JACOBS ENGINEERING GROUP INC.

M60050.001049
MCAS EL TORO
SSIC # 5090.3

CLEAN TRANSMITTAL/DELIVERABLE RECEIPT

M60050-001049

CONTRACT N-68711-89-D-9296

Doc. Control Number: CLE-C01-01F145-I3-0125

TO: Ms. Robin Green
Contracting Officer, Code 0232
Southwest Division
Naval Facilities Engineering Command
Contracts Department, Room 131
1220 Pacific Highway
San Diego, California 92132-5187

DATE: 15-Sep-94
CTO#: 145
LOCATION: MCAS El Toro
TASK/WORK ELEMENT:

hooshang h Nazafti, for
John Dolegowski/Project Manager

M. Ferbrache for . . .
Ken Tomeo/Resource Center Manager

DESCRIPTION: Project Note No. PN-0145-139, Contract Task Order (CTO) No. 145, Disposition of Investigation-Derived Wastes, Marine Corps Air Station El Toro, Phase I Remedial Investigation

TYPE: ____ Contract Deliverable ____ CTO Deliverable X Request for Change/Project Note

VERSION: _____ REVISION #: _____
(e.g., Draft, Draft Final, Final, etc.)

ADMIN RECORD Yes ____ No X Category ____ Confidential ____
(PjM to identify)

NEGOTIATED DELIVERY DATE: _____ **ACTUAL DELIVERY DATE:** _____

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PROJECT NOTE NO.	PROJECT NO.
PN-0145-139 CLE-C01-01F145-I3-0125	01-F145-H6

CONFIRMATION OF:	CONFERENCE	DATE HELD	N/A
	TELECOM	DATE ISSUED	15 September 1994
	OTHER X	RECORDED BY	Y. Chuang/CH2M HILL yc
		PLACE	N/A

SUBJECT

Contract Task Order (CTO) No. 145
Disposition of Investigation-Derived Wastes
Marine Corps Air Station El Toro
Phase I Remedial Investigation

PARTICIPANTS: (* DENOTES PART-TIME ATTENDANCE)

N/A

ACTION REQ'D. BY	ITEM

This project note provides a summary of the disposition of wastes generated during the Marine Corps Air Station (MCAS) El Toro Phase I Remedial Investigation (RI). Wastes generated during the investigation were managed in accordance with the MCAS El Toro Final Waste Management Plan (14 December 1991), as amended by decisions reached at MCAS El Toro Project Managers' (PjMs) meetings with the regulatory agencies throughout Phase I of the RI. These changes to waste management procedures are documented in the PjMs meeting minutes. A full discussion of waste management activities can be found in Section 2.5 "Waste Management" of the Phase I RI Draft Technical Memorandum (7 May 1993). A memorandum, dated 23 February 1993, presented the *final* approved waste classification scheme employed. These documents are both attached to this memorandum as Attachments A and B, respectively.

Sources of Wastes

Solid and liquid wastes were generated during the Phase I RI. Sources of solid wastes included:

- Drill (soil) cuttings
- Personal protective equipment (PPE)
- Solids from centrifuge processing of drilling mud and high solids water
- Settled solids from the decontamination pad
- Miscellaneous (household-type) trash

Liquid wastes generated included:

- Well development water
- Well purge water
- Aquifer test water

PROJECT NOTE NO. PN-0145-139

PROJECT NO. 01-F145-I3

CLE-C01-01F145-I3-0125

ACTION REQ'D. BY	ITEM

- o Decontamination water
- o Water from centrifuge processing of high solids water
- o Rainwater

Disposition of Solid Wastes

Approximately 1,300 cubic yards of waste soils and other solids were generated. Samples were collected and analyzed for an extensive list of parameters in order to classify the wastes as one of three waste types: hazardous, designated, or nonhazardous. Attachment A (Section 2.5 "Waste Management" of the Phase I RI Draft Technical Memorandum) contains information on sample collection procedures, list of analytes, and waste classification scheme. None of the solids were classified as hazardous according to existing federal or California state regulations. Approximately 400 cubic yards were classified as designated wastes, and the remaining 900 cubic yards were deemed nonhazardous.

The designated wastes are currently stored at the south cell of the on-Station Waste Storage Facility (WSF) situated on top of Site 5, the Perimeter Road Landfill. All designated wastes are stored between Hypalon plastic liners in configurations much like "burritos" and numbered with paint for identification. Figure 1 shows the designated waste locations. Table 1 presents the waste classification of each drum and waste container of solid wastes generated. The table also contains information on the source of the solid wastes, and the contaminants and concentrations that resulted in the designated waste classification.

The nonhazardous wastes were once stored at the north cell of the same WSF; they have since been leveled off with a bulldozer. Note that 10 "burritos" in the WSF contain nonhazardous wastes (see Table 1). The wastes were reclassified from designated to nonhazardous based on the final approved classification scheme (see Attachment B). The decision was made not to relocate them due to logistical difficulties.

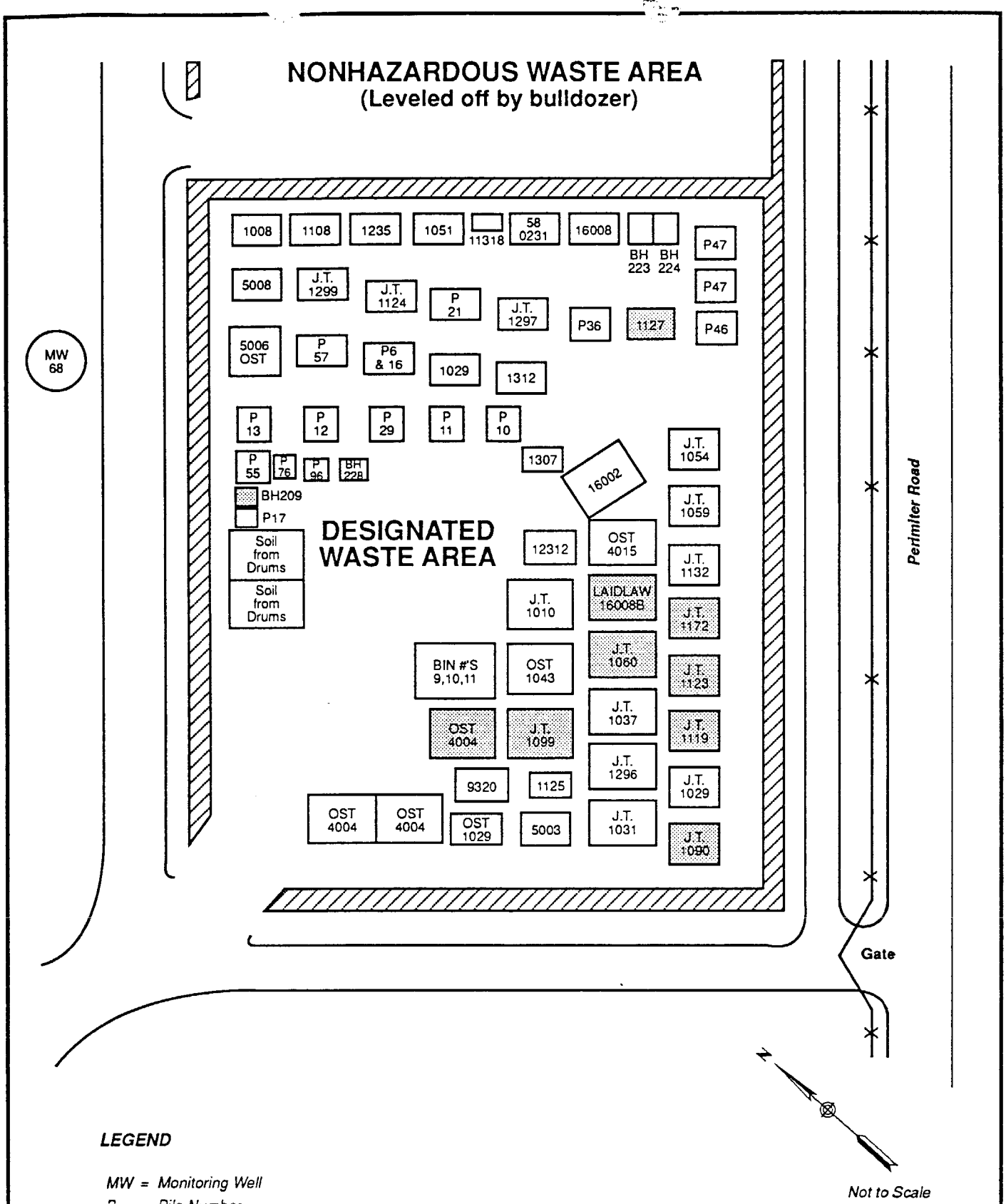
Waste PPE were classified as hazardous wastes and transported off-Station for disposal at a certified Class I landfill. The default classification was in accordance with instructions issued by MCAS El Toro.

Miscellaneous household-type trash generated were disposed off-Station to a Class III (municipal) landfill.

Disposition of Liquid Wastes

Wastewaters were processed through the on-Station granular activated carbon (GAC) treatment system. The treated effluent was pumped to the 1-million-gallon holding tank for irrigating the golf course. To date, almost 1.5 million gallons were processed by the GAC system and transferred to the holding tank.

cc: D. Crawley - Code 1831.DC



LEGEND

MW = Monitoring Well
P = Pile Number
BH = Borehole
J.T., OST, and LAIDLAW denote bin suppliers

Nonhazardous Waste

Figure 1
MCAS El Toro Phase I
Remedial Investigation
Waste Storage Facility (at Site 5)
Designated Waste Locations

mSCE31981.WG.00/Figure 1 12/94

TABLE 1.
Classification of Investigation-Derived Solid Wastes
MCAS El Toro Phase I Remedial Investigation

