WILLAMETTE RIVER

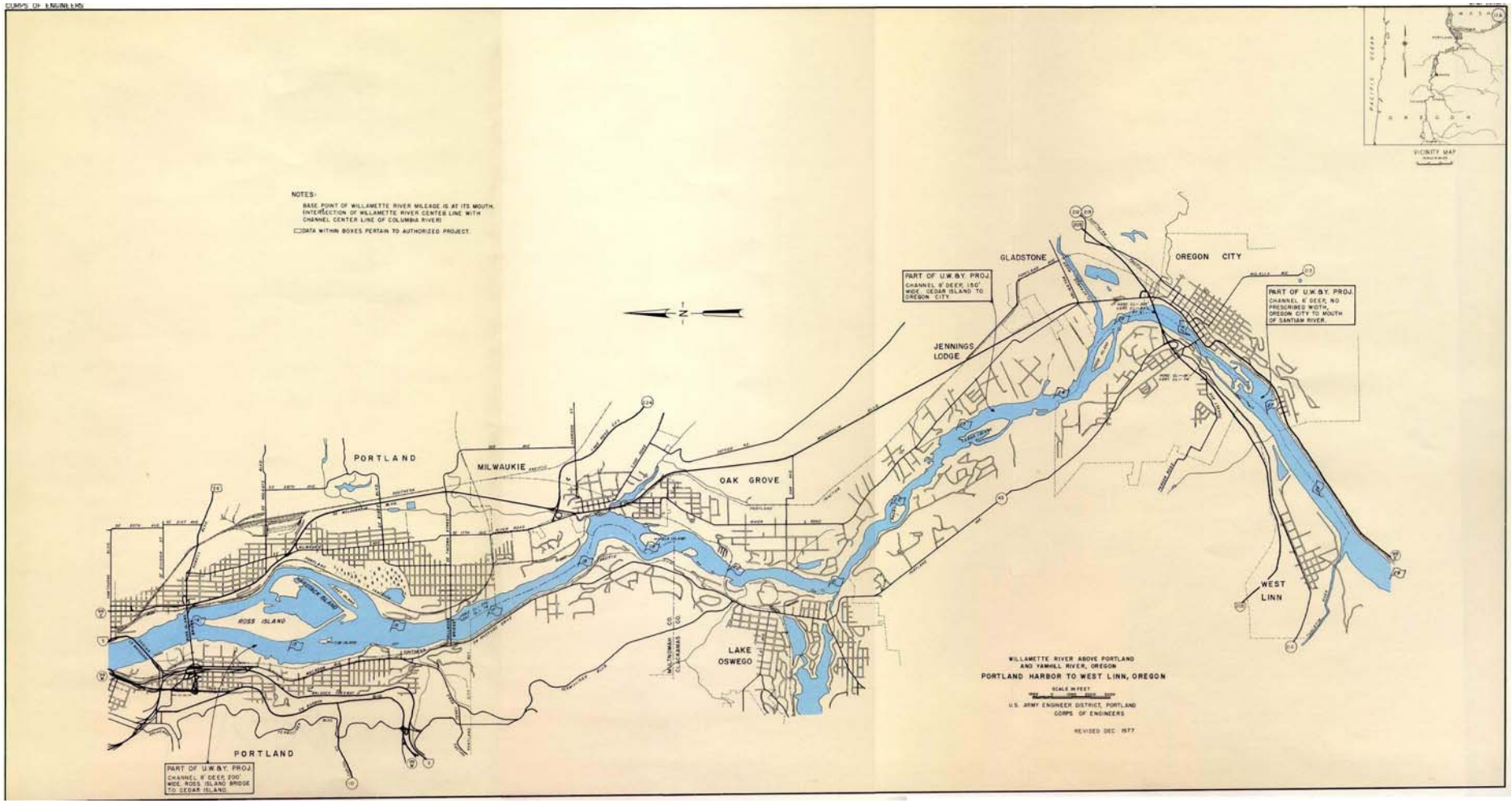
Local Sponsor: Port of Portland

Project Description

This project is maintained at an authorized depth of 40 feet from the mouth of the Willamette to the Broadway Bridge (RM 11+30). The width is typically 300 feet.

