Benthic Invertebrates, Sediment Characteristics, and Demersal Fishes Off Cottonwood Island, Columbia River, Before and After Rock Groin Construction, 1987-1988

by George T. McCabe, Jr., Susan A. Hinton, Robert L. Emmett, and Robert J. McConnell

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CONTENTS

	Page
INTRODUCTION	1
METHODS	1
RESULTS	5
Benthic Invertebrates	5
Sediment Characteristics	9
Demersal Fishes	12
DISCUSSION	12
ACKNOWLEDGMENTS	16
LITERATURE CITED	17
APPENDIX	18

INTRODUCTION

In 1987, the National Marine Fisheries Service (NMFS) entered into a cooperative agreement with the U.S. Army Corps of Engineers (COE) to study benthic invertebrates, sediment characteristics, and demersal fishes near pile dikes and rock groins at Cottonwood Island (Dobelbower Bar) in the Columbia River. Pile dikes in the Columbia River are used to help maintain the navigational channel and reduce maintenance dredging costs.

From 1925 to 1969, fifteen wooden pile dikes were constructed along Cottonwood Island (COE 1987). Over the years these pile dikes deteriorated and by 1987 most of the dikes were in poor condition. In early 1987, the COE proposed to replace seven of the pile dikes with submerged rock groins by placing rock along and around the existing pile dikes (COE 1987). Because of the paucity of information about benthic invertebrates and demersal fishes, particularly white sturgeon (<u>Acipenser transmontanus</u>), near the pile dikes, the COE arranged for NMFS to conduct four environmental surveys in the vicinity of the pile dikes and rock groins. Two surveys were to be done prior to rock groin construction and two after construction to assess short-term changes in the benthos and demersal fish community.

METHODS

Four benthic surveys were conducted at six stations near the pile dikes and rock groins along Cottonwood Island; the sampling

stations ranged from River Mile (RM) 68.4 to 70.6 (Fig. 1; Appendix Table 1). The first two surveys, July and November 1987, were prior to the rock-groin construction and the last two, July and December 1988, were after the construction. Construction began in January 1988 and was completed in March 1988. Five benthic invertebrate samples and one sediment sample were collected at each station using a $0.1-m^2$ Van Veen grab sampler (Word 1976). When practical, each benthic invertebrate sample was sieved through a 0.5-mm screen and the residue preserved in a buffered formaldehyde solution (>4%) containing rose bengal, an organic stain. If it appeared that most of the sample would not wash through the sieve, then the entire sample was preserved and sieved at a later time. Later the samples were washed with water and preserved in a 90% ethyl alcohol solution to prevent the destruction of calcareous invertebrate parts by formaldehyde. Each benthic invertebrate sample was sorted and the invertebrates were identified to the lowest practical taxonomic level and counted. Sediment samples were analyzed by the COE (North Pacific Division Materials Laboratory, Troutdale, Oregon) for sediment grain size and percent organic carbon (total volatile solids).

The benthic invertebrate data were analyzed by station. Information calculated for each station included the number of taxa; total number, frequency of occurrence, and mean number/m² and standard deviation (SD) for individuals in each taxon; mean number of invertebrates/sample and SD; and mean number of invertebrates/m²

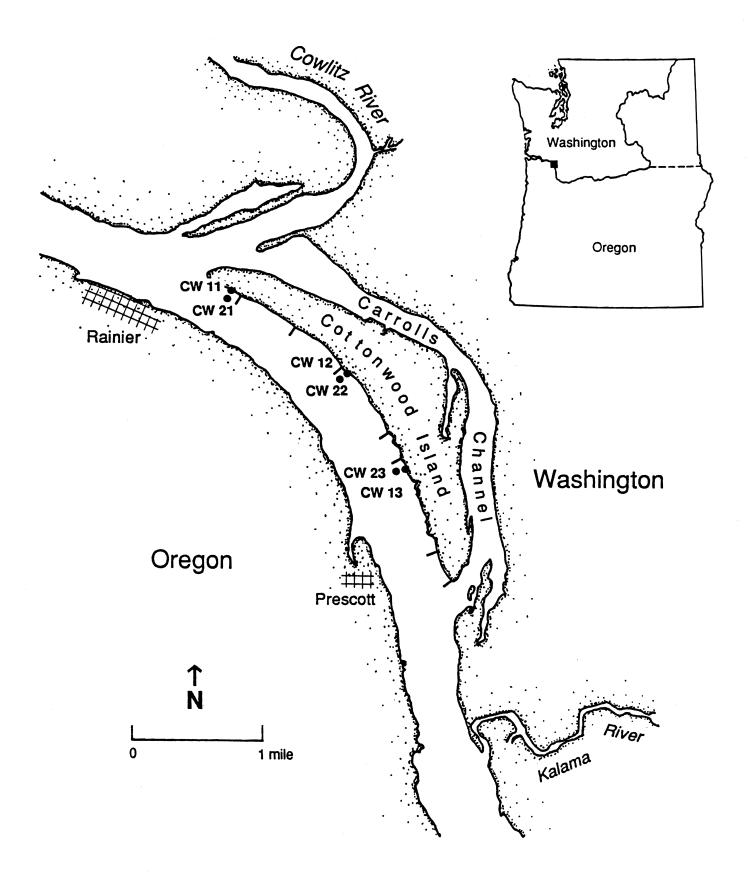


Figure 1.--Locations of the benthic and bottom-trawling stations off Cottonwood Island, Columbia River, 1987-1988. Benthic samples were collected at all six stations; however, trawling was done only at Stations CW21, CW22, and CW23. The seven pile dikes that were replaced with rock groins are indicated with heavy lines.

and SD. Also, two community structure indices were calculated for each station--Shannon-Wiener function (H') (Krebs 1978) and Evenness (J') (Pielou 1966):

$$H' = -\sum_{i=1}^{S} Pi \log_2 Pi$$

$$J' = H' / \log_2 s$$

where Pi = Xa/n (Xa is the number of individuals of a particular species in a sample and n is the total number of individuals in the sample), and s = number of species. The Shannon-Wiener function is a diversity index that incorporates two elements of diversity-number of species and species evenness (Krebs 1978). Evenness is a measure of the equitability of the proportional abundances of various species in the sample.

Total mean numbers (by station) for each survey were compared using a two-sample t-test (unpaired data, assuming unequal variance); the data were transformed to log₁₀ prior to making the comparisons (Elliott 1977). Mean numbers of the amphipod <u>Corophium</u> <u>salmonis</u>, the bivalve <u>Corbicula manilensis</u>, Heleidae larvae, and Oligochaeta were compared by survey (by station for each taxon) using the t-test. The data were transformed to log₁₀ prior to analysis. For Heleidae larvae, the data were transformed to log₁₀ of (number + 1) prior to analysis; 1 was added to the number because of one zero count.

A 4.9-m (headrope length) semiballoon shrimp trawl was used to collect demersal fishes near the pile dikes and rock groins at Cottonwood Island; trawling was done slightly west or southwest of the river ends of the dikes and groins. Mesh size in the body of the trawl was 32 mm (stretched); a 10-mm mesh liner was inserted in the cod end. Also, 10-mm knotless mesh was inserted in the wings and throat of the trawl. Trawl efforts were normally 5 minutes in duration in an upstream direction. Trawling began when the trawl and the proper amount of cable were deployed, and the effort was considered complete after 5 minutes. The distance the net fished was estimated during each sampling effort using a radar rangefinder. Using the distance fished during trawling and the estimated fishing width of the net (3.3 m), the area fished for each effort was calculated. The fish densities (by species) for each effort were calculated and expressed as number/hectare (ha) $(10,000 \text{ m}^2)$. The two community structure indices calculated for benthic invertebrates were also calculated for each trawling effort.

RESULTS

Benthic Invertebrates

Benthic invertebrate densities (total) off Cottonwood Island varied both spatially and temporally (Table 1; Appendix Table 2). Overall, the highest mean densities occurred during Survey 3 (21 July 1988), with densities ranging from 3,780 to 6,506

Table 1.--Summary of benthic invertebrate collections off Cottonwood Island, Columbia River, 1987-1988; five replicates were collected at each station. A mean depth (m) and standard deviation are shown for each station; depths at an individual station varied among surveys.

Station (Depth)	Survey 1 (7-9 Jul 87) Mean no./m² SD		Survey 2 (19 Nov 87) Mean no./m ² SD		Surve (21 Jul Mean no./	88)	Survey 4 (6-7 Dec 88) Mean no./m ² SD	
CW11 (3 <u>+</u> 1)	1,707	2,435	970	469	5,450	2,495	2,407	3,052
CW21 (12 <u>+</u> 2)	3,135	339	1,418	663	5,569	2,618	817	376
CW12 (4 <u>+</u> 2)	3,217	718	50	52	6,506	1,978	1,514	1,123
CW22 (12 <u>+</u> 3)	3,583	2,084	1,989	1,047	3,780	1,372	3,545	4,213
CW13 (4 <u>+</u> 1)	1,149	228	3,719	3,336	3,980	1,844	924	132
CW23 (11 <u>+</u> 2)	876	503	4,206	3,924	4,108	1,033	666	600

invertebrates/m². Within each year, invertebrates tended to be more abundant during July as compared to November and December; numbers were not significantly different for the first year (July vs November), but were significantly different (P < 0.05) for the second year (July vs December) (Table 2). Benthic invertebrate numbers were significantly higher in July 1988 (post-groin construction) than in July 1987 (pre-groin construction); however, there was no significant difference in invertebrate numbers between November 1987 (pre-groin construction) and December 1988 (postgroin construction). For the purposes of this study, the most important comparisons are for corresponding time periods of the two years, since even undisturbed benthic invertebrate populations fluctuate seasonally.

Diversity (H') was higher in July 1988 (mean 1.69) than in July 1987 (mean 1.32), and Evenness (J') values were similar for July 1987 and July 1988 (means 0.46 and 0.42, respectively). The primary reason for the higher diversity in July 1988 was the increase in the number of taxa, since the distribution among individual species abundances (Evenness) was similar in both years. In July 1988, the mean number of taxa collected at each station was 16, whereas in July 1987, the mean number of taxa at each station was 8. Both Diversity (H') and Evenness (J') were higher in December 1988 (means 1.78 and 0.52, respectively) than in November 1987 (means 1.00 and 0.38, respectively). There were two reasons for the higher diversity in December 1988--greater evenness among

Table 2.--Comparisons of benthic invertebrate numbers (by specific taxa and total) for the four surveys off Cottonwood Island, Columbia River; total includes all invertebrates, not just the dominant taxa listed below. T-test values are shown in the table; P values are shown in parentheses. The four surveys were on 7-9 July 1987, 19 November 1987, 21 July 1988, and 6-7 December 1988, respectively. Surveys 1 and 2 were prior to rock-groin construction, and Surveys 3 and 4 were after the construction.

		cisons	Taxon					
vs 4	2 v	75 3	1 v	s 4	3 т	vs 2	1	
(0.24)	1.25	(0.03)	-2.86	(0.01)	3.72	(0.62)	0.52	Corophium salmonis
(0.36)	-0.97	(0.00)	-3.69	(0.41)	-0.89	(0.35)	-1.03	Corbicula manilensis
(0.29)	-1.16	(0.02)	-3.23	(0.00)	7.42	(0.01)	3.78	Heleidae larvae
(0.04)	-2.33	(0.01)	-3.16	(0.24)	1.27	(0.31)	1.08	Oligochaeta
(0.81)	-0.26	(0.02)	-3.38	(0.00)	4.42	(0.46)	0.79	Total
(0)		(0002)		(,		(,		

the species as evidenced by the higher J' in 1988 and an increase in the number of taxa in 1988. In December 1988, the mean number of taxa collected at each station was 11, whereas in November 1987, the mean number of taxa at each station was 7.

The tube-dwelling amphipod Corophium salmonis was by far the dominant benthic invertebrate collected at the Cottonwood Island sites; mean densities ranged from 27 to $3,912/m^2$, with densities frequently exceeding $1,600/m^2$ (Table 3; Appendix Table 2). Other important taxa included the bivalve Corbicula manilensis, Heleidae larvae, and Oligochaeta. Corophium salmonis numbers were significantly higher in July 1988 as compared to December 1988 (P < 0.05), yet numbers in 1987 were not significantly different between July and November (Table 2). Numbers of C. salmonis were significantly higher in July 1988 (post-groin construction) than in July 1987 (pre-groin construction); whereas numbers during the November 1987 (pre-groin construction) and December 1988 (postgroin construction) surveys were not significantly different. Numbers of Corbicula manilensis, Heleidae larvae, and Oligochaeta were significantly higher in July 1988 than in July 1987 (Table 2). Comparing November 1987 and December 1988, numbers of Oligochaeta were significantly higher in 1988.

Sediment Characteristics

Sand was the predominant sediment type at the Cottonwood Island sampling stations; however, gravel was important at some stations (Table 4; Appendix Table 3). Organic content was less

Table 3.--Mean densities (number/m²) of four dominant benthic invertebrate taxa found off Cottonwood Island, Columbia River. The four surveys were on 7-9 July 1987, 19 November 1987, 21 July 1988, and 6-7 December 1988, respectively.

Station	Taxon	Survey 1	Survey 2	Survey 3	Survey 4
CW11	Corophium salmonis	1,094	544	3,912	2,079
	Corbicula manilensis	27	120	71	92
	Heleidae larvae	479	231	903	61
	Oligochaeta	32	57	225	105
CW21	Corophium salmonis	1,774	1,042	3,387	132
	Corbicula manilensis	29	237	128	464
	Heleidae larvae	691	38	867	136
	Oligochaeta	132	8	67	36
CW12	Corophium salmonis	2,230	44	3,805	861
	Corbicula manilensis	34	2	61	97
	Heleidae larvae	735	0	985	105
	Oligochaeta	202	4	1,504	321
CW22	Corophium salmonis	2,690	1,638	2,113	27
	Corbicula manilensis	86	44	281	2,337
	Heleidae larvae	716	67	802	336
	Oligochaeta	38	237	472	682
CW13	Corophium salmonis	794	3,370	2,480	357
	Corbicula manilensis	15,	164	80	31
	Heleidae larvae	279	160	777	223
	Oligochaeta	57	21	445	265
CW23	Corophium salmonis	500	3,547	2,369	242
	Corbicula manilensis	36	422	139	187
	Heleidae larvae	321	132	1,176	80
	Oligochaeta	17	34	275	52

Table 4.--Summary of percent sediment composition at six sampling stations off Cottonwood Island, Columbia River. The four surveys were on 7-9 July 1987, 19 November 1987, 21 July 1988, and 6-7 December 1988, respectively. A mean depth and standard deviation are shown for each station; depths at an individual station varied among surveys.

	Survey 1		Su	Survey 2		Survey 3		Survey 4				
Station (Depth, m)	Gr.*	Sd. [*]	Fn.°	Gr.	sd.	Fn.	Gr.	Sd.	Fn.	Gr.	Sd.	Fn.
CW11 (3 <u>+</u> 1)	32	68	0.	33	66	1	28	71	1	29	70	1
CW21 (12 <u>+</u> 2)	53	47	0	57	41	2	44	56	0	31	67	2
CW12 (4 <u>+</u> 2)	17	82	1	6	94	0	9	91	0	10	89	1
CW22 (12 <u>+</u> 3)	3	96	1	13	86	1	11	88	1	10	90	<1
CW13 (4 <u>+</u> 1)	2	98	0	10	90	0	4	96	0	5	95	<1
CW23 (11 <u>+</u> 2)	33	67	0	59	41	0	47	53	0	69	31	0

• Gr. = gravel; grain size ≥ 2 mm to <64 mm.

^b Sd. = sand; grain size 0.0625 to <2 mm.

