CENPP-PE-HR (1110-2-1150) 14 April 1994

MEMORANDUM FOR Chief, CENPP-OP-NW, ATTN: Chesser

SUBJECT: Yaquina River Sediment Evaluation

1. In February 1994, an environmental evaluation of the sediment from shoals in the Yaquina River between RM 6.0 and 11.0 was conducted following MPRSA and CWA guidelines. The sediment meets the exclusionary criteria of both laws and therefore needs no further chemical testing. Accordingly, the sediment is acceptable for in-water disposal in the ocean and inland waterways. It is also acceptable for upland disposal. These are the same conclusions arrived at in an extensive study conducted by the Corps in 1980. These disposal alternatives will have little impact on the environment due to the contaminant levels in the sediment.

2. If you have any questions regarding this study, please contact Jim Britton, CENPP-PE-HR, extension 6471.

Encl

STEVEN L. STOCKTON, P.E.
Chief, Planning and Engineering
Division

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30 March 1994

Yaqiuna River Sediment Quality Evaluation

Abstract

An evaluation of the sediment from shoals in the Yaquina River between RM 6.0 and 11.0 was conducted following MPRSA and CWA guidelines. The sediment is acceptable for in-water disposal in the ocean and inland waterways. It is also acceptable for upland disposal. These disposal alternatives will have little impact on the environment due to the contaminant levels in the sediment.

Introduction

1. The Yaquina River is located along the Oregon coast about 115 miles south of the Columbia River. The river and its tributaries drain an area of 253 square miles. Its length is 58.6 miles to the source. Elk Creek, a major tributary connecting to the river, is 29.7 miles long and drains 136 square miles. About 30 small creeks and sloughs drain into the Yaquina River. Yaquina Bay, the fourth largest estuary on the Oregon coast, extends upriver to about River Mile (RM) 3.0. Tidal influences extend upriver to RM 26. The diurnal tidal range is 7.9 feet with an extreme of 11.5 feet (1).

2. The towns of Newport (pop. 8,675) and Toledo (pop. 3,245) are the major population centers along the river and are located at RM 1.9 and 13.0 respectively. The principal industries of Lincoln County, where these towns reside, are lumber, fishing, agriculture and tourism. Newport considers itself the Dungeness crab capitol of the world and its primary industry is fishing (2). Toledo is a center for forest products industry in the mid-coast basin.

3. The focus of this sediment evaluation is the reach of the Yaquina River between RM 4.0 and 14.0. The Federally authorized navigation channel in this portion of the river varies in width. Generally, the channel is maintained 150 feet wide and 10 feet deep. At Toledo the channel widens to 200 feet and extends into Depot Slough. The upstream end of the project at RM 14.0 is a turning basin that is 350 feet wide and 500 feet long.

4. This stretch of the river develops shoals very slowly. Consequently, maintenance dredging is only necessary once every 10 to 15 years. Upland disposal sites along the stretch are not available because much of adjacent lands are valuable wetlands (3). No in-water disposal sites have been designated in this reach.

Previous Studies

5. Previous studies of Yaquina River sediment have shown it to be acceptable for in-water and upland disposal. An extensive sediment quality study of shoal material along the length of the entire Federal Project from the mouth to RM 14.0 was conducted in 1980 by the USACE, Portland District (1). This study evaluated the environmental impacts of in-water and upland disposal of sediments from the project. Ten sediment samples were subjected to elutriate tests and two samples, one from RM 2.0 and the other from Depot Slough, were tested for chemical contaminants. The results indicated that between RM 4.0 and 14.0 the sediment was acceptable for in-water disposal assuming a designated site was available. Upland and ocean disposal was

also considered acceptable. Sidecasting of sediments was not recommended because of impacts to areas of commercial and ecological significance.

6. In 1986 ten sediment samples were taken between the mouth and the Turning Basin at RM 2.0. No contaminants were detected at concentrations above levels of concern. The sediment was considered acceptable for in-water ocean disposal.

7. In April 1990 twenty-one sediment samples were taken from various areas, including Federal Channel and non Federal Channel areas (marinas & docks), in Yaquina Bay and Yaquina River up to RM 5.0 (4, 5). All samples, including those from non Federal Channel areas, were below established concern levels for contaminants except for one sample from South Beach Marina that exceeded the concern level for TBT. In general the marina/dock sediments were slightly higher in metals and PAHs than channel sediments. Based on the results, Federal Channel material was considered acceptable for in-water and upland disposal. South Beach Marina sediment was again evaluated in 1991. The second evaluation included chemical analysis and bioassays. The sediment was found to be acceptable for in-water and ocean disposal.