Sediment

Sediment from lower Willamette River range from coarse sand to clayey, sandy silt high in organic content. A cutline shoal develops between RM 8.0 and 10.1 along the West Side of the channel. This is the primary location requiring O&M dredging every 2 to 5 years. Other areas are not dredged or dredged infrequently. Willamette River sediments have been subjected to chemical characterization because of the physical characteristics of the material dredged and close vicinity of numerous known sources of contamination. The bulk of the material evaluated from the present 40-foot channel have repeatedly been found to be suitable for unconfined aquatic disposal, but some material has been found to contain chemicals-of-concern above established concern levels. These materials if dredged would require further biological testing or managed to avoid any unacceptable environmental impact. Management could include confined upland disposal or capped in-water disposal.


NOTES:
BASE POINT OF WILLAMETTE RIVER MILEAGE IS AT ITS MOUTH. (INTERSECTION OF WILLAMETTE RIVER CENTER LINE WITH CHANNEL CENTER LINE OF COLUMBIA RIVER)
DATA WITHIN BOXES PERTAIN TO AUTHORIZED PROJECT.
PORTLAND
MILWAUKIE
OAK GROVE
GLADSTONE
OREGON CITY
JENNINGS LODGE
LAKE OSWEGO
WEST LINN
ROSS ISLAND
PART OF U.W.B.Y. PROJ. CHANNEL 6' DEEP, 150' WIDE, CEDAR ISLAND TO OREGON CITY.
PART OF U.W.B.Y. PROJ. CHANNEL 6' DEEP, NO PRESCRIBED WIDTH, OREGON CITY TO MOUTH OF SANTIAM RIVER.
PART OF U.W.B.Y. PROJ. CHANNEL 6' DEEP, 200' WIDE, ROSS ISLAND BRIDGE TO CEDAR ISLAND.
VICINITY MAP
WILLAMETTE RIVER ABOVE PORTLAND AND YAMHILL RIVER, OREGON
PORTLAND HARBOR TO WEST LINN, OREGON
SCALE IN FEET
U.S. ARMY ENGINEER DISTRICT, PORTLAND
CORPS OF ENGINEERS
REVISED DEC 1977

Sediment Evaluation

1986 August/September, Lower Willamette. Seven samples were collected and analyzed for physical and volatile organic solids.

1988 March /April, Lower Willamette. Samples were collected using a gravity corer, ponar grab sampler, and a vibracorer. Physical, volatile solids, ammonia, TOC, metals, pesticides, PAH's, and elutriate testing was performed on the samples. Elutriate and solid-phase bioassays were conducted on material collected at RM4.4, 5.1, 7.1 and 7.3. Sediments from RM 10.7 and downstream consisted of silt with individual sandy or clayey layers. Sediments from RM 11.3 were very sandy in contrast to other sites. At RM 11.7 it comprised mostly of coarse gravel.

Some sediments had elevated levels for cadmium, copper, mercury, lead, zinc, DDD, and total PAH's. Lead and total PAH concentrations at the Broadway Bridge RM 11.7 were above concern levels. Elevations also occurred with PCB's at RM 10.3, DDT at RM 7.3, and cadmium at the Oregon Slough. Elutriate from Doane Lake Sediments was toxic to D. magna, while the less disturbed sediments in the solid phase test were not. Most sediments are acceptable for unconfined in-water disposal in the Columbia River. Shoals from RM 7.0- 7.5, 10.3, and 11.7 should be placed in an alternate confined in-water or upland disposal site.

1989 September, Lower Willamette Supplemental. Elutriate tests were conducted on two samples from the Oregon Slough collected in 1988. Testing was performed by Battelle Pacific Northwest Division Marine Science Laboratory. The bulk chemical tests showed relatively high cadmium levels in November 1988. However results of the elutriate test showed that the release was less than 0.039 mg/L soluble cadmium. Based on these results the sediments are acceptable for unconfined in-water disposal.

1989 July, Burlington Northern Railroad Bridge. Three samples were collected with a vibracore. Each core was split in half logged and subsampled for physical and chemical analysis. Physical analysis revealed that sediment was mostly fines. Chemical analysis reveled that metals, TOC, and oil and grease concentrations were low and typical of uncontaminated river sediment. Pesticides, PCB's, PAH's, phthalates, and phenols were below the method detection limit. Sediment was determined to be acceptable for unconfined in-water disposal.

