CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD May 4, 2016

SUBJECT: ANTIDEGRADATION DETERMINATION ON THE SEDIMENT QUALITY OF THE PROPOSED POST-DREDGE SEDIMENT SURFACE TO VERIFY COMPLIANCE WITH THE WASHINGTON STATE ANTIDEGRADATION POLICY FOR THE DUNLAP TOWING DREDGING PROJECT, OLYMPIA, WA.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington State Department of Ecology, Washington State Department of Natural Resources, and the Environmental Protection Agency) regarding the suitability of the exposed sediment surface after maintenance dredging at Dunlap Towing, Olympia, WA.

2. Background. Dunlap Towing is located along the west shore of lower Budd Inlet in Olympia, WA (Figure 1). The project site was reportedly first developed as a lumber mill in 1919, and between 1919 and 1966 operated as a sawmill, veneer plant and stud mill (Kennedy/Jenks, 2012). Also during this time a hog fuel burner operated on the southern boundary of the site with Westbay Marina. The project site is currently used as log sorting and storage yard by Dunlap Towing, and includes a ramp where bundles of logs are dewatered for storage in the upland areas before being loaded onto trucks. Sediments have accumulated in the area surrounding the loading ramp and are impeding the usage of several boat slips at the adjacent Westbay Marina. Dredging is needed to restore the project to authorized depths and to restore access to several boat slips within Westbay Marina.

3. Project Summary. Table 1 includes project summary and tracking information.

Table 1. Project Summary

Project ranking	High
Proposed dredging volume	4,814 CY
Proposed dredging depth	-3 ft MLLW, including 1 ft overdepth
Original SAP approval	February 2012
SAP Addendum submitted	January 5th, 2015
SAP addendum approved	January 14th, 2015
Sampling dates	March 12 – 13th, 2015
	December 1st – 4th, 2015
Draft data report received	May 8th, 2015
Comments provided on draft report	May 14th, 2015
Second draft data report	February 19, 2016
Final data report received	March 30, 2016

EIM Study ID	DUNLA15
USACE Permit Application Number	
Recency Determination (high rank = 3 years)	March 2018

4. Project Ranking and Sampling Requirements. This project was ranked high by the DMMP agencies according to the guidelines set out in the DMMP User Manual for lower Budd Inlet (DMMP 2014). In a high-ranked area the number of samples and analyses are calculated using the following guidelines:
   - Maximum volume of sediment represented by each field sample = 4,000 cubic yards
   - Maximum volume of sediment represented by each analysis in the upper 4-feet of the dredging prism (surface sediment) = 4,000 cubic yards

   This project was divided into two DMMUs (Figure 2) in order to remain within the DMMP's testing requirements specified above. DMMU 1 is the southern-most DMMU, located partially within Westbay Marina and encompassing areas within the boat slips. DMMU 2 is located adjacent to and north of DMMU 1. Each DMMU was proposed to be characterized by a composite of three cores.

5. Sampling. Sampling took place March 12 and 13 aboard the *R/V Mazama*, owned and operated by Gravity Consulting, LLC. The first day of sampling was conducted with a 4 inch vibratory impact corer. Large amounts of fibrous woody debris (see Figure 3) were encountered throughout the site, causing significant difficulty in collecting sediment samples with the vibracorer, which was only able to penetrate 1.5 ft into the sediment. Two samples, DMMU2-C1-3 and DMMU2-C2-2, were collected, composited and archived for the DMMU 2 dredged material sample.

   Following discussions with the DMMP agencies, on the second day of sampling a rotary-impact auger device was used in an attempt to penetrate to the full depth of the dredge prism and into the z-layer. A dredged material sample was collected from DMMU1-C3-2 and archived. After multiple attempts employing different techniques, finally z-samples were obtained by closing off the nose of the auger during drilling. Once the desired depth was reached, the blocker was removed and the sediment sampler was sent down the drill tube. The sampler was hammered past the cutting nose of the auger pipe in order to collect an undisturbed sample from the z-layer (Gravity, 2015b). Using this method, two z-samples were collected, one from DMMU 1 and one from DMMU 2.

   The approved sampling and analysis plan and SAP addendum (Kennedy/Jenks, 2012 and Gravity, 2015, respectively) was followed to the extent possible given the difficult conditions encountered in the field due to the predominance of wood waste throughout the project area. Figure 2 shows the target and actual coring locations. Table 2 gives the sample location coordinates and sample compositing scheme. All decisions regarding changing sampling locations and acceptance of cores was coordinated real-time with the DMMO. The samples collected are deemed representative of the proposed dredged material.

