TO: Dave Edwards
Horicon Area

FROM: Celia VanDerLoop
SW/3

SUBJECT—MESSAGE

— Dave —

Here are copies of the reports Gene gave me last week.

I spoke w/ John G. of Water Reg. & Zoning about the wetland dredging. He seemed to think that if the Superfund program would agree to a dredging project, the other obstacles might be able to be removed.

RECEIVED
Dept. of
Natural Resources
Horicon Area Hdqrs.

SIGNED Celia VanDerLoop DATE 9/6/89

REPLY

SIGNED ____________ DATE ____________

Verneta

WESTON • SPER River Center, 111 North Canal Street, 8th Floor, Suite 855,
Chicago, IL 60606 • (312) 993-1067

TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE REMOVAL AND PREVENTION
EPA CONTRACT 68-01-7367

June 26, 1989

TAT-05-G2-00962

Mr. Steven J. Faryan
Deputy Project Officer
Emergency Response Section
Western Response Unit
U.S. Environmental Protection Agency
11th Floor
230 South Dearborn Street
Chicago, Illinois 60604

Re: Oconomowoc Electroplating, Ashippun, Wisconsin
TDD# 5-8810-32

Dear Mr. Faryan:

On November 17, 1988, the U.S. Environmental Protection Agency (U.S. EPA) tasked the Technical Assistance Team (TAT) to develop removal action alternatives with cost estimates for the Oconomowoc Electroplating Company Inc. (OEC) site in Ashippun, Wisconsin (Figure 1). The OEC facility, which is located at 2573 West Oak Street in Ashippun, Wisconsin, is a potential responsible party (PRP) for contaminating the adjacent wetland sediments with heavy metals and cyanide.

Davy Creek, which flows through the wetland, is a tributary to the Rock River. Continued siltation and growth of dense vegetation over many years have restricted the flow of Davy Creek. Diminished flow resulted in flooded basements and damage to farmland in the surrounding area. In order to alleviate this problem, the Dodge County Drainage Board (DCDB) proposed, in 1983, to dredge and rechannelize a one-mile stretch of Davy Creek (Figure 2). The U.S. EPA and the Army Corps of Engineers opposed this proposal based on the belief that contaminants present in the wetland could be "flushed" into the Rock River.

The initial assessment of the OEC site was conducted by the Field Investigation Team (FIT) for the U.S. EPA in 1983. Based on the FIT assessment, the OEC site received a Hazard Ranking Score (HRS) of 31.86 and was placed on the National Priorities List. Subsequently, the U.S. EPA Emergency Response Branch tasked the TAT to conduct a preliminary sampling survey in the wetland and evaluate the immediate threats to human health and the environment posed by the site.