1989 October, US Moorings. Three sediments samples were taken. Some heavy metals and pesticides exceeded the Corps concern levels. PAH's were high by about 50 times the concern level. Sediment was determined not to be acceptable for unconfined in-water sites.

Supplemental testing was conducted for dioxins/furans. It revealed that the most toxic dioxin was not detected at 0.71 ng/kg. The levels of dioxins/furans may be of concern. At this time, unconfined in-water disposal is not recommended until there is further testing.

1992 June, Portland Harbor. The purpose of this study was to evaluate the shoal

material in the Lower Willamette River. There were five sample locations. Physical, TOC, volatile organic solids, metals, pesticides, PCB's, PAH's, phenols, and sulfide analysis was performed on some samples. Chemical analysis reveled zinc concentration exceeded the EPA concern level. Very low levels of DDE and DDD were detected in some of the samples. Endosulfan II and methoxchlor was detected in particular samples. PAH's were detected in low concentrations in five of the six samples. One sample exceeded the established concern levels. Phenols were detected in three samples but below concern levels.

From RM 8.0 to 10.2 sediment was determined to be acceptable for unconfined in-water and upland disposal. The sediment sample from RM 10.3 had the most contaminates of all samples. It was anticipated that the shoal would not be dredged at this time until further evaluations are conducted.

1994 June, US Moorings. A total of 21 surface grab samples were collected by ponar and subjected to physical analyses. Fifteen samples were subjected to chemical analyses, 9 of these were individual samples while 6 were composites. Chemical analyses included metals, PAHs, pesticides, PCBs, phenols, phthalates, TBT, AVS, and TOC. Four samples were analyzed for dioxins/furans. Sediments were found to be clayey, sandy silt high in organic content. Various locations were contaminated with lead, mercury, zinc, and DDT (and its derivatives). However the major contaminates are the PAHs with individual and total concentrations far above concern levels. Further testing including bioassays or dredged material management options developed should dredging of this material be pursued.

1995 May, US Moorings. A total of twelve 4-inch sediment cores were collected from the vicinity of Docks A and B. Each core was subsamples to provide discreet samples representing the proposed dredging prism and each 1-foot interval below the dredging prism. The dredging prism and the first three 1-foot sections below the dredging prism were subjected to chemical analysis.

Sediment from the U. S. Moorings is clayey, sandy silt high in organic content. PAHs are the major contaminants of concern with individual compounds and total amounts of PAHs detected far above established levels of concern. PAH contamination was evident in all analyses conducted. Pesticides were present but DDT, DDE, DDD, and lindane were the most widespread and present in the highest concentrations. Dioxins and furans were present in all samples though 2378-TCDD was found in only 2 of the 6 samples tested. TBT was not detected in any of the 6 samples tested.

Contamination was found throughout the length of the cores. Generally contamination increased with depth and riverside of dock A. Core stratigraphy indicated that the visible contamination is layered within the mud deposits indicating syndeposition. There was no evidence of an active seep, continuous transverse or longitudinal gradient in contamination abundance. Apparent sharp contacts between product layers and uncontaminated mud indicates low contaminate mobility.

1996 March, Oregon Slough. In attempting to dredge this reach of the Federal project in November 1995, the dredge Yaquina encountered oil droplets which were seen rising to the

surface and forming an oil sheen. The sheen developing from individual droplets formed a discontinuous sheet of discreet 13 to 18 cm circular patterns, which moved in a downstream direction in response to current action. Dredging was discontinued and sediment collecting and analyses was initiated. Four sediment samples were taken using a Benthos Gravity Corer on March 13, 1996 and subjected to physical and chemical analyses. Metals were found to be below levels of concern and similar to 1993 metals concentrations. Pesticides, 4,4'-DDD and 4,4'-DDE, were present in all four samples in amounts estimated to be between 2 and 4 ppb. There were no PCB's detected in any of the samples. Polynuclear Aromatic Hydrocarbons, PAH's, were detected by gas chromatography in all four samples at very low levels. Organotins were detected in all four of the samples, though the values were below established levels of concern. The results of the chemical analysis provide no information about the nature or source of the oily sheen that was noted during the November 1995 dredging. Based on the results of these analyses, sediments were found suitable for unconfined in-water disposal. The Federal project at Oregon Slough was dredged in June 1996 by the hopper dredge Essayons. No evidence of oil was apparent during the dredging. The source of the original concern has not been determined, but considering the absence of detection of oily residues in either the 1993 or 1996 sampling, it is possible that the sheen was the result of naturally occurring organic decomposition or a transient contamination that was washed away during the 1996 flooding.