8. These previous studies show that Federal Channel sediments from Yaquina Bay and Yaquina River are low in contamination and are acceptable for upland and in-water riverine or ocean disposal.

Current Study

9. The purpose of the current study was to determine if sediment from shoals in the upper portion of the Yaquina River project, primarily between RM 6.0 and 11.0, is acceptable for in-water (and upland) disposal according to guidelines in the Marine Protection Research and Sanctuaries Act (MPRSA) and Section 404 of the Clean Water Act (CWA). Another purpose of the evaluation was to determine if sediment from the project could be used for the benefit of native oysters. This was at the request of Oregon Department of Fish & Wildlife. The sediment samples would be examined for shell hash content and if an acceptable amount was present the sediment could be spread out in native oyster areas to improve habitat.

Methods

10. On 8 February 1994 six sediment samples were taken, using a ponar sampling device, from shoals between RM 6.0 and 11.0 as shown on the enclosed map. The samples were examined for shell hash and benthics. They were then placed in plastic baggies and cold stored until physical analysis. Field examination of these samples showed them to be clean sandy material low in organic content and fine-grained material. Shell hash was not observed in the samples. Following the Tiered Testing Evaluation described in the joint EPA/USACE Green Book, otherwise known as the Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual, it was decided that chemical testing was not necessary for this material in order to evaluate the ecological impacts of ocean disposal. The same conclusion was arrived at using 404 b (1) guidelines of the CWA in determining whether sufficient information was available to evaluate impacts of inland waterway disposal. To verify field observations the samples were subjected to physical analyses to determine grain size distribution and organic content. This information is also used to assist dredge contractors in preparing future bids for removal of sediment. Physical analyses were performed by the USACE, North Pacific Division Materials Testing Laboratory, Troutdale, Oregon.

Results

11. The sediment samples were predominantly clean sand (80.6-97.6 %) with a small amount of silt (2.7-19.4 %) (Table 1). One sample, near the outlet to Pooles Slough and opposite oysterville, contained much more silt than the other samples (19.4 %). The median grain sizes of the samples varied from fine to medium sand. The mean, median grain size of all the samples was 0.29 mm, or that of medium sand. The samples were low in organic content with an average of 2.5 % volatile solids. The roundness grading of the particles was sub angular to sub rounded. Field notes indicate that no shell hash was observed in the samples. One sample, YR-5, contained a small, live freshwater clam. For comparison the median grain size distribution and organic content of the samples taken in 1980 are shown in Table 1. The sediment physical characteristics have not changed over time.

Discussion

12. This material is proposed for in-water disposal, both inland and in the ocean, and for upland disposal. The need to evaluate the sediment for ocean disposal has arisen because of the lack of nearby in-water or upland disposal sites. Accordingly, the sediment must be evaluated by both CWA guidelines and MPRSA criteria for potential impacts of contaminants in the sediment on the environment of the disposal area. For the CWA, guidelines in 40 CFR 230 are used. For the MPRSA, a testing manual entitled Evaluation of Dredged Material proposed for Ocean Disposal (in short, the Green Book) that uses a tiered-testing procedure is used in the evaluation.

13. Both of these laws provide for exclusions from further testing for contaminants in sediment in order to arrive at conclusions regarding the environmental impacts of disposal. The material from RM 6.0 to 11.0 meets the exclusionary criteria of MPRSA regulations (section 227.13(b) of 40 CFR 220-228) and CWA 404 (b)(1) guidelines (section 230.60 (a-c) of 40 CFR 230) as the following discussion will show. Basically, material is excluded from further testing if it is primarily sand (or gravel), is located in a high energy area, is free of contaminants, is removed from contaminant sources, and is substantially similar to disposal site material in grain size and contaminant content. Field observations of the physical characteristics of the sediment samples from the current study and the confirming laboratory results indicate that sediment from the Federal Navigation Channel between RM 6.0 and 11.0 is clean sandy material low in organic content. This area of the river is a high energy area especially during outgoing tide. The grain sizes here are larger than in the lower reach of the river near Yaquina Bay. Current and historic physical and chemical data show that the sediments in this reach of the river have not changed in character since the last evaluation conducted in 1980. The grain size distribution and organic content in this reach have not changed (Table 1). Chemical results of the 1980 study revealed that bulk Yaquina River sediments between the mouth and upstream limit of the project (RM 14.0) were free of contaminants (1). Elutriate tests of Yaquina River sediment in this reach showed that most chemicals of concern were tightly bound to the sediment and rarely exceed water quality criteria in elutriate water (1). Recent chemistry results from adjacent samples in the Federal Channel, downstream from this reach, confirm that contaminants are below established concern levels (Table 2) (4, 5). The grain sizes of these downstream samples were substantially similar to those in the upstream reach. Generally, the material between RM 6.0 and 11.0 is removed from point source contaminants. The city of Toledo, upstream of the reach, does have 3

storm drain outfalls and one sewer outfall that empty into the river. The lack of metals and PAHs in sediment and elutriate samples indicates that urban runoff from Toledo is not a significant contributor of contaminants to sediment in the reach. The sewer water is fully treated before release to the river. Altogether, this background suggests the material complies with the exclusionary criteria of MPRSA regulations (section 227.13(b)) and CWA 404 (b)(1) guidelines (230.60 (a-c)). The material met these exclusions in the 1980 study as well. This was also the conclusion of the 1985 Interim Ocean Dredged Material Disposal Site Evaluation Study (7).