   A second round of sampling was conducted on December 1st – 4th, 2015 in order to characterize the native material located beneath the layer of wood debris. The same technique using the rotary-impact auger was employed to drill down to the bottom of the wood waste layer in DMMU 1 (see Figure 4 for sample location). A sediment sample, C1, was then collected from beneath the wood waste layer.

6. Chemical Analysis. According to DMMP guidelines (DMMP, 2014), if the TVS content is greater than 25% (roughly equivalent to 50% wood waste by volume), then bioassays must be run and passed in order that the DMMU to be eligible for open-water disposal. The applicant opted not to run bioassays due to the high amount of wood waste in the dredge prism, see photos in Figure 3. Upland disposal of the material is proposed, therefore no chemical or bioassay testing was conducted. Thus, open-water disposal is not allowed.

7. Sediment Exposed by Dredging. Due to the high percentage of wood waste throughout the dredge prism and in the z-samples, the DMMP agencies determined that only conventionals and dioxin analysis would be necessary to determine leave surface compliance with antidegredation. All analyses were conducted by Analytical Resources, Inc. of Tukwila, WA. The applicant chose not to subject dioxin data to Stage IV validation, and also elected to run the z-samples for semi-volatiles although this was not required by the DMMP Agencies.

   The conventional z-sample results are shown in Table 4. These results demonstrate that the z-samples contain a large fraction of wood waste, with a TOC content ranging from 18.2 to 13% in DL1-Z and DL2-Z, respectively. Total solids were also high, at 41.86 and 44.64% in DL1-Z and DL2-Z, respectively. Grain size analysis of the total sample was conducted for DL1-Z only since there was insufficient sediment for DL2-Z. Grain size results are likely heavily skewed due to the large amount of woody debris in the samples, and should not be considered to be an accurate representation of the physical properties of the sediments.

   Although not requested by the DMMP agencies, the applicant chose to analyze semi-volatiles on the z-samples, the results of which are also presented in Tables 4 and 6. There was one undetected exceedance of 2,4-dimethylphenol at 99U and 98U μg/kg (SL = 29) and one detected exceedance of benzoic acid at 1500Q and 2000Q μg/kg (SL = 650) in DMMUs 1 and 2, respectively. The Q qualifier on the benzoic acid results is likely the result of the high values encountered and indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum relative response factor).

   Dioxin results from the z-samples were 229 and 159 pptr TEQ in DL1-Z and DL2-Z, respectively (Table 5). Dioxin results were elevated above the DMMP disposal site management objective of 4 pptr TEQ (DMMP, 2010). Dioxin results from the December 2015 native sample (C1) is also presented in Table 5. Dioxin levels in C1 were much lower, at 15.05 pptr TEQ, indicating that the material beneath the wood waste layer is largely comprised of native sediments.

   The sediment to be exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) or the State's Antidegradation standard (Ecology, 2013) as outlined by DMMP guidance (DMMP, 2008). This guidance states that sediments above CSLs are not allowed to be left exposed. The new sediment rule doesn't provide a numeric criteria for dioxin, but rather the CSL would be the highest of PQL, regional background, and risk- and for dioxins, the highest value would likely be regional background. Although regional background has not been formally established for Budd Inlet, the nature and extent of dioxin concentrations in Budd Inlet was investigated and reported on in the Budd Inlet Sediment Characterization Study (SAIC, 2008). The mean Budd Inlet surface sediment dioxin concentration found in that study was 19.1 pptr TEQ.

Based on this, the DMMP agencies conclude that the dioxin concentrations found in the sediments containing wood waste from Dunlap Towing are elevated relative to the ambient dioxin concentrations in Budd Inlet. The dioxin concentrations in the native sediments beneath the wood waste layer are less than or equal to the ambient dioxin concentrations found in Budd Inlet, and are significantly less than the current surface concentrations. Therefore, in order to be in compliance with the State of Washington anti-degradation policy, **all wood waste must be removed from DMMUs 1 and 2 until native sediments are reached.**

8. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from Dunlap Towing for open-water disposal at the Anderson/Ketron open water disposal site and whether the sediments exposed by dredging meet the State of Washington's antidegradation standard. The approved sampling and analysis plan was generally followed. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program.

   In summary, based on the high levels of wood waste contained in the dredge prism combined with the applicant opting out of bioassay over-ride testing, **all 4,814 cy of dredged material are unsuitable** for open-water disposal at any of the DMMP disposal sites. Further, based on the elevated sediment chemistry (dioxin, benzoic acid, and 2,4-dimethylphenol) associated with wood waste in the z-samples, the DMMP agencies conclude that the leave surface that would be exposed by the proposed dredging is not in compliance with the State of Washington anti-degradation policy. In consideration of the high levels of dioxin observed and the difficulty in placing and maintaining a clean sediment backfill/capping layer over wood waste, the DMMP agencies have determined that **all wood waste, including wood waste below the proposed project depth of -3 ft MLLW, must be dredged and disposed at an approved upland disposal facility in order for this project to comply with Washington State's antidegradation policy.**

   A determination regarding the suitability of the material for upland disposal must be coordinated with the local Health Department.