1996 May, Willamette Falls Locks. The Willamette Falls Locks were totally inundated during the FEB '96 flood on the Willamette River. Approximately 6 ft of sediment was deposited in the downstream lock entrance, along the West Side of the channel. The deposit consists of silty sand and slopewash from the adjacent slope. Sediment was collected from material excavated from three areas with a 6 CY clamshell bucket. The sampled mass had a medium-strength organic (sewage) odor and was medium to dark gray in color. Samples were subjected to physical and chemical tests. Chemical analysis was conducted for metals, PAH, pesticides and PCB, total organic carbon, acid volatile sulfides, phenol, and glycol. Analyses was conducted by NPD Laboratory or its contract laboratories and are on file at the Corps of Engineers, Portland District. Three chemicals were found to be above screening levels for in-water disposal, but reported values are based on low-resolution data displays and represent the operator's estimate of the precise value. The reported values and the screening levels for the three substances are as follows:

Benzoic Acid - 628.0 ug/kg - Screening Level (SL) 216.0 ug/kg
Pentachlorophenol - 337.0 ug/kg - SL 100.0 ug/kg
Silver - 1.6 mg/kg - SL 1.2 ug/kg

The material in the dredging prism also contains flood deposited debris including fragments of plastics, fiber, fabric and wood. This may include large floatable fragments, (30cm diam. X 1.25 m long or possibly larger); the existence of which could adversely affect the placement operation at an unconfined in-water disposal site. Because the material appears, from limited testing, to be only marginally suitable for unconfined in-water disposal and because it contains solid debris that could possibly drift during in-water placement, confined in-water or upland placement of the material was recommended. **Subsequently, the material (1500 cubic yards) was placed up-land at Ross Island**.

1996 November, Portland Harbor. Six samples were analyzed for physical and chemical properties from sites along the shoal located between RM 8.2 and 10.1 on the West Side of the Federal channel. Chemical analyses included, TOC, volatile solids, total metals, pesticides, PCB's, PAH's, AVS, and organotins. Chromium was the only chemical found in the six samples at slightly over the established concern level. Very low levels of DDE, DDD and DDT were found in all samples. PAH's were also detected at low levels in all samples. Organotins (DBT and TBT) were detected in each of the samples, but were also far below concern levels. None of the analyses showed chemicals above concern levels, and the material to be dredged was determined to be acceptable for unconfined in-water disposal.

1997 June, As part of the Columbia River Channel Improvements Study (CRCIS), sixty-eight sediment samples (includes replicates and multiple samples from some cores) were collected in June 1997 from 43 sites on the Willamette River, from RM 0.10 to RM 11.55. Data is presented below:

Physical, Total Organic Carbon (TOC) & Total Volatile Solids (TVS) Analyses: Results for physical, TOC and TVS analyses are presented in Table 11. Of the 68 samples analyzed for grain size, 43 (63%) exceeded 20% fines and/or 5% volatile solids. The distribution of fines varied within the sampled area, both up and down the river as well as from the surface to the depth of the cores sampled.

Metals: Fifty-two sediment samples were analyzed for 9 inorganic metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, & Zn) and for organotin (TBT)(pore water). Of the 52 samples analyzed only the following exceeded SLs for metals, #42C for mercury and #42D for lead. Tributyltin exceeded the SL in samples #23 and #21.

Pesticides and PCBs: Results for pesticides and PCBs analyses are presented in Table 13. Of the 52 samples submitted, the SL was exceeded for DDT in nine samples (#s 4A, 4B, 21, 24A, 25A, 29, WR-C, 35A, 40A). Only one other pesticide, Dieldrin, exceeded the SL, sample (#40A). PCBs exceeded SL in only one sample, #42C.