14. The environmental impacts of upland disposal due to contaminants in the sediment are minimal. The material is mostly sand so that release of fine-grained particles to receiving water will be negligible. Contaminants in the sediment are well below established concern levels. Elutriate tests have shown that contaminants of concern released to water are generally at concentrations below water quality criteria. There is usually a low amount of sulfur in sandy material. For instance, the acid volatile sulfide (AVS) content of 12 samples taken between between RM 1.0 and 6.0 shows thaton average the AVS content of fine-grained marina sediment is 15 times higher than sandy channel sediment (794 ppm vs 53 ppm) (5). Sulfur in air dried sediment can oxidize and form acid when exposed to rainwater. Because the sulfur content of the sediment is presumed to be low, the potential for acidic conditions to develop is diminished. Thus, the potential for acidic leaching of metals from upland sediment is low. The material from this reach is excellent for beach nourishment or upland fill.

15. Since there was no obvious shell hash in the sediment samples, the material is not useful for native oyster habitat improvement.

Recommendations

Inland Waterways and Upland Disposal

16. Based on 404 (b) (1) Guidelines developed to implement section 404 of the Clean Water Act, the sediment from Yaquina River meets the exclusionary criteria for chemical testing. The material is medium sand from a high energy regime, similar to the substrate at disposal sites in this reach of the river, and is suitable for beach nourishment or restoration. Thus, as far as inland waterways are concerned, the sediment is considered acceptable for unconfined in-water disposal.

17. The material is also acceptable for upland disposal.

Ocean Disposal

18. Also, according to the tiered-testing procedures in the Green Book , the sediment is acceptable for unconfined in-water disposal in the ocean. Sediment at the disposal site is fine grained sand (median grain size 0.18 mm) shading towards medium sand (8). The sediment from Yaquina River is substantially similar to the substrate at the disposal site in terms of contaminants and grain size (0.29 mm). Few adverse environmental impacts are expected beyond burial of benthic organisms at the site. Usually, benthics recolonize a site quickly after disposal.

REFERENCES

1. Turner, R. 1980. Findings of Compliance, Dredged Material Disposal Activities, Yaquina Bay and River Federal Navigation Channel. U.S. Army Corp of Engineers, Portland District.

2. Percy, K.L., Bella, D.A., Sutterlin, C., Klingeman, P.C. 1974. Descriptions and Information Sources for Oregon Estuaries. Sea Grant College Program, Oregon State University.

3. Navigation Branch, Operations Division, U. S. Army Corps of Engineers, Portland District. September 1991. Federal Navigation Projects: Columbia River Maintenance Disposal Plan. (Prepared by Mandaville Associates, 600 S. W. Tenth #418, Portland, Oregon 92205)

4. Britton J. U. S. Army Corps of Engineers, Portland District. 17 July 1990. Yaquina Bay Sediment Evaluation April 1990.

5. Britton J. U. S. Army Corps of Engineers, Portland District. October 1990. Characterization of Sediments at yaquina Bay & Harbor. Prepared for U. S. Environmental Protection Agency, Region 10.

6. U. S. Environmental Protection Agency and U. S. Army Corps of Engineers. February 1991. Evaluation of Dredged Material Proposed for Ocean Disposal (Testing Manual).

7. U. S. Army Corps of Engineers, Portland District. April 1985. Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study.

8. U. S. Army Corps of Engineers, Portland District. October 1989. Data from Portland District sediment quality database. The ODMDS was sampled in october 1989. Median grain size was 0.18 mm.

Figure 1. Location of sediment samples taken by ponar from shoals in Yaquina River on 8 March 1994.