FIGURE 1
SITE LOCATION MAP
OCONOMOWOC ELECTROPLATING CO.
ASHIPPUN, WISCONSIN

SCALE: 1 INCH = 13 MILES

WESTON
MANAGERS DESIGNERS/CONSULTANTS

DRAWN BY P.M.S.	DATE 2-16-89	PCS # 2032
APPROVED BY R.M.	DATE 2-16-89	TDD # 5-8810-32

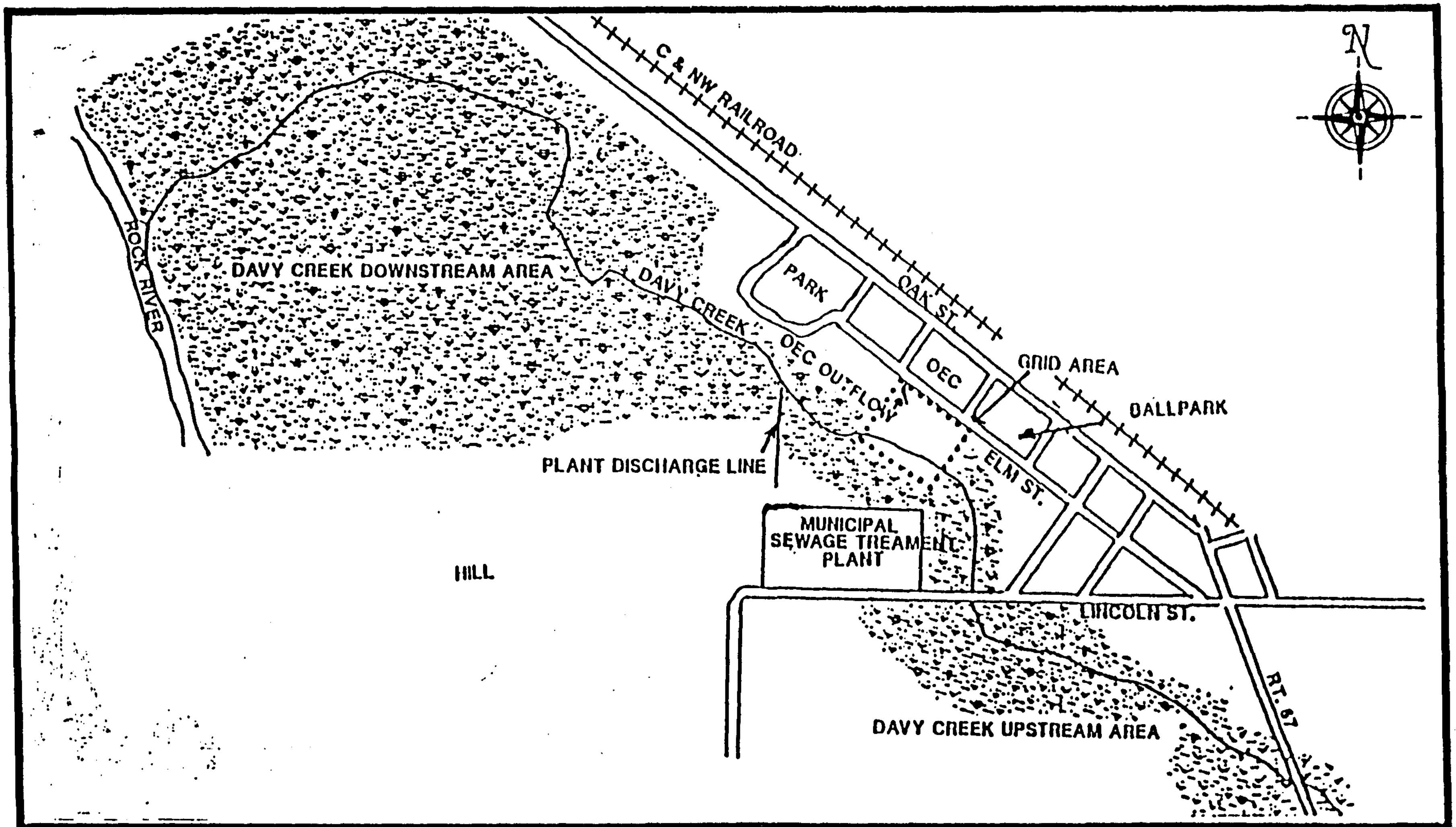

FIGURE 2
SITE MAP
OCONOMOWOC ELECTROPLATING COMPANY
DAVY CREEK WETLAND
ASHIPPUN, WISCONSIN
NOT TO SCALE

WESTON
MANAGERS DESIGNERS/CONSULTANTS

DRAWN BY P.M.S.	DATE 2-16-89	PCS # 2032
APPROVED BY R.M.	DATE 2-16-89	TDD # 5-8810-32

The TAT collected a limited number of sediment samples from the wetland on June 12 and 13, 1986. Analytical results of these samples indicate the presence of elevated levels of heavy metals and cyanide in the wetland immediately south of OEC, an area which is also near residential homes and a recreational park. Results of this preliminary sampling were submitted to the U.S. EPA in August 1986 (TDD# 5-8605-21).

Based on the results of the preliminary sampling, the U.S. EPA tasked the TAT to develop a detailed sampling plan to determine the extent-of-contamination of the wetland adjacent to OEC. This sampling plan was submitted to the U.S. EPA in February 1987 (TDD# 5-8702-35). In March and April 1987, the TAT conducted an extensive sediment and water sampling program which covered approximately 300 acres of wetland along Davy Creek. A 500 by 500 foot sampling grid was established in the wetland between the OEC discharge pipe and Davy Creek. Ninety four sediment samples were collected from within the grid and forty-five sediment samples were collected from both upstream and downstream locations outside of the grid (90 samples total). In addition, seven surface water samples were collected from different locations within the wetland.

The analytical results of the sediment samples indicate that an approximate 75,000 square-foot area confined to the central and upper-central parts of the grid (Figure 2) is contaminated with metals and cyanide typical to the electroplating process at OEC. This contamination appears to extend more than three feet beneath the sediment surface. Concentration isopleth maps for cyanide, cadmium, chromium, nickel, and zinc were constructed to display both the lateral and vertical distribution of these elements within the grid. Isopleth maps are included in the December 23, 1987 TAT extent of contamination study report (TDD#5-8702-35).

From December 1, 1987 through December 3, 1987, the U.S. EPA Environmental Response Team (ERT) conducted additional sediment sampling at the OEC site for use in a bioassay investigation. David Charters, Ph.D., of ERT reported the results of the bioassay tests on April 13, 1988, to U.S. EPA On-Scene Coordinator (OSC) Verneta Simon. The results indicated that the sediments sampled were toxic to both Fathead minnows and algae.

On July 19, 1988, Dr. Charters met with Roy F. Weston, Inc. statistician Charles Kufs to discuss developing biological response maps based on both the actual bioassay samples and the TAT sediment sampling results. Dr. Charters proposed developing biological response maps in order to aid him in defining specific areas and volumes of sediment in the wetland that would require removal in order to mitigate the threat to aquatic organisms.

On October 17, 1988, biological response maps were completed by Mr. Kufs and copies were submitted to Dr. Charters. Using the biological response maps, Dr. Charters developed a map delineating areas in the wetland adjacent to OEC that were recommended for excavation. The map divides the contaminated area into two parts. Area 1 represents the most highly contaminated sediments. Area 2 represents less severely contaminated sediments that may also be excavated to provide a greater margin of safety. A copy of this map was received by the TAT office on January 25, 1989 and is included in Attachment A. Using this map the TAT has developed cost estimates for the following removal options: soil removal from Area 1 with and without backfilling; soil removal from Areas 1 and 2 with and without backfilling; and fencing the perimeter of Areas 1 and 2.

Cost Estimates for Soil Removal from Areas 1 and 2, with Backfilling

Berming and excavating the maximum removal area outlined on the excavation map (excavation Areas 1 and 2, Attachment A) is estimated to cost $3,463,035 based on 90, 12-hour work days using O.H. Materials rates. This cost estimate assumes a 2-foot excavation depth and a sediment volume of 5,240 cubic yards (yd^3). The nine step approach used in this cost estimate is as follows:

1) After mobilization, a floating impermeable barrier will be installed outside the perimeter of the excavation area by four laborers under supervision of the barrier manufacturer. This barrier will prevent suspended sediment from being carried downstream.

