CENPS-OP-DMMO

MEMORANDUM FOR RECORD 19 February 1992

SUBJECT: SUPPLEMENTAL DETERMINATION ON THE SUITABILITY OF DREDGED MATERIAL TESTED UNDER PSDDA GUIDELINES FOR BELLINGHAM MAINTENANCE DREDGING IN SQUALICUM CREEK WATERWAY FOR DISPOSAL AT EITHER THE BELLINGHAM BAY NONDISPERSIVE OPEN WATER DISPOSAL SITE OR THE ROSARIO STRAIT DISPERSIVE SITE

1. The following summary replaces the June 3, 1991 suitability decision for Squalicum Creek Waterway. It reflects new information and additional analyses gathered for and reviewed by the PSDDA agencies'(Corps, Departments of Ecology and Natural Resources, and the Environmental Protection Agency). The decision is based on a careful review of the initial sediment characterization results and supplemental sampling data. A determination of suitability has been made for the 194,214 cubic yards of dredged material proposed for maintenance dredging from the Squalicum Creek Waterway navigation channel and adjacent berthing areas. The initial sediment characterization results can be found in the Dredged Material Management Office's 3 June 1991 suitability decision memorandum. Supplemental sampling was conducted 25 - 26 November 1991 by the Corps of Engineers and Port of Bellingham. Analysis of this supplemental data can be found in Science Application International Corporation's (SAIC) report dated 22 January 1992. Additional data in support of this suitability decision are contained in SAIC reports dated 4 February 1992 and 18 February 1992. This final determination is made relative to suitability for unconfined open-water disposal (UCOWD) at either the PSDDA Bellingham Bay nondispersive site or the PSDDA Rosario Strait dispersive site.

2. The initial sediment characterization indicated elevated concentrations of zinc in several dredged material management units (DMMU) in Squalicum Creek Waterway. The purpose of the supplemental sampling was to better characterize the distribution of zinc within and outside of the navigable waterway. However, supplemental sampling results showed no correspondence with the initial assessment of high zinc concentrations. A review of the original lab test data showed that the lab findings of high initial zinc concentrations was limited to a single laboratory batch. Archived sediments from the original composite DMMU were then analyzed by a second lab and subsequently by the original testing lab. Both labs determined that the zinc concentrations in the archived sediments were actually much lower than those reported in the initial characterization. This data corroborated the results from the supplemental sampling effort, which determined that the zinc levels were in fact relatively low and below the PSDDA screening level (SL). More detailed discussion of the sampling and analyses conducted follows below.

3. A total of thirty-four supplemental uncomposited surface analyses and four vertically composited subsurface analyses were conducted (round 5, November 1991) to further characterize the material from within the Squalicum Creek Waterway (**enclosure 1**). Eight of the analyses (i.e., surface samples S-27 to S-34) were conducted outside of the navigable waterway to better define the zinc distribution (**enclosure 2**). These analyses were conducted in addition to the twelve composited round 1 samples (November 1990) initially analyzed and discussed in the June 3, 1991 suitability decision memorandum. The distribution of supplemental round 5 samples shown in **enclosure 2** compared to the initial composited analyses are depicted in **enclosure 1** (note that **S** prefixes denote uncomposited samples and **C** prefix denotes composited subsurface samples).

Enclosure 3 summarizes the results of the round 5 resampling effort; zinc concentrations from the initial round 1 sediment characterization are included in this table. **Enclosure 4** shows the combined results of all testing including analyses conducted from the archived samples, a sharp contrast with the earlier zinc results for eight of the twelve analyses is evident. Results demonstrate that four of the six (C-5, C-9, C-10, C-11) round 1 dredged material management units (DMMU) initially considered unsuitable (Suitability Decision Memorandum, June 3, 1991) for unconfined open-water disposal are now suitable for disposal at either a designated non-dispersive unconfined open-water Bellingham Bay disposal site or a dispersive site (Rosario Strait) with confirmatory zinc concentrations below the screening level (SL). The two round 1 DMMU which initially exceeded the maximum level (ML) for zinc in Squalicum Creek Waterway (C-8, C-12), but were within allowable chemistry guidelines for biological testing (i.e., less than 100% greater than ML), were found to be below SL on retesting archived sediments. Biological testing confirmed that these two management units were suitable for UCOWD (see June 3, 1991 suitability decision memorandum).

4. No biological testing was performed on either DMMU C-1 or C-2, and both are considered to be unsuitable for UCOWD unless required bioassay testing is conducted for sample DMMU C-1 and bioassay testing and bioaccumulation testing is conducted for DMMU C-2 (**enclosure 5**). There currently is no plan to conduct these biological tests. The round 1 (archived samples) and round 5 results confirmed that zinc levels in composited surface DMMU C-1 and subsurface DMMU C-2 were below the SL, but initial round 1 results indicated that subsurface DDT levels (DMMU C-2) exceeded both the SL and Bioaccumulation Trigger (BT). Round 5 resampling and analyses (zinc, pesticides, PCBs) of three of the four original sampling locations making up the initial round 1 DMMU composite and an additional new, previously unsampled location within the DMMU (surface: S-24; subsurface: C-4) indicated that zinc was below the SL, but that DDT concentrations exceeded the SL in one surface sample (November 1991: S-23) and in two subsurface samples (November 1991: C-2, C-4), with PCB (undetected) exceeding the SL in one subsurface sample (November 1991: C-1).

5. Supplemental analyses were conducted for the PSDDA metals (except mercury) in three of the within batch (all high zinc concentrations occurred within a single batch) archived composited round 1 (November 1990) DMMU (C-1, C-9, C-11) and two of the resampled uncomposited round 5 (November 1991) samples (S-3, S-22) to validate the earlier data and confirm that cross-contamination of the samples did not occur. These results showed generally close correspondance with earlier results and indicated that cross-contamination of other metals within the zinc contaminated batch was not indicated (**enclosure 6**).