° Fn. = fines; grain size <0.0625 mm.

than 1% at all stations during all four surveys. The proportions of gravel, sand, and fines at the three shallower stations (CW11, CW12, and CW13) generally did not change dramatically from survey to survey. At two of the deeper stations (CW21 and CW23), changes in proportions of gravel and sand between surveys were more pronounced than at the shallower stations.

Demersal Fishes

Densities of demersal fishes off Cottonwood Island were relatively low; total densities ranged from 10 to 176 fishes/ha (Table 5; Appendix Table 4). Fishes collected during the surveys included white sturgeon, peamouth (<u>Mylocheilus caurinus</u>), northern squawfish (<u>Ptychocheilus oregonensis</u>), largescale sucker (<u>Catostomus macrocheilus</u>), sand roller (<u>Percopsis transmontana</u>), prickly sculpin (<u>Cottus asper</u>), unidentified Cottidae, and starry flounder (<u>Platichthys stellatus</u>). The mean fish density for July 1988 (mean 130 fish/ha) was somewhat higher than the density for July 1987 (mean 100 fish/ha), and densities for November 1987 (mean 28 fish/ha) and December 1988 (mean 29 fish/ha) were similar. Apparently, juvenile white sturgeon were not utilizing the area to any great degree during the times that we sampled, since only two juvenile sturgeon were collected during the four surveys.

DISCUSSION

Overall, the installation of rock groins along Cottonwood Island did not appear to adversely affect the benthic invertebrate

Station (depth, m)	Total no. captured	No./ha, total	Taxa captured (no./ha)
		Survey 1	(7-9 Jul 1987)
CW21 (17)	5	48	Prickly sculpin (10), Cottidae (38)
CW22 (17)	7	76	Cottidae (76)
CW23 (15)	14	176	White sturgeon (13), prickly sculpin (50), Cottidae (113)
		Survey 2	(19 Nov 1987)
CW21 (18)	3	33	Northern squawfish (11), peamouth (11) starry flounder (11)
CW22 (17)	2	20	White sturgeon (10), peamouth (10)
CW23 (16)	3	30	Peamouth (20), starry flounder (10)
		Survey 3	(21 Jul 1988)
CW21 (16)	9	99	Sand roller (55), prickly sculpin (11) Cottidae (33)
CW22 (17)	17	163	Sand roller (19), largescale sucker (19), prickly sculpin (10), Cottidae (115)
CW23 (15)	14	128	Prickly sculpin (46), Cottidae (82)
		Survey 4	(6-7 Dec 1988)
CW21 (16)	3	27	Peamouth (18), Cottidae (9)
CW22 (16)	1	10	Prickly sculpin (10)
CW23 (14)	5	51	Prickly sculpin (41), peamouth (10)

Table 5.--Catch summaries for fishes collected with a 4.9-m bottom trawl off Cottonwood Island, Columbia River, 1987-1988. There was one trawling effort at each station during each survey. community, at least in the short-term. Because of natural fluctuations in benthic invertebrate populations, variables other than the groin construction, and the short-term sampling, one should be cautious in attributing any specific observations to groin construction. Ideally, the benthos off Cottonwood Island should have been sampled for several years prior to and several years after the construction of the rock groins to accurately assess the effects of construction.

The area along Cottonwood Island (RM 68 to 71) is an important habitat for <u>C</u>. <u>salmonis</u>, as evidenced by the relatively high densities. <u>Corophium salmonis</u> is a common benthic invertebrate in the lower Columbia River (McCabe et al. 1989), yet its densities are often much lower than the densities reported off Cottonwood Island. Mean densities of <u>C</u>. <u>salmonis</u> at subtidal sampling stations between RMs 75 and 79 did not exceed $360/m^2$ during two surveys, April and September 1988 (McCabe et al. 1989). <u>Corophium</u> <u>salmonis</u> is particularly important in the lower Columbia River and its estuary as food for a variety of fishes, including juvenile Pacific salmon (<u>Oncorhynchus</u> spp.) and juvenile white sturgeon (McCabe et al. 1983; Kirn et al. 1986; Muir et al. 1988).

Results from the November 1987 and December 1988 trawling surveys near Cottonwood Island were consistent with trawling by NMFS in the same general area in November 1989 (unpublished data). Fish densities in 1989 were relatively low, averaging 34 fish/ha (range 11 to 69 fish/ha); during the 1987-1988 fall surveys,

densities were also low, averaging 28 fish/ha (range 20 to 33 fish/ha) and 29 fish/ha (range 10 to 51 fish/ha), respectively. A 7.9-m semiballoon trawl was used in 1989 instead of the 4.9-m semiballoon trawl used in 1987 and 1988. Seven juvenile white sturgeon were collected in three trawling efforts in 1989, compared to the two captured during the four surveys in 1987 and 1988. Four of the sturgeon collected in 1989 were young-of-the-year; one young-of-the-year sturgeon was collected in November 1987. It should be noted that all NMFS trawling was done during the day. Fish numbers during darkness could be considerably different than during the day.

It appears from NMFS sampling that the installation of rock groins along Cottonwood Island did not adversely affect the benthic invertebrate and demersal fish communities. This sampling addressed only short-term effects of rock-groin construction on the benthic invertebrate and demersal fish communities. Additional sampling over a period of several years would be needed to determine long-term changes. Also, this study should be viewed as a site-specific study. Construction of rock groins at other locations in the Columbia River should be considered and studied on a site-specific basis.

This report does not constitute NMFS' formal comments under the Fish and Wildlife Coordination Act or the National Environmental Policy Act.

ACKNOWLEDGMENTS

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APPENDIX

Data Tables

	Benthic	stations	
Station	Latitude	Longitude	
CW11	46° 05' 28''N.	122° 54' 59''W.	
CW21	46° 05' 26''N.	122° 55' 00''W.	
CW12	46° 04' 51''N.	122° 53' 45''W.	
CW22	46° 04' 50''N.	122° 53' 48''W.	
CW13	46° 04' 06''N.	122° 53' 04''W.	
CW23	46° 04' 05''N.	122° 53' 06''W.	

Appendix Table 1.--Locations of benthic and bottom trawling stations off Cottonwood Island, Columbia River, 1987-1988.

Trawl stations

Station	Latitude	Longitude
CW21	46° 05' 26''N.	122° 55' 00''W.
CW22	46° 04' 50''N.	122° 53' 48''W.
CW23	46° 04' 05''N.	122° 53' 06''W.

Station: CW11 Date: Depth: 3.4 m	7 Jul 87	Sam	ple size:	5
Taxon	Total number	Frequency of occurrence (%)		Standard deviation /m ²
Oligochaeta	15	60.0	31.5	38.6
Corbicula manilensis	13	80.0	27.3	19.0
Ostracoda	1	20.0	2.1	4.7
<u>Corophium salmonis</u>	521	100.0	1,094.1	1,850.0
Cladocera	2	20.0	4.2	9.4
<u>Bosmina</u> sp.	5	20.0	10.5	23.5
<u>Daphnia</u> sp.	2	20.0	4.2	9.4
Calanoida	16	60.0	33.6	52.7
Cyclopoida	6	40.0	12.6	18.8
Harpacticoida	1	20.0	2.1	4.7
Chironomidae pupae	3	20.0	6.3	14.0
Heleidae larvae	228	100.0	478.8	413.5
Number of taxa: 12				
Mean number/sample: 162.6	St	andard deviat	ion (SD):	231.9
Mean number/m ² : 1,707.3	SD	/m ² : 2,434.6		
H' = 1.43 $J' = 0.40$				

Appendix Table 2.--Summaries of benthic invertebrate collections off Cottonwood Island, Columbia River, 1987-1988. Two community structure indices -- H' and J' -- were calculated for each station; see Methods for descriptions of indices.

Station: CW21 Date:	7 Jul 87	Sam	ple size:	5
Depth: 8.5 m Taxon	Total number	Frequency of occurrence (%)		Standard deviation /m²
Oligochaeta	63	100.0	132.3	86.5
<u>Corbicula manilensis</u>	14	100.0	29.4	8.8
Ostracoda	2	40.0	4.2	5.8
<u>Corophium salmonis</u>	845	80.0	1,774.5	•
Isopoda	236	20.0	495.6	1,108.2
Chironomidae pupae	4	60.0	8.4	8.8
Heleidae larvae	329	100.0	690.9	131.0
Number of taxa: 7				
Mean number/sample: 298.6	S	tandard deviat	ion (SD):	32.3
Mean number/m ² : 3,135.3	SI	D/m ² : 339.2		
H' = 1.66 J' = 0.59				

Station: CW12 Depth: 5.8 m	Date: 9	Jul 87	Sam	ple size:	5
Taxon		Total number	Frequency of occurrence (%)	_	Standard deviation /m ²
<u>Neanthes</u> <u>limnicola</u> Oligochaeta <u>Corbicula manilensis</u> Ostracoda <u>Eogammarus confervicolus</u> <u>Corophium salmonis</u> Chironomidae larvae Chironomidae pupae Heleidae larvae		1 96 16 1 1,062 2 3 350	20.0 100.0 20.0 20.0 100.0 20.0 40.0 100.0	2.1201.633.62.12.12,230.24.26.3735.0	$\begin{array}{r} 4.7\\ 96.6\\ 15.6\\ 4.7\\ 4.7\\ 391.9\\ 9.4\\ 9.4\\ 258.4 \end{array}$
Number of taxa: 9 Mean number/sample: 306 Mean number/m ² : $3,217.2$ H' = 1.22 J' = 0.39			andard deviat /m²: 718.0	ion (SD):	68 .4

Station: CW22 Dat Depth: 9.8 m	e: 9 Jul 87	Sam	ple size:	5
	Total	Frequency of	Mean	Standard
Taxon	number	occurrence (%)	number /m²	deviation /m ²
Nematoda	· 1	20.0	2.1	4.7
Oligochaeta	18	40.0	37.8	59.7
<u>Corbicula manilensis</u>	41	100.0	86.1	51.1
Ostracoda	6	60.0	12.6	17.2
<u>Corophium</u> <u>salmonis</u>	1,281	100.0	2,690.1	1,590.4
Cladocera	5	40.0	10.5	18.2
<u>Bosmina</u> sp.	1	20.0	2.1	4.7
<u>Daphnia</u> sp.	5	60.0	10.5	10.5
Calanoida	3	40.0	6.3	9.4
Chironomidae larvae	1	20.0	2.1	4.7
Chironomidae pupae	3	40.0	6.3	9.4
Heleidae larvae	341	100.0	716.1	488.0
Number of taxa: 12				
Mean number/sample: 341.2	St	andard deviat	ion (SD):	198.4
Mean number/m ² : 3,582.6	SD)/m²: 2,083.6		
H' = 1.10 J' = 0.31				

Station: CW13 Date:	9 Jul 87	Sample size: 5		
Depth: 4.0 m Taxon	Total number	Frequency of occurrence (%)	_	Standard deviation /m ²
Oligochaeta Corbicula manilensis	27 7	100.0 60.0	56.7 14.7	52.3 15.9
Corophium salmonis	378	100.0	793.8	181.0
Chironomidae pupae	2	40.0	4.2	5.8
Heleidae larvae	133	100.0	279.3	113.2
Number of taxa: 5				
Mean number/sample: 109.4	St	andard deviati:	on (SD):	21.8
Mean number/m ² : 1,148.7	SI)/m²: 228.4		
H' = 1.19 J' = 0.51				

Station: CW23 Depth: 10.4 m Taxon	Date:	9 Jul 87	Sample size: 5		
		Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m²
Oligochaeta Corbicula manilensis		8 17	40.0 100.0	16.8 35.7	27.4 17.6
<u>Corophium salmonis</u> Chironomidae larvae		238 1	100.0 20.0	499.8 2.1	332.8 4.7
Heleidae larvae		153	80.0	321.3	283.5
Number of taxa: 5					
Mean number/sample: 8	3.4	St	andard deviati	on (SD):	47.9
Mean number/m ² : 875.7		SD	/m ² : 503.0		
H' = 1.31 J' = 0.56					

Station: CW11 Depth: 2.4 m	ate: 19 Nov 87	Sam	Sample size: 5		
Taxon	Total number	• •	Mean number /m²	Standard deviation /m²	
<u>Hydra</u> sp.	1	20.0	2.1	4.7	
Oligochaeta	27	80.0	56.7	48.5	
<u>Corbicula</u> <u>manilensis</u>	57	100.0	119.7	99.0	
<u>Corophium</u> <u>salmonis</u> Cladocera	259 6	100.0 20.0	543.9 12.6	284.3 28.2	
<u>Bosmina</u> sp.	1	20.0	2.1	4.7	
Calanoida	1	20.0	2.1	4.7	
Heleidae larvae	110	80.0	231.0	440.8	
Number of taxa: 8					
Mean number/sample: 92.	4 :	Standard deviat	ion (SD):	44.7	
Mean number/m ² : 970.2	5	SD/m ² : 469.4			
H' = 1.71 J' = 0.57					

	9 Nov 87	Sample size: 5		
Depth: 12.8 m Taxon	Total number	Frequency of occurrence (%)		Standard deviatior /m²
<u>Hydra</u> sp.	1	20.0	2.1	4.7
Oligochaeta	4	60.0	8.4	8.8
Corbicula manilensis	113	100.0	237.3	163.6
Eogammarus confervicolus	2	20.0	4.2	9.4
Corophium salmonis	496	100.0	1,041.6	492.3
<u>Corophium</u> <u>spinicorne</u> Heleidae larvae	38 18	60.0 60.0	79.8 37.8	107.2 67.5
Ephemeroptera	3	20.0	6.3	14.1
Number of taxa: 8				
Mean number/sample: 135.0	St	andard deviat	ion (SD):	63.1
Mean number/m ² : 1,417.5	SI)/m ² : 663.0		
H' = 1.25 J' = 0.42				

	te: 19 Nov 87	Samp	le size:	5
Depth: 1.5 m Taxon	Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m ²
Oligochaeta <u>Corbicula</u> <u>manilensis</u> <u>Corophium</u> <u>salmonis</u>	2 1 21	40.0 20.0 100.0	4.2 2.1 44.1	5.8 4.7 53.2
Number of taxa: 3				
Mean number/sample: 4.8	St	andard deviati	on (SD):	5.0
Mean number/m ² : 50.4 H' = 0.66 J' = 0.42	SD)/m ² : 52.2		

Station: CW22 Date: Depth: 7.9 m	19 Nov 87	Sam	ple size:	5
Taxon	Total number	Frequency of occurrence (%)	-	Standard deviation /m ²
Oligochaeta <u>Corbicula</u> <u>manilensis</u> <u>Eogammarus confervicolus</u> <u>Corophium</u> <u>salmonis</u> Heleidae larvae	113 21 1 780 32	100.0 100.0 20.0 100.0 100.0	237.3 44.1 2.1 1,638.0 67.2	164.0 20.2 4.7 1,247.8 58.7
Number of taxa: 5 Mean number/sample: 189.4 Mean number/m ² : 1,988.7 H' = 0.89 J' = 0.38		andard deviat)/m ² : 1,047.2	• • • • •	99.7

	:e: 19 Nov 87	Sa	Sample size: 5		
Depth: 2.7 m Taxon	Total numbe		_	Standard deviation /m ²	
Oligochaeta <u>Corbicula manilensis</u> <u>Corophium salmonis</u> Calanoida Chironomidae larvae Heleidae larvae	10 78 1,605 1 1 76	100.0 100.0 20.0 20.0	21.0 163.8 3,370.5 2.1 2.1 159.6	4.7	
Number of taxa: 6 Mean number/sample: 354.2 Mean number/m ² : 3,719.1		Standard devia SD/m ² : 3,336.	• • •	317.7	
H' = 0.58 J' = 0.22		SD/Щ-: 3,330.	2		