2) A containment area for excavated sediments will be constructed approximately 150 feet east of the excavation area on relatively dry ground. A bulldozer will be used to create the 300 foot diameter containment area. The base and walls of the containment area will be constructed of concrete and decanting drains of PVC piping will be installed. The containment area will be

partitioned so that some sediments can be drying and others decanting at the same time. As sediments are dried, they can be loaded for disposal.

3) After steps 1 and 2 are completed, an excavator equipped with tracks will be used to excavate the peat/humus surface sediment layer along the perimeter of the excavation area. This initial peat removal is to insure that the final berm structure will impede surface water migration. The excavator will load lined dump trucks which will transport the material to the containment area. The excavator will work as loads of 3- to 8-inch diameter rip-rap are dumped to create a road around the perimeter.

4) Upon completion of the road, clay will be used to create an impermeable berm around the outside of the perimeter road. It is likely that some leaks will occur in the berm; therefore, extra rip-rap and clay will be staged on high ground near the excavation area to be used to repair leaks.

5) Six 2-inch diameter pumps will be used to de-water the excavation area. Water with suspended sediment, trapped between the berm and floating barrier, will be pumped to the containment area where the water will be decanted. The barrier will then be removed. Since ground water upwelling in the area of excavation will likely cause flooding of the excavation zone, de-watering of the excavation zone will be continuous. This cost estimate assumes minimal upwelling. An initial hydrogeological study of the area to determine the potential problems related to upwelling is advisable; however, costs for such a study are not incorporated into this report.

6) Three tracked excavators and a cable crane with a clamshell bucket will work in conjunction with five dump trucks to excavate a 2-foot sediment layer. The wet sediment will be hauled to the containment area for drying/de-watering.

7) After excavation is completed, the sediment will be decanted to remove water and lime will be added to further dry the material.

8) Two front end loaders will be used to transfer the dried sediment to 20 cubic yard dump trucks. The material will be transported for disposal to the Chemical Waste Management Adams Center Landfill in Fort Wayne, Indiana.

9) Two excavators and two front end loaders will be used in conjunction with dump trucks to backfill the excavated area to grade with clean fill material. Pending sampling results the berm material can be used to backfill the site.

The projected schedule for this excavation action is outlined in Table 1 and the Removal Cost Management System (RCMS) cost estimates are included in Attachment B.

Soil Removal from Area 1, with Backfilling

The cost for excavating the minimum removal area outlined on the excavation map (excavation Area 1, Attachment A) is $2,149,659. This cost estimate assumes a 2 foot excavation depth and a sediment volume of 3,246 yd^3. This cost estimate follows the nine step approach outlined previously.

Soil Removal without Backfilling

The cost of excavation without backfilling or removing the containment area (i.e., completing steps 1 through 8 outlined previously) would be $3,340,379 based on a 2 foot excavation depth and a sediment volume of 5,240 yd^3 (Areas 1 and 2). The cost estimate for 3,246 yd^3 (Area 1 only) is $2,073,436. All excavation cost comparisons are summarized in Table 2.

Hydraulic Excavation versus Mechanical Excavation

Hydraulic excavation was less costly than mechanical excavation when comparing the cost of the excavation action alone. However, with hydraulic excavation additional costs would be incurred which include more extensive dewatering and mechanical removal of vegetation, refilling the excavation area with water, expanding the sediment/water containment area, adding a flocculent, and extended sediment dewatering time. Because of these additional costs, hydraulic dredging at this site would likely equal or exceed the cost of mechanical dredging.

TABLE 1

EXCAVATION PROJECTED SCHEDULE
OCONOMOWOC ELECTROPLATING CO. SITE
ASHIPPUN, WISCONSIN

ACTIVITY	PERFORMANCE PERIOD (DAYS) 0 — 90
MOBILIZATION	2
INSTALL BARRIER & EXCAVATE PEAT	20
CONSTRUCT CONTAINMENT AREA	10
CONSTRUCT ROAD/BERM	24
DE-WATER EXCAVATION AREA	40
EXCAVATION	36
DE-CANT & DRY SEDIMENT	41
TRANSPORTATION & DISPOSAL OF WASTES	22
BACKFILL	14
DEMOBILIZATION	2

TABLE 2

SUMMARY OF COST ESTIMATION OPTIONS
OCONOMOWOC ELECTROPLATING CO. SITE
ASHIPPUN, WISCONSIN

Action	Yards for Excavation	Projected Cost
Berming, Excavating and Backfilling (Areas 1 and 2)	5,240	$3,463,035
Berming, Excavating and Backfilling (Area 1)	3,246	$2,149,659
Berming and Excavating (Areas 1 and 2)	5,240	$3,340,379
Berming and Excavating (Area 1)	3,246	$2,073,436
Fencing (Areas 1 and 2)	NA	$39,839.97

NA = Not applicable

Land Disposal Restrictions

In determining whether the OEC waste is subject to land disposal restrictions (LDRs) it must first be determined whether the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste is a Resource Conservation and Recovery Act (RCRA) waste. Since the sediments were contaminated under a valid Wisconsin Pollutant Discharge Elimination System (WPDES) permit under the Clean Water Act (CWA), the waste is not a RCRA waste and therefore may not be subject to LDRs. An exception may apply to the OEC waste, however, since OEC had reportedly violated their WPDES permit and since the facility was discharging into the wetland prior to the establishment of the initial permit in 1974. If the sediments are subject to LDRs and since the sediments were contaminated by an electroplating process, the sediments are considered a first third waste and are therefore subject to LDRs as of August 8, 1988. If the LDRs cannot be met, a Treatability Variance may be obtained.