6. Composited round 1 subsurface DMMU C-10 had a slight exceedance of the nickel SL and was quantitated at 150 ppm, while the SL is 140 ppm. Retested archived DMMU C-9 and DMMU C-11 were also quantitated at 150 ppm, compared to inital nickel analyses levels of 120 and 130 ppm, respectively (note that averages for each DMMU do not exceed Ni SL) (**enclosure 6**). No firm AET has been established for nickel for either the oyster larvae or microtox bioassays, and both amphipod and benthic infaunal AET's are greater than 140 ppm. The overlying surface DMMU C-9 at this location passed biological testing guidelines with no exceedances of SL (Ni = 120 ppm). Given the chemistry and bioassay results of the overlying surface DMMU C-9, there is no reason to believe that the subsurface DMMU C-10, or C-9 and C-11 are a cause for concern. Based on the weight of evidence, DMMU C-10, C-9 and C-11 are suitable for UCOWD without biological testing.

7. The results summarized above indicated that a data quality assurance/quality control (QA/QC) investigation needed to be conducted to check the initial round 1 results and validate the adequacy of the data collected to make a suitability decision. Probable reasons for the high zinc concentrations and zinc contamination of samples were investigated by the laboratory responsible for the analyses and by the PSDDA agencies conducting the QA/QC review. The findings of high zinc concentrations was restricted to eight of the twelve round 1 (November 1990) within batch samples. A full chronology and explanation of probable sources and causes of the laboratory contamination is provided in **enclosure 7**, which indicate that the zinc contamination occurred after sampling and before analysis in the laboratory, and was not present in the original round 1 samples collected from Squalicum Creek Waterway (i.e., the in-situ sediments do not contain high zinc concentrations).

8. In general, the PSDDA approved sampling and analysis protocols were followed, and quality assurance/quality control guidelines specified by PSDDA were complied with. After reviewing all the data gathered for these characterizations (**enclosure 4**) including the QA/QC investigation report (**enclosure 7**), the PSDDA agencies concluded that the initial data collected (excepting the zinc contaminated DMMU summarized above) and supplemental data (resampling and reanalyses of archived samples) were sufficient and acceptable for regulatory decision-making under the PSDDA program.

9. **Enclosure 5** provides a chemistry and bioassay decision summary for each of the twelve DMMU, originally tested in Squalicum Creek Waterway as augmented by the resampling effort (round 5) and reanalyses conducted on archived (round 1) samples from Squalicum Waterway and depicts each DMMU suitability for unconfined open-water disposal at either the Bellingham Bay nondispersive site or the Rosario Strait dispersive site.

10. **Enclosure 8** provides revised cumulative volume testing summaries for each waterway (replacing enclosure 11 from June 3, 1991 suitability decision) for the federal and nonfederal (Port of Bellingham) portions of the project. Based on the above discussion and summary of chemical results for the Bellingham Harbor Maintenance Dredging Characterization for Squalicum Creek Waterway, the PSDDA agencies concluded that 164,912 cubic yards from the Squalicum Creek Waterway is suitable for dredging and unconfined open-water disposal at the Bellingham Bay nondispersive site. Testing results summarized above indicated that 29,302 cubic yards of material at the head of the Corp's navigation channel (DMMU C-1 and C-2) is unsuitable for dredging and unconfined open-water disposal at either the Bellingham Bay nondispersive site or at the Rosario Strait dispersive site. All the dredged material found suitable under the nondispersive test interpretation guidelines was also suitable for disposal at the Rosario Straits dispersive site except 19,574 cubic yards (DMMU C-12) from the Corp's navigation channel (**enclosure 5**). All the Port's material in Squalicum Creek Waterway was found suitable under the PSDDA nondispersive site guidelines and also passed the more restrictive dispersive site guidelines. Summary volumes for Whatcom Waterway and I & J Street Waterways remain unchanged as depicted in the June 3, 1991 Suitability Decision Memorandum and are summarized in **enclosure 8**.

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Enclosures

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Table 1. Squalicum Waterway partial summary of initial round 1 (November 1990) composite and analysis sampling number and chemical testing results. A subset of these samples were resampled (Table 2 below) to assess chemicals noted in table below.

COMPOSITE NUMBER	SAMPLE NUMBER	CHEMICALS > SL (CONCENTRATION)	DECISION ON SUITABILITY FOR UCOWD[1]
C-1 (SURFACE)	1, 2, 3, 4	Zn (13,000 ppm)	Unsuitable
C-2 (SUBSURFACE)	1, 2, 3, 4	Zn (6,100 ppm) DDT (63.7 ppb) PCB (510 ppb)	Unsuitable
C-5 (SURFACE)*	5, 7, 12	Zn (4,300 ppm)	Unsuitable
C-8 (SURFACE)*	16, 17 (18, 19, 20, 21)**	Zn (2,500 ppm)	Suitable
C-9 (SURFACE)	22, 23, 24, 25	Zn (5,700 ppm)	Unsuitable
C-11 (SURFACE)	29, 30, 31, 32	Zn (8,300 ppm)	Unsuitable

[1] initial suitability decision memorandum dated June 3, 1991 for nondispersive site disposal, which is replaced by the decision matrix shown in enclosure 5 of this suitability decision memorandum.

UCOWD = Unconfined Open-water Disposal

* Screening Level (SL) for 1,2,4-Trichlorobenzene = 13 ppb (per 3rd ARM), therefore C-5 (8.1 ppb) and C-8 (9.8 ppb) concentrations below current SL.