Polynuclear Aromatic Hydrocarbons (PAHs): Results for PAHs are presented in Table 14 & 15. Sample #s 20 and 22 exceeded almost all of the SLs and totals for both low and high PAHs. Sample #21, 11A & 15 exceeded SL for 2 PAHs. Sample # 16 exceeded one SL for PAHs. Sample #s 11 through 22 are from RM 2.90 to RM 6.20. The heaviest concentration of these contaminates are from RM 5.15 to RM 6.20.

P450 Reporter Gene Assay, (Dioxin/Furan Screen): Results for P450 RGA are presented in Table 16. P450 is the designation for a group of enzymes that play a key role in activating or deactivating many toxic chemicals including PAHs, PCBs, dioxins and furans. Samples WR-GC-18A, 22, 24A, 30A, 32A, 33A, 38A are all candidates to contain dioxins/furans and therefore require specific attention. Four of the samples (18A, 24A, 30A, & 33A) contain similar amounts of PCBs; this accounts for the chlorinated hydrocarbons detected in the P450 RGA. Three samples (22, 32A, 38A) contain possible low levels of dioxin/furans. Sample WR-BC-22 contains possible higher levels of dioxin/furan. If the area represented by these samples were to be dredged, it would warrant further testing for dioxin/furans.

In **September 1999** additional surface sediment samples were collected from 12 deep-water sites in the Willamette River (see Exhibit B of the CRCIS). All samples were collected below the proposed 43-foot (plus 2-foot overdepth) deepening project and ranged from –48 feet to –79 feet below the Columbia River Datum (CRD). Various stations exceeded the screening levels and maximum levels of the DMEF for several organic contaminate. No sample exceeded SL's for metals or TBT. As with the CRCD shoal samples and the EPA-DEQ 1997-1998 Sediment Quality Study, the middle reach of the river (RM 4.0to 8.0) is the most contaminated. High levels of PAHs were found at RM 6.1 (Grab-05).

1999 April, Nine vibra-core sediment samples were collected from the Willamette River, river mile (RM) 2+10 and RM 8+30 to 9+35, April 28, 1999. All samples were sent to Sound Analytical Services, Inc. laboratory of Tacoma, WA, for physical and chemical analyses, to include: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), herbicides, phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs), tributyltin (TBT) and dioxin/furan.

One or more contaminates were detected above the DMEF screening levels in the three potential dredge sites. At RM 2+10 (Oregon Steel Mill dock) DDT was detected within the proposed dredging prism. A strong petroleum odor was detected in the core approximately 5 feet below the dredging prism. Tributyltin (TBT) was detected above the SL in the shoal at RM 9 to 9+35. Both DDT and TBT were detected above the SL at RM 8+40 (Texaco dock). The sediment represented by the samples that exceeded the SL of the DMEF can not be determined to be suitable for open in-water disposal without further characterization at Tier III (biological testing) level.

November 1999, Analyses of the April 29, 1999 sampling of the shoal at RM 2+20 (DMMU 1), the Oregon Steel Mill dock, indicated DDT in the WR-VC-02 (11.3 ug/kg) sample to be above the SL (6.9 ug/kg). Possible PAH contamination was observed in the WR-VC-01(C) sample, at DMMU 1, which was not analyzed as it was at level 9' 6" below the surface, five feet below the dredging prism.

DDT exceeded the SL in one other sample (WR-VC-08C) (7.1 ug/kg) collected in front of the Texaco dock at RM 8+40 (DMMU 3).

Only three samples were analyzed for TBT, one from each DMMU, RM 2+10 (WR-VC-02), RM 9 to 9+35 (WR-VC-03) and RM 8+40 (WR-VC-05). Two of the 3 samples (WR-VC-05 at 0.315 ug/L and WR-VC-05 at 0.60 ug/L) analyzed for TBT exceeded the 0.15 ug/L screening level.