	19	Nov 87	Samj	ple size:	5
Depth: 9.1 m Taxon		Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m ²
Oligochaeta		16	80.0	33.6	29.1
Corbicula manilensis		201	100.0	422.1	164.9
Corophium salmonis		1,689	100.0	3,546.9	3,925.0
Corophium spinicorne		15	40.0	31.5	64.7
Isopoda		1	20.0	2.1	4.7
<u>Bosmina</u> sp.		2	40.0	4.2	5.8
Calanoida		2	40.0	4.2	5.8
Cyclopoida		1	20.0	2.1	4.7
Chironomidae larvae		12	40.0	25.2	37.6
Heleidae larvae		63	80.0	132.3	162.9
Homoptera		1	20.0	2.1	4.7
Number of taxa: 11					
Mean number/sample: 400.6		St	andard deviat:	ion (SD):	373.7
Mean number/m ² : 4,206.3		SD	/m ² : 3,924.0		
H' = 0.89 J' = 0.26					

Station: CW11 Dat Depth: 4.9 m	te: 21 Jul 88	Sam	ple size:	5
Taxon	Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m²
Nemertea	2	20.0	4.2	9.4
Nematomorpha	13	100.0	27.3	12.0
Turbellaria	6	40.0	12.6	22.8
<u>Neanthes</u> <u>limnicola</u>	5	40.0	10.5	18.2
Oligochaeta	107	100.0	224.7	118.2
<u>Corbicula manilensis</u>	34	100.0	71.4	38.9
Ostracoda	40	100.0	84.0	59.9
<u>Neomysis mercedis</u>	1	20.0	2.1	4.7
<u>Corophium</u> <u>salmonis</u>	1,863	100.0	3,912.3	1,830.6
<u>Corophium</u> <u>spinicorne</u>	7	60.0	14.7	21.8
<u>Daphnia</u> sp.	8	80.0	16.8	20.5
Cyclopoida	11	80.0	23.1	17.2
Diptera adults	1	20.0	2.1	4.7
Chironomidae larvae	10	60.0	21.0	22.3
Chironomidae pupae	50	100.0	105.0	53.5
Heleidae larvae	430	100.0	903.0	504.7
Odonata	2	40.0	4.2	5.8
Ephemeroptera	1	20.0	2.1	4.7
Hydracarina	4	40.0	8.4	11.5
Number of taxa: 19				
Mean number/sample: 519.0	S	tandard deviat	ion (SD):	237.6
Mean number/m²: 5,449.5	SI	D/m ² : 2,495.2		
H' = 1.48 J' = 0.35				

	21 Jul 88	Samj	ple size:	5
Depth: 13.4 m	Total	Frequency of	Mean	Standard
Faxon	number	occurrence (%)	number /m ²	deviation /m ²
Turbellaria	3	40.0	6.3	9.4
Oligochaeta	32	80.0	67.2	50.7
Corbicula manilensis	61	100.0	128.1	98.9
Ostracoda	4	60.0	8.4	8.8
<u>Corophium</u> spp.	65	40.0	136.5	195.0
<u>Corophium salmonis</u>	1,613	100.0	3,387.3	1,401.4
<u>Corophium spinicorne</u>	371	80.0	779.1	1,649.0
<u>Ramellogammarus</u> <u>oregonensis</u>	18	40.0	37.8	78.8
<u>Daphnia</u> sp.	29	60.0	60.9	71.4
Cyclopoida	6	40.0	12.6	17.2
Diptera adults	3	40.0	6.3	9.4
Chironomidae larvae	6	40.0	12.6	17.2
Chironomidae pupae	28	100.0	58.8	44.3
Heleidae larvae	413	100.0	867.3	291.7
Number of taxa: 14				
Mean number/sample: 530.4	St	andard deviat	ion (SD):	249.3
Mean number/m ² : 5,569.2	SD	/m ² : 2,617.9		
H' = 1.85 $J' = 0.49$				

Station: CW12 I Depth: 3.7 m	ate: 21	Jul 88	Samj	ple size:	5
Taxon		Total number	Frequency of occurrence (%)		Standard deviation /m²
Nemertea		1	20.0	2.1	4.7
Nematomorpha		5	60.0	10.5	12.9
Turbellaria		2	20.0	4.2	9.4
<u>Neanthes limnicola</u>		4	20.0	8.4	18.8
Oligochaeta		716	100.0	1,503.6	1,044.3
<u>Corbicula manilensis</u>		29	100.0	60.9	31.8
Ostracoda		1	20.0	2.1	4.7
<u>Neomysis</u> mercedis		1	20.0	2.1	4.7
<u>Corophium</u> <u>salmonis</u>		1,812	100.0	3,805.2	1,221.1
<u>Corophium</u> <u>spinicorne</u>		3	20.0	6.3	14.1
Daphnia sp.		9	60.0	18.9	26.1
Cyclopoida		11	100.0	23.1	11.5
Diptera adults		4	40.0	8.4	13.7
Chironomidae larvae		8	80.0	16.8	15.9
Chironomidae pupae Heleidae larvae		22	100.0	46.2	19.1
Hydracarina		469 1	100.0 20.0	984.9	201.9
nyuracarina		T	20.0	2.1	4.7
Number of taxa: 17					
Mean number/sample: 619	6	St	andard deviat:	ion (SD):	188.4
Mean number/m ² : 6,505.8		SD	/m²: 1,978.2		
H' = 1.61 J' = 0.39					

Station: CW22 Dat Depth: 14.0 m	e: 21	Jul 88	Sam	ple size:	5
pohous TISA m		Total	Frequency of	Mean	Standard
Taxon		number	occurrence (%)	number /m ²	deviation /m ²
Nematomorpha		3	40.0	6.3	9.4
Turbellaria		7	60.0	14.7	14.1
Oligochaeta		225	100.0	472.5	283.2
<u>Corbicula manilensis</u>		134	100.0	281.4	151.3
Ostracoda		1	20.0	2.1	4.7
<u>Corophium</u> spp.		5	20.0	10.5	23.5
<u>Corophium</u> <u>salmonis</u>		1,006	100.0	2,112.6	890.7
<u>Corophium</u> <u>spinicorne</u>		2	40.0	4.2	5.8
<u>Daphnia</u> sp.		5	40.0	10.5	14.8
Cyclopoida		8	60.0	16.8	21.8
Diptera adults		1	20.0	2.1	4.7
Chironomidae larvae		8	100.0	16.8	5.8
Chironomidae pupae		11	60.0	23.1	28.2
Heleidae larvae		382	100.0	802.2	323.3
Arachnida		2	40.0	4.2	5.8
Number of taxa: 15					
Mean number/sample: 360.0		St	andard deviat:	ion (SD):	130.7
Mean number/m ² : 3,780.0		SD	/m ² : 1,372.0		
H' = 1.84 $J' = 0.47$					

Station: CW13 Da Depth: 4.0 m	te: 21	Jul 88	Sam	ple size:	5
		Total	Frequency of	Mean	Standard
Taxon		number	occurrence	number	deviation
			(%)	/ m²	/m²
Nematomorpha		4	40.0	8.4	13.7
Neanthes limnicola		1	20.0	2.1	4.7
Oligochaeta		212	100.0	445.2	479.2
Corbicula manilensis		38	100.0	79.8	26.4
Corophium salmonis		1,181	100.0	2,480.1	1,115.0
Corophium spinicorne		7	80.0	14.7	15.9
Daphnia sp.		4	60.0	8.4	8.8
Cyclopoida		3	60.0	6.3	5.8
Diptera adults		2	40.0	4.2	5.8
Chironomidae larvae		64	60.0	134.4	209.7
Chironomidae pupae		7	60.0	14.7	21.8
Heleidae larvae		370	80.0	777.0	505.9
Odonata		1	20.0	2.1	4.7
Ephemeroptera		1	20.0	2.1	4.7
Number of taxa: 14					
Mean number/sample: 379.0		St	andard deviat	ion (SD):	175.6
Mean number/m ² : 3,979.5		SD	/m²: 1,843.7		
H' = 1.66 $J' = 0.44$					

Station: CW23 Date: Depth: 12.8 m	21 Jul 8	8 Sa	mple size:	5
Taxon	Tota numb	• •		Standard deviatior /m²
Nematomorpha	1	.4 100.0	29.4	26.1
Oligochaeta	13	1 100.0	275.1	221.2
Corbicula manilensis	6	6 80.0	138.6	98.9
Amphipoda (Gammaridae)		1 20.0	2.1	4.7
Corophium spp.	1	.1 60.0	23.1	23.9
Corophium salmonis	1,12	100.0	2,368.8	726.6
Corophium spinicorne	1	.0 80.0	21.0	24.6
<u>Ramellogammarus</u> sp.		1 20.0	2.1	4.7
<u>Daphnia</u> sp.		9 80.0	18.9	11.5
Cyclopoida		5 60.0	10.5	12.9
Tipulidae larva		1 20.0	2.1	4.7
Chironomidae larvae		6 80.0	12.6	11.5
Chironomidae pupae		9 100.0	18.9	8.8
Heleidae larvae	56		1,176.0	193.2
Homoptera		2 40.0	4.2	5.8
Collembola		1 20.0	2.1	4.7
Arachnida		1 20.0	2.1	4.7
Number of taxa: 17				
Mean number/sample: 391.2		Standard devia	tion (SD):	98.4
Mean number/m ² : 4,107.6		SD/m ² : 1,032.	6	
H' = 1.69 J' = 0.41				

Station: CW11 Date: Depth: 1.8 m	6 Dec 88	Sam	ple size:	5
Taxon	Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m ²
Nemertea	4	60.0	8.4	8.8
Hydra sp.	3	40.0	6.3	9.4
Turbellaria	6	40.0	12.6	18.8
Oligochaeta	50	100.0	105.0	77.9
<u>Corbicula manilensis</u>	44	100.0	92.4	120.0
Ostracoda	2	40.0	4.2	5.8
<u>Corophium</u> spp.	8	60.0	16.8	21.8
Corophium salmonis	990	100.0	2,079.0	2,849.6
Corophium spinicorne	3	20.0	6.3	14.1
Ramellogammarus oregonensis	3	20.0	6.3	14.1
Cyclopoida	1	20.0	2.1	4.7
Diptera larvae	1	20.0	2.1	4.7
Chironomidae larvae	2	20.0	4.2	9.4
Heleidae larvae	29	80.0	60.9	75.9
Number of taxa: 14				
Mean number/sample: 229.2	St	andard deviat	ion (SD):	290.7
Mean number/m ² : 2,406.6	SI)/m ² : 3,052.0		
H' = 0.93 $J' = 0.24$				

	:e: 6	Dec 88	Samp	le size:	5
Depth: 13.4 m Taxon		Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m ²
Nemertea Nematomorpha Turbellaria Oligochaeta <u>Corbicula manilensis</u> <u>Corophium spp. Corophium salmonis <u>Corophium spinicorne</u> Heleidae larvae</u>		15 2 2 17 221 2 63 2 65	100.0 40.0 20.0 100.0 100.0 40.0 100.0 40.0 100.0	31.5 4.2 4.2 35.7 464.1 4.2 132.3 4.2 136.5	47.0 5.8 9.4 17.6 339.4 5.8 85.8 5.8 85.8 5.8
Number of taxa: 9 Mean number/sample: 77.8 Mean number/m ² : 816.9 H' = 1.85 J' = 0.59			andard deviati)/m²: 376.5	on (SD):	35.9

Station: CW12 Date: Depth: 4.3 m	7 Dec 88	Samp	le size:	5
Taxon	Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m ²
Nemertea	33	100.0	69.3	59.7
Nematomorpha	3	60.0	6.3	5.8
<u>Hydra</u> sp.	1	20.0	2.1	4.7
Turbellaria	19	100.0	39.9	42.9
Oligochaeta	153	100.0	321.3	158.8
<u>Corbicula</u> <u>manilensis</u>	46	100.0	96.6	59.1
<u>Corophium</u> spp.	1	20.0	2.1	4.7
<u>Corophium</u> <u>salmonis</u>	410	100.0	861.0	1,004.7
<u>Corophium</u> <u>spinicorne</u>	2	20.0	4.2	9.4
Chironomidae larvae	3	40.0	6.3	9.4
Heleidae larvae	50	100.0	105.0	107.8
Number of taxa: 11				
Mean number/sample: 144.2	St	andard deviation	on (SD):	106.9
Mean number/m ² : 1,514.1	SD	/m²: 1,122.6		
H' = 1.92 J' = 0.55				

Station: CW22 Date: Depth: 15.2 m	7 Dec 88	Sam	ple size:	5
Taxon	Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m ²
Nemertea	25	100.0	52.5	47.5
Nematomorpha	1	20.0	2.1	4.7
<u>Hydra</u> sp.	3	60.0	6.3	5.8
Turbellaria	45	100.0	94.5	45.8
Oligochaeta	325	100.0	682.5	580.8
<u>Corbicula</u> <u>manilensis</u>	1,113	100.0	2,337.3	4,358.2
<u>Corophium</u> <u>salmonis</u>	13	60.0	27.3	44.3
<u>Corophium</u> <u>spinicorne</u>	1	20.0	2.1	4.7
Chironomidae larvae	1	20.0	2.1	4.7
Heleidae larvae	160	100.0	336.0	435.7
Ephemeroptera	1	20.0	2.1	4.7
Number of taxa: 11				
Mean number/sample: 337.6	St	andard deviat	ion (SD):	401.2
Mean number/m ² : 3,544.8	SI)/m ² : 4,213.2		
H' = 1.50 $J' = 0.43$				

	ate: 7 Dec 88	Samp	le size:	5
Depth: 4.3 m Taxon	Total number	Frequency of occurrence (%)	Mean number /m²	Standard deviation /m ²
Nemertea Nematomorpha Turbellaria Oligochaeta <u>Corbicula manilensis</u> <u>Corophium salmonis</u> Cyclopoida Heleidae larvae Lamprey	10 1 10 126 15 170 1 106 1	80.0 20.0 80.0 100.0 100.0 20.0 100.0 20.0	21.0 2.1 21.0 264.6 31.5 357.0 2.1 222.6 2.1	19.6 4.7 19.6 92.3 19.6 109.6 4.7 110.2 4.7
Number of taxa: 9 Mean number/sample: 88. Mean number/m ² : 924.0 H' = 2.02 J' = 0.64		andard deviati)/m²: 131.8	on (SD):	12.6

Station: CW23 Date: Depth: 13.1 m	7 Dec 88	Samp	le size:	5
Taxon	Total number	Frequency of occurrence (%)	Mean number /m ²	Standard deviatior /m ²
Nemertea	15	60.0	31.5	44.6
<u>Hydra</u> sp.	2	20.0	4.2	9.4
Turbellaria	10	20.0	21.0	47.0
Oligochaeta	25	80.0	52.5	94.2
<u>Corbicula</u> <u>manilensis</u>	89	100.0	186.9	164.6
<u>Corophium</u> spp.	1	20.0	2.1	4.7
<u>Corophium</u> <u>salmonis</u>	115	100.0	241.5	232.4
<u>Corophium</u> <u>spinicorne</u>	16	60.0	33.6	45.4
<u>Ramellogammarus</u> <u>oregonensis</u>	2	20.0	4.2	9.4
Chironomidae larvae	1	20.0	2.1	4.7
Heleidae larvae	38	80.0	79.8	114.2
Ephemeroptera	1	20.0	2.1	4.7
Number of taxa: 12				
Mean number/sample: 63.4	St	andard deviati	on (SD):	57.1
Mean number/m ² : 665.7	SD	/m ² : 599.8		
H' = 2.45 $J' = 0.68$				