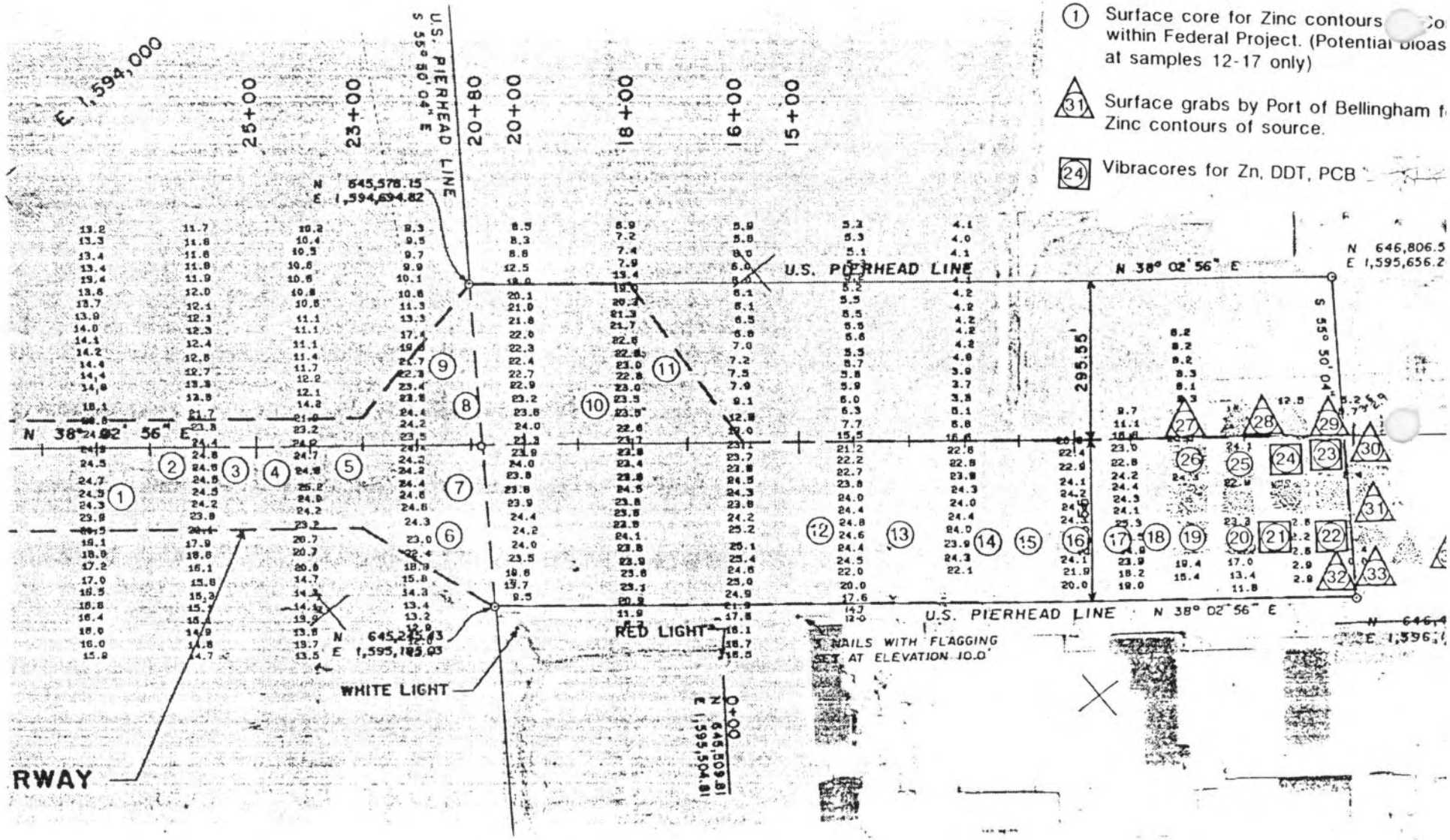
** Samples in parenthesis are not proposed for dredging at this time due to elevated subsurface zinc concentrations in samples at those locations.

Table 2. Squalicum Waterway supplemental round 5 (November 1991) resampling number for chemicals noted in Table 1 above, exceeding PSDDA guidelines.

New Sample # (Analysis #)	Old Sample # (Analysis #)	New Sample # (Analysis #)	Old Sample # (Analysis #)
1 (S-1 sur)	32 (C-11)	21 (S-21 sur; C-1 sub)*	4 (C-1 sur; C-2 sub)
2 (S-2 sur)	31 (C-11)	22 (S-22 sur; C-2 sub)*	3 (C-1 sur; C-2 sub)
3 (S-3 sur)	30 (C-11)	23 (S-23 sur; C-3 sub)*	1 (C-1 sur; C-2 sub)
4 (S-4 sur)	29 (C-11)	24 (S-24 sur; C-4 sub)*	
5 (S-5 sur)		25 (S-25 sur)	
6 (S-6 sur)	25 (C-9)	26 (S-26 sur)	
7 (S-7 sur)	24 (C-9)	27 (S-27 sur)	
8 (S-8 sur)	23 (C-9)	28 (S-28 sur)	
9 (S-9 sur)	22 (C-9)	29 (S-29 sur)	
10 (S-10 sur)	16 (C-8)	30 (S-30 sur)	
11 (S-11 sur)	17 (C-8)	31 (S-31 sur)	
12 (S-12 sur)	12 (C-5)	32 (S-32 sur)	
13 (S-13 sur)		33 (S-33 sur)	
14 (S-14 sur)	7 (C-5)	34 (S-34 sur)	
15 (S-15 sur)			
16 (S-16 sur)			
17 (S-17 sur)			
18 (S-18 sur)	5 (C-5)		
19 (S-19 sur)			
20 (S-20 sur)			

S = uncomposited single sample analysis
C = multiple samples composited for analysis
* Zn, DDT, PCB; Zn only for all other samples; subsurface samples will be composited vertically at each sample station for a single analysis.