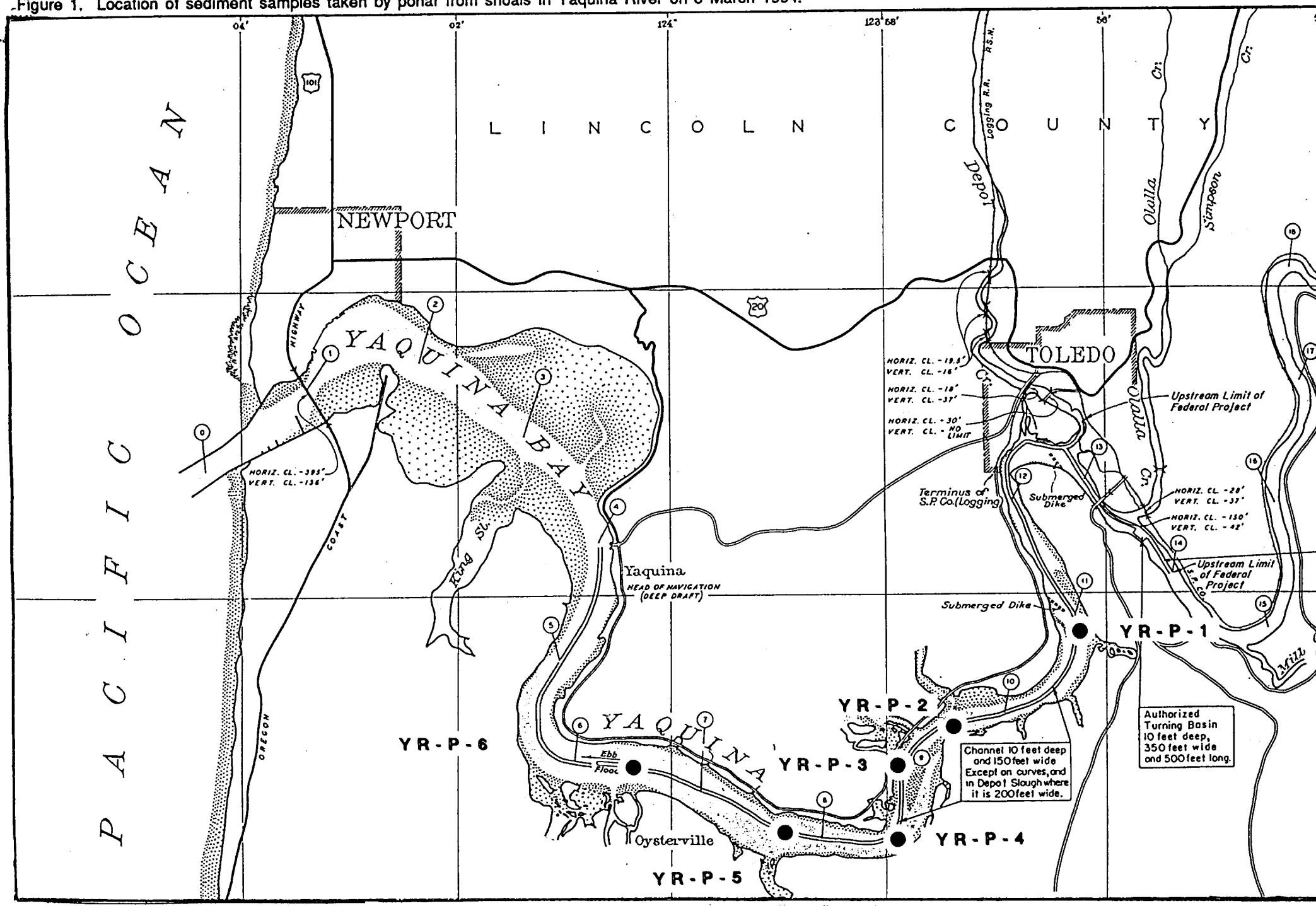

Table 1. Grain size distribution and organic content of Yaquina River sediment -1994 vs1980.

sample (RM)	median grain size mm	sand	silt	clay	volatile solids
		%			
1994 samples					
YR-1 (11.0)	0.39	97.3	2.7	-	7.3*
YR-2 (9.9)	0.36	97.6	2.4	-	1.3
YR-3 (9.4)	0.27	96.3	3.7	-	1.7
YR-4 (8.7)	0.18	96.2	3.8	-	2.1
YR-5 (7.8)	0.28	96.5	3.5	-	3.7
YR-6 (6.5)	0.24	80.6	19.4	-	3.5
mean 1994, n=6	0.29	94.1	5.9	-	3.3
mean 1980, n=4	0.26	94.0	3.5	2.5	2.6

* Wood debris in sample elevated organic content. Mean volatile solids is 2.5 % without this outlier.