Sample ID No.	Well/ Boring ID	Site No.	Container No.	Pile No.	Waste Classification	Soil Contaminant/Concentration** [**Units: Metals (mg/kg); TRPH, TPHD, TPHG (mg/kg); Organics (ug/kg); unless otherwise noted.]
1456532	209	18	AB209		Nonhazardous (@Designated)	
1459000	2	18	4012		Nonhazardous	
1459001	2	18	4023		Nonhazardous	
1459002	2	18	4024	11	Designated	copper/ 30.6; TRPH/ 110
1459003	2	18	5005		Nonhazardous	
1459004	2	18	4003		Nonhazardous	
1459005	2	18	4020		Nonhazardous	
1459006	4	18	4026	46	Designated	carbon tetrachloride/ 7J
1459007	4	18	4010		Nonhazardous	
1459008	4	18	4008		Nonhazardous	
1459012	3A	18	1076		Nonhazardous	
1459013	18	18	1302		Nonhazardous	
1459014	3A	18	1064		Nonhazardous	
1459015	17	18	1303		Nonhazardous	
1459016	5A	18	1307		Nonhazardous	
1459018	5A	18	1040		Nonhazardous	
1459019	3B	18	1127		Nonhazardous (@Designated)	
1459020	1B	18	4011		Nonhazardous	
1459021	1A	18	1047		Nonhazardous	
1459022	22	18	1004		Nonhazardous	
1459023	1	18	1107		Nonhazardous	
1459024	1B	18	1010		Nonhazardous	
1459027	-	9	1104		Nonhazardous	
1459028	-	18	1312		Nonhazardous	
1459029	5E	18	1129		Nonhazardous	
1459030	15	18	1124		Nonhazardous	
1459031	45	9	1061		Nonhazardous	
1459032	5B/5C	18	1094		Nonhazardous	
1459034	22	18	1059		Designated	antimony/ 3.5B; silver/ 0.77B
1459035	1C	18	1296		Designated	silver/ 0.76b
1459036	19	18	1037		Designated	silver/ 0.71B
1459037	9	18	1043		Nonhazardous	
1459038	9	18	1054		Designated	silver/ 0.75B
1459039	15	18	4015	6	Designated	arsenic/ 9.2; silver/ 1.1B
1459040	2	18	5006		Nonhazardous	
1459041	4	18	4016		Nonhazardous	
1459042	4	18	4029	13	Designated	silver/ 0.95B
1459045	5	18	1330		Nonhazardous	
1459046	27	5	1003		Nonhazardous	
1459047	32	13	1031		Designated	chromium/ 34.7

TABLE 1.
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MCAS El Toro Phase I Remedial Investigation

Sample ID No.	Well/ Boring ID	Site No.	Container No.	Pile No.	Waste Classification	Soil Contaminant/Concentration** [**Units: Metals (mg/kg); TRPH, TPHD, TPHG (mg/kg); Organics (ug/kg); unless otherwise noted.]
1459048	3	18	1112		Nonhazardous	
1459049	31	12	1315		Nonhazardous	
1459050	41	5	1005		Nonhazardous	
1459052	51	15	1099		Nonhazardous (@Designated)	
1459053	19	18	1300		Nonhazardous	
1459054	19	18	1311		Nonhazardous	
1459055	1	18	1306		Nonhazardous	
1459057	29	8	1100	29	Designated	benzo(b)fluoranthene/ 180J; benzo(k)fluoranthene/ 130J; benzopyrene/ 73J
1459058	47	22	1299		Designated	TRPH/ 6660; 2-methylnaphthalene/ 2300; fluorene/ 1900,n-nitrosodiphenylamine/ 7800; phenanthrene/ 3500
1459059	27	5	1123		Nonhazardous (@Designated)	
1459060	41	5	1297		Nonhazardous	
1459061	37	21	1081	10	Designated	chromium/ 43.4; butylbenzylphthalate/ 50J
1459062	19	18	1133		Nonhazardous	
1459063	39	3	1029		Designated	4-4-DDD/ 3.3JX
1459067	6	18	1321		Nonhazardous	
1459068	208	10	4023	55	Designated	chromium/ 97.8
1459070	50	14	16002		Nonhazardous	
1459071	50	14	1116		Nonhazardous	
1459072	3	18	16004		Nonhazardous	
1459073	19	18	4024		Nonhazardous	
1459074	50	14	10306		Nonhazardous	
1459075	1	18	12312		Designated	copper/ 22.9
1459079	55	20	11318		Designated	copper/ 30.2; TRPH/ 2100
1459080	Cntrfge	ALL	1008,1108		Designated	OCDD/ 0.49 (ng/g)
1459081	Cntrfge	ALL	1235,1051		Designated	OCDD/ 0.54 (ng/g)
1459082	Cntrfge	ALL	1033		Nonhazardous	
1459085	36	20	1328		Nonhazardous	
1459086	36	20	580232		Nonhazardous	
1459087	36	20	10318		Nonhazardous	
1459088	3	18	58233		Nonhazardous	
1459089	2	18	580237		Nonhazardous	
1459090	2	18	5003		Nonhazardous	
1459092	Cntrfge	ALL	1122		Nonhazardous	
1459093	26	3	17002		Nonhazardous	
1459095	2	18	570118,580237		Nonhazardous	
1459096	28	6	580227		Nonhazardous	
1459097	78	13	580231		Designated	TRPH/ 156
1459100	55	20	9320		Designated	copper/ 20.6; TRPH/ 809
1459101	55	20	570119		Nonhazardous	
1459102	49	13	5008		Designated	TRPH/ 856; chromium/ 41.5

TABLE 1.
Classification of Investigation-Derived Solid Wastes
MCAS El Toro Phase I Remedial Investigation

Sample ID No.	Well/ Boring ID	Site No.	Container No.	Pile No.	Waste Classification	Soil Contaminant/Concentration** [**Units: Metals (mg/kg); TRPH, TPHD, TPHG (mg/kg); Organics (ug/kg); unless otherwise noted.]
1459103	40	4	1047		Nonhazardous	
1459105	88	20	580241		Nonhazardous	
1459106	201	6	1303		Nonhazardous	
1459107	26	3	4026		Nonhazardous	
1459108	Cntrfge	18	1004		Nonhazardous	
1459109	Cntrfge	18	1010		Nonhazardous	
1459110	Cntrfge	18	1064		Nonhazardous	
1459111	Cntrfge	18	1107		Nonhazardous	
1459112	Cntrfge	18	1307		Nonhazardous	
1459113	Cntrfge	18	4008		Nonhazardous	
1459114	Cntrfge	18	4010		Nonhazardous	
1459115	-	18	4011		Nonhazardous	
1459117	Cntrfge	18	5005		Nonhazardous	
1459118	Cntrfge	18	570114		Nonhazardous	
1459119	Cntrfge	18	580223		Nonhazardous	
1459120	Cntrfge	18	580224		Nonhazardous	
1459121	Cntrfge	18	580235		Nonhazardous	
1459124	5	18	1127		Nonhazardous	
1459125	73	8	1312		Nonhazardous	
1459126	12	18	4023		Nonhazardous	
1459128	40	4	1302		Nonhazardous	
1459129	74	8	44		Nonhazardous	
1459130	202	8	1124		Designated	chromium/ 55.7; chromium-VI/ 0.35
1459131	43	7	1040		Nonhazardous	
1459132	54	19	1076		Nonhazardous	
1459133	8	18	16000		Nonhazardous	
1459136	Decon	-	4029	21	Designated	silver/ 0.85B
1459137	66	4	1094		Nonhazardous	
1459138	81	16	1129		Nonhazardous	
1459139	101	18	4039		Nonhazardous	
1459140	52	16	1132		Designated	chromium/ 38.4; copper/ 18.7
1459141	33	16	4003		Nonhazardous	
1459143	Decon	ALL	1035	57	Designated	TRPH/ 385
1459144	5	18	1104		Nonhazardous	
1459146	90	21	1043		Designated	chromium/ 35.9
1459147	69	6	1037		Nonhazardous	
1459148	27	5	1003	47	Designated	chromium/ 34.8
1459152	Decon	All	1059		Nonhazardous	
1459153	48	12	1133		Nonhazardous	
1459154	68	5	4016		Nonhazardous	

TABLE 1.
Classification of Investigation-Derived Solid Wastes
MCAS El Toro Phase I Remedial Investigation

Sample ID No.	Well/ Boring ID	Site No.	Container No.	Pile No.	Waste Classification	Soil Contaminant/Concentration** [**Units: Metals (mg/kg); TRPH, TPHD, TPHG (mg/kg); Organics (ug/kg); unless otherwise noted.]
1459155	35	19	10313		Nonhazardous	
1459156	Decon	ALL	16008		Designated	TRPH/ 441
1459160	18	18	1112		Nonhazardous	
1459162	5	18	1330		Nonhazardous	
1459165	Decon	All	5006		Designated	TRPH/ 585; OCDD/ 0.55 (ng/g); 4-4-DDE/ 14.0P; 4-4-DDT/ 18.9P
1459166	61	2	1029		Designated	selenium/ 4.3
1459167	68	5	4020	96	Designated	arsenic/ 10.8
1459168	86	19	4024	36	Designated	chromium/ 158
1459170	56	21	1123		Nonhazardous	
1459172	91	7	4012		Nonhazardous	
1459174	63	4	1297		Designated	4-4-DDE/ 3.5; 4-4-DDT/ 7.7
1459175	71	7	1008		Nonhazardous	
1459176	63	4	1081		Nonhazardous	
1459177	60	2	1100		Nonhazardous	
1459178	72	7	1108		Nonhazardous	
1459180	Decon	All	1061		Nonhazardous	
1459181	65	3	5003		Designated	chromium/ 33.9
1459182	70	7	10318		Nonhazardous	
1459183	53	17	11318		Nonhazardous	
1459185	Decon	All	1054		Nonhazardous	
1459186	65	3	4015		Designated	chromium/ 51.4
1459187	64	3	16002		Designated	chromium/ 68.6
1459188	59	2	17002		Nonhazardous	
1459189	25	2	4004		Nonhazardous (@Designated)	
1459191	55	20	9320		Nonhazardous	
1459192	88	20	580241		Nonhazardous	
1459194	202	8	1124		Nonhazardous	
1459195	81	16	1129		Nonhazardous	
1459201	5	18	1330		Nonhazardous	
1459202	75	9	12312	17	Designated	chromium/ 34.1
1459204	10	18	1010		Designated	selenium/ 0.45B
1459206	10	18	1307, 1312, 1029		Designated	selenium/ 0.50B
1459207	60	2	1100		Nonhazardous	
1459208	103	18	1124, 1129		Nonhazardous	
1459210	Decon	ALL	4016,1040	74	Designated	2-butanone/ 12J; phenol/ 85J; phenanthrene/ 76J; 4,4-DDE/ 2.7J; 4,4-DDT/ 2.2 JP; OCDD/ 0.47 (ng/g)
1459212	65X	3	1	12	Designated	TRPH/ 746
1459213	65X	3	2		Nonhazardous	
1459214	65X	3	3		Nonhazardous	
1459215	65X	3	4		Nonhazardous	
1459216	65X	3	5		Nonhazardous	

TABLE 1.
Classification of Investigation-Derived Solid Wastes
MCAS El Toro Phase I Remedial Investigation