ENCLOSURE - 2


LEGEND:
(1) Surface core for Zinc contours
within Federal Project. (Potential bioas
at samples 12-17 only)
(31) Surface grabs by Port of Bellingham f
Zinc contours of source.
(24) Vibracores for Zn, DDT, PCB
E 1,594,000
25+00
23+00
20+80
20+00
18+00
16+00
15+00
U.S. PIERHEAD LINE
S 55° 50' 04" E
N 645,578.15
E 1,594,694.82
N 38° 02' 56" E
N 646,806.5
E 1,595,656.2
295.55'
U.S. PIERHEAD LINE
N 38° 02' 56" E
RED LIGHT
WHITE LIGHT
N 645,245.93
E 1,595,193.93
NAILS WITH FLAGGING
SET AT ELEVATION 10.0'
RWAY

CHEMICAL SUMMARY OF ANALYSES CONDUCTED FROM UNCOMPOSITED[1] ROUND 5 SAMPLES COLLECTED IN NOVEMBER 1991 FROM SQUALICUM CREEK WATERWAY

ROUND 1 COMPOSITE #	ROUND 1 SAMPLE #	ROUND 5 RESAMPLE # NEW (OLD)	ZINC (ppm)	ALDRIN (ppb)	CHLORDANE (ppb)	TOTAL DDT (ppb)	DIELDRIN (ppb)	HEPTACHLOR (ppb)	LINDANE (ppb)	TOTAL PCB (ppb)
C-1 (SUR)	1, 2, 3, 4	S-21 (4) S-22 (3) S-23 (1) S-24 (NEW)	95 75 140 160 (13,000)[2]	3.8 3.0 1.9 3.1 (2.7)	2.0 1.6u 2.8u 2.6u (4.1)	1.8u 1.6u 17.2 (SL) 4.4 (4.2)	0.7u 0.6u 1.1u 1.0u (0.8u)	0.9u 0.8u 1.4u 1.3u (1.0u)	0.5u 0.5u 0.8u 0.8u (0.6u)	36u 32u 110u 52u (39u)
C-2 (SUB)	1, 2, 3, 4	C-1 (4) C-2 (3) C-3 (1) C-4 (NEW)	100 86 100 130 (6,100 ML)	4.0 4.7 0.6u 1.4 (1.6)	2.7 8.4u 2.1u 2.4u (2.1u)	1.9u 8.4u (SL) 2.1u 11.1 (SL) (63.7 SL|BT)	0.8u 3.4u 0.8u 1.0u (1.0)	1.0u 4.2u 1.1u 1.2u (1.0u)	0.6u 2.5u 0.6u 0.7u (0.6u)	190u (SL) 34u 42u 48u (510 SL)
C-5 (SUR)	5, 7, 12	S-12 (12) S-13 (NEW) S-14 (7) S-15 (NEW) S-16 (NEW) S-17 (NEW) S-18 (5)	150 130 130 120 140 140 140 (4,300 ML)	NA	NA	NA	NA	NA	NA	NA
C-8 (SUR)	16, 17, 18, 19, 20, 21	S-10 (16) S-11 (17)	140 140 (2,500 ML)	NA	NA	NA	NA	NA	NA	NA
C-9 (SUR)	22, 23, 24, 25	S-6 (25) S-7 (24) S-8 (23) S-9 (22)	150 140 160 140 (5,700 ML)	NA	NA	NA	NA	NA	NA	NA
C-11 (SUR)	28, 29, 30, 31,32	S-1 (32) S-2 (31) S-3 (30) S-4 (29) S-5 (28)	160 150 170 150 150 (8,300 ML)	NA	NA	NA	NA	NA	NA	NA
NOT SAMPLED PREVIOUSLY		S-27 S-28 S-29 S-30 S-31 S-32 S-33 S-34	130 140 160 92 94 79 51 100	NA	NA	NA	NA	NA	NA	NA

[1] uncomposited surface samples denoted by S prefix; subsurface samples denoted with C prefix were composited vertically at four stations.

[2] (ROUND 1, November 1990 characterization)