Date : 19 Nov 1987 System : Columbia River System : Columbia River Date : 7 Jul 1987 Depth : 2.4 m Project: Cottonwood Island Depth : 3.4 m Project: Cottonwood Island --Method: 0.1-m2 Van Veen Station: CW11 Method: 0.1-m2 Van Veen Station: Cill ... **U.S.Sieve** Percent Percent Percent by size U.S.Sieve | Percent Percent Percent by size ... Pan # Phi ! finer retained classification Pan # Phi ! finer retained classification Size m Size m ** 64 mm 2-1/2 in -6 | 100.0 0.0 0.0 % Rubble 0.0 0.0 % Rubble 64 mm 2-1/2 in -6 ! 100.0 32 mm 1-1/4 in -5 ! 100.0 0.0 & Coarse gravel 32 mm 1-1/4 in -5 | 100.0 0.0 0.0 & Coarse gravel 0.0 5/8 in -4 ! 100.0 0.0 16 m 16 m 5/8 in -4 | 99.0 1.0 2.0 2.0 % Medium gravel 8 mm 5/16 in -3 ; 8 mm 5/16 in -3 ! 98.0 97.0 2.0 3.0 % Medium gravel No. 5 -2 | No. 5 -2 | 85.0 13.0 4 mm 87.0 10.0 4 100 10 -1 ! 10 -1 ! 68.0 19.0 2 100 67.0 18.0 31.0 % Fine gravel 2 m 29.0 % Fine gravel ... 0! 50.0 18.0 18 0 ! 51.0 16.0 1 100 18 1 mm ... 33.0 17.0 1! 36.0 15.0 31.0 Coarse sand 0.5 mm 35 1 | 35.0 % Coarse sand 0.5 mm 35 20.0 % Medium sand 0.25 m 60 2 ! 16.0 17.0 17.0 % Medium sand 0.25 🚥 60 2 ! 16.0 20.0 .. 0.125 📠 120 3 ! 4.0 12.0 0.125 mm 120 3 ! 4.0 12.0 ... 0.0625 mm 230 4.0 0.0625 mm 230 4 ! 3.0 15.0 % Fine sand 4 ! 0.0 16.0 % Fine sand 1.0 ... <.0625 mm <230 0.0 0.0 % Silt/clay <.0625 mm <230 1.0 1.0 % Silt/clay ? Gravel = 32.0 \$ Organics Gravel = 33.0 \$ 0.3 % Organics ... Sand = 68.0 \$ 66.0 \$ Sand = .. Fines = 0.0 \$ 1.0 \$ Fines = ----... System : Columbia River Date : 21 Jul 1988 System : Columbia River Date : 6 Dec 1988 Project: Cottonwood Island Depth: 4.9 m Project: Cottonwood Island Depth : 1.8m ... Station: CW11 Method: 0.1-m2 Van Veen Station: CW11 Method: 0.1-m2 Van Veen ... U.S.Sieve ! Percent Percent Percent by size Percent Percent U.S.Sieve Percent by size Pan # Phi | finer retained Size m classification Pan # Phi ! finer retained Size m classification 64 mm 2-1/2 in -6 | 100.0 0.0 0.0 % Rubble 64 mm 2-1/2 in -6 ! 100.0 0.0 0.0 % Rubble 32 mm 1-1/4 in -5 | 100.0 0.0 0.0 % Coarse gravel 32 mm 1-1/4 in -5 ! 100.0 0.0 0.0 & Coarse gravel 16 mm 5/8 in -4 ! 96.0 4.0 16 m 5/8 in -4 ! 99.0 1.0 8 mm 5/16 in -3 ! 93.0 3.0 8 mm 5/16 in -3 ! 96.7 2.3 7.0 % Medium gravel 3.3 & Medium gravel ... No. 5 -2 ! 4 mm 84.0 9.0 4 mm No. 5 -2 | 84.8 11.9 .. 2 🔳 10 -1 ! 72.0 12.0 21.0 \$ Fine gravel 2 mm 10 -1 ! 70.9 13.9 25.8 % Fine gravel . . 56.0 1 m 18 0 ! 16.0 1 m 18 0 ! 61.4 9.5 ... 0.5 = 38.0 35 1! 18.0 34.0 & Coarse sand 35 51.3 19.6 & Coarse sand 0.5 📷 1! 10.1 .. 0.25 mm 60 2 ! 24.0 14.0 14.0 % Medium sand 17.3 % Medium sand 0.25 mm 60 2 ! 34.0 17.3 0.125 📠 120 3 ! 10.0 14.0 0.125 mm 120 25.3 3 ! 8.7 230 0.0625 mm 4 1 1.0 9.0 23.0 % Fine sand 0.0625 mm 230 4 ! 1.3 7.4 32.7 % Fine sand <.0625 mm <230 1.0 1.0 % Silt/clay <.0625 mm 1.3 <230 1.3 % Silt/clay Gravel = 28.0 \$? § Organics Gravel = 29.1 \$ 0.6 % Organics Sand = 71.0 \$ Sand = 69.6 \$ 1.0 \$... Fines = Pines = 1.3 \$

Appendix Table 3.--Summaries of sediment characteristics off Cottonwood Island, Columbia River, 1987-1988.

Date : 19 Nov 1987 Date : 7 Jul 1987 System : Columbia River System : Columbia River Project: Cottonwood Island Depth : 12.8 m Depth : 8.5 m Project: Cottonwood Island ... Method: 0.1-m2 Van Veen Station: CW21 Station: CW21 Method: 0.1-m2 Van Veen ... Percent Percent Percent by size U.S.Sieve **U.S.Sieve** ! Percent Percent Percent by size Pan | Phi | finer retained classification Pan # Phi | finer retained classification Size m Size m 0.0 % Rubble 0.0 64 mm 2-1/2 in -6 | 100.0 64 mm 2-1/2 in -6 | 100.0 0.0 0.0 % Rubble 32 mm 1-1/4 in -5 18.0 & Coarse gravel 82.0 18.0 32 m 1-1/4 in -5 | 100.0 0.0 0.0 % Coarse gravel 16 m 5/8 in -4 | 98.0 2.0 16 mm 5/8 in -4 ! 71.0 11.0 5/16 in -3 ¦ 61.0 10.0 21.0 % Medium gravel 93.0 8 118 8 118 5/16 in -3 ! 5.0 7.0 % Medium gravel No. 5 No. 5 -2 | 72.0 21.0 -2 | 52.0 9.0 4 mm 4 m -1 ! 43.0 9.0 18.0 **%** Fine gravel 2 100 10 -1 ! 47.0 25.0 46.0 % Fine gravel 2 10 10 ... 1 m 18 1! 28.0 19.0 1 m 18 0 ! 33.0 10.0 35 35 1! 26.0 7.0 17.0 & Coarse sand 0.5 m 1! 16.0 12.0 31.0 & Coarse sand 0.5 mm ... 10.0 % Medium sand 60 16.0 10.0 60 2 ! 8.0 % Medium sand 2 ! 0.25 mm 8.0 8.0 0.25 m . . 0.125 💼 120 3 ! 1.0 7.0 0.125 💼 120 3 ! 4.0 12.0 ... 0.0625 mm 230 4 ! 0.0 1.0 8.0 \$ Fine sand 0.0625 mm 230 4 ! 2.0 2.0 14.0 % Fine sand 2.0 2.0 \$ Silt/clay <.0625 mm <230 0.0 0.0 % Silt/clay <.0625 💼 <230 ? Gravel = 53.0 \$ Gravel = 57.0 \$ 0.4 & Organics **%** Organics . . Sand = 47.0 \$ Sand = 41.0 \$... Pines = 0.0 \$ Pines = 2.0 \$ System : Columbia River Date : 21 Jul 1988 System : Columbia River Date : 6 Dec 1988 Project: Cottonwood Island Depth : 13.4 m Project: Cottonwood Island Depth : 13.4 m Station: CM21 Method: 0.1-m2 Van Veen Station: CW21 Method: 0.1-m2 Van Veen Percent Percent Percent by size Percent Percent **U.S.Sieve U.S.Sieve** Percent by size .. Pan | Phi | finer retained classification Pan # Phi ! finer retained classification Size m Size m .. 64 mm 2-1/2 in -6 ! 100.0 0.0 0.0 % Rubble 64 mm 2-1/2 in -6 | 100.0 0.0 0.0 % Rubble 32 mm 1-1/4 in -5 | 92.0 8.0 32 m 1-1/4 in -5 ! 100.0 8.0 & Coarse gravel 0.0 0.0 & Coarse gravel 16 📷 5/8 in -4 | 86.0 6.0 5/8 in -4 | 99.6 16 mm 0.4 5/16 in -3 ! 8 mm 74.0 12.0 18.0 % Medium gravel 8 mm 5/16 in -3 ! 99.1 0.5 0.9 % Medium gravel No. 5 -2 ! 10.0 4 m 64.0 No. 5 -2 1 90.6 8.5 4 mm -1 ! 2 . 10 56.0 8.0 18.0 % Fine gravel 10 -1 | 69.3 21.3 29.8 % Fine gravel 2 mm ... 0 ! 18 43.0 1 mm 13.0 1 mm 18 0 ! 54.9 14.4 0.5 mm 35 1! 31.0 12.0 35 1! 25.0 & Coarse sand 0.5 m 41.1 13.8 28.2 & Coarse sand 0.25 💼 60 2! 16.0 15.0 15.0 % Medium sand 0.25 m 60 2! 14.2 26.9 26.9 % Medium sand ... 0.125 mm 120 3 ! 1.0 15.0 120 1.1 0.125 💼 3 ! 6.5 0.0625 mm 230 4 ! 0.0 1.0 16.0 \$ Fine sand 0.0625 💼 230 4 ! 2.2 4.3 12.0 \$ Fine sand <.0625 mm <230 0.0 0.0 \$ Silt/clay <.0625 mm <230 2.2 2.2 Silt/clay Gravel = 44.0 \$ 0.3 & Organics Gravel = 30.7 \$ 0.3 % Organics ... Sand = 56.0 \$ Sand = 67.1 \$... Fines = 0.0 \$ 2.2 \$ Pines =