Sample ID No.	Well/ Boring ID	Site No.	Container No.	Pile No.	Waste Classification	Soil Contaminant/Concentration** [**Units: Metals (mg/kg); TRPH, TPHD, TPHG (mg/kg); Organics (ug/kg); unless otherwise noted.]
1459218	68	5	4020		Nonhazardous	
1459219	65	3	4015		Nonhazardous	
1459220	64	3	16002		Nonhazardous	
1459222	82	17	16008		Nonhazardous (@Designated)	
1459223	82	17	1060		Nonhazardous (@Designated)	
1459225	Drums	All	6,7,8		Nonhazardous	
1459226	Drums	All	9,10,11		Designated	chromium/ 42.90; TRPH/ 400
1459227	75	9	12312		Nonhazardous	
1459228	Cntrfge	ALL	1092		Nonhazardous	
1459229	Cntrfge	ALL	1132		Nonhazardous	
1459230	Cntrfge	ALL	1172		Nonhazardous (@Designated)	
1459231	Cntrfge	ALL	1123		Nonhazardous	
1459232	Cntrfge	ALL	1119		Nonhazardous (@Designated)	
1459233	Cntrfge	ALL	1029		Nonhazardous	
1459234	Cntrfge	ALL	1090		Nonhazardous (@Designated)	
1459235	Cntrfge	ALL	1125		Designated	OCDD/ 0.24 (ng/g)
1456508-9	228	18	AB228		Designated	TPHD/ 106; TPHG/ 28.8
1456584-9	224	18	AB224		Designated	TPHD/ 2.27; TRPH/ 909
1456592-7	223	18	AB223		Designated	Methoxychlor/ 50.5; TPHD/ 15.3; TPHG/ 131; TRPH/ 5873
Various	Various	-	Drums		Designated	

Notes:
Cntrfge - Solids generated from centrifuging process.
Nonhazardous (@Designated) - Nonhazardous wastes currently stored in the Designated Waste Cell of the on-Station Waste Storage Facility.
Soil Contaminants - A portion of the waste soils were also analyzed for Total Petroleum Hydrocarbon - Diesel (TPHD) and TPH-Gasoline (TPHG).

ATTACHMENT A

Section 2.5 "Waste Management"

of

Marine Corps Air Station El Toro
El Toro, California
Installation Restoration Program
Phase I Remedial Investigation
Draft Technical Memorandum

7 May 1993

2.5 Waste Management

Wastes generated during the Phase I RI were managed in accordance with the MCAS El Toro Final Waste Management Plan (WMP [14 December 1991]), as amended by decisions reached at MCAS El Toro managers' meetings with the regulatory agencies throughout Phase I. These waste management changes are documented in meeting minutes and other written records.

Solid and liquid wastes were generated during the Phase I RI. Most of the solid wastes were drill cuttings and PPE generated from drilling and sampling activities. Other solid wastes were sediments from treatment of wastewater and drilling mud, solids generated at the decontamination pad, and miscellaneous trash. Liquid wastes consisted primarily of well development water, well purge water, aquifer test water, and decontamination water.

All waste soils generated at the drilling sites, and other solids from the drilling mud and high-solids wastewater were containerized in roll-off bins or drums. A full-time Waste Manager tracked these solid wastes with an internal accounting system from their origination points to the Waste Staging Area (WSA) to the final on-Station long-term storage facility. The wastes were classified according to their hazard potential and managed accordingly as described in Subsection 2.5.2. Waste classification was based on analysis of samples collected directly from the roll-off bins, or environmental samples associated with soils containerized in drums. Of the total of about 1,300 cubic yards of waste soils and other solids, none were hazardous according to existing federal or California state regulations; about 400 cubic yards were classified as designated waste,

and the remaining 900 cubic yards were deemed nonhazardous. All such solid wastes are currently stored in one of two bermed cells at the on-Station Waste Storage Facility (WSF). The WSF, situated on top of Site 5 (Perimeter Road Landfill), was specially constructed to manage such RI-derived wastes. Final treatment, if needed, and/or disposal of wastes will be determined later.

All PPE was assumed to be hazardous and was disposed of properly at an off-Station Class I landfill. All miscellaneous trash was handled as common trash and was disposed of properly at an off-Station municipal landfill.

A total of about 1.4 million gallons of wastewater, including rainwater and other incidental wastewater collected in the WSA, was treated by a triple-bed granular activated carbon (GAC) treatment system (Figure 2-2). The GAC system is located within the WSA, which in turn is situated on top of Site 3 (Original Landfill). The treated effluent was discharged into the storage tank used to store water for irrigating the Station's golf course. The primary objective of the treatment system was to remove dissolved contaminants. The treated effluent was sampled and analyzed on a regular schedule to confirm effective operation of the GAC system. None of the water discharged has exceeded any effluent limits.

2.5.1 Sources of Wastes

The solid and liquid wastes generated during the RI had several sources, as described below.

2.5.1.1 Solid Waste

Solid wastes generated included:

- Drill cuttings
- Personal protective equipment (PPE)
- Solids from centrifuge processing
- Settled solids from the decontamination pad
- Miscellaneous trash

Drill Cuttings

Drill cuttings brought to the surface during drilling were containerized in 12-cubic-yard roll-off bins or 55-gallon drums at the drill site.

PPE

Potentially hazardous PPE was produced during drilling, sample collection, and aquifer testing. Waste PPE included used Tyvek suits, rain suits, rubber gloves, rubber boots, respirator cartridges, and other disposable equipment. Used filter

04-30-93

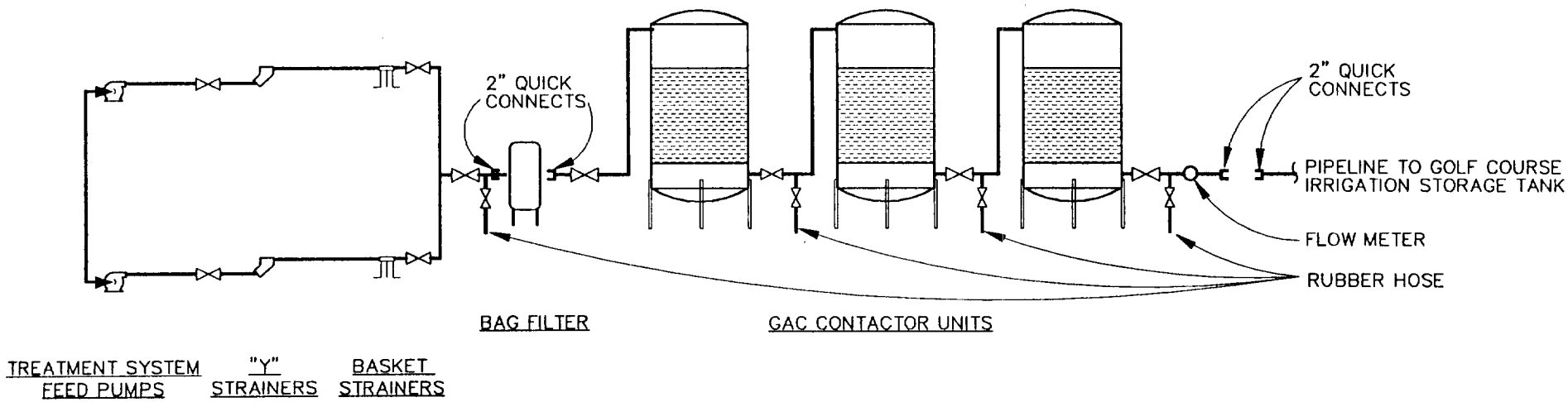

FIGURE 2-2
GAC CONTACTOR UNIT
TREATMENT SYSTEM
MCAS EL TORO PHASE I RI
TECHNICAL MEMORANDUM

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bags from the GAC treatment system and empty plastic muriatic acid bottles were also managed similarly to waste PPE.

Solids from Centrifuge Processing

Various types of liquid wastes with high solids content, such as drilling mud, decontamination water, and well development water, were generated. Because of their solids content, they required centrifuging prior to treatment by the GAC system. The mud rotary drilling method uses a drilling fluid of water and bentonite additives. Waste drilling mud, which has the consistency of a slurry, also contained soil cuttings. Water with diluted drilling mud and suspended solids was routinely generated from drilling equipment steam cleaning activities and well development. Water used to decontaminate drill rigs, development rigs, sampling equipment, vacuum trucks, roll-off bins, and water tanks was generated primarily
at the on-Station decontamination pad. Well development water was generated when flushing the wells.

Waste drilling mud was contained at the drill site in portable holding tanks and transferred to 22,000-gallon Baker tanks. The waste liquid was then processed with a centrifuge system that separated the solids from the liquid. The solids were then stored in roll-off bins, and the liquid was processed through the GAC system.

Water from the decontamination pad was first pumped into a 6,500-gallon polyethylene holding tank; when the tank was full, it was emptied by the vacuum truck into the larger Baker tanks located at the WSA. Well development water was pumped directly from the vacuum trucks into the Baker tanks. When the suspended solids had settled, the clear water was pumped off the top and processed by the GAC system. The tank bottoms were pumped to another Baker tank for centrifuge processing. The solids generated after centrifuging were stored in roll-off bins, as described above.

Settled Solids from the Decontamination Pad

Waste soils and other solids that remained at the bottom of the decontamination pad sump were removed routinely and transferred to roll-off bins.

Miscellaneous Trash

Common household-type trash (not directly associated with sampling) was also generated, such as miscellaneous paper, wrappers, cups, and plastics. These wastes were not tracked and were disposed of as municipal wastes.

2.5.1.2 Liquid Waste

Liquid wastes generated included:

- Well development water
- Well purge water
- Aquifer test water
- Decontamination water
- Water from centrifuge processing of high solids water
- Rainwater

Because well purge water and aquifer test water contained a minimal amount of suspended sediments, the solids were settled in the holding tanks before processing the water through the GAC system.

2.5.2 Hazard Categories of Wastes

Proper waste management was contingent on waste classification according to applicable federal and state regulations (as discussed in the WMP) and as advised by regulatory agencies throughout the project. Laboratory analyses of waste samples were performed to help classify the wastes.

2.5.2.1 Classifications

Waste waters were not evaluated according to any hazard classification schemes because they were treated and processed through the GAC system; however, confirmation sampling was performed as described below.