   This suitability determination does ***not*** constitute final agency approval of the project. During the public comment period that follows a public notice, the resource agencies will provide input on the overall project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act.

   A pre-dredge meeting with DNR, Ecology and the Corps of Engineers is required at least 7 days prior to dredging. A dredging quality control plan and transloading plan must be developed and submitted to the Regulatory Branch of the Seattle District Corps of Engineers at least 7 days prior to the pre-dredge meeting.

9. References.

DMMP, 2014. *Dredged Material Evaluation and Disposal Procedures (Users Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, December 2014.

DMMP, 2010. *Dredged Material Management Program New Interim Guidelines for Dioxins*. 6

December 2010.

DMMP, 2008. *Quality of Post-Dredge Sediment Surfaces (Updated).* A Clarification Paper Prepared by David Fox (USACE), Erika Hoffman (EPA) and Tom Gries (Ecology) for the Dredged Material Management Program, June 2008.

DMMP/SMS, 1997. Management of Wood Waste under Dredged Material Management Programs (DMMP) and the Sediment Management Standards (SMS) Cleanup Program. Clarification Paper prepared by David Kendall (USACE) and Teresa Michelsen (Ecology) for the DMMP and SMS. September 1997.

SAIC, 2008. Sediment Characterization Study Budd Inlet, Olympia, WA, Final Data Report. 12 March 2008.

Ecology, 2013. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, February 2013.

Gravity, 2015. Dredge Sampling and Analysis Plan Clarifications for Dunlap Olympia West Bay Site. 5 January, 2015.

Gravity, 2016. Sediment Analysis Data Report, Dunlap Towing Company, West Bay, Olympia, sediment Characterisation. 1 April 2016.

Kennedy/Jenks, 2012. Sampling and Analysis Plan Dredge Sediment Characterization, Dunlap Towing, Budd Inlet, Olympia, WA. 17 February, 2012.

10. Agency Signatures.

The signed copy is on file in the Dredged Material Management Office

Concur:

_____ _____
Date Kelsey van der Elst - Seattle District Corps of Engineers

_____ _____
Date Erika Hoffman - Environmental Protection Agency

_____ _____
Date Laura Inouye, Ph.D. - Washington Department of Ecology

_____ _____
Date Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP signatories

Shawn Hinz, Gravity Consulting

Shannon Soto, DNR

Erika Shaffer, DNR

Jim Sanford, Dunlap Towing

Mike Harlan, Dunlap Towing

Table 2. Sampling and Compositing.

		DMMU 1	DMMU 2	Total
	SAP volume (CY):	3,058	1,756	4,814
Station	Vibracore			
	DMMU2-C1-3		5.9 to 4.6	
	DMMU2-C2-2		4.3 to 2.9	
	Auger			
	DMMU1-C3-2	2.4 to -2.6		
	DMMU1-C3-3	-4.1 to -5.1		
	DMMU2-C2-1		-3 to -3.5	
	DMMU2-C3-1		-3 to -4	
	C1		-10.5 to -11.5	

Notes:

1) The design depth is -3 ft MLLW, including 1 foot of overdepth.

indicates z-sample

Table 3. Sampling and Compositing.

		Coordinates	
		X (US Feet)	Y (US Feet)
Station	Vibracore		
	DMMU2-C1-3	1038251.34	641124.12
	DMMU2-C2-2	1038295.39	641160.69
	Auger		
	DMMU1-C3-3	1038303.86	641005.91
	DMMU2-C2-1	1038275.82	641174.99
	DMMU2-C3-1	1038328.4	641195.99
	C1	1038280.3	641026.1