NA = NOT ANALYZED

SUR = SURFACE

SUB = SUBSURFACE

ENCLOSURE - 3

COMPLETE SUMMARY OF ANALYSES RESULTS CONDUCTED FOR THE BELLIN HARBOR MAINTENANCE PROJECT
FROM SQUALICUM CREEK WATERWAY

ROUND 1 COMPOSITE #	ROUND 1 SAMPLE #	INITIAL CONCENTRATION (LAB 1: 11/90)	REANALYSIS CONCENTRATION (LAB 2: 12/91)*	REANALYSIS CONCENTRATION (LAB 1: 1/92)*	ROUND 5 RESAMPLING EFFORT** R-5 (R-1) SAMPLE #	CONCENTRATION (LAB 1: 12/91)
C-1 (SURFACE)	1, 2, 3, 4	13,000 PPM	82, 97, 87 PPM MEAN = 89 PPM	66 PPM[b]	S-21 (4) S-22 (3) S-23 (1) S-24 NEW	95 PPM 75 PPM[b] 140 PPM 160 PPM MEAN = 118 PPM
C-2 (SUBSURFACE)	1, 2, 3, 4	6,100 PPM	87 PPM	75 PPM[b]	C-1 (4) C-2 (3) C-3 (1) C-4 NEW	100 PPM 86 PPM 100 PPM 130 PPM MEAN = 104 PPM
C-3 (SURFACE)	9, 10, 11	110 PPM	121 PPM	NOT ANALYZED	NOT RESAMPLED	
C-4 (SUBSURFACE)	9, 10, 11	110 PPM	NOT ANALYZED	NOT ANALYZED	NOT RESAMPLED	
C-5 (SURFACE)	5, 7, 12	4,300 PPM	NOT ANALYZED	110 PPM	S-12 (12) S-13 (NEW) S-14 (7) S-15 (NEW) S-16 (NEW) S-17 (NEW) S-18 (5)	150 PPM 130 PPM 130 PPM 120 PPM 140 PPM 140 PPM 140 PPM MEAN = 136 PPM
C-6 (SURFACE)	6, 8, 13	110 PPM	NOT ANALYZED	NOT ANALYZED	NOT RESAMPLED	
C-7 (SURFACE)	14, 15, 26, 27	110 PPM	NOT ANALYZED	NOT ANALYZED	NOT RESAMPLED	
C-8 (SURFACE)	16, 17, 18, 19, 20, 21	2,500 PPM	119, 115, 114 PPM MEAN = 116 PPM	100 PPM	S-10 (16) S-11 (17)	140 PPM 140 PPM
C-9 (SURFACE)	22, 23, 24, 25	5,700 PPM	114 PPM	96 PPM	S-6 (25) S-7 (24) S-8 (23) S-9 (22)	150 PPM 140 PPM 160 PPM 140 PPM MEAN = 148 PPM
C-10 (SUBSURFACE)	18, 19, 20, 21	5,000 PPM	116, 114, 117 PPM MEAN = 116	110 PPM	NOT RESAMPLED	
C-11 (SURFACE)	28, 29, 30, 31, 32	8,300 PPM	116 PPM	110 PPM	S-1 (32) S-2 (31) S-3 (30) S-4 (29) S-5 (28)	160 PPM 150 PPM 170 PPM 150 PPM 150 PPM MEAN = 156 PPM
C-12 (SURFACE)	33, 34, 35, 36	3,000 PPM	114 PPM	100 PPM	NOT RESAMPLED	

* reanalysis of archived Round 1 (November 1990) sediment (@ -18°C). Round 1 samples split and subsamples archived after homogenizing in field.

** Round 5 (November 1991) sampling effort to resample and characterize zinc distribution within Squalicum Creek Waterway. S = uncomposited surface samples; C = vertically composited subsurface samples.

[b] Blank contaminated qualified value: sample value less than or equal to five times the blank value (17 ppm), sample value may be high.

SUPPLEMENTAL DREDGED MATERIAL SUITABILITY DECISION MATRIX FOR SQUALICUM CREEK WATERWAY

SAMPLE ID	DMMU VOLUME (CY)	SPONSOR	SAMPLING & TESTING ROUND	COC > SL	COC > BT	NONDISPERSIVE (PASS / FAIL)	DISPERSIVE (PASS / FAIL)
SQUALICUM CREEK WATERWAY							
C1 (SURFACE)	7,235	CORPS	1, 5	1 (DDT)		FAIL (D)	FAIL (D)
C2 (SUBSURFACE)	22,067	CORPS	1, 5	2 (DDT, PCB)	1 (DDT)	FAIL (D)	FAIL (D)
C3 (SURFACE)	11,820	POB	1			PASS (C)	PASS (C)
C4 (SUBSURFACE)	21,060	POB	1, 3	1 (DDT)		PASS (B)	PASS (B)
C5 (SURFACE)	9,662	CORPS	1, 5			PASS (C)	PASS (C)
C6 (SURFACE)	22,689	CORPS	1, 3	1 (Hg)		PASS (B)	PASS (B)
C7 (SURFACE)	14,685	CORPS	1			PASS (C)	PASS (C)
C8 (SURFACE)	13,073	CORPS	1, 3, 5			PASS (B)	PASS (B)
C9 (SURFACE)	22,076	CORPS	1, 5			PASS (C)	PASS (C)
C10 (SUBSURFACE)	6,273	CORPS	1	1 (Ni)[1]		PASS (C)	PASS (C)
C11 (SURFACE)	24,000	CORPS	1, 5			PASS (C)	PASS (C)
C12 (SURFACE)	19,574	CORPS	1, 3			PASS (B)	FAIL (B)
TOTAL: TESTED / ND FAILED	194,214 / 29,302[2]					2 / 12 FAIL	3 / 12 FAIL

LEGEND:
SL = SCREENING LEVEL
BT = BIOACCUMULATION TRIGGER VALUE
CY = CUBIC YARDS
DMMU = DREDGED MATERIAL MANAGEMENT UNIT
ND = NONDISPERSIVE SITE DISPOSAL GUIDELINES
POB = PORT OF BELLINGHAM
PASS (B) = PASSES BIOASSAY DISPOSAL GUIDELINES
FAIL (B) = FAILS BIOASSAY DISPOSAL GUIDELINES
PASS (C) = PASSES CHEMISTRY DISPOSAL GUIDELINES (ALL COC < SL)
FAIL (D) = INITIAL (ROUND 1) COMPOSITED ANALYSIS AND REANALYSES OF FOUR UNCOMPOSITED (ROUND 5) SAMPLES SHOWED EXCEEDANCES OF SL AND BT AS DEPICTED ABOVE FOR ALL ANALYSES (ROUND 1 + ROUND 5) CONDUCTED WITHIN DMMU FOR C-1 (SURFACE) AND C-2 (SUBSURFACE), THEREBY REQUIRING BIOASSAYS FOR C-1, AND BIOASSAYS + BIOACCUMULATION TEST FOR C-2. DMMU UNSUITABLE PENDING BIOLOGICAL TESTING
ROUND 1 = NOVEMBER (13 - 17) 1990 SAMPLING PERIOD
ROUND 3 = FEBRUARY (12 - 13) 1991 (resampling effort for bioassay retesting only)
ROUND 5 = NOVEMBER (25 - 26) 1991 SAMPLING PERIOD

[1] Initial analyses (November 1990) indicated Zn exceedance of ML, and Ni slightly over SL at 150 ppm (SL = 140 ppm). Reanalysis by two labs confirmed Zn below SL; DMMU suitable based on BPJ (Ni LAET > 140 ppm: Amphipod and Benthic AET).