Table 2. Contaminant levels in sediment samples from Yaquina River Federal Project.

year (no. samples)	As	Cd	Cr	Cu	Hg	Pb	Ni	Zn	total PAHs	Pesticides	PCBs
	ppm								ppb		
1980 (1)	6	-	10	8	0.02	10	10	7,600	-	ND	26
1986 (4)	0.6	-	-	4.3	0.05	24	-	18	<10,000	<1.0	<1.0
1990 (2)	7.8	0.11	28.9	9.2	0.04	3	20	38.9	392	<4	<80
screening level*	57	0.96	180	81	0.21	66	140	160	2,410	10	130

* Screening level for marine waters from EPA, Region 10 .

DEPARTMENT OF THE ARMY
NORTH PACIFIC DIVISION LABORATORY
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1491 N.W. GRAHAM AVENUE
TROUTDALE, OREGON 97060-9503

CENPD-PE-GT-L (1110-1-8100c) March 1, 1994

MEMORANDUM FOR Commander, Portland District, ATTN: CENPP-PE-HR (Britton)

SUBJECT: W.O. #94-221, Report of Soil Analysis

Project: PORTLAND DISTRICT DREDGING
Source of Material: Depot Slough, Depoe Bay and Yaquina River, Oregon
Submitted by: CENPP-PE-HR (Britton)
Date Sampled: --- Date Received: 10 Feb 94
Method of Test or Specification: ASTM, EM1110-2-1906
Reference: 1) Charge nos. CAYQU0712460000 and CADPA0712460000
2) NPD Form 300 Transmittal of Materials dated 10 Feb 94

1. Enclosed is report of dredge tests for 17 sediment samples submitted from the above project.

a) Enclosure 1, Results of Dredge Test Analysis

b) Enclosures 2 through 18, Report of Particle Size Analysis and Classification Tests, one for each sample submitted.

2. This completes all physical analysis requested.

Timothy J. Seeman

TIMOTHY J. SEEMAN
Director

Enclosures

Copy Furnished: CENPD-PE-GT

Yaquina River

Sample no.	Resuspended Density gm/l	Void Ratio	Volatile Solids,%	Specific Gravity	Particle Roundness Grading
YR-1	1686	1.358	7.3	2.618	Sub Angular-Sub Rounded
YR-2	1722	1.252	1.3	2.628	Sub Angular-Sub Rounded
YR-3	1660	1.458	1.7	2.622	Sub Angular-Sub Rounded
YR-4	1634	1.580	2.1	2.636	Sub Angular-Sub Rounded
YR-5	1719	1.303	3.7	2.658	Sub Angular-Sub Rounded
YR-6	1501	2.202	3.5	2.604	Sub Angular-Sub Rounded

CENPDL No. 4833, received 10 Feb 94

* * * Corps of Engineers - North Pacific Division Materials Laboratory * * *

YAQUINA RIVER (94-221)

Boring: -- Sample: **YR-1** Depth: -- Lab No.: 22102

------ Sieve Analysis ------

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	3.39	99.5
5/16 In.	5.22	99.3
No. 5	8.45	98.8
No. 10	17.04	97.6
Pan	697.73	0.0
No. 18	2.33	94.6
No. 35	18.03	74.4
No. 60	67.61	10.7
No. 120	73.35	3.3
No. 230	73.82	2.7
Pan	75.95	0.0

No hydrometer analysis.