Fencing

As a temporary measure, a fencing option may be considered to restrict site access; therefore, limiting the threat of direct contact with the contaminated sediment. Currently there is a fence located along Oak Street, however, the contaminated area can be accessed by circumventing the fence. This cost estimate will include fencing the remaining three sides. The cost of fencing will involve installing a 6-foot, 3-strand barbed wire fence along the perimeter of Areas 1 and 2. In addition to the fence a 10-foot service gate will be included in the estimate. The fence installation is estimated to take five days at a cost of $39,839.97.

Should you have any questions or require additional information, please feel free to contact us.

Very truly yours,

ROY F. WESTON, INC.

Phillip C. Wicklein
Technical Assistance Team
Leader, Region V

PCW:dn
Attachment

ATTACHMENT A

ATTACHMENT B

Cost Projection Scenario: OEC Page: 1

Projection ID No.: 2000 Date: 01/27/89
Cleanup Contractor: OH MATERIALS TAT Contractor:

Cost Projection Summary

Contractor Personnel	539,658.55
Contractor Equipment	77,041.43
At Cost Materials	41,569.74
Subcontractors	411,269.17
Waste Transportation	384,988.80
Waste Disposal	928,098.00
Cleanup Contractor Subtotal	2,382,625.69
15 % Contractor Contingency	357,393.85
Cleanup Contractor Total	2,740,019.54
TAT Personnel	132,480.00
Total TAT Costs	132,480.00
Extramural Subtotal	2,872,499.54
15 % Project Contingency	430,874.93
Total Extramural Cost	3,303,374.48
EPA Regional Personnel	73,980.00
EPA Headquarters Direct (10 % of Regional Hours)	0.00
EPA Indirect	85,680.00
EPA Total	159,660.00
Project Total	3,463,034.48

Projection ID No.: 2000
Cleanup Contractor: OH MATERIALS

Date: 01/27/89
TAT Contractor:

Project Scope

Number	Step/Milestone	Estimated Duration (Days)
1	MOBILIZATION	2
2	INSTALL FLOATING BARRIER	1
3	CONSTRUCT CONTAINMENT AREA	10
4	EXCAVATE PEAT/HUMUS LAYER	20
5	CONSTRUCT BERM/ROAD	20
6	CONSTRUCT CLAY BERM	5
7	DE-WATER REMOVAL AREA	40
8	EXCAVATE CONTAMINATED SEDIMENT	36
9	DE-WATER/DRY SEDIMENT	41
10	TRANSPORTATION/DISPOSAL	22
11	BACKFILL REMOVAL AREA	14
12	DEMOBILIZATION	2

Cost Projection Scenario: OEC

Projection ID No.: 2000 Date: 01/27/89
Cleanup Contractor: OH MATERIALS TAT Contractor:

Contractor Personnel

Job Category	No. Emplyes	No. Days	Hrs per day	Labor	PD,Lodge Travel	Total Charge
SUPERVISOR	1	90	12.0	55587.60	10164.83	65752.43
FOREMAN	1	90	12.0	38415.60	10164.83	48580.43
LABORERS	1	67	12.0	28598.28	7567.15	36165.43
LABORERS	1	90	12.0	38415.60	10164.83	48580.43
LABORERS	4	3	12.0	5122.08	1355.31	6477.39
EQUIP OPERATOR	1	12	12.0	5884.80	1355.31	7240.11
EQUIP OPERATOR	1	22	12.0	10788.80	2484.74	13273.54
EQUIP OPERATOR	2	52	12.0	51001.60	11746.02	62747.62
EQUIP OPERATOR	2	16	12.0	15692.80	3614.16	19306.96
EQUIP OPERATOR	2	24	12.0	23539.20	5421.24	28960.44
EQUIP OPERATOR	1	38	12.0	18635.20	4291.82	22927.02
TRUCK DRIVER	12	2	12.0	11769.60	2710.62	14480.22
TRUCK DRIVER	2	22	12.0	21577.60	4969.47	26547.07
TRUCK DRIVER	3	52	12.0	76502.40	17619.03	94121.43
FLD CLERK/TYPIST	1	90	12.0	34333.20	10164.83	44498.03
			Total Personnel Cost:			539658.55

Contractor Equipment

Equipment Item	Reg Days	Stby Days	Mob/Dmob Hours	Decon Hours	Mileage	Total Charge
TRLR DECON 8X40	90	0	0	0	N/A	2828.28
TRLR OFF 8X40 EQUIP	90	0	0	0	N/A	3758.52
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00