[2] unsuitable dredged material for dispersive site (Rosario Straits) disposal = 48,876 cubic yards.

COMPARATIVE WITHIN BATCH METALS[1] ANALYZED FROM INITIAL, ARCHIVED, AND SUPPLEMENTAL SAMPLING EFFORT.

SAMPLE # (Sample date)	ROUND 1 DMMU C-1 (11/90)		ROUND 1 DMMU C-9 (11/90)		ROUND 1 DMMU C-11 (11/90)		ROUND 5 S-3 (11/91)	ROUND 5 S-22 (11/91)
METALS (ppm)	INITAL	RETEST	INITIAL	RETEST	INITIAL	RETEST	INITIAL	INITIAL
ANTIMONY	0.87	0.66	1.6	1.1	1.7	1.1	0.74	1.2
ARSENIC	8.6	7.8	16	14	11	13	11	8.6
CADMIUM	0.5	0.12	0.38	0.06	0.34	0.18	0.11	0.07
COPPER	51	42	44	54	46	54	56	21
LEAD	51	17	7.3	11	6.0	6.2	9.7	12
NICKEL	71	49	120	150	130	150	160	25
SILVER	0.09u	0.22	0.1u	0.16	0.1u	0.2	0.1u	0.1u
ZINC	13,000	85	5,700	92	8,300	120	110	78

[1] metals depicted are digested within batch using the Total Acid Digestion procedure and various Puget Sound Estuary Program (PSEP) approved analysis methods (GFAA and ICP). Mercury not included; analyses out of batch utilizing the PSEP approved CVAA protocol.

u = undetected at detection limit depicted

PSDDA AGENCY REVIEW OF QA/QC DATA ISSUE RELATIVE TO THE ROUND 1 (NOVEMBER 1990) CHEMICAL TESTING OF ZINC.

Problem Identification.

A resampling effort was initiated in November 1991 to further characterize zinc distributions at thirty-four surface sampling locations and at four subsurface locations (enclosure 2). The purpose of the resampling and analysis exercise was to better elucidate the concentration of zinc throughout Squalicum Creek Waterway in order to make better distinctions between suitable and unsuitable dredged material. However, when testing data from this resampling effort came back to the prime contractor (SAIC) it was noted that the concentrations were very low, and all below the PSDDA screening level (SL). This was in marked contrast to the high concentrations noted in eight of the twelve round 1 (November 1990) results, which ranged from 2,500 - 13,000 ppm (dry weight). SAIC initiated a retest of archived round 1 (November 1990) samples at another laboratory (lab 2 = Weyerhaeuser) to verify the earlier high zinc results. These results were also low and below the PSDDA SL (see enclosure 4). The initial testing lab (lab 1 = AmTest) then retested the archived samples. The analyses of the archived round 1 samples all came back with low readings for zinc. Collectively, the results showed conclusively that something anomalous occurred with zinc analyses for eight of the twelve round 1 samples tested from Squalicum Creek Waterway.

A review of the chain of custody forms and review of the QA/QC data supporting these results, indicated that the apparent contamination of the samples occurred after sample splitting occurred, and the analyses results indicated that the high zinc readings all occurred within a single laboratory batch analysis for zinc. The results also indicated that the initial samples collected were not contaminated at the time of collection, because the archived samples (split from the original samples collected for COC analysis following homogenization) all showed low zinc. Selective analyses of all metals analyzed within the batch specific samples, indicated that the contamination problem did not extend to the other metals (see enclosure 6), and appeared to be restricted to the zinc alone. A review of the relevant QA/QC results pertaining to the batch specific analyses follows.

QA/QC Review.

During the initial QA/QC review conducted by the PSDDA agencies all relevant QA/QC data were examined to evaluate the data for decision making. The QA/QC review showed that PSDDA prescribed detection limits were achieved. It indicated that there was no contamination of the method blanks. The standard reference material (NBS 2704) results were all within Puget Sound Estuary Program (PSEP) action limits (80 to 120 percent recovery) for zinc and other metals, except lead (75 percent recovery). Matrix Spike recoveries were generally within acceptable ranges (80 to 120 percent recovery) for all metals except antimony (73 percent recovery). Quality control duplicate analyses were all within the recommended twenty percent Relative Percent Difference (RPD) limit.

Examination of the chain of custody sheets for the Squalicum Creek Waterway samples indicated that all the samples which had the high zinc concentrations (C-1, C-2, C-5, C-8, C-9, C-10, C-11, C-12) were sampled during the same continuous time interval (13 - 15 November 1990) and delivered to the testing lab on 15 November 1990 at 12:03 p.m.. Four containers of each homogenized, composited sample were delivered to the testing laboratory for analysis. The containers consisted of two sample jars for volatile organics analysis, one sample jar for Chemical-Of-Concern (COC) testing (metals, semivolatile organics, pesticides, etc.) and conventionals analysis, and a single jar for total sulfides analysis. It should be noted that the sulfide sample is fixed in the field with approximately 5 mL of 2 Normal zinc acetate solution per 30 gram sediment sample.

The initial PSDDA agency QA/QC review indicated that the round 1 results were adequate for decision making under the PSDDA evaluation procedures. Subsequent evaluation of the zinc contamination issue after conducting a QA/QC review of the additional analysis results (round 5 resampling and analysis of archived round 1 samples) indicated that the initial batch 1 analysis data for round 1 zinc were suspect and should not be used in decison-making. Zinc concentrations measured in the uncomposited round 5 samples compared favorably with the archived round 1 zinc measurements. The resampling data and archived analysis data were used collectively to make the supplemental suitability decision relative to zinc. The initial round 1 data quality for chemicals other than zinc for round 1/batch 1 analyses was suitable for decision making under the PSDDA program.