Pan 11.0

$\bar{X} = 0.43$

D85: 0.64 D60: 0.43 D50: 0.39 D30: 0.31 D15: 0.26 D10: 0.23 mm

Cu: 1.84 Cc: 0.96

Liquid Limit: NP Plasticity Index: NP

Fines Type Used for Classification: ML, SILT

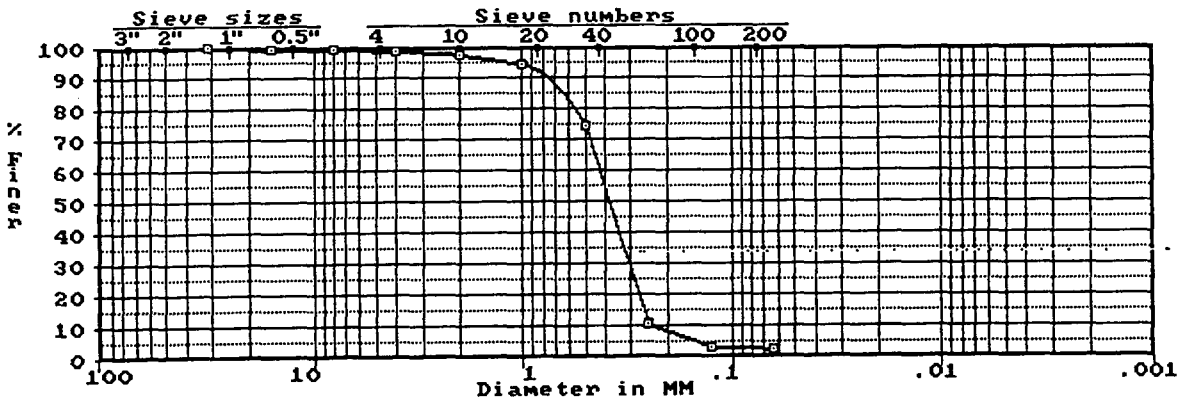
Gravel: 1.0% Sand: 96.1% Fines: 2.9%

---------- ASTM D 2487 Classification ----------

SP Poorly graded SAND

---------- Comments ----------

- VOLATILE SOLIDS 7.3
- PLUS NO. 10 NON-SEDIMENT WEIGHT 3.39 TYPE WOOD



%

Sand 97.3

Silt 2.7

* * * Corps of Engineers - North Pacific Division Materials Laboratory * * *

YAQUINA RIVER (94-221)

Boring: -- Sample: **YR-2** Depth: -- Lab No.: 22103

------ Sieve Analysis ------

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	1095.58	0.0
No. 18	0.70	99.2
No. 35	12.93	84.4
No. 60	72.85	11.9
No. 120	80.28	2.9
No. 230	80.70	2.4
Pan	82.66	0.0

No hydrometer analysis.

Run 9.85

$\bar{x} = 0.38$

D85: 0.51 D60: 0.40 D50: 0.36 D30: 0.30 D15: 0.26 D10: 0.22 mm

Cu: 1.84 Cc: 1.04

Liquid Limit: NP Plasticity Index: NP

Fines Type Used for Classification: ML, SILT

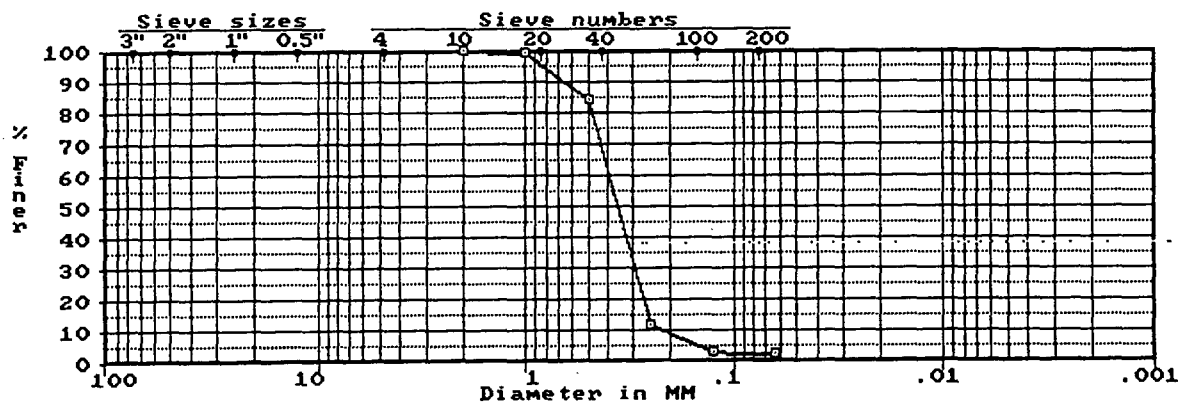
Gravel: 0.0% Sand: 97.5% Fines: 2.5%

---------- ASTM D 2487 Classification ----------

SP Poorly graded SAND

---------- Comments ----------

- VOLATILE SOLIDS 1.3



%

Sand 97.6

Silt 2.4

* * * Corps of Engineers - North Pacific Division Materials Laboratory * * *

YAQUINA RIVER (94-221)

Boring: -- Sample: **YR-3** Depth: -- Lab No.: 22104

------ Sieve Analysis ------

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	578.06	0.0
No. 18	0.33	99.6
No. 35	3.90	95.2
No. 60	46.50	42.5
No. 120	76.50	5.4
No. 230	77.94	3.7
Pan	80.90	0.0

No hydrometer analysis.

