18 U	18 U	1,500	Yes.
Anthracene	120-12-7	µg/kg dry weight	18 U	18 U	960	Yes.
Di-n-Butylphthalate	84-74-2	µg/kg dry weight	18 U	18 U	1,400	Yes.
Fluoranthene	206-44-0	µg/kg dry weight	18 U	18 U	1,700	Yes.
Pyrene	129-00-0	µg/kg dry weight	18 U	18 U	2,600	Yes.
Butylbenzylphthalate	85-68-7	µg/kg dry weight	18 U	18 U	63	Yes.
Benzo(a)anthracene	56-55-3	µg/kg dry weight	18 U	18 U	1,300	Yes.
bis(2-Ethylhexyl)phthalate	117-81-7	µg/kg dry weight	45 U	46 U	1,300	Yes.
Chrysene	218-01-9	µg/kg dry weight	18 U	18 U	1,400	Yes.
Di-n-Octyl phthalate	117-84-0	µg/kg dry weight	18 U	18 U	6,200	Yes.

Table 3

Analytical Results from Backfill Sources Approved for Use in the DSOA Corrective Measure in 2013[1,2]

Analyte	CAS Number	Units	DP-QDU1-13 12/9/2013	JPM-QDU1-13 12/9/2013	Table 3.1 Criteria[3]	Are results below Table 3.1 Criteria?
SVOCs by 8270D (continued)						
Benzo(a)pyrene	50-32-8	µg/kg dry weight	18 U	18 U	1,600	Yes.
Indeno(1,2,3-cd)pyrene	193-39-5	µg/kg dry weight	18 U	18 U	600	Yes.
Dibenz(a,h)anthracene	53-70-3	µg/kg dry weight	18 U	18 U	230	Yes.
Benzo(g,h,i)perylene	191-24-2	µg/kg dry weight	18 U	18 U	670	Yes.
1-Methylnaphthalene	90-12-0	µg/kg dry weight	18 U	18 U	--	Not applicable.
Total Benzofluoranthenes		µg/kg dry weight	36 U	36 U	3,200	Yes.
SVOCs by 8270DSIM						
Dibenz(a,h)anthracene	53-70-3	µg/kg dry weight	4.5 U	4.6 U	230	Yes.
1,4-Dichlorobenzene	106-46-7	µg/kg dry weight	4.5 U	4.6 U	110	Yes.
1,2,4-Trichlorobenzene	120-82-1	µg/kg dry weight	4.5 U	4.6 U	31	Yes.
Hexachlorobenzene	118-74-1	µg/kg dry weight	4.5 U	4.6 U	22	Yes.
Hexachlorobutadiene	87-68-3	µg/kg dry weight	4.5 U	4.6 U	11	Yes.
Dimethylphthalate	131-11-3	µg/kg dry weight	4.5 U	4.6 U	71	Yes.
Butylbenzylphthalate	85-68-7	µg/kg dry weight	4.5 U	4.6 U	63	Yes.
2-Methylphenol	95-48-7	µg/kg dry weight	4.5 U	4.6 U	63	Yes.
2,4-Dimethylphenol	105-67-9	µg/kg dry weight	23 U	23 U	29	Yes.
N-Nitrosodiphenylamine	86-30-6	µg/kg dry weight	4.5 U	4.6 U	28	Yes.
Benzyl Alcohol	100-51-6	µg/kg dry weight	18 U	18 U	57	Yes.
Pentachlorophenol	87-86-5	µg/kg dry weight	18 U	18 U	360	Yes.
1,2-Dichlorobenzene	95-50-1	µg/kg dry weight	4.5 U	4.6 U	35	Yes.
1,3-Dichlorobenzene	541-73-1	µg/kg dry weight	4.5 U	4.6 U	--	Not applicable.
Metals by 6010C, 7471A, and SM3500Cr-D						
Arsenic	7440-38-2	mg/kg	5 U	10 U	13.6	Yes.
Cadmium	7440-43-9	mg/kg	0.2 U	0.5 U	<5.1	Yes.
Chromium	7440-47-3	mg/kg	21.2	55	260	Yes.
Hexavalent Chromium	18540-29-9	mg/kg	0.4 U	0.4 U	1.2	Yes.
Copper	7440-50-8	mg/kg	16.3	41	80	Yes.
Lead	7439-92-1	mg/kg	2	5 U	250	Yes.
Mercury	7439-97-6	mg/kg	0.02 U	0.02 U	<0.41	Yes.
Nickel	7440-02-0	mg/kg	25	46	210	Yes.
Silver	7440-22-4	mg/kg	0.3 U	0.7 U	<6.1	Yes.
Zinc	7440-66-6	mg/kg	32.5	42	<410	Yes.

Notes:

-- Criterion not developed or no applicable criterion.

1 Cursory data validation has been completed by Floyd|Snider.

2 Sample DP-QDU1-13 was collected from DuPont Pioneer Aggregates in DuPont, Washington; sample JPM-QDU1-13 was collected from Johns Prairie Mine in Shelton, Washington. Additional information on these facilities, as well as sample collection methodology, is provided in the memorandum *Request for Approval of Quarry Sites for Use in the DSOA and Southwest Bank Corrective Measures* (Floyd|Snider 2012).

3 Table 3.1 criteria are listed in Attachment 3 of the memorandum *Request for Approval of Quarry Sites for Use in the DSOA and Southwest Bank Corrective Measures* (Floyd|Snider 2012).

Abbreviations:

CAS Chemical Abstract System
DSOA Duwamish Sediment Other Area
µg/kg Micrograms per kilogram
mg/kg Milligrams per kilogram

Qualifier:

U Not detected