Potential Source for Zinc Contamination of Samples.

An internal review by the contractor responsible for sample collections (SAIC) and the chemical testing laboratory (AmTest), of all sampling and analysis procedures, could not account for the high zinc levels encountered during the initial analysis (see attached letters from SAIC and AmTest). The method blank data associated with the round 1 batch specific analyses confirmed that reagents were not a significant source of zinc. The duplicate analyses, matrix spike recoveries, and standard reference material results were generally satisfactory and confirmed that the equipment (GFAA and ICP) was functioning properly. There was no direct evidence of contamination due to any of these factors.

One possible explanation for the high zinc results is that the eight sulfide samples delivered to the lab at the same time were mistakenly analyzed for metals during the batch 1/round 1 analyses instead of the COC samples. As noted above, sulfide samples are fixed in the field with a solution of zinc acetate. Another potential explanation is that sample jars utilized for COC analyses were mistakenly innoculated with zinc acetate solution. Desk-top calculations indicate that a zinc-acetate fixed sediment sample could theoretically approach the high concentrations of zinc observed in the eight round 1/batch 1 samples. Calculations indicate that a 25 gram sample of sediment (total solids = 61.25 %) fixed with 5 mL of 2 Normal zinc acetate solution would have a theoretical zinc concentration of 42,450 ppm, whereas a 500 gram sample would have a zinc concentration of 2,120 ppm by comparison. There is no direct evidence, however, that either of these scenarios actually occurred. This concentration range indicates that zinc acetate is a potential source of zinc contamination in the samples. In consideration of the entire sediment sampling and testing procedures used in this project, other potential sources of zinc contamination are not obvious. There was no final determination as to the source of the zinc contamination.

Corrective Action Taken.

The PSDDA agencies have reviewed QA/QC procedures to make corrections and clarifications of sampling and analyses procedures to reduce potential future QA/QC problems. A number of clarifications have been proposed for implementation following the next PSDDA Annual Review Meeting to insure that agents and labs have clear directions on appropriate protocols and procedures to be followed. The potential concern of fixatives such as zinc acetate are acknowledged, and the PSDDA agencies will look at ways of reducing potential contamination of samples by fixatives or other sources in the future.

Science Applications International Corporation
An Employee-Owned Company

February 19, 1992

Dr. David Kendall
US Army Corps of Engineers
Seattle District
4735 Marginal Way
Seattle, WA 98124-2255

Dear Dr. Kendall:

The objective of this letter is to provide you with a statement of the recent events connected with SAIC's sampling and analysis of sediment from the Squalicum Creek Waterway to determine if material from this location was suitable for open-water disposal in Puget Sound under PSDDA guidelines.

Background: SAIC performed initial sediment characterization of the Squalicum Creek Waterway in November, 1990. Samples were collected by personnel from the Corps of Engineers in Seattle and SAIC in Bothell, WA following PSDDA/PSEP guidelines for field collection and sample handling. Sediments were sent to our subcontractor (AmTest) for analysis, and results showed that eight of the composite samples had levels for zinc (ranging from 2,500-13,000 ppm) which exceeded PSDDA screening levels. All other contaminants were below PSDDA screening levels. The laboratory performed an internal QA/QC check before submitting the data to us, an internal QA1 review was performed by SAIC before communicating the results to our client, and all relevant QA/QC data required for PSDDA sampling also were submitted to PSDDA agencies and reviewed as part of the initial suitability decision made by the PSDDA agencies at that time.

- On November 25 and 26, 1991, SAIC collected more sediment core sections from 34 stations in the Squalicum Creek Waterway; four of these samples were subdivided, making a total of 38 samples that were submitted to our chemistry lab subcontractor (AmTest) for analysis.

- On December 31, 1991, SAIC received the results of the sediment analyses; the concentrations of zinc were much lower than found the previous year, ranging from 51 - 150 ppm. In an attempt to understand the difference in results between the two sampling times, SAIC performed the following actions:

1. The analytical laboratory (AmTest) was contacted to verify the calculations used in deriving both the 1990 and 1991 results; the lab confirmed the accuracy of the numbers. The lab also reviewed all records and procedures from the 1990 analyses (see letter from AmTest). No apparent discrepancies were discovered.

2. We re-examined our field logs from each year to identify any shipboard activities which may have contributed to possible zinc contamination in the field. None were discovered.

3. Archived samples from the initial 1990 collection were retrieved and sent to an independent lab (Weyerhaeuser) for verification and to AmTest for re-testing; both labs reported low zinc levels comparable to those found in 1991 (Weyerhaeuser results ranged from 82-124 ppm; AmTest results ranged from 66-110 ppm.)

After exhaustive internal reviews, we can find no evidence to explain the anomalous zinc levels found in our 1990 results; no discrepancies were noted during the three levels of QA/QC reviews that occurred after the 1990 sampling (at AmTest, at SAIC, and at the PSDDA agencies), and all our efforts over the past two months have not led to a clear understanding how or why the high 1990 zinc levels were obtained.

I hope the information in these letters together with the preponderance of solid analytical data provided by SAIC and its subcontractors on the chemical characteristics of Squalicum Waterway sediments will help the Corps with its final management decision on the suitability of these sediments for open water disposal.

Sincerely,

William J. Reynolds

for Joseph D. Germano, Ph.D.
Manager, Environmental Science Division

JDG:jg

cc: J. Lunz
S. Chillcott
R. Wade
P. Debrule

AMTEST

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February 19, 1992

David R. Kendall, Ph.D.
Seattle District Corps of Engineers
Dredged Material Management Office

Dear Dr. Kendall:

The objective of this letter is to summarize the events pertaining to the receipt, sample tracking, digestion, analysis and subsequent data reporting of marine sediments from Squalicum Creek Waterway. I will direct my remarks specifically to the element of concern, Zinc. It should be noted, though, that all analysis data for all elements is validated using the same Standard Operating Procedures (SOPs).