The DMMU 4 at RM 11 was evaluated in the November event at a Tier IIb level only. DDT or its breakdown products exceeded the 6.9 ug/kg SL in sample WR-VC-07ABC, representing the dredging prism with 8.8 ug/kg of Total DDT. Analyses for sample WR-VC-07D, representing the "newly exposed surface" after dredging, indicated a 15.4-ug/kg Total DDT level present in the sample. DMMU 4 will require further characterization at the Tier III level to determine potential disposal methods.

DMMUs, 1 through 3, have been evaluated at the Tier II and Tier III levels, but results are inconclusive for determination of suitability for unconfined, inwater disposal. Chemical tests conducted in conjunction with the November biological Tier III (due to exceedances of DMEF screening levels for DDT and TBT in the April sampling event) did not exceed any screening levels of the DMEF. Therefore, Tier III biological evaluation (conducted simultaneously with the chemical analyses) were actually conducted on "clean" material. This raises sufficient ambiguity such that a third analyses (sampling event) will be necessary to either confirm contamination found in the first sampling event or verify contamination is no longer present in the dredging prism.

2001 August & September. This study found three reference areas that can be used as suitable reference areas for Tier III biological testing under the DMEF. The study utilized data from a 2 phase sampling plan. The phase I event collected limited physical and chemical screening data from 10 sampling stations. The best 3 candidate sites from phase I were selected for phase II extensive chemical and biological sampling. These reference areas are: HC-2 for coarse-grained sediment located by Ross Island; HC-10 for medium-grained sediment located within Cedar Island Cove; and HC-8 for fine-grained sediment located by Elk Rock Island.

Two of these reference areas (HC-2 and HC-8) had no detectable concentrations of bioaccumulative compounds above DMEF SLs and are suitable for use as bioaccumulation study reference sediment areas.

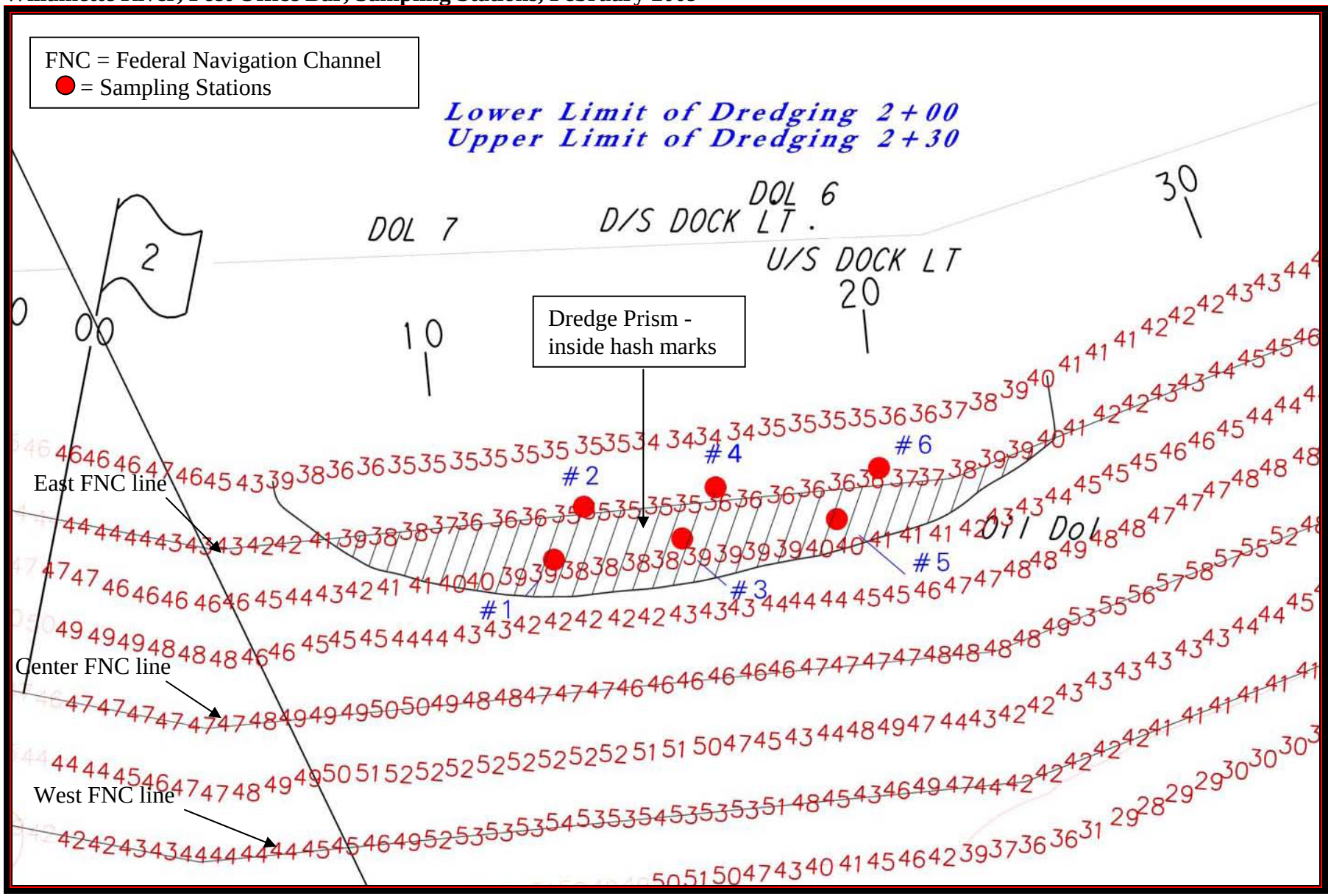
For the medium-grained reference location (HC-10 located within Cedar Island Cove), the pesticide DDT (and its metabolites) were not detected during the Phase I reconnaissance portion of this study, but were detected at levels exceeding DMEF SLs during the Phase II portion of the study. This location's use as a bioaccumulation testing reference site when DDT is a contaminant of concern should be further evaluated by additional chemical testing of Cedar Island Cove to identify the extent of DDT present at this location.