Solid wastes were classified in three waste categories:

- Hazardous wastes
- Designated wastes
- Nonhazardous wastes

Hazardous Wastes

Wastes were classified as hazardous if their hazard potential met either the federal regulatory definitions as specified in the Code of Federal Regulations (CFR), Volume 40, Parts 260 to 268 (40 CFR 260 to 268), and/or state regulations as specified in various sections of Title 22 California Code of Regulations (22 CCR). (Note: California has recodified Title 22 CCR to obtain RCRA authorization; the old, but more familiar, references are used here when referring to California's hazardous waste citations.) None of the wastes generated during the RI were classified as hazardous. The Station classified all waste PPE as hazardous, regardless of its real hazard potential; none of the other generated wastes were classified as hazardous.

Designated Wastes

Wastes were classified as designated if, although their hazard potential fell below federal and/or state hazardous criteria (as defined in the federal and state citations above), they may pose potential hazards to the quality of the groundwater beneath MCAS El Toro. The California RWQCB has made provisions (in Title 23 CCR) to establish specific water quality objectives to regulate disposal of designated wastes on land. For the MCAS El Toro Phase I RI, solid wastes were compared against threshold levels for metals (derived from

on-Station background soil samples), for organics (based on available drinking water standards and detection limits), and for petroleum and fuel hydrocarbons concentrations.

Nonhazardous Wastes

Wastes were classified as nonhazardous only when their hazard potential fell below federal and/or state hazardous criteria (defined in the regulatory citations listed above), and when they also were determined not to degrade the groundwater quality.

2.5.2.2 Analyses

Available information on potential wastes and contaminants for each site was reviewed to develop the analytical testing requirements for that site. Required analyses for solid wastes are listed in Table 2-2.

As indicated previously, although wastewaters were not classified, they were analyzed to ensure that they had not exceeded effluent limitations established for treated wastewaters discharged to the Station's golf course. Wastewater analysis was also designed to assess the performance of the GAC contactor units. Although the triple-bed system was designed to prevent breakthrough, a primary objective of the analysis was to gauge whether breakthrough occurs earlier than anticipated. Analyses performed were:

- Total dissolved solids (TDS)
- Nitrate/nitrite
- pH
- Metals
- Volatile organic compounds (VOCs)
- Semivolatile organic compounds (SVOCs)
- Total recoverable petroleum hydrocarbons (TPH)
- Pesticides and polychlorinated biphenyls(PCBs)
- Herbicides

Table 2-2
Required Analyses for Solid Wastes
MCAS El Toro Phase I RI Technical Memorandum

Site	VOCs[a]	SVOCs[b]	Pesticides/ PCBs[c]	Herbicides	TRPH[d]	Metals	Organic Lead	Reactivity-Total Sulfide	Reactivity-Total Cyanide	Dioxins and Furans
1	X	X			X	X		X		X
2	X	X	X	X	X	X				X
3	X	X	X	X	X	X				X
4	X	X			X	X				
5	X	X	X	X	X	X	X			X
6	X	X			X	X				
7	X	X	X		X	X				
8	X	X	X		X	X				
9	X	X			X	X	X			
10	X	X	X	X	X	X				
11	X	X	X							
12			X		X	X		X	X	
13	X	X			X	X				
14	X	X	X		X	X				
15	X	X			X	X				
16	X	X	X		X	X	X			X
17	X	X	X	X	X	X	X	X	X	
18	X	X			X	X	X			
19	X	X			X	X				
20	X	X			X	X				
21	X	X	X	X	X	X			X	
22	X	X	X	X	X	X				

[a]VOCs = Volatile Organic Compounds
[b]SVOCs = Semivolatile Organic Compounds
[c]PCBs = Polychlorinated Biphenyls
[d]TRPH = Total Recoverable Petroleum Hydrocarbon

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2.5.2.3 Sample Collection

Waste soil cuttings were containerized in roll-off bins and drums. The drums were used for cuttings from sites that were suspected to have the greatest hazard potential. The smaller capacities of the drums provided the benefit of segregating potentially hazardous cuttings from nonhazardous cuttings because drilling often cuts through zones of different contamination.

The cuttings in the roll-off bins were classified from representative samples; these samples were collected by compositing subsamples of soil situated at four locations at the top of each roll-off bin, as specified in the WMP. Minor changes in protocol were made when necessitated by field conditions and worker safety. The sample collection equipment was decontaminated between uses.

In general, waste samples were not collected from the cuttings contained in drums in order to reduce the analytical costs. Waste soils in drums were classified on the basis of associated subsurface soil samples, or the drums were transferred to bins for sampling and analysis.

Three drums of drilling cuttings were classified by the analysis of environmental samples associated with the drummed wastes. For example, a 60-foot angle boring drilled at Agua Chinon Wash would have generated three drums of drill cuttings; six samples were collected from the boring and analyzed. Depending on the laboratory analytical results, each drum was classified accordingly. To be conservative in waste classification, the highest concentrations from the six samples were used to represent the entire angle boring; if any of the six samples showed contaminant concentrations at designated levels, then all three drums were classified as designated. It was necessary to transfer contents of some unlabeled drums and drums with illegible labeling into smaller 3-cubic yard bins for sampling and analysis. Two composite samples were taken from these bins for laboratory analysis.

Water samples were taken at different stages of treatment about every 2 weeks. Three samples were collected in each round, at the following sampling points (refer to Figure 2-2):

- Before the bag filter for the GAC system
- After the first GAC column
- After the third GAC column, before discharge to the golf course

The following field and laboratory QA/QC samples were also taken:

- One duplicate sample for every 10 waste samples
- One matrix spike/matrix spike duplicate (MS/MSD) for every 20 waste samples
- One equipment rinsate sample for every 20 waste samples
- One trip blank for each environmental medium included with each shipment containing waste samples requiring VOC analysis

2.5.3 Waste Management Techniques

The large volume of potentially hazardous solid and liquid wastes generated during the RI required a waste tracking system and proper waste management techniques.

2.5.3.1 Waste Tracking

A system was developed to track the wastes generated. Soil cuttings at each drill site were first containerized in 12-cubic-yard roll-off bins. These bins were then moved to the on-Station WSA, and staged there until they were sampled and properly classified. The Waste Manager documented the following information:

- Roll-off bin number
- Origination point of the waste (well or boring and site numbers)
- Approximate volume of waste
- Date the waste was generated
- Date the waste was transferred to the WSA
- Date the waste was sampled

- Sample identification (ID) number
- Laboratory analyses requested
- Type of QA/QC samples, if applicable
- Date the waste was classified
- Soil classification
- Date the waste was transferred to the WSF
- Final on-Station destination (nonhazardous or designated cell of WSF)

A similar tracking system was attempted for the drummed wastes. Many of the 25- and 60-foot borings drilled were suspected to have high hazard potentials; their drill cuttings were containerized in 55-gallon drums. Cuttings from boreholes with high headspace readings were also drummed. Although the drums were also labeled by origination point, depth interval, and date, much of the label information on some of the drums became illegible before classification. In such cases, the drum contents were transferred to a 3-cubic-yard bin and sampled prior to categorizing the waste.

The Waste Manager also tracked the volumes of wastewater and rainwater processed through the GAC system.

2.5.3.2 Waste Staging Area

The WSA served as a central clearinghouse for all solid and liquid wastes generated during the RI. Samples were collected from roll-off bins transferred to the WSA. Upon waste classification, the wastes containerized in bins and drums were then transferred to one of two cells at the WSF.

The WSA is located on the north side of the intersection of North Marine Way and the Gate 2 entrance road and is situated on top of Site 3 (Perimeter Road Landfill). The WSA is a 482-by-123-foot concrete pad that is sloped at a 1 percent cross fall toward the east-west centerline, and sloped at a 2.5 percent on the east-west centerline into a 1-foot-wide trench drain. In the event of rain, water collected within the WSA was designed to drain to the trench drain and to be collected in a concrete sump (10 by 10 by 4 feet). Water from the sump could then be pumped automatically into two 22,000-gallon Baker tanks for

processing by the GAC system. The WSA, and the surge tank capacity of the GAC system, were designed to contain and to treat rainwater generated by a 25-year, 24-hour rainfall event.

Per agreement with the regulatory agencies, rainfall runoff collected at the Waste Staging Area (WSA) while investigation-derived waste was present was required to be treated by the granular activated carbon (GAC) system prior to discharge. The majority of collected rainwater was processed through the GAC system as planned.

MCAS El Toro experienced record rainfalls from December 1992 through February 1993. Several rainfall events exceeded the design capacity (25-year, 24-hour rainfall event) of the containment system of the WSA and the holding tank capacity of the GAC treatment system. During the heaviest rainfall, some of the rainwater that collected within the WSA overflowed the berm into the adjacent Agua Chinon Wash. To minimize potential impacts, pumping of rainwater from the sump into the two Baker tanks was started as soon as possible after rainfall began. During the heaviest storms, pumping was augmented by portable gasoline-powered pumps. With this technique, all of the "first flush" runoff from the WSA was collected in the Baker tanks prior to overflow of runoff into the adjacent wash.

2.5.3.3 On-Station Waste Storage Facility

An on-Station WSF was constructed for long-term storage of drill cuttings and solids generated from drilling mud and wastewaters with a high solids content. The wastes transferred to the facility are meant to be stored until final treatment and disposal alternatives for soils remediation have been evaluated. The WSF is an unlined, bermed 200- by 450-foot area that is situated on top of Site 5 (Perimeter Road Landfill). It is divided into two approximately equal cells, for storage of nonhazardous and designated wastes. The north half (referred to as the "clean" area) has a 1-foot berm and stores nonhazardous wastes. The south half has a 3-foot berm and stores designated wastes.

All designated wastes transferred from the WSA to the WSF were placed between Hypalon plastic liners in configurations termed "burritos." Waste soils totaling 185 roll-off bins were generated during the RI; wastes in 53 of these bins (about 400 cubic yards) were classified as designated, and those in the remaining 132 bins (about 900 cubic yards) were classified as nonhazardous. Of the drummed wastes, about 50 cubic yards and 10 cubic yards were classified as designated and nonhazardous, respectively.

2.5.3.4 GAC Treatment and On-Station Discharge

Wastewaters were processed through the on-Station GAC treatment system, and totaled 1,437,110 gallons. Of this water, about 217,580 gallons were rainwater.

The GAC system consists of three 2000-pound-capacity GAC adsorber units connected in series, with two feedwater pumps, two "Y" strainers, two basket strainers, and one bag filter. The strainers and bag filter were used to prevent sand and other particulates from entering the GAC contactor units, where they could potentially reduce the sorption capacity. The contactor units were backwashed occasionally by operating the system in a downflow configuration in which each contactor unit had only one inlet and one outlet open. The flow rate through the GAC system ranged between 10 gallons per minute (gpm) and 15 gpm, and averaged 12 gpm.