Contractor Equipment

Equipment Item	Reg Days	Stby Days	Mob/Dmob Hours	Decon Hours	Mileage	Total Charge
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
TRUCK ROAD TRACTOR	2	0	0	0	N/A	472.00
LDR FT END CAT 966	16	0	0	0	N/A	8634.98
LDR FT END CAT 966	16	0	0	0	N/A	8634.98
LDR FT END CAT 966	24	0	0	0	N/A	11225.45
LDR FT END CAT 966	24	0	0	0	N/A	11225.45
DOZER D-6 W/6WAY BL	12	0	0	0	N/A	6364.98
FORK LIFT 2 TON	4	0	0	0	N/A	424.43
ANYL CYANIDE MONITOR	3	0	0	0	N/A	111.99
ANYL CYANIDE MONITOR	3	0	0	0	N/A	111.99
ANYL CYANIDE MONITOR	3	0	0	0	N/A	111.99
ANYL CYANIDE MONITOR	3	0	0	0	N/A	111.99
ANYL CYANIDE MONITOR	67	0	0	0	N/A	1119.88
ANYL CYANIDE MONITOR	90	0	0	0	N/A	1455.84
ANYL CYANIDE MONITOR	90	0	0	0	N/A	1455.84
ANYL CYANIDE MONITOR	90	0	0	0	N/A	1455.84
ANYL CYANIDE MONITOR	90	0	0	0	N/A	1455.84
ANYL CYANIDE MONITOR	22	0	0	0	N/A	485.28
ANYL CYANIDE MONITOR	22	0	0	0	N/A	485.28
ANYL CYANIDE MONITOR	52	0	0	0	N/A	970.56
ANYL CYANIDE MONITOR	52	0	0	0	N/A	970.56
ANYL CYANIDE MONITOR	52	0	0	0	N/A	970.56
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
LOWBOY, 20 TON	2	0	0	0	N/A	404.72

Projection ID No.: 2000 Date: 01/27/89
Cleanup Contractor: OH MATERIALS TAT Contractor:

Contractor Equipment

Equipment Item	Reg Days	Stby Days	Mob/Dmob Hours	Decon Hours	Mileage	Total Charge
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
LOWBOY, 20 TON	2	0	0	0	N/A	404.72
COMPUTER PORTABLE-PC	90	0	0	0	N/A	2487.72

Total Equipment Cost: 77041.43

At Cost Material

Material Name	Use	Quantity/Amount	Total Charge
FLOATING BARRIER	BARRIER	7500 FT2	6966.00
MISCELLANEOUS	UNPLANNED COST	100.00/DAY	10989.00
PIPING	DE-WATERING	60 FEET	232.20
POSTS	HOLD BARRIER	95	1323.54
PPE	PROTECTION	1200+ESC.PACK	11610.00
UTILITIES	PHONE/ELECTRIC	90 DAYS	10449.00

Total At Cost Material Cost: 41569.74

Subcontractors

Subcontractor	Service	Total Charge
ANALYTICAL	ANALYSES	10200.00

Projection ID No.: 2000 Date: 01/27/89
Cleanup Contractor: OH MATERIALS TAT Contractor:

Subcontractors

Subcontractor	Service	Total Charge
BUILDING MATERIAL	RIP-RAP FOR RAMP	217.69
BUILDING MATERIAL	CLAY FOR BERM	9288.00
BUILDING MATERIAL	CONCRETE FOR SPOIL	132063.75
BUILDING MATERIAL	BANK-RUN FOR FILL	17415.00
BUILDING MATERIAL	LIME FOR DRYING	78367.50
BUILDING MATERIAL	RIP-RAP FOR ROAD	29025.00
FLOATING BARRIER	SUPERVISOR 1 DAY	464.40
GUARD SERVICE	SECURITY	15046.56
PORT-A-JON	PORTABLE JON	696.60
RENTAL AGENCY	2INCH PUMP	1741.50
RENTAL AGENCY	2INCH PUMP	1741.50
RENTAL AGENCY	CABLE CRANE	9586.38
RENTAL AGENCY	TRACKED EXCAVATOR	7151.76
RENTAL AGENCY	DUMP TRUCK	5108.40
RENTAL AGENCY	PALLETS	174.15
RENTAL AGENCY	TRACKED EXCAVATOR	14303.52
RENTAL AGENCY	TRACKED EXCAVATOR	14303.52
RENTAL AGENCY	SHEEPSFOOT-SPREADER	2094.59
RENTAL AGENCY	DUMP TRUCK	5108.40
RENTAL AGENCY	DUMP TRUCK	10216.80
RENTAL AGENCY	DUMP TRUCK	10216.80
RENTAL AGENCY	DUMP TRUCK	10216.80
RENTAL AGENCY	BOAT	310.97
RENTAL AGENCY	PASSENGER VAN 3 DAY	261.23
RENTAL AGENCY	PASSENGER VAN 90 DY	7836.75
RENTAL AGENCY	PASSENGER VAN 24 DY	2089.80
RENTAL AGENCY	PASSENGER VAN 52 DY	4527.90
RENTAL AGENCY	PASSENGER VAN 52 DY	4527.90
RENTAL AGENCY	2INCH PUMP	1741.50
RENTAL AGENCY	2INCH PUMP	1741.50
RENTAL AGENCY	2INCH PUMP	1741.50
RENTAL AGENCY	2INCH PUMP	1741.50

Subcontractors

Subcontractor	Service	Total Charge
	Total Subcontractor Cost:	411269.17

Waste Transportation

Waste Type	Amount	No. Loads	Cost per Ld. Mile	No. Miles	Total Charge
CN/METAL SOLIDS	6740 YDS	337	4.00	280	384988.80
	Total Waste Transportation Cost:				384988.80

Waste Disposal

Waste Type	Disposal Method	Units	No. Units	Unit Cost	Total Charge
CN/METAL SOLIDS	LANDFILL	YDS	6740	135.00	928098.00
	Total Waste Disposal Cost:				928098.00

TAT Personnel

Level	No. TATMs	No. Days	Hrs per day	Hr Rate	Labor	PD,Lodge Travel	Total Charge
PL2	2	90	12.0	45.00	97200.00	13680.00	110880.00

Projection ID No.: 2000 Date: 01/27/89
Cleanup Contractor: OH MATERIALS TAT Contractor:

TAT Personnel

Level	No. TATMs	No. Days	Hrs per day	Hr Rate	Labor	PD,Lodge Travel	Total Charge
PL2	1	60	8.0	45.00	21600.00	0.00	21600.00

Total TAT Personnel Cost: 132480.00

EPA REGIONAL PERSONNEL COSTS

Title	No. Days	Hrs per Day	Hr Rate	Labor	PD,Lodge Travel	Total Charge
COMM RELATIONS	15	8.0	30.00	3600.00	1140.00	4740.00
OSC	90	12.0	40.00	43200.00	6840.00	50040.00
OSC	60	8.0	40.00	19200.00	0.00	19200.00

EPA Regional Personnel Cost: 73980.00

EPA Headquarters Cost: 0.00
(Based on 10 % of Regional hours)

EPA Indirect Cost: 85680.00
(Based on 1680 hours @ $51 per hour)

Total EPA Cost: 159660.00

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Cost Projection Scenario: OEC - FENCING Page: 1

Projection ID No.: 1010 Date: 05/15/89
Cleanup Contractor: OH MATERIALS TAT Contractor:

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Cost Projection Summary

Contractor Personnel	2,781.70
Subcontractors	16,817.90
Cleanup Contractor Subtotal	19,599.60
Extramural Subtotal	19,599.60
15 % Extramural Contingency	2,939.94
Extramural Subtotal	22,539.54
TAT Personnel	6,530.00
Total TAT Costs	6,530.00
Extramural Subtotal	29,069.54
15 % Project Contingency	4,360.43
Total Extramural Cost	33,429.97
EPA Regional Personnel	3,970.00
EPA Headquarters Direct (10 % of Regional Hours)	0.00
EPA Indirect	2,440.00
EPA Total	6,410.00
Project Total	39,839.97

Projection ID No.: 1010 Date: 05/15/89
Cleanup Contractor: OH MATERIALS TAT Contractor:

Project Scope

Number	Step/Milestone	Estimated Duration (Days)
1	FENCE CONTAMINATED AREA	5

Cost Projection Scenario: OEC - FENCING

Projection ID No.: 1010 Date: 05/15/89
Cleanup Contractor: OH MATERIALS TAT Contractor:

Contractor Personnel

Job Category	No. Emplyes	No. Days	Hrs per day	Labor	PD,Lodge Travel	Total Charge
SUPERVISOR	1	5	8.0	2378.80	402.90	2781.70
			Total Personnel Cost:			2781.70

Subcontractors

Subcontractor	Service	Total Charge
FENCING INC.	FENCING	15383.34
FENCING INC.	2 EQUIPMENT GATES	976.72
FENCING INC.	PERSONNEL GATE	183.14
RENTAL CAR INC.	CAR RENTAL	274.70
	Total Subcontractor Cost:	16817.90

TAT Personnel

Level	No. TATMs	No. Days	Hrs per day	Hr Rate	Labor	PD,Lodge Travel	Total Charge
ADM	1	10	8.0	45.00	3600.00	0.00	3600.00
PL2	1	5	8.0	65.00	2600.00	330.00	2930.00
				Total TAT Personnel Cost:			6530.00

EPA REGIONAL PERSONNEL COSTS

Title	No. Days	Hrs per Day	Hr Rate	Labor	PD,Lodge Travel	Total Charge
OSC	5	8.0	91.00	3640.00	330.00	3970.00

Cost Projection Scenario: OEC - FENCING

Projection ID No.: 1010
Cleanup Contractor: OH MATERIALS

Date: 05/15/89
TAT Contractor:

EPA REGIONAL PERSONNEL COSTS

Title	No. Days	Hrs per Day	Hr Rate	Labor	PD, Lodge Travel	Total Charge

EPA Regional Personnel Cost:	3970.00
EPA Headquarters Cost: (Based on 10 % of Regional hours)	0.00
EPA Indirect Cost: (Based on 40 hours @ $61 per hour)	2440.00
Total EPA Cost:	6410.00

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
EDISON, NEW JERSEY 08837

April 13, 1988

Subject: Oconomowoc Electroplating Company Inc.

To: Glen Cekus
Remedial Project Manager
Region V

Verneta Simon
On Scene Coordinator
Region V

From: David W. Charters, Ph.D.
Environmental Scientist
Environmental Response Team

Enclosed please find the first of two reports on the Oconomowoc Electroplating Company Inc. in Ashippun, WI.

The report on the toxicity of the sediments in the wetland and the corresponding chemical analysis is enclosed. Statistical analysis of the data will be completed soon and will be reported under separate cover.

The results of the tests indicate that the sediments are toxic to both the fathead minnows as well as algae. The high level of toxicity was not predicted based on the TAT results and the location in a wetland environment. We are however, convinced that the data is solid and has passed all QA.

As to the question of dredging the area, or channelizing the creek I will be contacting you to ascertain the specifics of the problem.

Preliminary Report
Results of Toxicity Tests and Chemical Analysis

Oconomowoc Electroplating Company Inc.
Ashippun, Wisconsin
April 1988

David W. Charters, Ph.D.
Environmental Protection Agency
Environmental Response Team
Edison, New Jersey 08837

in conjunction with

Gary Buchanan, REAC
and
Richard G. Henry, REAC

OCONOMOWOC ELECTROPLATING COMPANY, INC., SITE

BACKGROUND

The Oconomowoc Electroplating Company, Inc. (OECI) site is located in Ashippun, Wisconsin. This electroplating company discharges wastewater to adjacent Davy Creek through a wetland. High concentrations of metals and cyanide have accumulated in this marsh due to the OECI discharge. The objective of this investigation was to determine if the contaminated sediments from this wetland are toxic to aquatic organisms. The primary objective of this study is to determine if the use of standard toxicity tests and chemical analysis in conjunction with appropriate statistics will allow the determination of a scientifically defensible cleanup standard which will reduce the volume of material which must be remediated.