Coordinates are in Washington State Plane South, NAD83

Table 4. Chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1 Z-sample		DMMU 2 Z-sample	
	SL	BT	ML				
CONVENTIONALS				conc	LQ	conc	LQ
Gravel, %				7.6		17.3	
Sand, %				39.8		58.7	
Silt, %				34.4		nm	
Clay, %				18.2		nm	
Fines (Silt + Clay), %				52.6		24	
Total Solids, %				41.86		44.64	
Volatile Soilids, %				41.72		33.09	
Total Organic Carbon, %				18.2		13	
Total Sulfides, mg/kg				348		416	
Total Ammonia, mg N/kg				5.38		6.81	
METALS (mg/kg dry)							
Antimony	150	---	200	0.4	U	0.6	U
Arsenic	57	507	700	2.6		2.7	
Cadmium	5.1	11.3	14.0	0.2		0.6	
Chromium	260	260	---	13		10	
Copper	390	1,027	1,300	56.2		33	
Lead	450	975	1,200	4.8		4.2	U
Mercury	0.41	1.5	2.3	0.03	U	0.07	U
Selenium	---	3	---	0.9	U	1	
Silver	6.1	6.1	8.4	0.4	U	0.6	U
Zinc	410	2,783	3,800	75		50	
PAHs (ug/kg dry)							
Total LPAH	5,200	---	29,000	371		71	J
Naphthalene	2,100	---	2,400	38		14	J
Acenaphthylene	560	---	1,300	20	U	20	U
Acenaphthene	500	---	2,000	20	U	20	U
Fluorene	540	---	3,600	33		16	J
Phenanthrene	1,500	---	21,000	160		100	U
Anthracene	960	---	13,000	110		28	
2-Methylnaphthalene	670	---	1,900	30		13	J
Total HPAH	12,000	---	69,000	1023		475	
Fluoranthene	1,700	4,600	30,000	360		230	
Pyrene	2,600	11,980	16,000	310		180	
Benzo(a)anthracene	1,300	---	5,100	71		20	U
Chrysene	1,400	---	21,000	120		20	U
Total benzofluoranthenes	3,200	---	9,900	120		65	
Benzo[a]pyrene	1,600	---	3,600	42		20	U
Indeno(1,2,3-c,d)pyrene	600	---	4,400	20	U	20	U
Dibenzo(a,h)anthracene	230	---	1,900	4.9	U	4.9	U
Benzo(g,h,i)perylene	670	---	3,200	20	U	20	U
CHLORINATED BENZENES (ug/kg dry)							
1,2-Dichlorobenzene	35	---	110	4.9	U	4.9	U
1,4-Dichlorobenzene	110	---	120	4.9	U	4.9	U
1,2,4-Trichlorobenzene	31	---	64	4.9	U	4.9	U
Hexachlorobenzene	22	168	230	4.9	U	4.9	U

CHEMICAL	DMMP Guidelines			DMMU 1 Z-sample		DMMU 2 Z-sample	
	SL	BT	ML				
PHTHALATE ESTERS (ug/kg dry)							
Dimethyl phthalate	71	---	1,400	4.9	U	4.9	U
Diethyl phthalate	200	---	1,200	20	U	20	U
Di-n-butyl phthalate	1,400	---	5,100	20	U	20	U
Butyl benzyl phthalate	63	---	970	4.9	U	4.9	U
Bis(2-ethylhexyl)phthalate	1,300	---	8,300	49	U	49	U
Di-n-octyl phthalate	6,200	---	6,200	20	U	20	U
PHENOLS (ug/kg dry)							
Phenol	420	---	1,200	330		290	
2 Methylphenol	63	---	77	4.9	U	4.9	U
4 Methylphenol	670	---	3,600	390		140	
2,4-Dimethylphenol	29	---	210	99	U	98	U
Pentachlorophenol	400	504	690	99	U	98	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)							
Benzoic acid	650	---	760	1500	Q	2000	Q
Benzyl alcohol	57	---	870	20	U	20	U
Dibenzofuran	540	---	1,700	20	U	20	U
Hexachlorobutadiene	11	---	270	4.9	U	4.9	U
N-Nitrosodiphenylamine	28	---	130	4.9	U	4.9	
PESTICIDES (ug/kg dry)							
Aldrin	10	---	---	na		na	
Total Chlordane	3	37	---	na		na	
Dieldrin	2	---	---	na		na	
Heptachlor	2	---	---	na		na	
p,p'-DDE	9	---	---	na		na	
p,p'-DDD	16	---	---	na		na	
p,p'-DDT	5	---	---	na		na	
Total DDT		50	69	na		na	
PCBs (ug/kg dry)							
Total PCBs	130	---	3,100	na		na	
Total PCBs (mg/kg OC)	---	38	---	na		na	
	SL	BT	ML	DMMU 1 Z-sample		DMMU 2 Z-sample	

J = estimated concentration
U = undetected
Q =

na = not analyzed
OC = organic carbon
SL = screening level
BT = bioaccumulation trigger
ML = maximum level