The pH of all wastewater transferred to the Baker tanks (which served as surge tanks and settling tanks) was checked. If the wastewater was clear and its pH measured between 6.5 and 8.5, it was processed through the GAC system. If the pH was greater than 8.5, muriatic acid was added to lower the pH before GAC processing; this addition also helped to settle the suspended sediments. If the pH level was less than 6.5, lime was added to raise the pH level to between 6.5 and 8.5 before processing.

Treated wastewater from the GAC was then pumped through a PVC pipe (2-1/2-inch-diameter, Schedule 40) to the 1-million-gallon holding tank for water

irrigating the golf course. The tank is filled with Irvine Ranch Water District (IRWD) reclaimed water. When in operation, the GAC system effluent makes up less than one percent of total irrigation waters.

The PVC pipeline is buried 6 to 8 inches belowgrade. Currently, plans are underway to replace the pipeline with 2-1/2-inch-diameter Schedule 80 PVC.

2.5.3.5 Off-Station Class I Landfill

Waste PPE was collected in plastic trash bags and containerized in roll-off bins. After the bins were full, the Waste Manager prepared a manifest that was signed by the assigned ROICC for the RI. The manifest accompanied each waste PPE shipment sent off-Station to a certified Class I landfill. The waste was transported by a subcontractor to Beylik.

2.5.3.6 Off-Station Class III Landfill

Miscellaneous "household" trash was stored separately in plastic trash bags, then disposed off-Station to a Class III (municipal) landfill through a contract trash source.

ATTACHMENT B

Final Waste Classification Scheme

JACOBS ENGINEERING GROUP INC.

CLE-C01-01F145-I3-0125

MEMORANDUM

TO: Andy Piszkin - Code 1812.AP **DATE:** 23 February 1993

FROM: John Dolegowski - CH2M HILL
Yueh Chuang - CH2M HILL

SUBJECT: **Marine Corps Air Station (MCAS) El Toro Remedial Investigation (RI) - Derived Soil Cuttings Proposed Background Soil Threshold Levels for Metals and Other Waste Classification Issues**

This memorandum presents the proposed background metals concentrations for the purpose of documenting field changes in waste classification of waste soil cuttings generated during the MCAS RI. It also formally documents several decisions already reached at previously held Remedial Project Managers Meetings, and the Data Quality Objectives (DQO) Workshops.

Metals

Threshold levels are required for Designated Wastes, wastes with concentrations that are below hazardous levels but which may still degrade the quality of water below MCAS El Toro. Such threshold levels for metals are needed because the RI-derived soil cuttings generated are expected to fall below hazardous levels, yet naturally occurring metals exist in all soils. It was agreed that the soil cuttings will be compared against "background" levels at the 10 August 1992 Project Managers Meeting. Background soil samples were defined as soil samples collected from on-Station sites that were not impacted by MCAS El Toro activities. It was further agreed that an appropriate

statistical methodology will be used to generate the threshold levels for metals at the 18-20 November 1992 DQO Workshop. As a result of the workshop, it was decided the statistical approach of choice was to use a multivariate comparison of waste samples against background samples at 80 percent confidence, and 90 percent power. A confidence level of 80 percent implies that 20 in 100 soil bins may be classified as designated waste when they are actually clean.

Strategy for Selection of Background Samples

All soil samples collected on Station for the RI were screened for use as background samples against aerial photography findings, site use information, field data gathered during sample collection, and organics results. The availability of the pool of background samples is limited by whether metals were analyzed for a particular sample. For example, soil samples from Operable Unit (OU)-1 wells were not included because, consistent with the Sampling and Analysis Plan (SAP) (21 February 1991), and the Sampling and Analysis Plan Amendment (26 August 1992), metals were not analyzed for those samples. The screening strategy is as follows:

- Subsurface soil samples collected from upgradient OU-2 and OU-3 wells were selected. Since these wells were located in order to assess groundwater quality upgradient of potentially contaminated sites, they generally should not be impacted by Station activities. The soil samples were collected generally at a depth within 30 feet above the water table.

- Surface soil samples and shallow soil boring samples (e.g., 0-6 inch and 18-24 inch soil samples) associated with the same upgradient well locations were also selected using similar reasoning. Note that the soil samples collected between ground surface and 2 feet below ground surface are referred to as shallow soil samples in the discussion below. Shallow soil samples associated with deep borings, angle borings, and 25-foot borings were eliminated because those soil borings were specifically located in suspected areas of

contamination. Shallow soil samples associated with downgradient wells and other shallow soil samples are likely to be affected by past Station activities.

- The list of soil samples generated using the two screening steps described above was refined using aerial photography findings and past site use information.

- Remaining soil samples were eliminated if high headspace measurements were recorded during sample collection.

- Finally, those samples which exhibited organics contamination (e.g., total recoverable petroleum hydrocarbon [TRPH] levels much greater than 100 mg/kg) were also eliminated. It is not uncommon to find soils contaminated with waste oils also to be contaminated with metals. Some Station activities include machining process and vehicle maintenance oil changeouts.

After screening the soil samples through the procedure outlined above, 35 soil samples (six are duplicate samples) were selected for statistical analysis. Except for one sample, they essentially consist of shallow and subsurface soil samples associated with upgradient OU-2 and OU-3 wells. The samples were not segregated by depth since a comparison of the metal concentrations did not show significant differences between shallow and subsurface soil samples. Table 1 lists the soil samples, by location and depth, which were screened as appropriate for use as background samples.

Data with Qualifiers

Data used for this analysis includes detected values (e.g., values above the contract required detection limit [CRDL] with no qualifiers), nondetected values (e.g., values below the instrument detection limit [IDL] with "U" qualifiers), and values between the CRDL and IDL (e.g., data with "B" qualifiers). Data with other qualifiers were not used in the analysis.

All nondetected values were assigned values of the CRDL for the statistical analysis (e.g., silver concentration for the 0-6 inch sample at Well 25 [Site 2] is below the detection limit of 0.3 mg/kg; however, a data value of 0.3 mg/kg was assigned).

Table 1 List of Soil Samples Used in Background Threshold Level Analysis			
Well No.	**Site No.**	**Depth (bgs)**	**Remarks**
25	2	0-6 inch 18-24 inch 50 feet	 Above Screen
26	3	0-6 inch 0-6 inch	 Duplicate
27	5	0-6 inch 0-6 inch 175 feet	 Duplicate Above Screen
28	6	18-24 inch 148 feet	 Above Screen
100	7	5 feet 10 feet 15 feet 20 feet 25 feet 30 feet 30 feet 40 feet 40 feet 111 feet	 Duplicate Duplicate Above Screen
31	12	18-24 inch 98 ft	 Above Screen
32	13	18-24 inch 130 feet	 Above Screen
NA	15	18-24 inch	
33	16	0-6 inch 0-6 inch 18-24 inch 18-24 inch 158 feet	 Duplicate Duplicate Above Screen
36	20	0-6 inch 18-24 inch 100 feet	 Above Screen
37	21	18-24 inch 70 feet	 Above Screen

Statistical Methodology

The multivariate approach, although conceptually desirable, is complex to implement and can produce results that appear unreasonable. The proposed statistical approach uses univariate comparisons at 99 percent confidence, and 90 percent power. By specifying an individual comparison confidence level of 99 percent, an overall confidence of 85 percent is achieved. The calculations are based on 16 metals for comparison, therefore, 16 individual comparisons ($0.99^{16} = 0.85$). Results from these univariate comparisons achieve approximately the same desired confidence of 80 percent for a multivariate approach.

Proposed Threshold Levels

Threshold levels are proposed for 16 metals. All of the metals have regulatory standards, namely hazardous waste standards, drinking water standards, and/or health advisories. Standards for each metal are listed in Table 2. The background soil samples were analyzed for all 23 metals listed in the Target Analyte List (TAL). However, threshold levels are proposed for only 16 of the 23 metals for the following reasons:

- Four metals are common cations (e.g., calcium, magnesium, potassium, and sodium). The concentrations of these metals naturally range over several orders of magnitude; therefore, they are not included in the statistical analysis.

- Three metals (e.g., aluminum, iron, and manganese) were not analyzed in the waste samples since they did not have hazardous waste criteria and were not specified for waste sample analysis in the Waste Management Plan. Therefore, a comparison against background levels is not possible.

- Additionally, molybdenum, a metal regulated under California hazardous waste rules, was not analyzed as part of the TAL. Although waste samples were

analyzed for molybdenum, the background samples were not; a comparison against background levels is not possible.

The metals data for the background samples are assumed and demonstrated to be lognormally distributed (see Figures 1 through 16 of Attachment A). The threshold levels are calculated as the upper bound of the mean of the natural logarithm of the concentrations, plus 2.88 times the standard deviation of the natural logarithm of the concentrations. The value 2.88 is the "K" factor for 99 percent confidence and 90 percent power for a population of 30 samples. The background threshold levels for the 16 metals are also listed in Table 2. Attachment A presents a more detailed discussion of the statistical approach used, including the pros and cons of the multivariate and univariate approaches. It also presents calculations for the relative standard deviations due to the variability in duplicate sample results, laboratory analysis, and spatial location.

Table 2
Regulatory Standards, Health Advisories,
and Proposed Background Threshold Levels for Metals
MCAS El Toro

Metal	USEPA TCLP[1] (mg/l)	California TTLC[2] (mg/kg)	California STLC[3] (mg/l)	USEPA MCL[4] (mg/l)	California MCL[5] (mg/l)	Health Advisories			IRIS		Threshold Level (mg/kg)
						10-day (ug/l)	Chronic (Lifetime) Noncancer (ug/l)	Chronic (Lifetime) Cancer (ug/l)	RfD (ug/Kg-day)	10^{-6} Risk (ug/l)	
Antimony		500	15.0			15	3		0.4		3.1
Arsenic	5.0	500	5.0	0.050(P)	0.050			0.03	1		8.5
Barium	100.0	10,000	100	2,000(P)	1.000		>2,000		70		309
Beryllium		75	0.75			30,000		0.008	5	0.008	1.32
Cadmium	1.0	100	1.0	0.005(P)	0.010	>40	>5		0.5		4.2
Chromium (Total)	5.0	2,500	580	0.100(P)	0.050	>1,000	>100		5		32.2
Cobalt		8,000	80								13.4
Copper		2,500	25.0	1.000(S)							18.0
Lead	5.0	1000	5.0	0.050(P)	0.050						33.2
Mercury	0.2	20	0.2	0.002(P)	0.002		>2		0.3		0.16
Nickel		2,000	20.0			>1,000	>100		20		28.6
Selenium	1.0	100	1.0	0.010(P)	0.010				5		0.33
Silver	5.0	500	5.0	0.050(P)	0.050	200	100		5		0.69
Thallium		700	7.0			7	0.4		0.07		0.45
Vanadium		2,400	24.0			80	20		3		89.8
Zinc		5,000	250	5.000(S)		4,000	2,000		200		124

1 - USEPA Resource Conservation and Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP).
2 - California Total Threshold Limit Concentration (TTLC).
3 - California Soluble Threshold Limit Concentration (STLC).
4 - USEPA Maximum Contaminant Level (MCL); "P" denotes primary standard, and "S" denotes secondary standard.
5 - California MCL.
6 - Developed by either USEPA's Health Advisory Program, or the National Academy of Sciences recommendations based on Suggested No-Adverse Response Levels.
7 - USEPA's Integrated Risk Information System (IRIS).
8 - Oral Reference Doses (RfD).