Rm 9, 38

$\bar{X} = 0.29$

D85: 0.43 D60: 0.31 D50: 0.27 D30: 0.21 D15: 0.16 D10: 0.14 mm

Cu: 2.18 Cc: 0.99

Liquid Limit: NP Plasticity Index: NP

Fines Type Used for Classification: ML, SILT

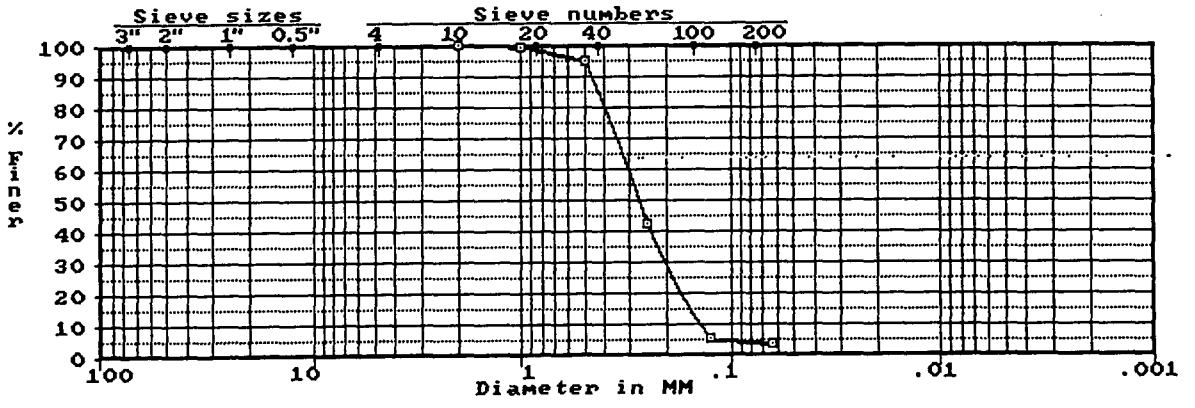
Gravel: 0.0% Sand: 95.9% Fines: 4.1%

---------- ASTM D 2487 Classification ----------

SP Poorly graded SAND

---------- Comments ----------

- VOLATILE SOLIDS 1.7



90

Sand 96.3

Silt 3.7

* * * Corps of Engineers - North Pacific Division Materials Laboratory * * *

YAQUINA RIVER (94-221)

Boring: -- Sample: **YR-4** Depth: -- Lab No.: 22105

------ Sieve Analysis ------

No hydrometer analysis.

Rm 8.66

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	517.16	0.0
No. 18	0.23	99.7
No. 35	0.74	99.0
No. 60	5.08	93.2
No. 120	68.91	8.4
No. 230	72.37	3.8
Pan	75.20	0.0

$\bar{X} = 0.18$

D85: 0.23 D60: 0.19 D50: 0.18 D30: 0.15 D15: 0.13 D10: 0.13 mm

Cu: 1.51 Cc: 0.92

Liquid Limit: NP Plasticity Index: NP

Fines Type Used for Classification: ML, SILT

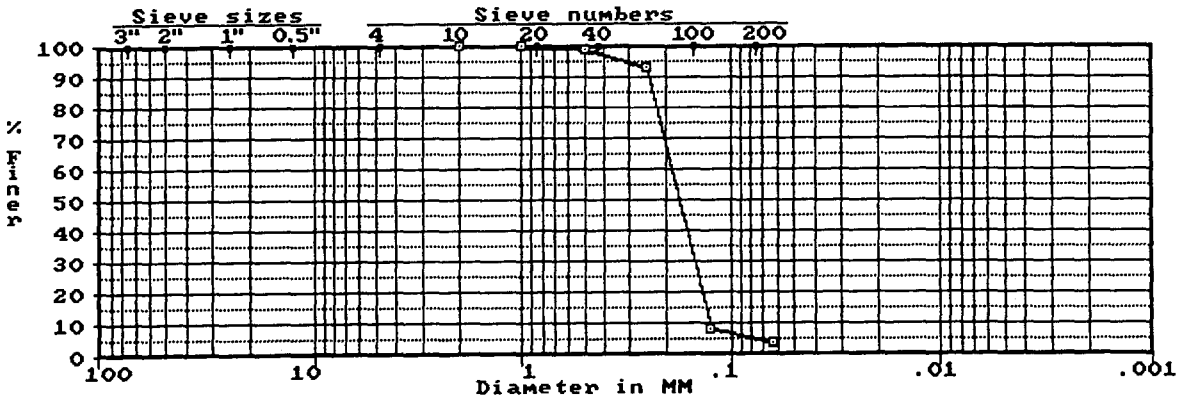
Gravel: 0.0% Sand: 95.0% Fines: 5.0%

---------- ASTM D 2487 Classification ----------

SP Poorly graded SAND

---------- Comments ----------

VOLATILE SOLIDS 2.1



	%
Sand	96.2
Silt	3.8

* * * Corps of Engineers - North Pacific Division Materials Laboratory * * *

YAQUINA RIVER (94-221)

Boring: -- Sample: **YR-5** Depth: -- Lab No.: 22106

------ Sieve Analysis ------

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.64	99.9
No. 10	1.59	99.8
Pan	730.38	0.0
No. 18	0.34	99.4
No. 35	3.70	95.4
No. 60	50.65	40.2
No. 120	80.40	5.2
No. 230	81.89	3.5
Pan	84.83	0.0

No hydrometer analysis.