Table 5. Dioxin/Furan results in ng/kg

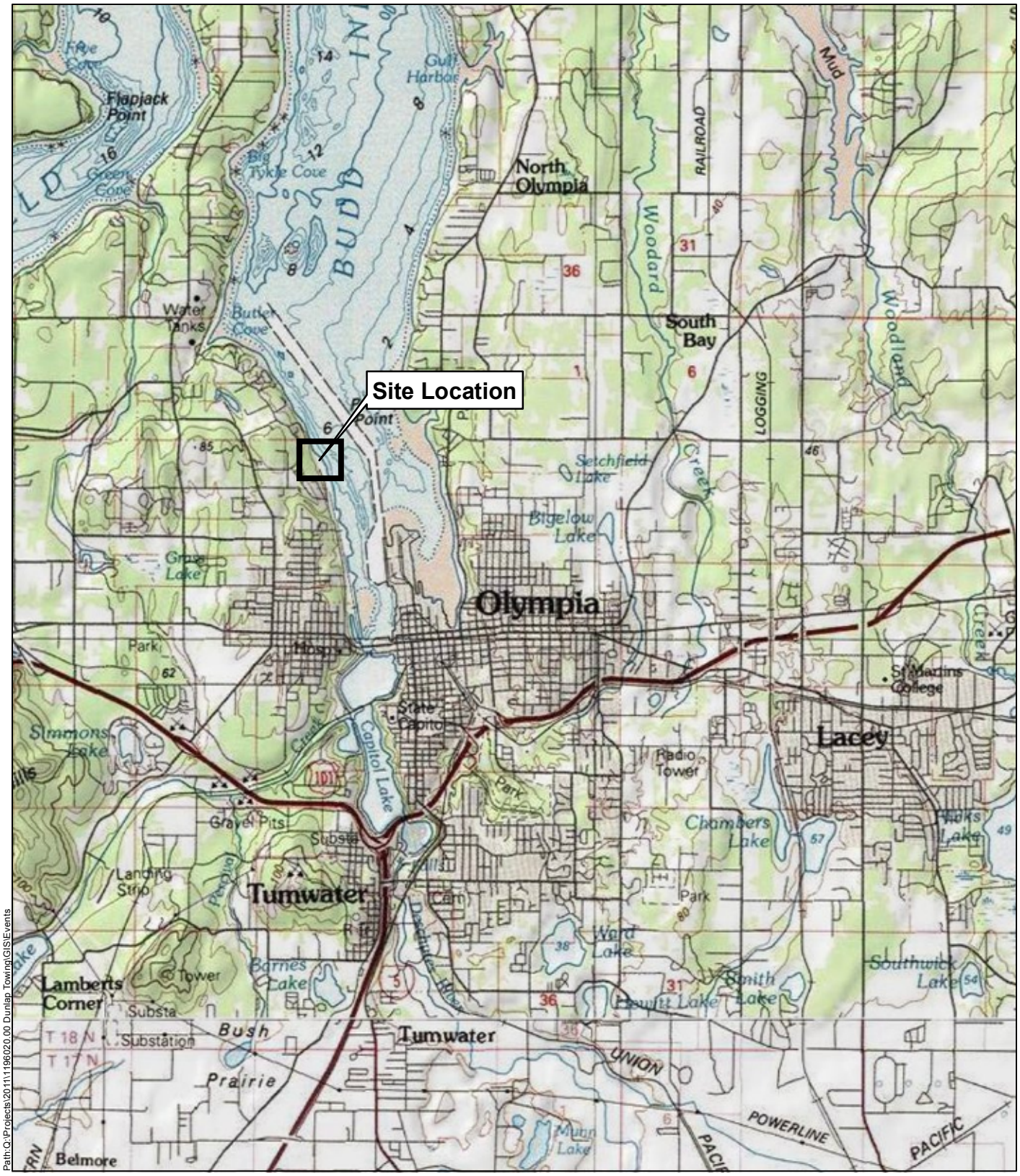
CHEMICAL	TEF	DMMU 1 Z-sample				DMMU 2 Z-sample				C1 native sample			
DIOXINS/FURANS		conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
1,2,3,4,6,7,8-HpCDD	0.01	916	J	9.16	9.16	894		8.94	8.94	252		2.52	2.52
1,2,3,4,6,7,8-HpCDF	0.01	2,820		28.2	28.2	1,470		14.7	14.7	156		1.56	1.56
1,2,3,4,7,8,9-HpCDF	0.01	11.7		0.117	0.117	8.5		0.085	0.085	2.63		0.0263	0.0263
1,2,3,4,7,8-HxCDD	0.1	21.8		2.18	2.18	17.6		1.76	1.76	2.74		0.274	0.274
1,2,3,4,7,8-HxCDF	0.1	15.2		1.52	1.52	12.8		1.28	1.28	6.61		0.661	0.661
1,2,3,6,7,8-HxCDD	0.1	600		60	60	461		46.1	46.1	43.4		4.34	4.34
1,2,3,6,7,8-HxCDF	0.1	7.9		0.79	0.79	7.56		0.756	0.756	4.02		0.402	0.402
1,2,3,7,8,9-HxCDD	0.1	346		34.6	34.6	236		23.6	23.6	5.11		0.511	0.511
1,2,3,7,8,9-HxCDF	0.1	6.45		0.645	0.645	4.8		0.48	0.48	2.74		0.274	0.274
1,2,3,7,8-PeCDD	1	86.1		86.1	86.1	55.7		55.7	55.7	2.51		2.51	2.51
1,2,3,7,8-PeCDF	0.03	2.27		0.0681	0.0681	2.96	B	0.0888	0.0888	1.83	EMPC	0	0.02745
2,3,4,6,7,8-HxCDF	0.1	12.9		1.29	1.29	12.5		1.25	1.25	7.59		0.759	0.759
2,3,4,7,8-PeCDF	0.3	2.4		0.72	0.72	2.6		0.78	0.78	1.87		0.561	0.561
2,3,7,8-TCDD	1	3.48		3.48	3.48	2.09		2.09	2.09	0.387	JEMPC	0	0.1935
2,3,7,8-TCDF	0.1	0.825		0.0825	0.0825	2.03		0.203	0.203	1.24		0.124	0.124
OCDD	0.0003	598		0.1794	0.1794	1,910		0.573	0.573	914		0.2742	0.2742
OCDF	0.0003	1,130		0.339	0.339	576		0.1728	0.1728	106		0.0318	0.0318
TOTAL TEQ (pptr)				229.5	229.5			158.6	158.6			14.8	15.0