System : Col	lumbia Riv		Date : 9			Columbia Riv			9 Nov 1987
roject: Cot	ttonwood Is		Depth : 5.		Project:	Cottonwood I	sland	Depth : 1	
tation: CW	12		Method: 0.	1-m2 Van Veen	Station:	CW12		Method: 0	.1-m2 Van Veen
۵.3	S.Sieve	Percent	Percent	Percent by size		U.S.Sieve	•	t Percent	-
			retained	classification	Size mm			retained	
*******	******	** *******	*********	*****	********	*********	********	*******	***************
64 mm 2-	-1/2 in -	6 100.0	0.0	0.0 % Rubble		2-1/2 in -	6 100.0	0.0	0.0 🕯 Rubble
	-1/4 in -		0.0	0.0 % Coarse gravel		1-1/4 in -	-5 100.0	0.0	0.0 % Coarse grav
16 mm	5/8 in -	4 100.0	0.0		16 mm	5/8 in -	4 100.0	0.0	
8 mm - 1	5/16 in -	3 99.0	1.0	1.0 🎗 Medium gravel	~~ 8 mm	5/16 in -	-3 100.0	0.0	0.0 % Medium grav
4 m	No. 5 -	2 96.0	3.0			No. 5 -	-2 99.0	1.0	
2 mm	10 -	1 83.0	13.0	16.0 % Fine gravel	2 100	10 -	-1 94.0	5.0	6.0 % Fine gravel
1 mm	18	0 63.0	20.0	-	1 mm	18	0 77.0	17.0	
0.5 mm		1 44.0	19.0	39.0 & Coarse sand	0.5 📷		1 43.0	34.0	51.0 % Coarse sand
0.25 mm		2 22.0	22.0	22.0 % Medium sand	~~ 0.25 mm		2 11.0		32.0 % Medium sand
).125 m		3 10.0	12.0		°° 0.125 🖬	120	3 2.0	9.0	
0625 mm		4 1.0	9.0	21.0 % Fine sand	°° 0.0625 📾	230	4 0.0	2.0	11.0 \$ Fine sand
0625 💼	<230	•	1.0	1.0 % Silt/clay	<.0625 m	<230	·	0.0	0.0 % Silt/clay
Gravel =	17.0 \$?	\$ Organics	Gravel	= 6.0 %			0.3 % Organics
Sand =	82.0 \$			-	Sand	= 94.0 %			
Fines =	1.0 \$				Fines	= 0.0 \$			
					···				
System : Co Project: Co	blumbia Riv		Depth : 3.	1 Jul 1988 7 m .1-m2 Van Veen	System : Project: Station:	Columbia Riv Cottonwood J	 Ver	Depth : 4	Dec 1988 .3 m .1-m2 Van Veen
System : Co Project: Co Station: CW	blumbia Riv Stonwood I 12	sland	Depth : 3. Nethod: 0	.7 m .1-m2 Van Veen	System : Project:	Columbia Riv Cottonwood I CW12	ver Island	Depth : 4 Method: 0	.3 m).1-m2 Van Veen
System : Co Project: Co Station: CM U.	blumbia Riv ottonwood I 112 S.Sieve	sland ¦ Percen	Depth : 3. Nethod: 0 t Percent	.7 m .1-m2 Van Veen Percent by size	System : Project: Station:	Columbia Riv Cottonwood I CW12 U.S.Sieve	ver Island ¦ Percen	Depth : 4 Nethod: 0 it Percent	.3 m 1.1-m2 Van Veen Percent by size
System : Co Project: Co Station: CW U. .ze mn	olumbia Riv ottonwood I 12 S.Sieve Pan ‡ Ph	sland ¦ Percen i ¦ finer	Depth : 3. Nethod: 0 t Percent retained	7 m .1-m2 Van Veen Percent by size classification	System : Project: Station: Size mm	Columbia Riy Cottonwood I CW12 U.S.Sieve Pan ‡ Ph	ver Island ¦ Percen hi ¦ finer	Depth : 4 Method: 0 t Percent retained	.3 m .1-m2 Van Veen : Percent by size classification
System : Co Project: Co Station: CM U. .ze mn	olumbia Riv ottonwood I 812 S.Sieve Pan ‡ Ph	sland Percen i finer ***	Depth : 3. Method: 0 t Percent retained	7 m .1-m2 Van Veen Percent by size classification	System : Project: Station: Size mm	Columbia Riu Cottonwood J CW12 U.S.Sieve Pan ‡ Ph	Ver Island ¦ Percen hi ¦ finer	Depth : 4 Method: 0 t Percent retained	.3 m 0.1-m2 Van Veen C Percent by size Classification
System : Co Project: Co Station: CW U. .ze mn 54 mm 2	olumbia Riv olumbia Riv S.Sieve Pan # Ph HANNANANAN -1/2 in -	sland Percen i finer **!****** 6 100.0	Depth : 3. Nethod: 0 t Percent retained	7 m 1-m2 Van Veen Percent by size classification ************************************	System : Project: Station: Size mm	Columbia Riy Cottonwood I CW12 U.S.Sieve Pan ‡ Ph ************************************	ver Island ¦ Percen hi ¦ finer ***********	Depth : 4 Method: 0 It Percent retained 0.0	.3 m .1-m2 Van Veen : Percent by size : classification :************************************
System : Co Project: Co Station: CW 	olumbia Riv ottonwood I fl2 S.Sieve Pan ‡ Ph Hattattattattattattattattattattattattatt	sland Percen i finer **!****** 6 100.0 5 100.0	Depth : 3. Method: 0 t Percent retained 	7 m .1-m2 Van Veen Percent by size classification	System : Project: Station: Size mm Size mm 4 mm 32 mm	Columbia Riv Cottonwood I CW12 U.S.Sieve Pan ‡ Ph ************************************	ver Island hi ¦ Percen hi ¦ finer **** ******** -6 ¦ 100.0 -5 ¦ 98.0	Depth : 4 Method: 0 retained *********** 0.0 2.0	.3 m 0.1-m2 Van Veen : Percent by sige : classification
System : Co roject: Co station: CM U. ze mm 64 mm 22 mm 1 16 mm	blumbia Riv ottonwood I fl2 S.Sieve Pan ‡ Ph Hattatatatatatatatatatatatatatatatatata	<pre>sland</pre>	Depth : 3. Method: 0 t Percent retained 0.0 0.0 0.0 0.0	7 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel	System : Project: Station: Size mm *********** 64 mm 32 mm 16 mm	Columbia Rin Cottonwood H CW12 U.S.Sieve Pan ‡ Ph ************************************	ver Island hi ¦ finer ********** -6 ¦ 100.0 -5 ¦ 98.0 -4 ¦ 98.0	Depth : 4 Method: 0 retained 0.0 2.0 0.0	.3 m .1-m2 Van Veen Percent by size classification .0.0 % Rubble 2.0 % Coarse grav
System : Co roject: Co station: CW U. Ze mm 1 statatett 64 mm 2 32 mm 1 16 mm 8 mm	Diumbia Riv ottonwood I 12 S.Sieve Pan ‡ Ph 2-1/2 in - 1-1/4 in - 5/8 in - 5/16 in -	<pre>sland</pre>	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************	System : Project: Station: Size mm ********** 64 mm 32 mm 16 mm 8 mm	Columbia Rin Cottonwood I CW12 U.S.Sieve Pan ‡ Ph ************************************	ver Island hi ¦ Percen **** ******* -6 ¦ 100.0 -5 ¦ 98.0 -4 ¦ 98.0 -3 ¦ 98.0	Depth : 4 Method: 0 retained 0.0 2.0 0.0 0.0	1.3 m 1.1-m2 Van Veen Percent by size classification ************************************
System : Co Project: Co Station: CW 20. 20. 20. 20. 20. 20. 20. 20. 20. 20.	Diumbia Riv ottonwood I 12 S.Sieve Pan # Ph 2-1/2 in - 1-1/4 in - 5/16 in - 5/16 in - No. 5 -	<pre>sland</pre>	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************		Columbia Riu Cottonwood I CW12 U.S.Sieve Pan ‡ Pt 2-1/2 in - 1-1/4 in - 5/8 in - 5/16 in - No. 5 -	ver Island hi ¦ Percen ************************************	Depth : 4 Method: 0 retained 0.0 2.0 0.0 0.0 0.0 1.6	.3 m .1-m2 Van Veen Percent by size classification
system : Co roject: Co station: CW ze mn 1 ************ 64 mm 2 32 mm 1 16 mm 8 mm 4 mm 2 mm	Diumbia Riv Stonwood I 812 S.Sieve Pan # Ph 2-1/2 in - 1-1/4 in - 5/8 in - 5/8 in - 5/16 in - No. 5 - 10 -	sland Percen i finer ************************************	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel		Columbia Riu Cottonwood I CW12 U.S.Sieve Pan ‡ Ph ************************************	Ver Island hi finer **** ******** -6 100.0 -5 98.0 -3 98.0 -3 98.0 -2 96.4 -1 90.1	Depth : 4 Method: 0 t Percent retained 0.0 2.0 0.0 0.0 1.6 . 6.3	.3 m .1-m2 Van Veen : Percent by size : classification ::::::::::::::::::::::::::::::::::::
ystem : Co roject: Co tation: CW ze num 1 ************************************	Diumbia Riv ottonwood I 12 S.Sieve Pan ‡ Ph 2-1/2 in - 1-1/4 in - 5/8 in - 5/8 in - 5/8 in - 10 - 10 - 18	sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 100.0 2 97.0 1 91.0 0 78.0	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************	System : Project: Station: Size mm ***********************************	Columbia Riu Cottonwood I CW12 U.S.Sieve Pan ‡ Ph ************************************	ver Island hi finer ************************************	Depth : 4 Method: 0 retained ************************************	 .3 m .1-m2 Van Veen Percent by size classification classi
ystem : Co roject: Co tation: CM C. ze mm 1 **********************************	blumbia Riv stonwood I fl2 S.Sieve Pan # Ph -1/2 in - L-1/4 in - 5/8 in - 5/16 in - No. 5 - 10 - 18 35	sland Percen i finer **'******* 6 100.0 5 100.0 4 100.0 3 100.0 2 97.0 1 91.0 0 78.0 1 55.0	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************	System : Project: Station: Size mm Size mm 	Columbia Riv Cottonwood I CW12 U.S.Sieve Pan ‡ Pt 2-1/2 in - 1-1/4 in - 5/8 in - 5/16 in - No. 5 - 10 - 18 35	ver Island hi ¦ finer *** ******* -6 ¦ 100.0 -5 ¦ 98.0 -3 ¦ 98.0 -2 ¦ 96.4 -1 ¦ 90.1 0 ¦ 83.1 1 ¦ 66.6	Depth : 4 Method: 0 retained 0.0 2.0 0.0 0.0 1.6 6.3 7.0 5 16.5	 .3 m .1-m2 Van Veen Percent by size classification classification 0.0 % Rubble 2.0 % Coarse grav 0.0 % Medium grav 7.9 % Fine grave 23.5 % Coarse sand
ystem : Co roject: Co tation: Ci ze mm 1 ********** 64 mm 2 32 mm 1 16 mm 8 mm 4 mm 2 mm 0.5 mm 0.25 mm	blumbia Riv ottonwood I fl2 S.Sieve Pan ‡ Ph Hattattatt 2-1/2 in - L-1/4 in - 5/8 in - 5/16 in - No. 5 - 10 - 18 35 60	sland Percen i finer ** ******** 6 100.0 5 100.0 4 100.0 3 100.0 2 97.0 1 91.0 0 78.0 1 55.0 2 1.0	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************		Columbia Riv Cottonwood H CW12 U.S.Sieve Pan ‡ Pt 2-1/2 in - 1 -1/4 in - 5/8 in - 5/16 in - 10 - 18 18 35 60	ver Island hi ¦ finer *********** -6 ¦ 100.0 -5 ! 98.0 -3 98.0 -3 98.0 -2 96.4 -1 90.1 0 83.1 1 66.6 2 50.3	Depth : 4 Method: 0 retained 0.0 2.0 0.0 0.0 1.6 6.3 7.0 16.5 16.3	.3 m .1-m2 Van Veen Percent by size classification
System : Co roject: Co itation: CW ze mm 1 :*********** 64 mm 2 32 mm 1 16 mm 8 mm 4 mm 2 mm 1 mm 0.5 mm 0.25 mm 0.125 mm	Diumbia Riv S.Sieve Pan # Ph -1/2 in - -1/2 in - 5/8 in - 5/16 in - No. 5 - 10 - 18 35 60 120	sland Percen i finer ************************************	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by sise classification 	System : Project: Station: Size mm *********** 64 mm 	Columbia Rin Cottonwood I CW12 U.S.Sieve Pan ‡ Ph ************************************	ver Island hi finer ************************************	Depth : 4 Method: 0 retained 0.0 2.0 0.0 0.0 1.6 6.3 7.0 16.5 16.3 3 43.7	 .3 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 2.0 % Coarse grav 0.0 % Medium grav 7.9 % Fine gravel 23.5 % Coarse sand 16.3 % Medium sand
ystem : Co roject: Co tation: CW 52 mm 1 *********** 64 mm 2 32 mm 1 16 mm 8 mm 4 mm 2 mm 1 mm 0.5 mm 0.5 mm 0.25 mm 0.25 mm	Diumbia Riv S.Sieve Pan # Ph -1/2 in - -1/2 in - 5/8 in - 5/16 in - No. 5 - 10 - 18 35 60 120	sland Percen i finer ** ******** 6 100.0 5 100.0 4 100.0 3 100.0 2 97.0 1 91.0 0 78.0 1 55.0 2 1.0	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************		Columbia Riu Cottonwood I CW12 U.S.Sieve Pan # Pf ************************************	ver Island hi ¦ finer *********** -6 ¦ 100.0 -5 ! 98.0 -3 98.0 -3 98.0 -2 96.4 -1 90.1 0 83.1 1 66.6 2 50.3	Depth : 4 Method: 0 retained 0.0 2.0 0.0 0.0 1.6 6.3 7.0 16.5 16.3 3 43.7	.3 m .1-m2 Van Veen Percent by size classification
ystem : Co roject: Co tation: Cw ***********************************	Diumbia Riv S.Sieve Pan ‡ Ph ************************************	sland Percen i finer ************************************	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************		Columbia Rin Cottonwood I CW12 U.S.Sieve Pan ‡ Ph ************************************	<pre>ver Island</pre>	Depth : 4 Method: 0 retained 2.0 0.0 0.0 1.6 6.3 7.0 16.5 16.3 5.43.7 5.5	 .3 m .1-m2 Van Veen Percent by size classification
System : Co Project: Co Station: CM 2 mm 4 mm 2 mm 1 mm 0.5 mm 0.25 mm 0.25 mm 0.25 mm 0.25 mm 0.25 mm 0.25 mm 0.25 mm	Diumbia Riv S.Sieve Pan # Ph Pan	sland Percen i finer ************************************	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************		Columbia Rin Cottonwood I CW12 U.S.Sieve Pan # Ph ************************************	ver Island hi finer *** ******* -6 100.0 -5 98.0 -3 98.0 -3 98.0 -2 96.4 -1 90.1 0 83.1 1 66.6 2 50.3 3 6.6 4 1.1	Depth : 4 Method: 0 retained 2.0 0.0 0.0 1.6 6.3 7.0 16.5 16.3 5.43.7 5.5	 .3 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 2.0 % Coarse grav 0.0 % Medium grav 7.9 % Fine gravel 23.5 % Coarse sand 16.3 % Medium sand 49.2 % Fine sand
System : Co Project: Co Station: CW 20. 20. 20. 20. 20. 20. 20. 20. 20. 20.	Diumbia Riv S.Sieve Pan ‡ Ph ************************************	sland Percen i finer ************************************	Depth : 3. Method: 0 t Percent retained 	7 m 1-m2 Van Veen Percent by size classification ************************************		Columbia Rin Cottonwood I CW12 U.S.Sieve Pan ‡ Ph ************************************	ver Island hi finer ********** -6 100.0 -5 98.0 -3 98.0 -3 98.0 -2 96.4 -1 90.1 0 83.1 1 66.6 2 50.3 3 6.6 4 1.1	Depth : 4 Method: 0 retained 2.0 0.0 0.0 1.6 6.3 7.0 16.5 16.3 5.43.7 5.5	 .3 m .1-m2 Van Veen Percent by size classification