Hexavalent Chromium

Consistent with the Final MCAS El Toro Waste Management Plan (14 December 1991), all waste soil will be first classified based on total chromium levels. If the total chromium levels exceed the newly proposed background threshold level of 32.2 mg/kg, the soil will be classified as designated waste (provided the levels are less than corresponding hazardous threshold levels for total chromium).

However, if the total chromium levels also exceed 50 mg/kg, which is 10 times the Soluble Threshold Limit Concentration (STLC) for hexavalent chromium (ignore the difference in units between soil and extract fluid), the soil may be hazardous according to California hazardous waste rules. Note that for this to occur, it would require applying the most conservative assumption that the total chromium concentration represents hexavalent chromium only and that complete leaching occurs during extraction testing.

It is proposed that all such soils will be automatically resampled for additional analysis for both total chromium and hexavalent chromium levels. If the hexavalent chromium levels are less than 50 mg/kg, the soil will remain classified as designated waste. This formally amends the procedures stated in the Waste Management Plan, which stipulates the regulatory agencies will be consulted for further direction.

Total Recoverable Petroleum Hydrocarbon

As stated in the 10 August 1992 Project Managers Meeting, a threshold level of 300 mg/kg generally will be used for TRPH. However, as was agreed in the 17-18 February 1993 Project Managers Meeting, waste soil with TRPH levels between 100 and 300 mg/kg also will be classified as designated if gasoline fraction compounds, specifically benzene, toluene, ethylbenzene, or xylene (BTEX), are showing above detection limits. Any waste soil with less than 300 mg/kg of TRPH and showing no BTEX compounds will be classified as clean, and can be managed on Station as

nonhazardous soil. Waste soil with greater than 300 mg/kg of TRPH and showing no BTEX compounds, or waste soil with TRPH between 100 and 300 mg/kg and showing BTEX compounds, will be classified as designated waste, stored in polyethylene "burritos" in the soil disposal areas, and treated and/or disposed at a subsequent date.

Organic Compounds

Waste soil will be classified as designated waste (provided the levels are less than corresponding hazardous threshold levels) if any organic level exceeds either the Federal or California drinking water standard (DWS) or the practical quantitation limit (PQL), whichever is greater. For example, 1,1,1-trichloroethane has a DWS of 0.2 mg/l, and a PQL generally between 11 and 13 ug/l depending on dilution factors or moisture percentage. The threshold level for 1,1,1-trichloroethane would be 0.2 mg/l, the greater of the 2 values. Conversely, the DWS for trichloroethylene (TCE) is 5 ug/l but the PQL is again between 11 and 13 ug/l. The threshold limit for TCE would be the PQL, the greater of the 2 values.

The above discussion pertains to all data values without a qualifier. However, data values with "J" qualifiers will be treated as above the detection limits even though they are estimated values. Data values with "J" qualifier are defined as estimated values when the mass spectral data indicates the presence of those compounds below their stated PQLs, or when concentrations are estimated due to analytical interferences. For example, if a TCE value of 7 ug/l with "J" qualifier is returned, the soil would be classified as designated waste. This is because the TCE value is greater than the DWS of 5 ug/l even though it is less than the stated PQL.

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ATTACHMENT A
Proposed Statistical Methodology

At the 18-20 November 1992 Data Quality Objectives (DQOs) Workshop, it was agreed that the proposed statistical methodology for comparison of waste soil samples contained in bins with background soil samples was to use a multivariate comparison at 90 percent power and 80 percent confidence. Instead, a univariate approach is proposed because the first approach will be difficult to implement and may not be desirable in practice.

There are four statistical parameters used to design a statistical comparison: 1) alpha (1 - confidence); 2) beta (1 - power); 3) delta (the difference to be detected with probability beta); and 4) sample size. If three of these parameters are specified, the fourth can be calculated. For the comparison of bin samples with background samples, the sample size is already determined by what is available. The confidence level of 80 percent implies that 1 in 5 bins may be misclassified as above background for each parameter when, in fact, they are similar to background.

The multivariate approach is conceptually desirable because it eliminates what is known as the multiple comparison problem. If 16 parameters are tested, each with an 80 percent confidence of correctly specifying that each is not significantly different from background, then there is a 2.8 (i.e., 0.80^{16}) percent probability that all 16 would be correct. This virtually assures that all bins will be classified as above background (97 out of 100 bins) even though they are similar to background. However, if a multivariate test was used with the same confidence level of 80 percent, then only 20 percent of the bins will be misclassified as above background.

There are practical problems in implementing a multivariate test. The standard statistical software packages do not have a multivariate test option; the test would have to be programmed and tested. While this can be done, the more important issue is how the test would be used and explained. The description of a multivariate test is usually done in terms of matrix algebra, which is likely beyond the comprehension of the general public. The comparison is complex enough that a computer routine will be needed to use the procedure. The net result is the use of a "black box" to determine whether or not a bin is classified as above background. Further, the results may not always seem reasonable because it is possible for a bin to be classified as above background even though no single parameter is significantly above background levels.

The alternate approach is to use univariate comparisons with a higher confidence level for each comparison. This is the traditional approach, not only because of the complexities discussed but also because of the consequences of each type of error. The confidence can be chosen so that the overall probability of rejecting a bin is the specified 80 percent. The individual comparison confidence level used to determine this is approximately 99 percent ($0.99^{16} = 0.85$).

Table A-1 shows the results of the analysis of the background soil data. The data used for this analysis only includes detected and non-detected values (i.e., data values with

Table A-1
Summary of Statistical Analysis Results of Background Soil Concentrations

Parameter	Estimated Duplicate RSD	Upper and Lower 2 SD bounds for one Sample Measurement		Total Spatial + Analytical RSD	Analytical Fraction of Total Variability	Estimated Mean Background Concentration	Tolerance Limit 99% Confidence value is greater than 90% of data	Ratio of Mean Concentration to Background for 90% Power and 99% Confidence
		Upper Value times	Lower Value times					
Aluminum	0.39	2.09	0.48	0.52	0.590	8050.65	29336.469	9.25
Antimony				0.05		2.69	3.141	1.28
Arsenic	0.32	1.83	0.55	0.56	0.348	2.16	8.538	10.77
Barium	0.37	2.02	0.50	0.49	0.600	90.44	308.652	8.18
Berylium	0.30	1.77	0.56	0.49	0.397	0.39	1.319	8.17
Cadmium	0.28	1.72	0.58	0.56	0.283	1.06	4.166	10.61
Calcium	0.37	2.03	0.49	0.50	0.576	4411.86	15553.917	8.69
Chromium	0.14	1.32	0.76	0.53	0.079	8.64	32.231	9.68
Cobolt	0.36	1.98	0.51	0.51	0.521	3.75	13.407	8.92
Copper	0.22	1.52	0.66	0.42	0.283	6.08	17.978	6.27
Iron	0.28	1.70	0.59	0.48	0.356	9927.15	33066.949	7.81
Lead	1.13	5.95	0.17	0.89	1.426	4.93	33.212	31.81
Magnesium	0.27	1.69	0.59	0.54	0.278	3642.67	13818.049	9.99
Manganese	0.25	1.63	0.61	0.43	0.364	207.74	626.284	6.50
Mercury				0.57		0.04	0.164	10.93
Nickel	0.36	1.97	0.51	0.57	0.431	7.18	28.647	11.00

Table A-1
Summary of Statistical Analysis Results of Background Soil Concentrations

Parameter	Estimated Duplicate RSD	Upper and Lower 2 SD bounds for one Sample Measurement		Total Spatial + Analytical RSD	Analytical Fraction of Total Variability	Estimated Mean Background Concentration	Tolerance Limit 99% Confidence value is greater than 90% of data	Ratio of Mean Concentration to Background for 90% Power and 99% Confidence
		Upper Value times	Lower Value times					
Potassium	0.26	1.65	0.61	0.53	0.261	2646.08	9863.099	9.66
Selenium	0.44	2.29	0.44	0.33	1.692	0.14	0.328	4.37
Silver				0.16		0.45	0.694	2.01
Sodium	0.13	1.28	0.78	0.34	0.146	276.22	676.186	4.46
Thallium	0.14	1.31	0.76	0.29	0.228	0.20	0.447	3.71
Vanadium	0.27	1.70	0.59	0.52	0.306	24.79	89.768	9.15
Zinc	0.19	1.44	0.69	0.52	0.148	34.46	124.106	9.05

no qualifiers, and "B" and "U" qualifiers). Data with other qualifiers were not used in the analysis.

A comparison was made among data from subsurface soils (greater than 2 feet) and from shallow soils (less than or equal to 2 feet) to test for significant differences in metals concentrations. Since significant differences were not found between the two groups of samples, all values were used for analysis of the background data.

The first data column of the table shows the relative standard deviation (RSD), also referred to as coefficient of variation (CV), of the duplicate analysis. The second and third columns show the two standard deviation (SD) factors for a single measurement. For example, barium has a RSD of 0.37; this means that the true concentration of barium in a sample is between 0.5 and 2.02 times greater than the reported value. Another way of stating this is that the reported barium concentration is between plus 100 percent and minus 50 percent of the true value.