Table 6. Chemical results compared to SMS regulatory guidelines.

CHEMICAL	SMS Guidelines		DMMU 1 Z-sample		DMMU 2 Z-sample	
	SQS	CSL	conc	LQ	conc	LQ
Total Organic Carbon, %			18.2		13	
METALS (mg/kg dry)						
Arsenic	57	93	2.6		2.7	
Cadmium	5.1	6.7	0.2		0.6	
Chromium	260	270	13		10	
Copper	390	390	56.2		33	
Lead	450	530	4.8		4.2	U
Mercury	0.41	0.59	0.03	U	0.07	U
Silver	6.1	6.1	0.4	U	0.6	U
Zinc	410	960	75		50	
PAHs (mg/kg OC)						
Total LPAH	370	780	2.038		0.546	J
Naphthalene	99	170	0.209		0.108	J
Acenaphthylene	66	66	0.110	U	0.154	U
Acenaphthene	16	57	0.110	U	0.154	U
Fluorene	23	79	0.181		0.123	J
Phenanthrene	100	480	0.879		0.769	U
Anthracene	220	1200	0.604		0.215	
2-Methylnaphthalene	38	64	0.165		0.100	J
Total HPAH	960	5300	5.621		3.654	
Fluoranthene	160	1200	1.978		1.769	
Pyrene	1000	1400	1.703		1.385	
Benzo(a)anthracene	110	270	0.390		0.154	U
Chrysene	110	460	0.659		0.154	U
Benzofluoranthenes	230	450	0.659		0.500	
Benzo(a)pyrene	99	210	0.231		0.154	U
Indeno(1,2,3-c,d)pyrene	34	88	0.110	U	0.154	U
Dibenzo(a,h)anthracene	12	33	0.027	U	0.038	U
Benzo(g,h,i)perylene	34	88	0.110	U	0.154	U
CHLORINATED BENZENES (mg/kg OC)						
1,2-Dichlorobenzene	2.3	2.3	0.027	U	0.038	U
1,4-Dichlorobenzene	3.1	9	0.027	U	0.038	U
1,2,4-Trichlorobenzene	0.81	1.8	0.027	U	0.038	U
Hexachlorobenzene	0.38	2.3	0.027	U	0.038	U

	SMS Guidelines		DMMU 1 Z-sample		DMMU 2 Z-sample	
PHTHALATE ESTERS (mg/kg OC)						
Dimethyl phthalate	53	53	0.027	U	0.038	U
Diethyl phthalate	61	110	0.110	U	0.154	U
Di-n-butyl phthalate	220	1700	0.110	U	0.154	U
Butyl benzyl phthalate	4.9	64	0.027	U	0.038	U
Bis(2-ethylhexyl)phthalate	47	78	0.269	U	0.377	U
Di-n-octyl phthalate	58	4500	0.110	U	0.154	U
PHENOLS (ug/kg dry)						
Phenol	420	1200	330		290	
2 Methylphenol	63	63	4.9	U	4.9	U
4 Methylphenol	670	670	390		140	
2,4-Dimethylphenol	29	29	99	U	98	U
Pentachlorophenol	360	690	99	U	98	U
MISCELLANEOUS EXTRACTABLES (mg/kg OC)						
Dibenzofuran	15	58	0.110	U	0.154	U
Hexachlorobutadiene	3.9	6.2	0.027	U	0.038	U
N-Nitrosodiphenylamine	11	11	0.027	U	0.038	
PCBs (mg/kg OC)						
Total PCBs (mg/kg carbon)	12	65	na		na	
MISCELLANEOUS EXTRACTABLES (ug/kg dry)						
Benzyl alcohol	57	73	20	U	20	U
Benzoic acid	650	650	1500	Q	2000	Q