System : (Project: (Station: (lottonwood		ind 1	Date : 9 Depth : 9. Method: 0.	8 n 1-m2 Van Veen	•	Columbia Rive Cottonwood Is CW22		Date : 19 Depth : 7. Method: 0.	
ize m		Phi	finer	Percent retained	Percent by size classification	Size ma		i finer	t Percent retained	classification
			•		**************************************					0.0 % Rubble
	2-1/2 in			0.0 0.0	0.0 % Rubble 0.0 % Coarse gravel		2-1/2 in -0 1-1/4 in -0			0.0 % Coarse grave
52 mm 16 mm	1-1/4 in 5/8 in			1.0	U.U & COALSE GLAVEL		•	•		U.V & CUALSE GLAVE
	5/16 in		•	0.0	1.0 % Medium gravel	~~ 10 mm	•	•		0.0 % Medium grave
оши 4 mm	No. 5			1.0	I.U & REULUM YLAVEL	• • • • • • • • • • • • • • • • • • •	•	2 97.0		0.0 8 neurum grave
	10		•	1.0	2.0 % Fine gravel	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		1 87.0		13.0 % Fine gravel
2 ma 1 ma	18		•	6.0				0 72.0		10.0 8 l'inc graver
0.5 mm	35		•	13.0	19.0 \$ Coarse sand	~~ 0.5 mm		1 45.0		42.0 % Coarse sand
0.25 mm	60		•	17.0		••••••••••••••••••••••••••••••••••••••		2 15.0		30.0 % Medium sand
1.125 mm	120		-	46.0	11.0 4 Heating Source	0.125 mm		3 5.0		Joro a meatum Jana
0625 mm	230		•	14.0	60.0 % Fine sand	0.0625 mm		4 1.0		14.0 % Fine sand
.0625 mm	<230		1 1.0	1.0	1.0 % Silt/clay	<.0625 mm		7 I I I	1.0	1.0 % Silt/clay
	.590			2.0	1.0 0 Dilejelaj	******			2.0	In V birt/olaj
Gravel =	3.0	\$?	<pre>\$ Organics</pre>	Gravel	= 13.0 \$			0.4 % Organics
Sand =				•	V ULJULIOU	Sand :				VII V OLYMILOU
Pines =						Fines				
		•								
		====				 				
roject: (Columbia Cottonwoo (1972)		and	Date : 21 Depth : 14 Method: 0	.0 m		Columbia Riv Cottonwood I:		Date : 7 Depth : 15 Wethod: 0	5.2 m
Project: (Cottonwoo		and	Depth : 14	.0 m 1-m2 Van V ee n		Columbia Riv Cottonwood I:		Depth : 15	
Project: (Station: (Cottonwoo	d Isl	and	Depth : 14	.0 m 1-m2 Van Veen		Columbia Riv Cottonwood I:	sland	Depth : 15 Method: 0.	.2 m 1-m2 Van Veen
roject: (station: (Cottanwaa CW22 U.S.Sieve	d Isl	and ¦ Percent	Depth : 14 Method: 0.	.0 m 1-m2 Van Veen Percent by size	System : Project: Station:	Columbia Riv Cottonwood I: CW22 U.S.Sieve	sland ¦ Percen	Depth : 15 Method: 0.	5.2 m 1-m2 Van Veen Percent by size
roject: (Station: (ze mm	Cottonwoo CW22 U.S.Sieve Pan #	d Isl	and ¦ Percent ¦ finer	Depth : 14 Method: 0. Percent retained	.0 m 1-m2 Van Veen Percent by size	System : Project: Station: Size mm	Columbia Riv Cottonwood I: CW22 U.S.Sieve Pan # Phi	sland ¦ Percen i ¦ finer	Depth : 15 Method: 0. t Percent retained	5.2 m 1-m2 Van Veen Percent by size
roject: (tation:) ze mm	Cottonwoo CW22 U.S.Sieve Pan ‡	d Isl Phi *****	and Percent finer *******	Depth : 14 Method: 0. Percent retained	1.0 m 1-m2 Van Veen Percent by size classification	System : Project: Station: Size m *******	Columbia Riv Cottonwood I: CW22 U.S.Sieve Pan ‡ Ph:	sland Percen i finer **!******	Depth : 15 Method: 0 t Percent retained	5.2 m 1-m2 Van Veen Percent by size classification
roject: (tation: (re mn *********	Cottonwoo CW22 U.S.Sieve Pan ‡	d Isl Phi ***** -6	and Percent finer ********	Depth : 14 Method: 0. Percent retained	.0 m 1-m2 Van Veen Percent by size classification	System : Project: Station: Size mn ************************************	Columbia Riv Cottonwood I: CW22 U.S.Sieve Pan ‡ Ph:	sland Percen i finer **¦****** 6 100.0	Depth : 15 Hethod: 0 t Percent retained	2.2 m 1-m2 Van Veen Percent by size classification ************************************
roject: (tation: (re mn *********	Cottonwoo CW22 U.S.Sieve Pan # ******** 2-1/2 in	d Isl Phi ***** -6 -5	and Percent finer ******** 100.0 100.0	Depth : 14 Method: 0. Percent retained	1.0 m 1-m2 Van Veen Percent by size classification classification 0.0 % Rubble	System : Project: Station: Size mn	Columbia Riv Cottonwood I: CW22 U.S.Sieve Pan ‡ Ph: ************ 2-1/2 in 1-1/4 in -	sland Percen i finer **!****** 6 100.0 5 100.0	Depth : 15 Method: 0. t Percent retained	2.2 m 1-m2 Van Veen Percent by size classification ************************************
roject: (tation: (ke mm ********** 64 mm 32 mm	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in	d Isl Phi ***** -6 -5 -4	and Percent finer ********* 100.0 100.0 100.0	Depth : 14 Method: 0. Percent retained 	1.0 m 1-m2 Van Veen Percent by size classification classification 0.0 % Rubble	System : Project: Station: Size mm ***********************************	Columbia Riv Cottonwood I: CW22 U.S.Sieve Pan ‡ Ph 2-1/2 in - 1-1/4 in - 5/8 in -	<pre>sland</pre>	Depth : 15 Method: 0. t Percent retained *********** 0.0 0.0 0.0 0.0	3.2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav
roject: (tation: (ze mm ********* 64 mm 32 mm 16 mm	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in	d Isl Phi ***** -6 -5 -4 -3	and Percent finer ******** 100.0 100.0 100.0 99.0	Depth : 14 Method: 0. Percent retained 0.0 0.0 0.0 0.0	1.0 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel	System : Project: Station: Size mm ********** 64 mm 32 mm 16 mm	Columbia Riv Cottonwood I: CW22 U.S.Sieve Pan ‡ Ph ************ 2-1/2 in - 1-1/4 in - 5/8 in - 5/16 in -	<pre>sland</pre>	Depth : 15 Method: 0. t Percent retained *********** 0.0 0.0 0.0 0.0 0.2	3.2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav
roject: (tation:) ze mm ********* 64 mm 32 mm 16 mm 8 mm	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in	d Isl Phi ***** -6 -5 -4 -3 -2	and Percent finer ********* 100.0 100.0 100.0 99.0 97.0	Depth : 14 Method: 0. Percent retained 0.0 0.0 0.0 0.0 1.0	1.0 m 1.1-m2 Van Veen Percent by size classification 	System : Project: Station: Size mn ************************************	Columbia Riv Cottonwood I: CH22 U.S.Sieve Pan # Ph ************************************	sland Percen i finer **!******* 6 100.0 5 100.0 4 100.0 3 99.8	Depth : 15 Method: 0.0 t Percent retained ************************************	 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 0.2 % Medium grav
roject: (tation:) xe mm ********* 64 mm 32 mm 16 mm 8 mm 4 mm	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5	d Isl Phi ***** -6 -5 -4 -3 -2 -1	and Percent finer ************************************	Depth : 14 Method: 0. Percent retained 	1.0 m 1.1-m2 Van Veen Percent by size classification 	System : Project: Station: Size mn ************************************	Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan ‡ Ph: ************************************	sland Percen i finer **!******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6	Depth : 15 Method: 0. t Percent retained ************************************	 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 0.2 % Medium grav
roject: (itation:) ************************************	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10	d Isl Phi ***** -6 -5 -4 -3 -2 -1 0	and Percent finer 100.0 100.0 100.0 99.0 97.0 89.0 72.0	Depth : 14 Method: 0. Percent retained ************************************	1.0 m 1.1-m2 Van Veen Percent by size classification 	System : Project: Station: Size mm ***********************************	Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan # Ph: 	sland Percen i finer ** ******* 6 100.0 5 100.0 3 99.8 2 98.6 1 90.3	Depth : 15 Method: 0. t Percent retained *********** 0.0 0.0 0.0 0.0 0.2 1.2 8.3 19.4	 3.2 m 3.1-m2 Van Veen Percent by size classification Classification Classification Coarse grave Coarse grave Coarse grave S % Fine gravel
ze mm ***********************************	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18	d Isl Phi ****** -6 -5 -4 -3 -2 -1 0 1	and Percent finer ********* 100.0 100.0 100.0 99.0 99.0 97.0 89.0 72.0 42.0	Depth : 14 Method: 0. Percent retained 0.0 0.0 0.0 0.0 1.0 2.0 8.0 17.0	1.0 m 1-m2 Van Veen Percent by size classification Classif	System : Project: Station: Size mm ***********************************	Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan ‡ Ph 2-1/2 in - 1-1/4 in - 5/8 in - 5/16 in - No. 5 - 10 - 18 0 35	sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9	Depth : 15 Method: 0. t Percent retained *********** 0.0 0.0 0.0 0.0 0.2 1.2 8.3 19.4 24.8	 3.2 m 3.1-m2 Van Veen Percent by size classification Classification Classification Coarse grave Coarse grave Coarse grave S % Fine gravel
roject: (station:) ze mm 64 mm 16 mm 1 mm 0.5 mm 0.25 mm	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35	Phi ****** -6 -5 -4 -3 -2 -1 0 1 2	and Percent finer ********* 100.0 100.0 100.0 99.0 97.0 89.0 72.0 42.0 16.0	Depth : 14 Method: 0.4 Percent retained 0.0 0.0 0.0 1.0 2.0 8.0 17.0 30.0	1.0 m 1-m2 Van Veen Percent by sise classification ************************************	System : Project: Station: Size mm ***********************************	Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan ‡ Ph ************************************	sland Percen i finer **!****** 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1	Depth : 15 Method: 0. t Percent retained *********** 0.0 0.0 0.0 0.0 0.2 1.2 8.3 19.4 24.8 26.0	 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 0.2 % Medium grav 9.5 % Pine gravel 44.2 % Coarse sand
roject: (Station:) 22 mm 32 mm 16 mm 8 mm 4 mm 2 mm 1 mm	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35 60	d Isl ****** -6 -5 -4 -3 -2 -1 0 1 2 3	and Percent finer ********* 100.0 100.0 100.0 99.0 97.0 97.0 89.0 72.0 42.0 16.0 3.0	Depth : 14 Method: 0. Percent retained 0.0 0.0 0.0 1.0 2.0 8.0 17.0 30.0 26.0	1.0 m 1-m2 Van Veen Percent by sise classification ************************************	System : Project: Station: Size mm ***********************************	Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan # Ph ************************************	sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1 2 20.1	Depth : 15 Method: 0. t Percent retained *********** 0.0 0.0 0.0 0.0 0.0 0.2 1.2 8.3 19.4 24.8 26.0 19.1	 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 0.2 % Medium grav 9.5 % Pine gravel 44.2 % Coarse sand
roject: (tation: (ze mm ********** 64 mm 32 mm 16 mm 8 mm 4 mm 2 mm 1 mm 0.25 mm .125 mm 0625 mm	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35 60 120	d Isl Phi ****** -6 -5 -4 -3 -2 -1 0 1 2 3 4	and Percent finer ********* 100.0 100.0 100.0 99.0 97.0 97.0 89.0 72.0 42.0 16.0 3.0	Depth : 14 Method: 0. Percent retained 0.0 0.0 0.0 1.0 2.0 8.0 17.0 30.0 26.0 13.0	1.0 m 1.1-m2 Van Veen Percent by sise classification 	System : Project: Station: Size mm Size mm - 64 mm - 64 mm - 16 mm - 16 mm - 2 mm - 2 mm - 0.5 mm - 0.25 mm - 0.125 mm - 0.125 mm - 0.0625 mm	Columbia Riv Cottonwood I: CW22 U.S.Sieve Pan # Ph: ************************************	sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1 2 20.1 3 1.0	Depth : 15 Method: 0. t Percent retained *********** 0.0 0.0 0.0 0.0 0.0 0.2 1.2 8.3 19.4 24.8 26.0 19.1	 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse graw 0.2 % Medium grav 9.5 % Pine gravel 44.2 % Coarse sand 26.0 % Medium sand
roject: (itation:) ze mm ***********************************	Cottonwoo CW22 U.S.Sieve Pan # ********** 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35 60 120 230 <230	d Isl Phi ****** -6 -5 -4 -3 -2 -1 0 1 2 3 4	and Percent finer ********* 100.0 100.0 100.0 99.0 97.0 97.0 89.0 72.0 42.0 16.0 3.0	Depth : 14 Method: 0. Percent retained 	 1.0 m 1-m2 Van Veen Percent by size classification Classification Classification Coarse gravel Coarse gravel Coarse gravel Coarse gravel Coarse sand Coarse sand<!--</td--><td>System : Project: Station: Size mm ***********************************</td><td>Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan # Ph: ************************************</td><td>sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1 2 20.1 3 1.0</td><td>Depth : 15 Method: 0.4 t Percent retained ************************************</td><td> 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grave 0.2 % Medium grave 9.5 % Fine gravel 44.2 % Coarse sand 26.0 % Medium sand 19.9 % Fine sand 0.2 % Silt/clay </td>	System : Project: Station: Size mm ***********************************	Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan # Ph: ************************************	sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1 2 20.1 3 1.0	Depth : 15 Method: 0.4 t Percent retained ************************************	 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grave 0.2 % Medium grave 9.5 % Fine gravel 44.2 % Coarse sand 26.0 % Medium sand 19.9 % Fine sand 0.2 % Silt/clay
roject: (tation: (ze mm ********** 64 mm 32 mm 16 mm 4 mm 2 mm 1 mm 0.25 mm 0.25 mm 0.25 mm 0625 mm 0625 mm	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35 60 120 230 <230 <230	d Isl Phi ****** -6 -5 -4 -3 -2 -1 0 1 2 3 4 \$	and Percent finer ********* 100.0 100.0 100.0 99.0 97.0 97.0 89.0 72.0 42.0 16.0 3.0	Depth : 14 Method: 0. Percent retained 	 1.0 m 1-m2 Van Veen Percent by size classification Classification Classification Coarse gravel Coarse gravel Coarse gravel Coarse gravel Coarse sand Coarse sand<!--</td--><td>System : Project: Station: Size mm ***********************************</td><td>Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan # Ph: ************************************</td><td>sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1 2 20.1 3 1.0</td><td>Depth : 15 Method: 0.4 t Percent retained ************************************</td><td> 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grave 0.2 % Medium grave 9.5 % Fine gravel 44.2 % Coarse sand 26.0 % Medium sand 19.9 % Fine sand </td>	System : Project: Station: Size mm ***********************************	Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan # Ph: ************************************	sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1 2 20.1 3 1.0	Depth : 15 Method: 0.4 t Percent retained ************************************	 2 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grave 0.2 % Medium grave 9.5 % Fine gravel 44.2 % Coarse sand 26.0 % Medium sand 19.9 % Fine sand
roject: (tation: (ze mm ***********************************	Cottonwoo CW22 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35 60 120 230 <230 11.0 88.0	d Isl Phi ****** -6 -5 -4 -3 -2 -1 0 1 2 3 4 \$	and Percent finer ********* 100.0 100.0 100.0 99.0 97.0 97.0 89.0 72.0 42.0 16.0 3.0	Depth : 14 Method: 0. Percent retained 	 1.0 m 1-m2 Van Veen Percent by size classification Classification Classification Coarse gravel Coarse gravel Coarse gravel Coarse gravel Coarse sand Coarse sand<!--</td--><td>System : Project: Station: Size mm ***********************************</td><td>Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan # Ph ************************************</td><td>sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1 2 20.1 3 1.0</td><td>Depth : 15 Method: 0.4 t Percent retained ************************************</td><td> 3.2 m 3.1-m2 Van Veen Percent by size classification Classification Classification Coarse grav Coarse grav Coarse fravel Coarse sand Silt/clay </td>	System : Project: Station: Size mm ***********************************	Columbia Riv Cottonwood I: CM22 U.S.Sieve Pan # Ph ************************************	sland Percen i finer ** ******* 6 100.0 5 100.0 4 100.0 3 99.8 2 98.6 1 90.3 0 70.9 1 46.1 2 20.1 3 1.0	Depth : 15 Method: 0.4 t Percent retained ************************************	 3.2 m 3.1-m2 Van Veen Percent by size classification Classification Classification Coarse grav Coarse grav Coarse fravel Coarse sand Silt/clay