The study area (Figure 1), is approximately 5.7 acres in size. It is bordered on the north (Elm Street) and portions of the east and west by a ten foot chain link fence. The southern border is not fenced, although deepwater habitat, including Davy Creek, represents a significant natural barrier. Access to the site was gained through a locked gate located in the northeastern corner of the fence.

The site consists of wetlands as defined by the US Army Corps of Engineers as per Section 404 of the Clean Water Act and 33 CFR, parts 320 through 330. Typically, three criteria are employed to identify regulated wetlands. These include: 1) the appropriate hydrology; 2) a predominance of wetland vegetation; and, 3) the presence of hydric soils. This wetland is tentatively classified as Palustrine, Emergent, Persistent by the U.S. Fish and Wildlife Service.

The main channel of Davy Creek is located approximately 100 meters south of Elm Street and forms the central core of the site's hydrosystem. Water flow is in a westerly direction. Davy Creek is approximately 10 meters wide and 2.5 meters deep where it enters the eastern portion of the site and becomes progressively smaller until it is reduced to a shallow channel in the southwestern corner. The surface discharge of Davy Creek appears much reduced and apparently a substantial portion enters the shallow groundwater system at this point. The area between Davy Creek and Elm Street contains a number of meandering channels which coalesce into pools and ultimately enter Davy Creek.

MATERIALS AND METHODS

The U.S. Environmental Response Team (ERT) assisted by REAC and the ERT Technical Assistance Team (TAT) conducted this investigation at the OECI site. Those present included David W. Charters, USEPA ERT, Richard Henry and Gary Buchanan, Weston REAC, and Linda Delia and Mark Houston, Weston ERT TAT.

The field investigation commenced on December 1, 1987 and was completed on December 3, 1987. Initial site entry was made in level B for the purpose of monitoring potential airborne contaminants, particularly HCN gas. Monitoring instruments employed included an HNu photoionization detector, HCN Monotox, and Drager HCN colorimetric indicating tubes. Following instrument calibration, a site survey was conducted along the perimeter and interior of the site. Readings were taken at various heights ranging from ground level to eye level. No instrument readings above background were observed with the exception of an HNu reading of 0.9 ppm above background at sample location G 01. This reading was taken at the waters surface following the disturbance of sediments and water column. Based upon data gathered during this phase of the investigation, it was decided that subsequent sampling activities would be conducted in Level C. Monitoring with direct reading instruments accompanied all sampling activities.

A site survey was conducted on December 2, 1987 for the purpose of locating sample points and determining sampling methodology. Eight sample locations previously determined by spatial statistics were identified and flagged. Many of the sites were staked by Region V TAT those not flagged were measured out with a tape. In addition, one upstream reference sample point and one downstream sample point were located. Sampling points are depicted in Figures 1 and 2.

The purpose of this effort was to sample sediments for physical and chemical parameters and toxicity determination. Physical analysis was limited to particle size determination. Chemical analysis included priority pollutant metals, cyanide, total organic carbon, and extraction procedure toxicity test (EP Tox) method for metals. In addition, toxicity of sediment elutriates were determined utilizing both chronic and acute standard methods. A total of ten locations were sampled; one reference location upstream of the site, one downstream of the site, and eight on the site.

At each sampling point, sediments were collected utilizing either an Ekman dredge, a bucket auger, or a spade. All samples were collected from the top 30 centimeters of sediment. Sediment samples were placed into stainless steel buckets, mixed thoroughly, and transferred to labeled sample bottles. One 32 oz. sample was collected for particle size analysis and one 16 oz. sample was collected for chemical analysis. In addition, a 2.5 gallon sample was collected for toxicity testing. Standard operating procedures were followed for sample collection, preservation, documentation, shipping, and equipment decontamination. Samples for physical/chemical analysis were shipped on December 3, 1987 by overnight air to Weston/REAC, Edison, NJ, prior to delivery to the contract laboratory. Samples for toxicity testing were also shipped by overnight air to International Technology, Edison, NJ, for analysis. Table 1 details sample locations and corresponding sample identification numbers.

The acute and chronic effects of an elutriate prepared from the ten sediment samples were tested! Acute testing involved the 96 hour static test using fathead minnows (Pimephales promelas) (<30 days old). Chronic testing included the 7-day static renewal Fathead Minnow Larval Survival and Growth Test (Method 1000.0) and the Algal (Selenastram capricornutum) Growth test (EPA/600/4-85/014). All ten samples were tested using the acute fathead minnow test and the chronic algal test. Only five of the sediment samples were tested using the chronic fathead minnow test. Five samples (DS-1 (7585), US-1 (7584), G5 (7580), G/H01 (7582), and C9 (7583)) underwent additional testing as they showed no acute toxicity.

A statistician has been retained to aid in the interpretation of chemical and toxicity data. The overall objective is to relate the concentration of single or groups of contaminants with the observed toxicity. A report detailing the analysis conducted and results will be submitted under separate cover.