The results of the bioaccumulation study indicate both of the tested species, the oligochaete *Lumbriculus variegates* and the bivalve *Corbicula fluminea*, were acceptable as freshwater test species based on survival during the 28-day test period and similar accumulation characteristics for the bioaccumulative compounds found in the test sediments.

2003 September. As part of a dredge material characterization study, subsurface sediment coring was completed within the Federal Navigational Channel of the Willamette River, from 53 sampling stations, at river mile (RM) 2 and RM 8-10. Samples were grouped to form 19 separate composites. The 19 composited sediment samples (CSSs), along with 2 reference samples, were submitted for Dredge Material Evaluation Framework (DMEF) Tier II a&b physical and chemical and Tier III bioassay and bioaccumulation analyses. Chemical results indicated several of the 19 composite samples exceeded the chemical screening levels for DDT, TBT (Organotin) and PCBs. Bioassay results for all 19 samples passed the 1998 DMEF guidelines for open in-water placement (The same 19 samples were, also, submitted for the extended 28-day test protocol, results were not interpreted due to the lack of end-point interpretative guidance). Three (3) of the 19 composite samples were submitted for bioaccumulation testing. The bioaccumulation results indicated that DDT, TBT and PCBs accumulated at low levels in the test species, *Lumbriculus*. Interpretation of bioaccumulation data is still being studied to develop guidance for promulgation in a later version of the sediment evaluation framework.

2009 February. Sediment shoals within the FNC were characterized at approximate river mile (RM) 2.1-2.4, Post Office Bar. A total of six (6) vibra-core samples were collected February 11, 2009. Three (3) cores were collected in the dredging prism (DP) and were retained as discrete samples, which were then divided to represent the dredging prism and the new surface material (NSM). Three (3) additional vibra-core samples were collected just shoreward of the DP to represent the potential sloughing materials; surface material and the area below that which might have the potential to slough.

The physical analyses classified material as elastic silt with 89.4% fines and 10.6% sand, with mean grain-size of 0.024 mm and 2.47% total organic carbon; ranging from 1.97% to 2.94 % .

Some chemical data results exceed the interim 2006 SLs in one or more samples for Cd, Zn, DDT, PCBs and PAHs. At this time it has not been determined if dredging will occur. It has been proposed that dredging with natural attenuation be allowed, with monitoring to insure accretion is occurring.

Willamette River, Post Office Bar, Sampling Stations, February 2009