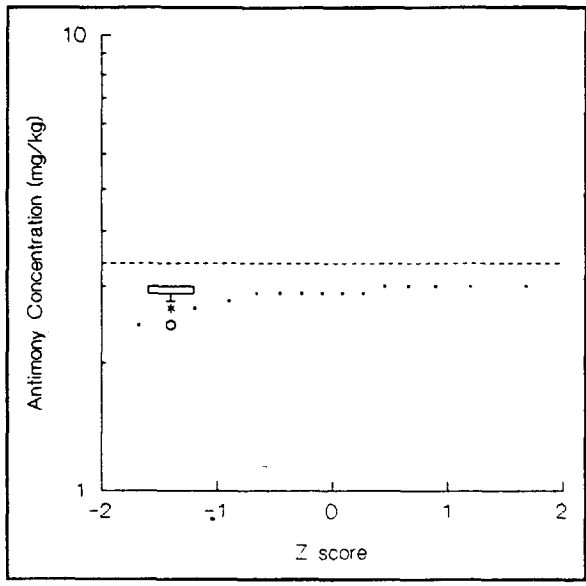
The fourth column shows the RSD for the background data. This RSD is a combination of the laboratory variability and the spatial variability. The fifth column shows the fraction of the total variability due to the laboratory. This ranges from about 8 percent for chromium to 60 percent for barium. Two parameters (lead and selenium) had more variability in the duplicates than was observed in the background data, indicating a possible quality control (QC) problem with these parameters.

The sixth column shows the estimated mean background concentration for each parameter. This mean is estimated using the assumption that the background concentrations of each parameter are lognormally distributed.

The seventh column of the table shows the upper tolerance limits for 99 percent confidence that 90 percent of the background concentrations are less than this limit. This column represents the threshold levels for the metals. The tolerance limit is calculated as the mean of the natural logarithm of the concentrations plus 2.88 times greater than the standard deviation of the natural logarithm of the concentrations. The value 2.88 is the "K" factor for 99 percent confidence of the 90th percentile assuming 30 samples.

Figures 1 through 16 show the distribution of background data values for each metal in the form of a box plot and a normal probability plot. The 99 percent confidence limit that the threshold levels exceed 90 percent of the values are also plotted in these figures (represented with dashed lines).

The last column shows the ratio of the potential mean bin concentration to the background mean for 90 percent power and 99 percent confidence. For example, this ratio is 8.2 for barium. Since the mean background concentration is 90 mg/kg, the probability of misclassifying a bin as clean when it has a barium concentration of 738 mg/kg (i.e., 8.2 x 90 mg/kg) is less than 10 percent when the 99 percent confidence tolerance limit is used.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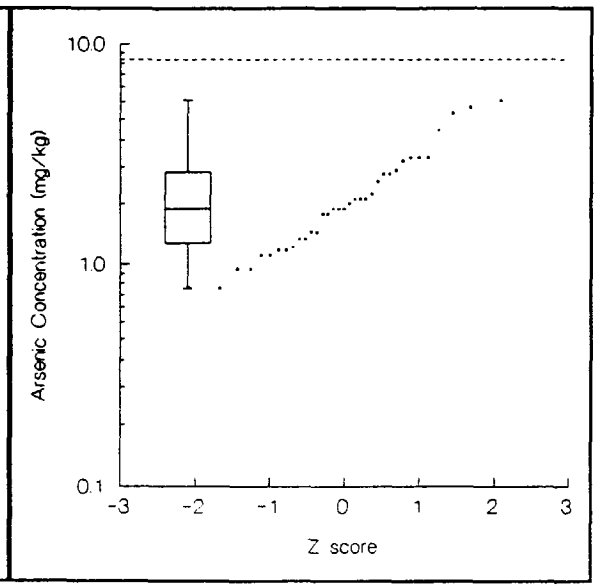
Antimony Concentration (mg/kg)
-2
-1
0
1
2
Z score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Arsenic Concentration (mg/kg)
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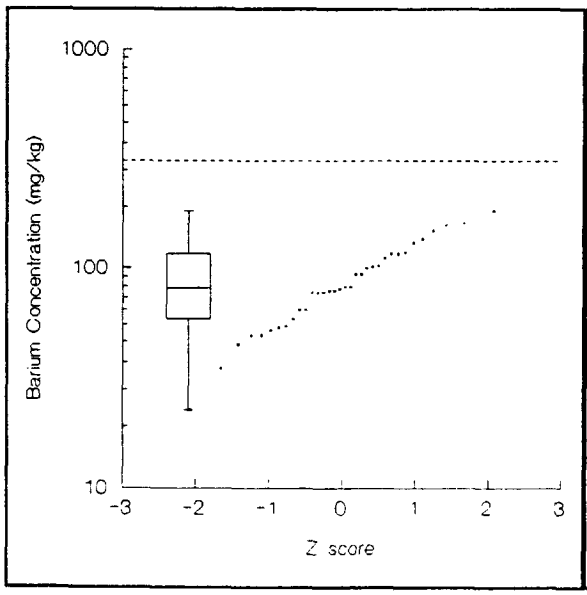
-1
0
1
2
3
Z score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100
10
Barium Concentration (mg/kg)
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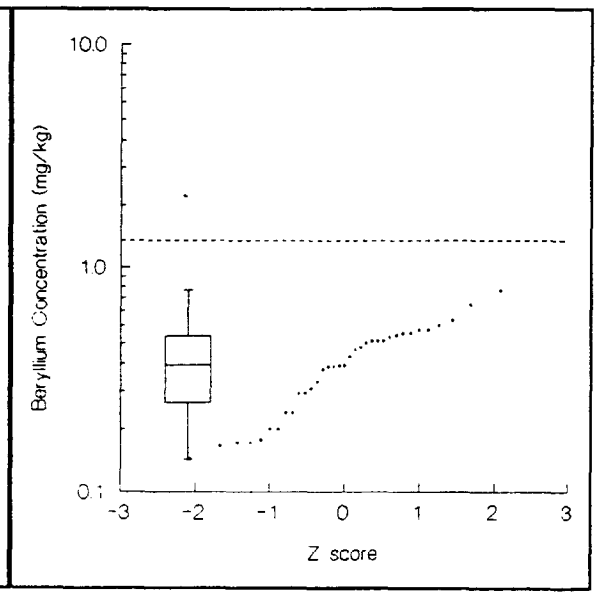
-2
-1
0
1
2
3
Z score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1.0
0.1
Beryllium Concentration (mg/kg)
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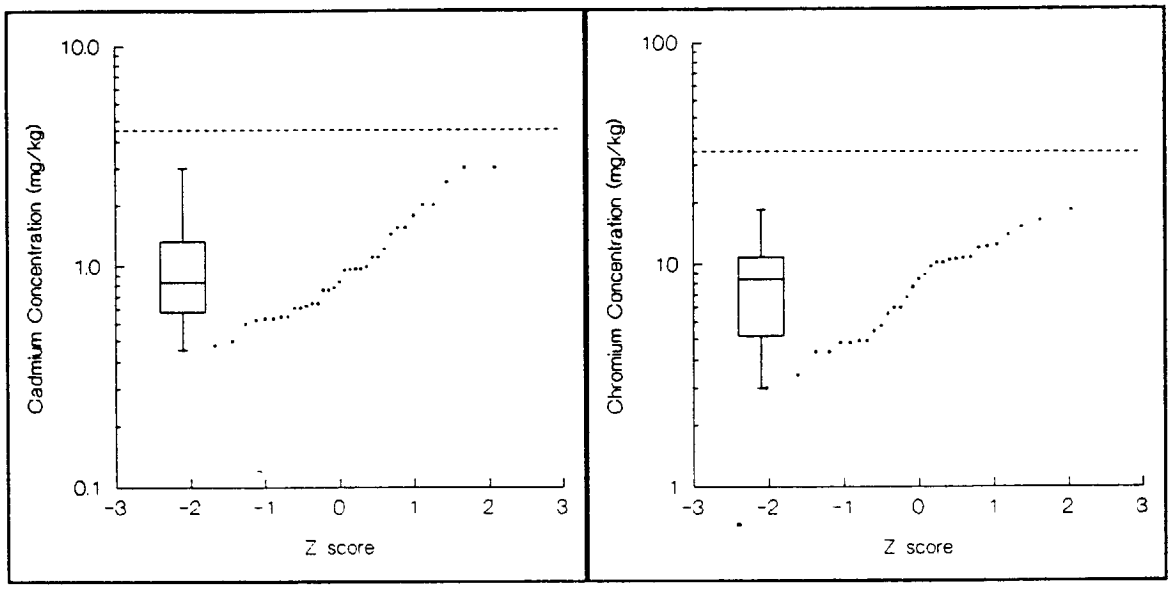
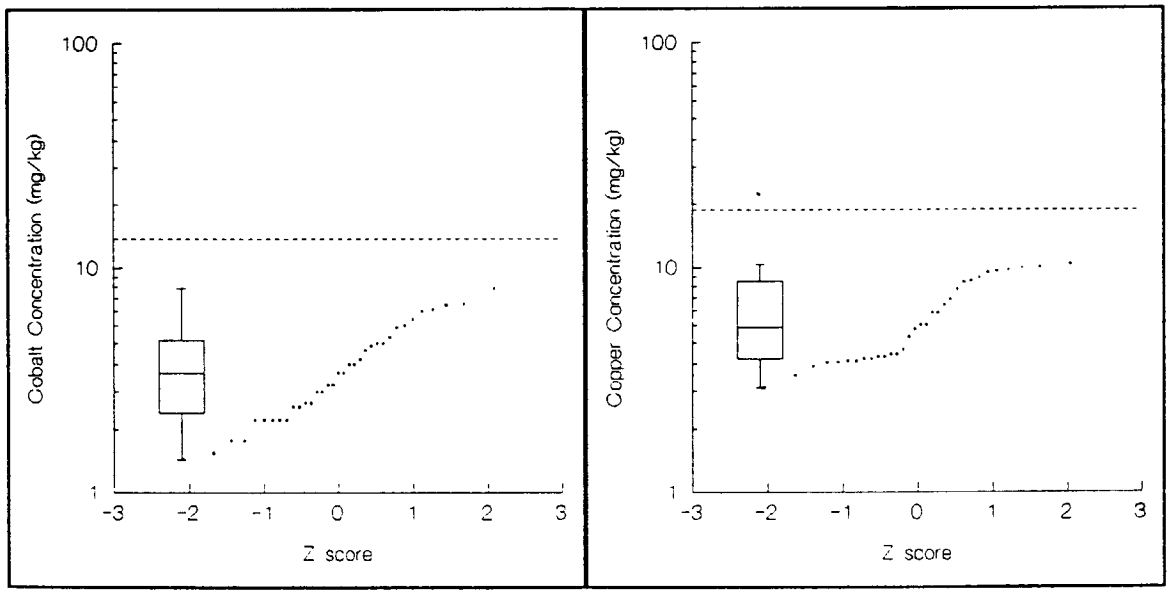
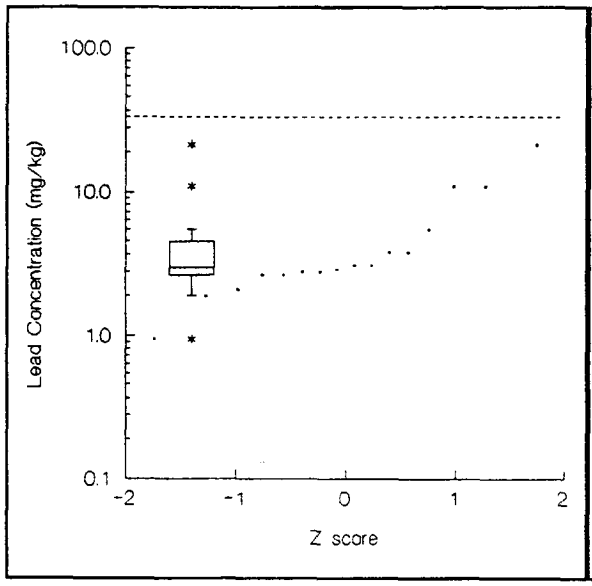
-2
-1
0
1
2
3
Z score