Rm 7.80

$\bar{x} = 0.29$

D85: 0.43 D60: 0.31 D50: 0.28 D30: 0.21 D15: 0.16 D10: 0.14 mm

Cu: 2.19 Cc: 1.02

Liquid Limit: NP Plasticity Index: NP

Fines Type Used for Classification: ML, SILT

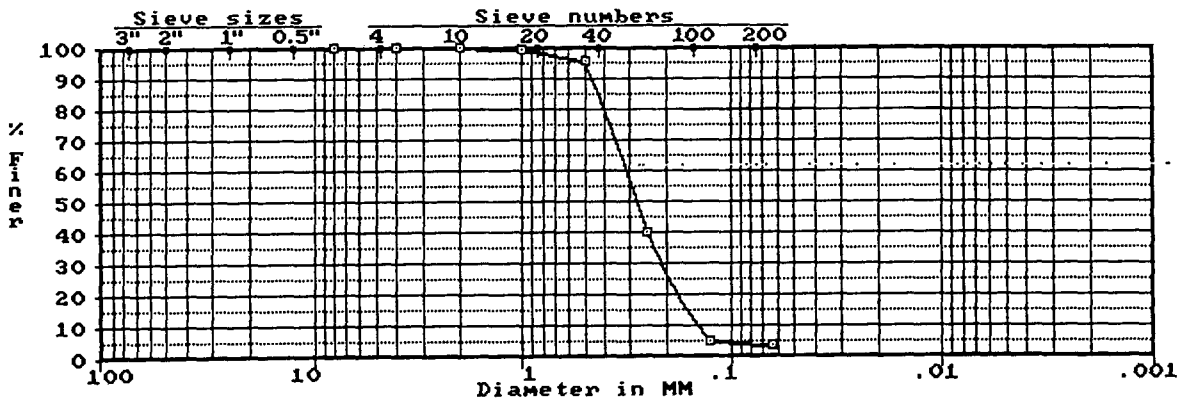
Gravel: 0.0% Sand: 96.0% Fines: 3.9%

---------- ASTM D 2487 Classification ----------

SP Poorly graded SAND

---------- Comments ----------

- VOLATILE SOLIDS 3.7



%

Sand 96.5

Silt 3.5

* * * Corps of Engineers - North Pacific Division Materials Laboratory * * *

YAQUINA RIVER (94-221)

Boring: -- Sample: **YR-6** Depth: -- Lab No.: 22107

------ Sieve Analysis ------

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	523.16	0.0
No. 18	2.28	98.3
No. 35	5.79	95.8
No. 60	65.70	52.0
No. 120	106.80	22.0
No. 230	110.37	19.4
Pan	136.99	0.0

No hydrometer analysis.

Rm 6.53

D85: 0.41 D60: 0.28 D50: 0.24 D30: 0.16 mm

Liquid Limit: NP Plasticity Index: NP

Fines Type Used for Classification: ML, SILT

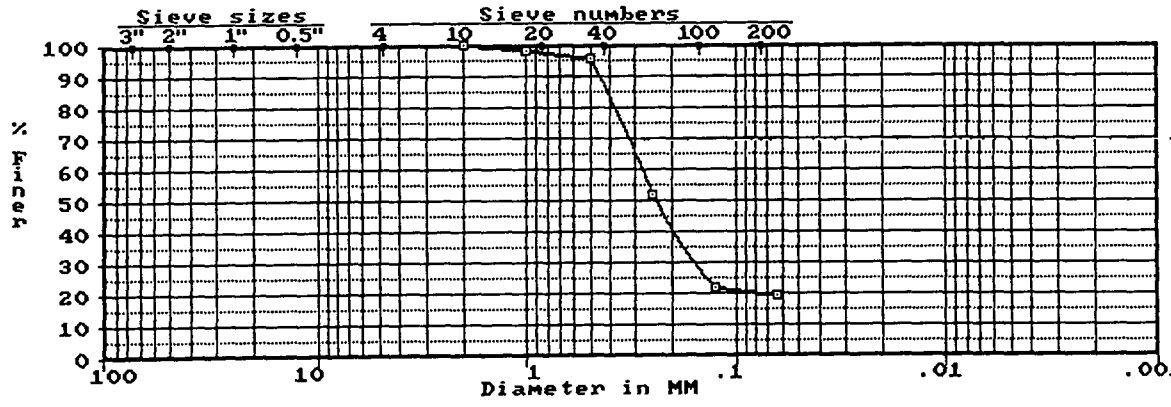
Gravel: 0.0% Sand: 79.9% Fines: 20.1%

---------- ASTM D 2487 Classification ----------

SM Silty SAND

---------- Comments ----------

- VOLATILE SOLIDS 3.5



	%
Sand	80.6
Silt	19.4