System : C	olumbia River		Date : 9	Jul 1987		Columbia Rive) Nov 1987
roject: C	ottonwood Isla	ind	Depth : 4.	0 m.		Cottonwood Is	l and	Depth : 2.	7 m
tation: C			Method: 0.	1-m2 van veen	Station:	CW13		Method: 0	.1-m2 Van Veen
σ	J.S.Sieve	Percent	Percent	Percent by size		U.S.Sieve		t Percent	
ze mn	Pan 🛔 Phi		retained	classification	Size mn	Pan 🕴 Phi		retained	
*******	******	******	********	***************	********	***********	* ******	*******	**************
64 mm	2-1/2 in -6	100.0	0.0	0.0 % Rubble		2-1/2 in -6			0.0 % Rubble
32 💼	1-1/4 in -5	100.0	0.0	0.0 % Coarse gravel		1-1/4 in -5	100.0	0.0	0.0 🕯 Coarse grav
16 mm	5/8 in -4	100.0	0.0		16 mm	5/8 in -4	99.0		
8 1111			0.0	0.0 % Medium gravel	· 8 mm		•		2.0 % Medium grav
4 im.	No. 5 -2	-	1.0		••••••••••••••••••••••••••••••••••••••		96.0		
2 mm	10 -1	•	1.0	2.0 % Fine gravel	2 🖬		90.0		8.0 % Fine gravel
1 mm	18 0		3.0		••• 1 mm		82.0		
0.5 mm	35 1	•	11.0	14.0 % Coarse sand	0.5 mm		69.0		21.0 % Coarse sand
0.25 mm	60 2		47.0	47.0 % Medium sand	0.25 mm		30.0		39.0 % Medium sand
).125 💼	120 3	•	35.0		0.125 🗰		3 2.0		
0625 mm	230 4	0.0	2.0	37.0 % Fine sand	0.0625 🖿		0.0	2.0	30.0 % Fine sand
.0625 📠	<230		0.0	0.0 % Silt/clay	<.0625 🖬	<230		0.0	0.0 % Silt/clay
Gravel =			?	\$ Organics	Gravel				0.5 \$ Organics
	98.0 1				Sand	= 90.0 %			
Sand =	T								
Fines =	0.0 \$		 Date : 21	 L Jul 1988	Fines		 Pr	 Date : 7	 Dec 1988
Fines =	0.0 %	and	Depth : 4.		Pines System : Project: Station:	Columbia Rive Cottonwood Is		Depth : 4	
Fines = System : () Project: () Station: ()	0.0 % Columbia River Cottonwood Isla CW13	and	Depth : 4. Method: 0.	0 n 1-m2 Van Veen	Pines System : Project:	Columbia Rive Cottonwood Is GW13	land	Depth : 4 Method: 0	.3 m .1-m2 Van Veen
Fines = System : () roject: () Station: () Ze mm	0.0 % Columbia River Cottonwood Isl; CW13 U.S.Sieve Pan # Phi	and Percent finer	Depth : 4. Method: 0. Percent retained	0 m 1-m2 Van Veen Percent by size classification	Fines System : Project: Station: Size mm	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi	land ¦ Percen ¦ finer	Depth : 4 Method: 0 t Percent retained	.3 m .1-m2 Van Veen Percent by size classification
Fines = System : () Troject: () Station: () Ze mm	0.0 % Columbia River Cottonwood Isla CW13 J.S.Sieve Pan # Phi	and Percent finer ******	Depth : 4. Method: 0. Percent retained	0 m 1-m2 Van Veen Percent by size classification	Fines System : Project: Station: Size m *********	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi	land Percen finer	Depth : 4 Method: 0 t Percent retained	.3 m .1-m2 Van Veen Percent by size classification
Fines = System : () troject: () tation: () ze mm statistication 64 mm	0.0 % Columbia River Cottonwood Isla CM13 J.S.Sieve Pan # Phi ************ 2-1/2 in -6	and Percent finer ********	Depth : 4. Method: 0. Percent retained	0 m 1-m2 Van Veen Percent by size classification ************************************	Fines System : Project: Station: Size m *********	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi	land Percen finer *******	Depth : 4 Method: 0 t Percent retained	.3 m .1-m2 Van Veen Percent by size classification ************************************
Fines = system : () troject: () station: () ze mm ***********************************	0.0 % Columbia River Cottonwood Isla CW13 U.S.Sieve Pan # Phi ************ 2-1/2 in -6 1-1/4 in -5	and Percent finer ******** 100.0 100.0	Depth : 4. Method: 0. Percent retained ********** 0.0 0.0	0 m 1-m2 Van Veen Percent by size classification	System : Project: Station: Size mn ************************************	Columbia Rive Cottonwood Is GW13 U.S.Sieve Pan ‡ Phi ************************************	land Percen finer ******* 100.0 5 100.0	Depth : 4 Method: 0 t Percent retained	.3 m .1-m2 Van Veen Percent by size classification
Fines = system : C roject: C station: C ze mm ********** 64 mm 32 mm 16 mm	0.0 % Columbia River Cottonwood Isl: CW13 U.S.Sieve Pan ‡ Phi 2-1/2 in -6 1-1/4 in -5 5/8 in -4	and Percent finer 100.0 100.0 100.0	Depth : 4. Method: 0. Percent retained 0.0 0.0 0.0 0.0	0 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel	System : Project: Station: Size mm ***********************************	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi 2-1/2 in -6 1 1-1/4 in -5 5/8 in -4	land Percen finer 100.0 100.0	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0	.3 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav
Fines = ystem : () roject: () tation: () ze mm ***********************************	0.0 % Columbia River Cottonwood Isl: CW13 U.S.Sieve Pan ‡ Phi 2-1/2 in -6 1-1/4 in -5 5/8 in -4 5/16 in -3	and Fercent finer 100.0 100.0 100.0 100.0	Depth : 4. Method: 0. Percent retained 	0 m 1-m2 Van Veen Percent by size classification ************************************	Fines System : Project: Station: Size un taktoria	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi ************************************	land Percen finer 100.0 100.0 100.0	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.4	.3 m .1-m2 Van Veen Percent by size classification .0.0 % Rubble 0.0 % Coarse grav
Fines = ystem : () roject: () tation: () ze mm ***********************************	0.0 % Columbia River Cottonwood Isla CW13 U.S.Sieve Pan # Phi ************************************	and Percent finer ********* 100.0 100.0 100.0 100.0 99.0	Depth : 4. Method: 0. Percent retained 	0 m 1-m2 Van Veen Percent by size classification 	Fines System : Project: Size mn Size mn Attricted 4 mn Attrine Attricted 4 mn Attricted	Columbia Rive Cottonwood Is CM13 U.S.Sieve Pan # Phi ************************************	land Percen finer 100.0 100.0 100.0 99.6 98.4	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.4 1.2	.3 m .1-m2 Van Veen Percent by size classification .10 % Rubble 0.0 % Coarse grav 0.4 % Medium grav
Fines = ystem : C roject: C tation: C ze mm ********** 64 mm 32 mm 16 mm 8 mm 4 mm 2 mm	0.0 % Columbia River Cottonwood Isla CM13 U.S.Sieve Pan # Phi ************************************	and Percent tiner ************************************	Depth : 4. Method: 0. Percent retained ********** 0.0 0.0 0.0 0.0 1.0 3.0	0 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel	Fines System: System: System: Size mn Size mn Attriction: Size mn Size mn Size mn Attriction: Attrited: Attriction: Attriction: Attriction: Attriction: Attr	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi ************************************	land Percen finer 100.0 100.0 100.0 99.6 98.4 98.4	Depth : 4 Method: 0 t Percent retained ********** 0.0 0.0 0.0 0.0 0.4 1.2 2.7	.3 m .1-m2 Van Veen Percent by size classification .10 % Rubble 0.0 % Coarse grav 0.4 % Medium grav
Fines = ystem : () roject: () tation: () ze mm ***********************************	0.0 % Columbia River Cottonwood Isla CN13 U.S.Sieve Pan # Phi ************************************	and Percent finer #******** 100.0 100.0 100.0 100.0 99.0 96.0 89.0	Depth : 4. Method: 0. retained retained 0.0 0.0 0.0 0.0 0.0 1.0 3.0 7.0	0 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel 0.0 % Medium gravel 4.0 % Fine gravel	Fines System : Project: Station: Size mn ************************************	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi 2-1/2 in -6 1 -1/4 in -5 5/8 in -4 5/16 in -3 No. 5 -2 1 0 -1 18 0	land Percen finer 100.00	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.4 1.2 2.7 3.9	3 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 0.4 % Medium grav 3.9 % Fine gravel
Fines = ystem : (roject: C tation: C tation: C C tation: C C tation: C C tation: C C T tation: C C T tation: C C C T T T T T T T T T T T T T	0.0 % Columbia River Cottonwood Isla CW13 U.S.Sieve Pan # Phi ************************************	and Fercent finer 100.0 100.0 100.0 100.0 99.0 99.0 89.0 5.0	Depth : 4. Method: 0. Percent retained ********** 0.0 0.0 0.0 0.0 0.0 1.0 3.0 7.0 24.0	0 m .1-m2 Van Veen Percent by size classification 	Fines System : Project: Station: Size mn Size mn 4 mn 16 mn 2 m 1 mn 0.5 m	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi 2-1/2 in -6 1 -1/4 in -5 5/8 in -4 5/16 in -3 No. 5 -2 10 -1 18 0 35 1	land Percen finer 100.00	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.0 0.4 1.2 2.7 3.9 10.1	3 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 0.4 % Medium grav 3.9 % Fine gravel 14.0 % Coarse sand
Fines = ystem : C roject: C tation: C ze mm ***********************************	0.0 % Columbia River Cottonwood Isl: CW13 U.S.Sieve Pan # Phi 2-1/2 in -6 1-1/4 in -5 5/8 in -4 5/16 in -3 No. 5 -2 10 -1 18 0 35 1 60 2	and Fercent finer ************************************	Depth : 4. Method: 0. Percent retained 	0 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel 0.0 % Medium gravel 4.0 % Fine gravel	Fines System : Project: Size mm Size mm Size mm Automatication Size mm Size ma Size mm Automatication Automa	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi 2-1/2 in -6 1 -1/4 in -5 5/8 in -4 5/16 in -3 No. 5 -2 10 -1 18 0 35 1 60 2	land Percen finer 100.00	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.4 1.2 2.7 3.9 10.1 42.7	3 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 0.4 % Medium grav 3.9 % Fine gravel 14.0 % Coarse sand
Fines = system : C roject: C tation: C ze mm ***********************************	0.0 % Columbia River Cottonwood Isl: CW13 U.S.Sieve Pan # Phi ************************************	and Fercent finer ************************************	Depth : 4. Method: 0. Percent retained 	0 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel 0.0 % Medium gravel 4.0 % Fine gravel 31.0 % Coarse sand 53.0 % Medium sand	Fines System : Project: Size mm Size mm Size mm Automatication Size mm Automatication Size mm Automatication O.5 mm O.125 mm Class ma Class ma	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi 2-1/2 in -6 1 -1/4 in -5 5/8 in -4 5/8 in -4 5/16 in -3 No. 5 -2 1 10 -1 18 0 1 35 1 60 2 120 3	land Percen finer 100.0 100.0 99.6 99.6 99.6 98.4 95.7 91.8 191.8 13.7 91.8 13.7 91.8 13.7 91.8	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.4 1.2 2.7 3.9 10.1 42.7 36.3	3 m .1-m2 Van Veen Percent by size classification
Fines = ystem : C roject: C tation: C tation: C C tation: C C T tation: C C T tation: C C T tation: C C T T tation: C C T T T T T T T T T T T T T	0.0 % Columbia River Cottonwood Isl: CW13 U.S.Sieve Pan # Phi 2-1/2 in -6 1-1/4 in -5 5/8 in -4 5/16 in -3 No. 5 -2 10 -1 18 0 35 1 60 2	and Fercent finer ************************************	Depth : 4. Method: 0. Percent retained 	0 m .1-m2 Van Veen Percent by size classification 	Fines System : Project: Size mn ************************************	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan # Phi ************************************	land Percen finer 100.00	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.4 1.2 2.7 3.9 10.1 42.7 36.3	3 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 0.4 % Medium grav 3.9 % Fine gravel 14.0 % Coarse same
Fines = ystem : C roject: C tation: C ze mm ***********************************	0.0 % Columbia River Cottonwood Isla CM13 U.S.Sieve Pan # Phi ************************************	and Fercent finer ************************************	Depth : 4. Method: 0. Percent retained *********** 0.0 0.0 0.0 0.0 1.0 3.0 7.0 24.0 53.0 10.0 2.0	0 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse gravel 0.0 % Medium gravel 4.0 % Fine gravel 31.0 % Coarse sand 53.0 % Medium sand 12.0 % Fine sand 0.0 % Silt/clay	Fines System : Project: Station: Size mn ************************************	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan ‡ Phi 2-1/2 in -6 1 -1/4 in -5 5/8 in -4 5/16 in -3 No. 5 -2 1 10 -1 1 18 0 1 35 1 1 60 2 1 20 3 1 20 4	land Percen finer 100.0 100.0 99.6 99.6 99.6 98.4 95.7 91.8 191.8 13.7 91.8 13.7 91.8 13.7 91.8	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.4 1.2 2.7 3.9 10.1 42.7 36.3 2.3	3 m .1-m2 Van Veen Percent by size classification ************************************
Fines = System : C troject: C station: C ze mm ***********************************	0.0 % Columbia River Cottonwood Isla CM13 U.S.Sieve Pan # Phi ************************************	and Fercent finer ************************************	Depth : 4. Method: 0. Percent retained *********** 0.0 0.0 0.0 0.0 1.0 3.0 7.0 24.0 53.0 10.0 2.0	0 m 1-m2 Van Veen Percent by size classification ************************************	Fines System : Project: Station: Size mn ************************************	Columbia Rive Cottonwood Is CW13 U.S.Sieve Pan # Phi 2-1/2 in -6 1 -1/4 in -5 5/8 in -4 5/16 in -3 No. 5 -2 10 -1 18 0 1 35 1 1 60 2 1 230 4 1 230 4 1 230	land Percen finer 100.0 100.0 99.6 99.6 99.6 98.4 95.7 91.8 191.8 13.7 91.8 13.7 91.8 13.7 91.8	Depth : 4 Method: 0 t Percent retained ********* 0.0 0.0 0.0 0.0 0.4 1.2 2.7 3.9 10.1 42.7 36.3 2.3	3 m .1-m2 Van Veen Percent by size classification