U = undetected
QL = laboratory qualifier
OC = organic carbon
SMS = Sediment Management Standards
SQS = sediment quality standard
CSL = cleanup screening level



Path:Q:\Projects\2011\1196020.00 Dunlap Towing\GIS\Events

N

0 1 2

Miles

Kennedy/Jenks Consultants

Dunlop Towing, Sampling Analysis Plan
Olympia, Washington

Site Location

1196020*00
December 2011

Figure 1

Figure 2 *Summary of core attempts from March 2015*

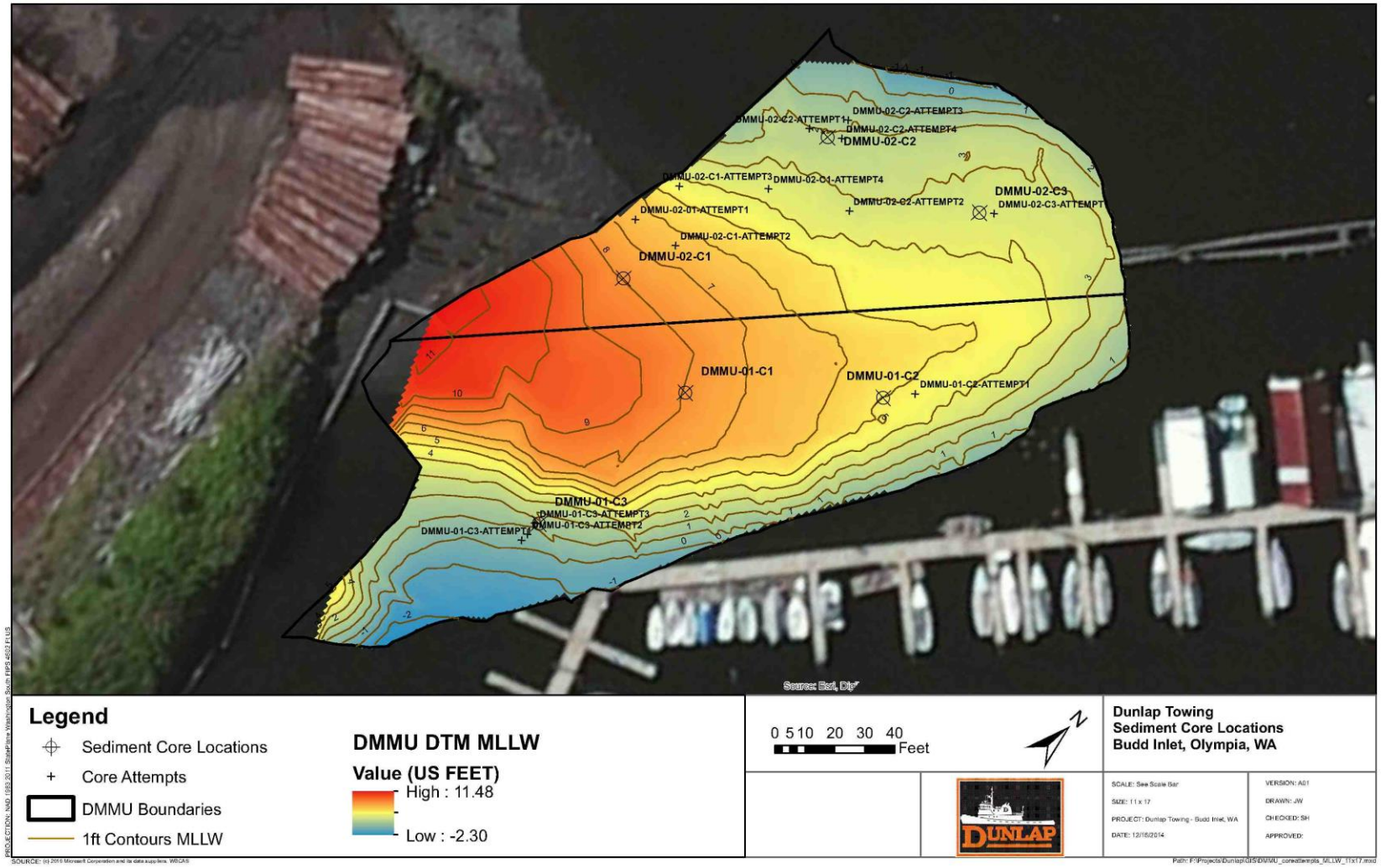


Figure 3. Z-layer sample at DMMU-02-C3

Site conditions at DMMU 02

Figure 3 cont. Recovery at DMMU-02-C1

Photo 2. Recovery at DMMU-01-C3

Figure 3 cont. Site conditions at DMMU 01

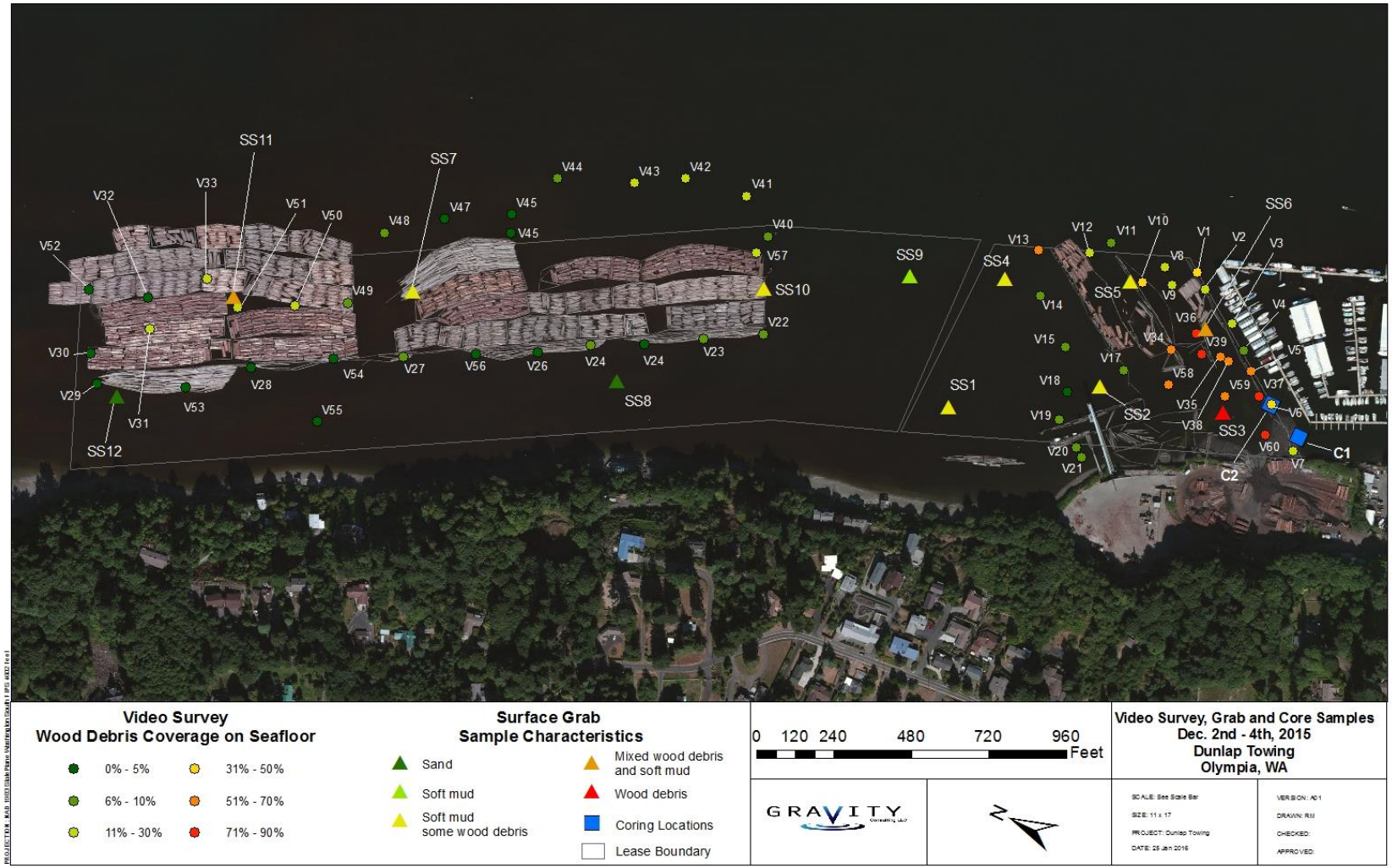



Figure 4. *Surface Grab Sample and Video Survey Results, Dec. 2015*