In November 1990, two batches of samples were delivered to the laboratory for the analysis of zinc and other elements. The eight samples showing elevated levels of zinc were received in the initial shipment. The second shipment of samples, several days later, were reported low in zinc. The two shipments of samples were acid digested, using the same reagents, for zinc on two separate days by the same experienced analyst. Both sets of sediment samples including the requisite Quality Assurance/Quality Control (QA/QC) samples were analyzed on the same instrument during the same batch run.

The instrumental analysis (ICP) indicated both high and low zinc levels in the samples set. The first shipment were all high and the second shipment were all low. This is not necessarily alarming due to the unknown origin of samples by the laboratory. This allows unbiased analysis which must be supported by the appropriate QA/AC data. In this case, documented records indicate that the instrument met all calibration requirements set by the method as well as the manufacturer.

All required QA/QC samples were also within prescribed method acceptance limits. These QA/QC samples include acid reagent blanks, duplicates, spikes, and Certified Standard Reference Materials. Reagent blanks were carried through the digestion procedure for both shipments of samples. The reagent blanks in both cases showed no significant levels of contamination. The Certified Standard Reference Materials (known values) were within acceptance limits indicating the lack of contamination during the analysis.

The QA/AC data validates the reported levels of zinc in the samples from the November 1990 sampling. This would suggest that any contamination of the sample, if any, would be prior to acid digestion. To assure that incorrect samples are not inadvertently analyzed, a strict sample tracking system is in place utilizing unique lab sample numbers for each sample. It should be noted that due to strict holding times and additional QA/QC requirements, all PSDDA samples are "flagged" for special attention. In addition, these samples are typically submitted in one (1) liter glass jars for metals determinations, rather than the usual four (4) ounce or eight (8) ounce jars.

This provides an additional "visual" confirmation to the analyst as the subsample is drawn from the one (1) liter glass jar. These jars are bought precleaned, tested, and sealed prior to sampling.

An issue has been raised as to the possible contamination of the samples with zinc by the introduction of 2N Zinc Acetate used as a preservative for sulfide analysis. Due to the large amount of sample submitted (1 liter) a great deal of zinc would have to be added to the one (1) liter jar to generate such high values. This equates to the unlikely addition of a large volume of 2N Zinc Acetate to the jars, not merely an accident splash or spill.

The same analyst who performed the metals digestion performed the sulfide analysis and was extremely aware of the obvious difference between a four (4) ounce plastic specimen cup used for the sulfides and a one (1) liter glass jar used for metals. It should be noted that all solid samples submitted for metals analysis, including PSDDA sediments, are submitted in glass jars, not plastic, as per the SOP. These two analyses are performed in distinctly different laboratories in the facility and physical cross contamination is virtually impossible.

The issue that a subsample of the zinc acetate "preserved" sulfide sample was used for metals analysis is equally unlikely due to the obvious difference in the sample containers and the experience of the analyst. In addition, the zinc values expected from such a scenario would all be consistently high (in excess of 20,000 ppm) as opposed to the variability experienced (2,500 to 13,000 ppm).

Subsequent analysis of marine sediments from Squalicum Creek Waterway including the samples collected November 1991 as well as the re-analysis of archived November 1990 samples were all analyzed using the same standard protocols as the initial November 1990 samples. These subsequent analyses indicate relatively low levels of zinc.

In summary, the internal laboratory QA/AC data review for all Squalicum Creek Waterway samples supports and validates all analytical data reported to our contractor. Without access to information regarding station location, depth or historical chemical analysis data, we are unable to comment on the data validity in that regard. Historical data, cross referencing analytical data with station location, is not a function of the laboratories scope of work. Am Test Laboratories has cooperated fully, donating time and analytical services in an attempt to resolve this issue. Unfortunately, the samples in question were disposed of after acceptance of the data (60 days after submittal of final report) and the discrepancies in the analytical data will never be fully resolved.

We continue to pledge our support and assistance to this project as well as other PSDDA projects in the future.

Sincerely,

Shawn P. Moore

Shawn P. Moore
General Manager

SPM/ld

Supplemental Summary[1] of Suitable and Unsuitable Dredged Material from the Bellinham Harbor Maintenance Project tested for Unconfined Openwater Disposal at Bellingham Bay **Nondispersive**[2] Disposal Site.

WATERWAY	FEDERAL (CORPS)		PORT OF BELLINGHAM		TOTALS:			
	volume (cy) suitable	volume (cy) unsuitable	volume (cy) suitable	volume (cy) unsuitable	Total tested volume (cy)	volume (cy) suitable	volume (cy) unsuitable	percent (%) unsuitable
Whatcom Creek Waterway	NO TEST	NO TEST	0	12,000	12,000	0	12,000	100
Squalicum Creek Waterway	132,032	29,302	32,880	0	194,214	164,912	29,302	15.1
I & J Street Waterway	33,544	14,067	34,634	10,666	92,911	68,178	24,733	26.6
GRAND TOTALS:	165,576	43,369	67,514	22,666	299,125	233,090	66,035	22.1

[1] based on initial data documented in June 3, 1991 suitability decision memorandum and supplemental sampling and analyses conducted in Squalicum Creek Waterway during November 1991.

[2] all Port of Bellingham dredged material is suitable for dispersive site disposal at Rosario Straits except 7,427 cy of material from I and J Street Waterway (DMMU C-18). All suitable federal dredged material in I & J Street Waterway is suitable for dispersive site disposal except 6,836 cubic yards (DMMU's S-4 and S-7). All suitable federal maintenance dredged material in Squalicum Creek Waterway is suitable for dispersive disposal at Rosario Straits except 19,574 cubic yards (DMMU C-12).