System :	Columbia	River		Date : 9	Jul 1987	**		Columbia 1			Date : 19	
Project:	Cottonwoo	i Isla		Depth : 10			Project:		i Isla		Depth : 9.	
Station:	CW23		1	Method: 0.	1-m2 Van Veen	••	Station:	CW23			Method: 0.	1-m2 Van Veen
	U.S.Sieve			Percent	Percent by size	••		U.S.Sieve			Percent	-
ize mn	Pan 🛔			retained	classification		Size m	Pan 🛔			retained	
					*************	**			•			
	2-1/2 in			0.0	0.0 % Rubble			2-1/2 in			0.0	0.0 % Rubble
	1-1/4 in			3.0	3.0 \$ Coarse grav	iel		1-1/4 in			0.0	0.0 % Coarse grav
16 🚥	•			8.0	10 0 0 W. H		16 mm	5/8 in			27.0	10 0 4 Madium anam
8 100				10.0	18.0 % Medium grav	rei	8 mm	5/16 in			13.0 10.0	40.0 % Medium grav
4		•		7.0	10 0 4 9in - manual		4 mm	No. 5	•		9.0	10 0 9 Pine gravel
2 m				5.0	12.0 \$ Fine gravel		2 1	10			9.0 6.0	19.0 % Fine gravel
1 mma 0.5 mma		•		5.0 9.0	14.0 % Coarse sand		1 mm 0.5 mm	18 35	-		4.0	10.0 % Coarse sand
0.25 mm		•		33.0			0.25 mm	55			17.0	17.0 % Medium sand
0.25 mm 0.125 mm		•		55.0 17.0	33.0 % Medium sand		0.25 mm	120			13.0	17.0 % Medium Sanu
.0625 mm				3.0	20.0 % Fine sand		0.0625 mm	230		•	13.0	14.0 % Fine sand
.0625 mm		•	0.0	0.0	0.0 % Silt/clay	**	<.0625 mm		•	0.0	0.0	0.0 % Silt/clay
.0023 888	1234			0.0	viv V bill/clay	**		1230			0.0	ore a prickeral
Gravel :	= 33.0	1		?	% Organics	**	Gravel :	= 59.0	1			0.5 % Organics
Sand =				•	V OLYMIIO	**	Sand =					tit t trymitos
		•							•			
Pines :						 	Fines :					
System : Project:	Columbia Cottonwoo	====== River	nd	Depth : 12			System : Project:	Columbia Cottonwoo	 River		Date : 7 Depth : 13 Method: 0	3.1 m
System : Project:	Columbia Cottonwoo CW23	River d Isla	nd	Depth : 12 Method: 0	2.8 m .1-m2 Van Veen	 	Systen :	Columbia Cottonwoo CW23	River d Isla		Depth : 13 Method: 0	3.1 m .1-m2 Van Veen
System : Project: Station:	Columbia Cottonwoo CW23 U.S.Sieve	River d Isla	nd Percent	Depth : 12 Method: 0 Percent	2.8 m 1-m2 Van Veen Percent by size	 	System : Project: Station:	Columbia Cottonwoo CW23 U.S.Sieve	River d Isla	Percent	Depth : 13 Method: 0 t Percent	3.1 m .1-m2 Van Veen Percent by size
System : Project: Station:	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡	River d Isla Phi {	nd Percent finer	Depth : 12 Method: 0 Percent retained	2.8 m 1-m2 Van Veen Percent by size classification	 	System : Project: Station: Size mm	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡	River d Isla Phi ¦	Percent finer	Depth : 13 Method: 0 t Percent retained	3.1 m .1-m2 Van Veen Percent by size classification
System : Project: Station:	Columbia Cottonwoo CH23 U.S.Sieve Pan ‡	River d Isla Phi :	nd Percent finer	Depth : 12 Method: 0 Percent retained	2.8 m 1-m2 Van Veen Percent by size classification	 	System : Project: Station: Size mm	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡	River d Isla Phi :	Percent finer	Depth : 13 Method: 0 t Percent retained	3.1 m .1-m2 Van Veen Percent by size classification
System : Project: Station: Lie mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # *********	River d Isla Phi { *****	nd Percent finer ********	Depth : 12 Method: 0 Percent retained	2.8 m 1-m2 Van Veen Percent by size classification ************************************	 	System : Project: Station: Size mm ***********	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡	River d Isla Phi *****	Percent finer	Depth : 1: Method: 0 t Percent retained 0.0	3.1 m .1-m2 Van Veen Percent by size classification ************************************
System : Project: Station: .se mm .se mm .se se mm .se se mm .se se mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in	River d Isla Phi { -6 { -5 }	nd Percent finer ******** 100.0 89.0	Depth : 12 Method: 0 Percent retained ********* 0.0 11.0	2.8 m 1-m2 Van Veen Percent by size classification	 	System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ 2-1/2 in 1-1/4 in	River d Isla Phi ***** -6	Percent finer ******** 100.0 100.0	Depth : 13 Method: 0 t Percent retained ********** 0.0 0.0	3.1 m .1-m2 Van Veen Percent by size classification ************************************
System : Project: Station: 4 mm 64 mm 32 mm 16 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # ********** 2-1/2 in 1-1/4 in 5/8 in	River d Isla Phi { -6 { -5 { -4 {	nd Percent finer 100.0 89.0 73.0	Depth : 12 Method: 0 Percent retained 0.0 11.0 16.0	2.8 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 11.0 % Coarse grav		System : Project: Station: Size mm *********** 64 mm 32 mm 16 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ 2-1/2 in 1-1/4 in 5/8 in	River d Isla Phi ****** -6 -5 -4	Percent finer 100.0 100.0 70.8	Depth : 13 Method: 0 t Percent retained 0.0 0.0 29.2	3.1 m .1-m2 Van Veen Percent by size classification ************************************
System : Project: Station: .1e mm .1e mm .32 mm .16 mm .8 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # 2-1/2 in 1-1/4 in 5/8 in 5/16 in	River d Isla Phi : -6 : -5 : -4 :	nd Fercent finer 100.0 89.0 73.0 64.0	Depth : 12 Method: 0 Percent retained 0.0 11.0 16.0 9.0	2.8 m 1-m2 Van Veen Percent by size classification ************************************		System : Project: Station: Size mm *********** 64 mm 32 mm 16 mm 8 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # 2-1/2 in 1-1/4 in 5/8 in 5/16 in	River d Isla Phi -5 -4	Percent finer 100.0 100.0 70.8 43.3	Depth : 13 Method: 0 t Percent retained 0.0 0.0 29.2 27.5	3.1 m .1-m2 Van Veen Percent by size classification ************************************
System : Project: Station: (ite mm 4 mm 32 mm 16 mm 8 mm 4 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ ********* 2-1/2 in 1-1/4 ir 5/8 in 5/16 ir Wo. 5	River d Isla Phi : -6 : -5 : -4 : -3 : -2 :	nd finer ******** 100.0 89.0 73.0 64.0 59.0	Depth : 12 Method: 0 Percent retained ********* 0.0 11.0 16.0 9.0 5.0	2.8 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 11.0 % Coarse grav 25.0 % Medium grav		System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan # 2-1/2 in 1-1/4 in 5/16 in No. 5	River d Isla Phi +***** -6 -5 -4 -3 -2	Percent finer 100.0 100.0 70.8 43.3 33.7	Depth : 13 Method: 0 t Percent retained 0.0 0.0 29.2 27.5 9.6	3.1 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 56.7 % Medium grav
System : Project: Station: Station: 4 mm 32 mm 16 mm 8 mm 4 mm 2 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # ********** 2-1/2 in 1-1/4 ir 5/16 ir No. 5	River d Isla Phi : -6 : -5 : -4 : -3 : -2 : -1 :	nd Fercent finer ******** 100.0 89.0 73.0 64.0 59.0 53.0	Depth : 12 Method: 0 Percent retained ********** 0.0 11.0 16.0 9.0 5.0 6.0	2.8 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 11.0 % Coarse grav		System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ ********** 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5	River d Isla Phi ****** -6 -5 -4 -3 -2 -1	Percent finer 100.0 100.0 70.8 43.3 33.7 31.1	Depth : 13 Method: 0 t Percent retained *********** 0.0 0.0 29.2 27.5 9.6 2.6	3.1 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 56.7 % Medium grav
System : Project: Station: .se nm .se nm .statistic: .64 nm .32 nm .16 nm .4 nm .2 nm .1 nm	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ ********** 2-1/2 in 1-1/4 ir 5/8 in 5/16 ir No. 5 10 18	River d Isla Phi (-6 (-3 (-3 (-2 () -1 (0 (nd Percent finer 100.0 89.0 73.0 64.0 59.0 53.0 48.0	Depth : 12 Method: 0 Percent retained ********** 0.0 11.0 16.0 9.0 5.0 6.0 5.0	2.8 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 11.0 % Coarse grav 25.0 % Medium grav 11.0 % Fine gravel		System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10	River d Isla Phi : ***** -6 : -5 -4 : -3 -2 : -1 0 :	Percent finer 100.0 100.0 70.8 43.3 33.7 31.1 28.4	Depth : 13 Method: 0 t Percent retained *********** 0.0 0.0 29.2 27.5 9.6 2.6 2.7	3.1 m .1-m2 Van Veen Percent by size classification ************************************
System : Project: Station: Station: 64 mm 32 mm 16 mm 4 mm 2 mm 1 mm 0.5 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # ********* 2-1/2 in 1-1/4 in 5/8 in 5/16 ir No. 5 10 18 35	River d Isla Phi : -6 : -5 : -4 : -2 : -1 : 0 : 1 :	nd Fercent finer 100.0 89.0 73.0 64.0 59.0 53.0 48.0 38.0	Depth : 12 Method: 0 Percent retained ********** 0.0 11.0 16.0 9.0 5.0 6.0	2.8 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 11.0 % Coarse grav 25.0 % Medium grav		System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan # 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10	River d Isla Phi : ****** -6 : -6 : -5 -4 : -3 -2 : -1 : 0 : 1	Percent finer 100.0 100.0 70.8 43.3 33.7 31.1 28.4 18.0	Depth : 13 Method: 0 t Percent retained *********** 0.0 0.0 29.2 27.5 9.6 2.6	3.1 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 56.7 % Medium grav 12.2 % Fine gravel 13.1 % Coarse sand
System : Project: Station: 64 mm 32 mm 16 mm 4 mm 2 mm 0.5 mm 0.25 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # ********** 2-1/2 in 1-1/4 ir 5/8 in 5/16 ir No. 5 10 18 35 60	River d Isla Phi : -6 : -5 : -6 : -5 : -2 : 0 : 1 : 2 :	nd Fercent finer 100.0 89.0 73.0 64.0 59.0 53.0 48.0 38.0 9.0	Depth : 12 Method: 0 Percent retained ********** 0.0 11.0 16.0 9.0 5.0 6.0 5.0 10.0	2.8 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 11.0 % Coarse grav 25.0 % Medium grav 11.0 % Fine gravel 15.0 % Coarse same		System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan # 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35 60	River d Isla Phi : ****** -6 : -5 -4 : -3 -2 : -1 0 : 1 2 :	Percent finer 100.0 70.8 43.3 33.7 31.1 28.4 18.0 6.7	Depth : 13 Method: 0 t Percent retained ********** 0.0 0.0 29.2 27.5 9.6 2.7 10.4	3.1 m .1-m2 Van Veen Percent by size classification ************************************
System : Project: Station: Station: 64 mm 32 mm 16 mm 4 mm 2 mm 1 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # ********** 2-1/2 in 1-1/4 ir 5/8 in 5/16 ir No. 5 10 18 35 60 120	River d Isla Phi -5 -4 -3 -2 -1 0 1 2 3	nd finer 100.0 89.0 73.0 64.0 59.0 53.0 48.0 38.0 9.0 1.0	Depth : 12 Method: 0 Percent retained 0.0 11.0 16.0 9.0 5.0 6.0 5.0 10.0 29.0	2.8 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 11.0 % Coarse grav 25.0 % Medium grav 11.0 % Fine gravel 15.0 % Coarse same		System : Project: Station: Size mm *********** 64 mm 32 mm 16 mm 8 mm 4 mm 2 mm 1 mm 0.5 mm 0.25 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35 60	River d Isla Phi +***** -6 -5 -4 -3 -2 -1 0 0 1 2 3 3	Percent finer 100.0 70.8 43.3 33.7 31.1 28.4 18.0 6.7 0.4	Depth : 13 Method: 0 t Percent retained 0.0 0.0 29.2 27.5 9.6 2.7 10.4 11.3	3.1 m .1-m2 Van Veen Percent by size classification ************************************
System : Project: Station: Station: 125 mm 16 mm 32 mm 16 mm 4 mm 2 mm 1 mm 0.5 mm 0.25 mm 0.125 mm 0.625 mm	Columbia Cottonwood CW23 U.S.Sieve Pan # ********** 2-1/2 in 1-1/4 ir 5/16 ir No. 5 10 18 35 60 120 230	River d Isla Phi : -6 : -5 : -4 : -3 : -2 : -1 : 0 : 1 : 2 : 3 : 4 :	nd finer 100.0 89.0 73.0 64.0 59.0 53.0 48.0 38.0 9.0 1.0	Depth : 12 Method: 0 Percent retained ********* 0.0 11.0 16.0 9.0 5.0 6.0 5.0 10.0 29.0 8.0	2.8 m 1-m2 Van Veen Percent by size classification Classif		System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan # 2-1/2 in 1-1/4 in 5/16 in No. 5 10 18 35 60 120 230	River d Isla Phi : ****** -6 : -5 : -4 : -5 : -4 : -5 : -1 : 0 : 1 : 2 : 3 : 4 :	Percent finer 100.0 70.8 43.3 33.7 31.1 28.4 18.0 6.7 0.4	Depth : 13 Method: 0 t Percent retained 0.0 0.0 29.2 27.5 9.6 2.6 2.7 10.4 11.3 6.3	3.1 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 56.7 % Medium grav 12.2 % Pine gravel 13.1 % Coarse sand 11.3 % Medium sand
System : Project: Station: Station: 4 mm 32 mm 4 mm 2 mm 0.5 mm 0.25 mm 0.25 mm 0.25 mm 0.25 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan # *********** 2-1/2 in 1-1/4 ir 5/16 ir No. 5 10 18 35 60 120 230 <230	River d Isla Phi { -6 -5 -4 -3 -2 0 1 2 3 4	nd finer 100.0 89.0 73.0 64.0 59.0 53.0 48.0 38.0 9.0 1.0	Depth : 12 Method: 0 Percent retained ********** 0.0 11.0 16.0 9.0 5.0 6.0 5.0 10.0 29.0 8.0 1.0	2.8 m 1-m2 Van Veen Percent by size classification Classification Construction 0.0 % Rubble 11.0 % Coarse grave 11.0 % Fine grave 15.0 % Coarse sand 29.0 % Medium sand 9.0 % Fine sand 0.0 % Silt/clay		System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan # ********** 2-1/2 in 1-1/4 in 5/8 in 5/16 in No. 5 10 18 35 60 120 230 <230	River d Isla Phi ****** -6 -5 -4 -5 -4 -1 0 1 2 3 4	Percent finer 100.0 70.8 43.3 33.7 31.1 28.4 18.0 6.7 0.4	Depth : 13 Method: 0 t Percent retained 	 3.1 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 56.7 % Medium grav 12.2 % Fine gravel 13.1 % Coarse sand 11.3 % Medium sand 6.7 % Fine sand 0.0 % Silt/clay
System : Project: Station: Station: 64 mm 32 mm 16 mm 4 mm 2 mm 0.5 mm 0.25 mm 0.125 mm	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ ********** 2-1/2 in 1-1/4 ir 5/8 in 5/16 ir No. 5 10 18 35 60 120 230 <230 <230	River d Isla Phi { -6 -5 -6 -3 -2 0 1 2 3 4	nd finer 100.0 89.0 73.0 64.0 59.0 53.0 48.0 38.0 9.0 1.0	Depth : 12 Method: 0 Percent retained ********** 0.0 11.0 16.0 9.0 5.0 6.0 5.0 10.0 29.0 8.0 1.0	2.8 m 1-m2 Van Veen Percent by size classification 0.0 % Rubble 11.0 % Coarse grav 25.0 % Medium grav 11.0 % Fine gravel 15.0 % Coarse sand 29.0 % Medium sand 9.0 % Fine sand		System : Project: Station: Size mm ***********************************	Columbia Cottonwoo CW23 U.S.Sieve Pan ‡ 2-1/2 in 1-1/4 in 5/16 in No. 5 10 18 35 60 120 230 <230	River d Isla Phi ****** -6 -5 -4 -1 0 1 2 3 4	Percent finer 100.0 70.8 43.3 33.7 31.1 28.4 18.0 6.7 0.4	Depth : 13 Method: 0 t Percent retained 	 3.1 m .1-m2 Van Veen Percent by size classification 0.0 % Rubble 0.0 % Coarse grav 56.7 % Medium grav 12.2 % Fine gravel 13.1 % Coarse sand 11.3 % Medium sand 6.7 % Fine sand

Appendix Table 4.--Summaries of fish catches off Cottonwood Island, Columbia River, 1987-1988. Two community structure indices -- H' and J' -- were calculated for each trawling effort (see Methods for descriptions of indices).

STATION: CW21 Gear: 4.9-m Trawl Date: 9 Jul 1987 Time: 1312 h Depth: 17.4 m Distance traveled: 315 m

Species	No. captured	No./ha
Prickly sculpin Unidentified Cottidae	1 4	10 38
TOTAL	5	48

H' = 0.72 J' = 0.72

STATION: CW22 Gear: 4.9-m Trawl Date: 9 Jul 1987 Time: 1244 h Depth: 17.4 m Distance traveled: 278 m

Species	No. captured	No./ha
Unidentified Cottidae	7	76
TOTAL	7	76

 $H' = 0.00 \qquad J' = 1.00$

STATION: CW23 Gear: 4.9-m Trawl Date: 9 Jul 1987 Time: 1215 h Depth: 14.9 m Distance traveled: 241 m

Species	No. captured	No./ha
White sturgeon	1	13
Prickly sculpin	4	50
Unidentified Cottidae	9	113
TOTAL	14	176

H' = 1.20 J' = 0.76

STATION: CW21 Gear: 4.9-m Trawl Date: 19 Nov 1987 Time: 0815 h Depth: 18.0 m Distance traveled: 278 m

Species	No. captured	No./ha
Northern squawfish	1	11
Starry flounder	1	11
Peamouth	1	11
TOTAL	3	33

H' = 1.58 J' = 1.00

STATION: CW22 Gear: 4.9-m Trawl Date: 19 Nov 1987 Time: 0901 h Depth: 16.8 m Distance traveled: 296 m

Species	No. captured	No./ha
White sturgeon Peamouth	1 1	10 10
TOTAL	2	20

H' = 1.00 J' = 1.00

STATION: CW23		
Gear: 4.9-m Trawl		
Date: 19 Nov 1987		
Time: 0931 h		
Depth: 15.5 m		
Distance traveled:	296	m

Species	No. captured	No./ha
Peamouth Starry flounder	2 1	20 10
TOTAL	3	30

H' = 0.92 J' = 0.92

STATION: CW21 Gear: 4.9-m Trawl Date: 21 Jul 1988 Time: 1611 h Depth: 16.2 m Distance traveled: 278 m

Species	No. captured	No./ha
Sand roller	5	55
Prickly sculpin	1	11
Unidentified Cottidae	3	33
TOTAL	9	99

H' = 1.35 J' = 0.85

STATION: CW22		
Gear: 4.9-m Trawl		
Date: 21 Jul 1988		
Time: 1544 h		
Depth: 17.4 m		
Distance traveled:	315	m

Species	No. captured	No./ha
Sand roller	2	19
Largescale sucker	2	19
Prickly sculpin	1	10
Unidentified Cottidae	12	115
TOTAL	17	163

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H' = 1.32 J' = 0.66

STATION: CW23 Gear: 4.9-m Trawl Date: 21 Jul 1988 Time: 1453 h Depth: 14.9 m Distance traveled: 333 m

Species	No. captured	No./ha
Prickly sculpin Unidentified Cottidae	5 9	46 82
TOTAL	14	128

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H' = 0.94 J' = 0.94

STATION: CW21		
Gear: 4.9-m Trawl		
Date: 7 Dec 1988		
Time: 1227 h		
Depth: 15.5 m		
Distance traveled:	333	m

Species	No. captured	No./ha
Peamouth Unidentified Cottidae	2 1	18 9
TOTAL	3	27

H' = 0.92 J' = 0.92

STATION: CW22 Gear: 4.9-m Trawl Date: 7 Dec 1988 Time: 1159 h Depth: 16.2 m Distance traveled: 296 m

Species	No. captured	No./ha
Prickly sculpin	1	10
TOTAL	1	10

 $H' = 0.00 \qquad J' = 1.00$

STATION: CW23		
Gear: 4.9-m Trawl		
Date: 7 Dec 1988		
Time: 1130 h		
Depth: 14.0 m		
Distance traveled:	296	m

Species	No. captured	No./ha
Prickly sculpin Peamouth	4 1	4 1 10
TOTAL	5	51

H' = 0.72 J' = 0.72