10.0
1.0
0.1
Cadmium Concentration (mg/kg)
-3 -2 -1 0 1 2 3
Z score
100
10
1
Chromium Concentration (mg/kg)
-3 -2 -1 0 1 2 3
Z score


100
10
1
Cobalt Concentration (mg/kg)
-3 -2 -1 0 1 2 3
Z score
100
10
1
Copper Concentration (mg/kg)
-3 -2 -1 0 1 2 3
Z score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0.1
Lead Concentration (mg/kg)
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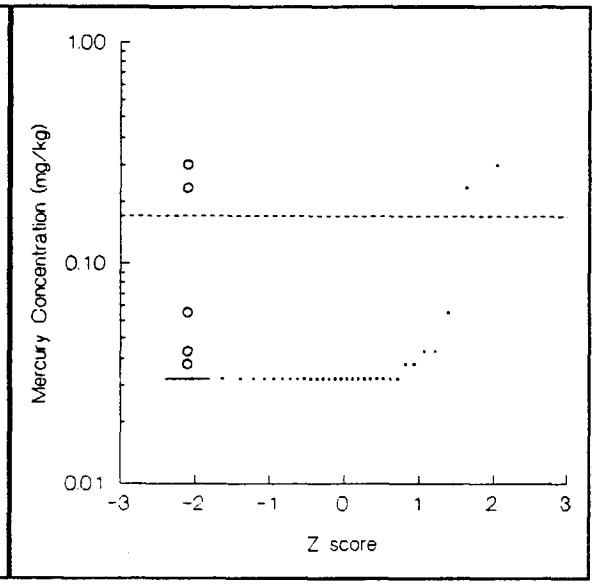
-1
0
1
2
Z score


1.00
0.10
0.01
Mercury Concentration (mg/kg)
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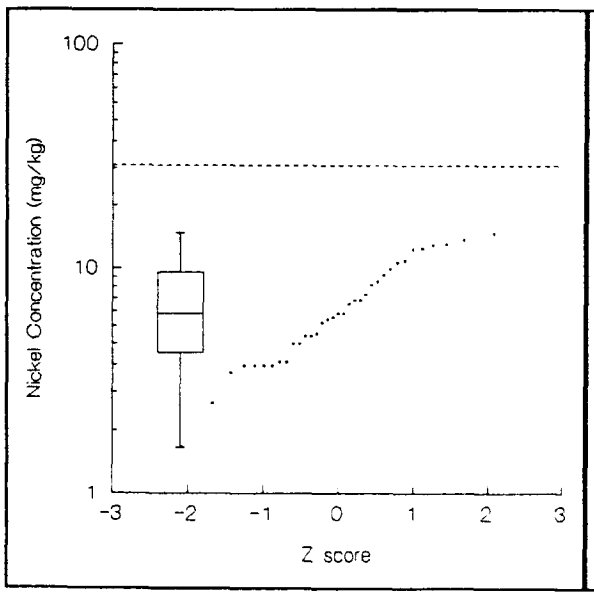
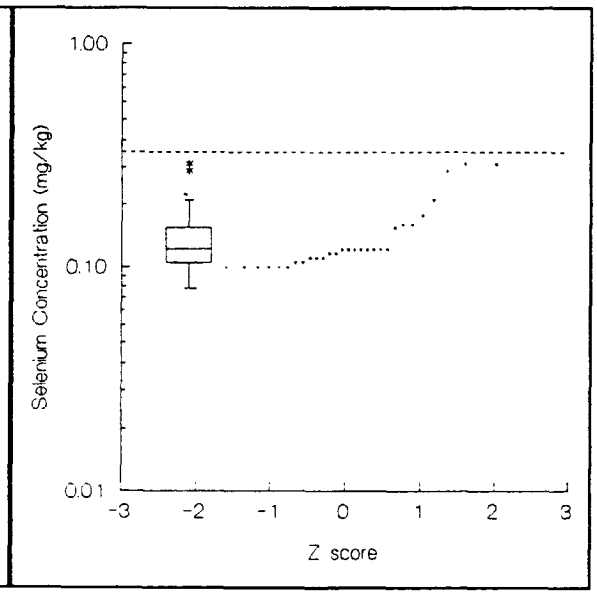
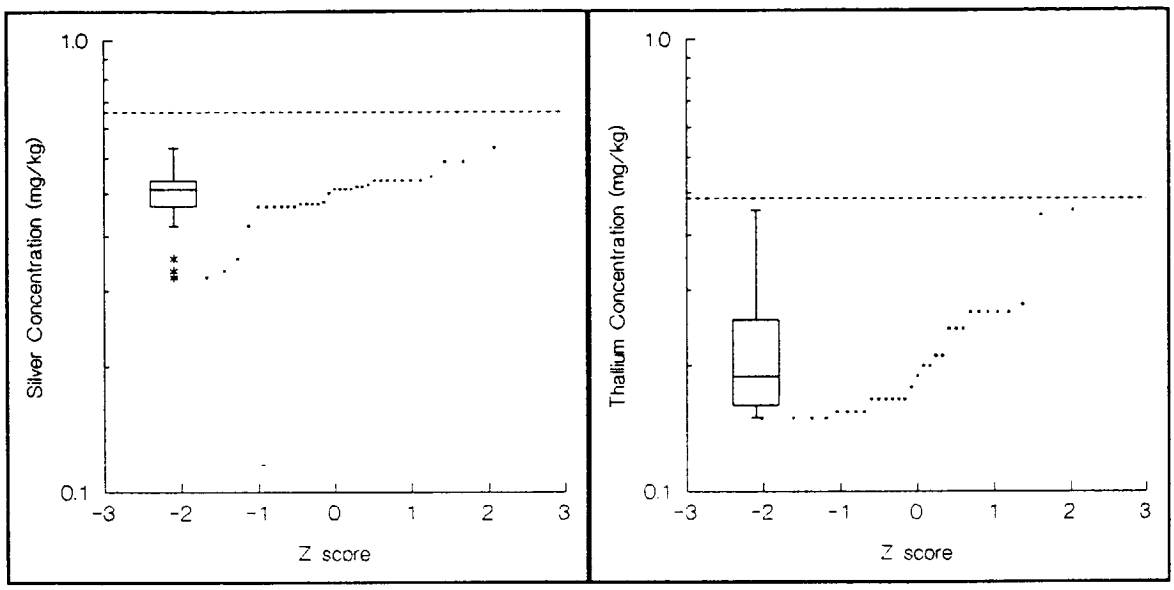
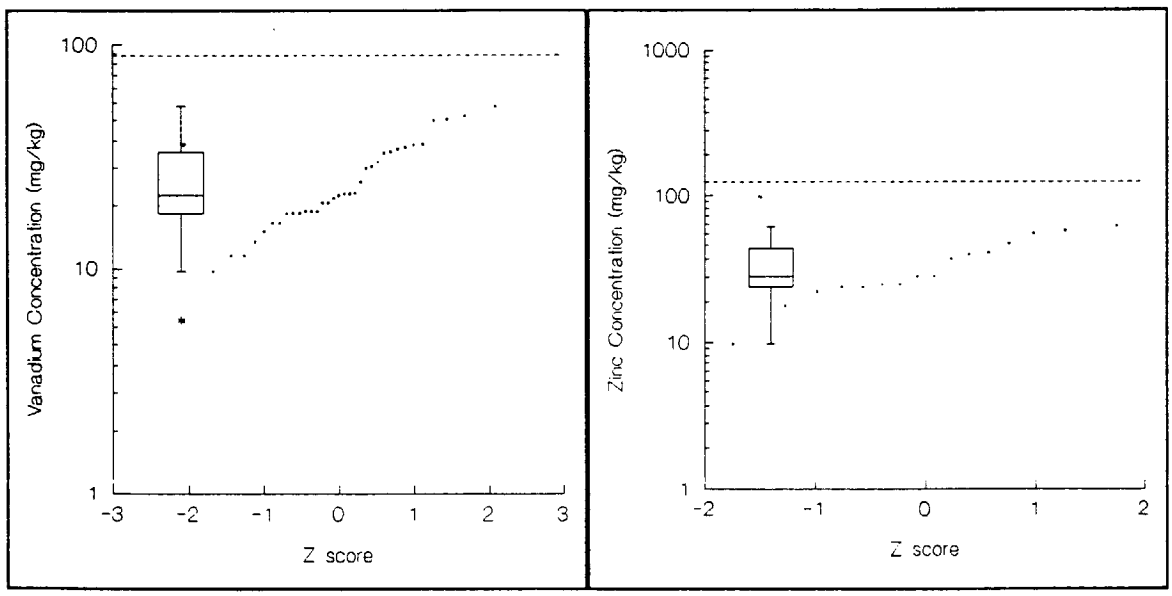
-2
-1
0
1
2
3
Z score


100
10
1
Nickel Concentration (mg/kg)
-3
-2
-1
0
1
2
3
Z score


1.00
0.10
0.01
Selenium Concentration (mg/kg)
-3
-2
-1
0
1
2
3
Z score


1.0
0.1
Silver Concentration (mg/kg)
-3
-2
-1
0
1
2
3
Z score
1.0
0.1
Thallium Concentration (mg/kg)
-3
-2
-1
0
1
2
3
Z score


100
10
1
Vanadium Concentration (mg/kg)
-3
-2
-1
0
1
2
3
Z score
1000
100
10
1
Zinc Concentration (mg/kg)
-2
-1
0
1
2
Z score