RESULTS

Presently, the vast majority of the site acreage is an emergent wetland with a small amount of young secondary growth forest. Table 2 details vegetation encountered on site. The composition of the community at any one spot is largely dependent upon the position on an environmental continuum as graded from the lower permanently flooded areas to dryer areas that are several inches higher in elevation. Tussock sedge and bulrush dominate the lower flooded areas. Within these areas, plant establishment is confined to narrow columnar hummocks which are surrounded by 0.15 to 1 meter (0.5 - 3 feet) of water. Filamentous green algae and duckweed were observed in the open water. At the opposite end of the continuum is a lowland secondary growth forest which is located in the northeastern quarter of the site. Because this area is several inches higher in elevation, surface water was not present at the time of the field investigation. In addition, based on local drainage patterns and the absence of drift lines, sediment deposition and watermarks, this area does not appear to be frequently inundated. Species present include oak, willow, red maple, ash and elm. Diameter at the breast height of most stems ranges from one to three inches. The herbaceous layer is dominated by panic grass. Intermediate in elevation are dense patches of cattail marsh.

The site has been mapped by the Dodge County Soil Conservation Service as Palms Muck. The Palms Muck series is generally a level, very poorly drained soil formed on glacial lake plains and in depressions on till plains and moraines. This series formed in decomposed herbaceous material and is black to dark reddish brown in color. Soils encountered on site consist of dark, fine textured organic muck. Typically, the upper layers were saturated and composed primarily of matted vegetative litter in various states of decomposition. Subsurface layers were also saturated but consisted of fine textured brown to black organic soil material.

It appears that the hydrology of the Davy Creek wetland complex has been altered in recent history. Sedimentation resulting from surrounding land use has altered the channel configuration of Davy

Creek and subsequently restricted outflow. In areas, the wetland has shifted from a lowland forest to flooded emergent wetland and is presently too deep to support tree regeneration.

Diversity of biota encountered was low, primarily as a result of seasonal factors. Species observed include birds, mammals, fish, and invertebrates, and are listed in Table 3.

Sediment characteristics, water depth, and collection method for each sample were recorded and are described as follows:

D 02 - Sample location was in 15 to 45 centimeters (cm) of water. This area apparently receives effluent from electroplating operation. Surface layer of sediment was light orange/tan in color and somewhat murky with organic matter in lower layers. HNU readings at time of sampling initially went off scale on 0-20 ppm range and subsequently stabilized at 5 to 10 ppm. Sample was collected with an Ekman dredge.

D 04 - Surface water was not present at sample location, however, sediments were saturated. Sample was collected from beneath matted cattail litter. Sediments were brown to black in color with common, fine and distinct orange yellow mottles. Sample was collected with a spade.

E 03 - Water depth at sample location was approximately 15 cm. Upper layers of sediment were light yellow brown while lower layers were dark brown. Sample was collected with an Ekman dredge.

D/E 02 - Surface water was absent at this location, however, sediments were saturated. Sample was collected from beneath matted cattail litter. Sediments were brown black in color, fine textured, firm, and plastic in spots. Sediments were collected with a spade.

G 05 - Surface water was 15 to 45 cm deep at this sample location. Sediments were brown to black in color. The surface layer contained much plant litter; subsurface layers were fine textured, firm, and plastic. Sample was collected with an auger.

F 06 - Sample location was in 15 to 60 cm of water. A sheen was noted on water surface. Sediments were dark brown in color and fine textured. Sample was collected with an auger and Ekman dredge.

G/H 01 - Water depth at this location was 45 cm. Sediments were dark brown in color and were mucky with much organic matter. Sample was collected with a spade and Ekman dredge.

C 09 - Surface water was absent from this location, however, sediments were saturated. Sediment was dark brown in color and collected from beneath matted cattail litter. Sample was collected with a spade.

US 01 - Sample was collected from a depositional environment in the main channel of Davy Creek approximately 15 meters upstream of Route 67 immediately upstream of a wooden foot bridge. Sediments were mixed with plant material and collected with an Ekman dredge.

DS 01 - Sample was collected from a depositional environment in the center of the main channel of Davy Creek approximately 15 meters downstream of sewage treatment plant outfall. Sediments were a layer of black, fine textured sediment mixed with plant material over a layer of gravel and loose rocks. Sample was collected with a spade.

The analytical results for metals and cyanide are summarized in Table 4. Only ten of the 13 metals analyzed are depicted, as concentrations of antimony, beryllium, and thallium were detected sporadically, in relatively low concentrations or not detected. The complete analytical results are listed in Appendix A. Concentrations of cadmium, chromium, copper, nickel, zinc, and cyanide were highly elevated and in some cases were detected in percent concentrations. The most heavily contaminated sites for each metal varied but generally sites D2, E3, and F6 exhibited the highest concentrations. Sites DS01 and US01 exhibited the lowest concentrations relative to the other sites. These latter two sites correspond to the downstream site and upstream reference site. Arsenic concentrations were comparatively low with all sites exhibiting concentrations less than 60 mg/Kg. Mercury concentrations exceeded 1 mg/Kg only at C9. Selenium concentrations ranged from not detected at site D4 to 30 mg/Kg at site D/E 2. Silver was only detected at four of the ten sites with 71 mg/Kg being the highest concentration observed. Lead concentrations ranged from not detected at four sites to 918 mg/Kg at site D2.

Six of the sites sampled duplicated sites examined by the Region V TAT investigation (April 1987). A comparison of data indicates that concentrations of individual metals between the two sampling methods are highly variable, explanations are offered in the conclusions.

The results of the Extraction Procedure (EP) Toxicity Analysis are listed in Table 5. Eight metals were analyzed. The results indicate that all of the metals except cadmium were detected well below the EP Toxicity limits or not detected. Concentrations of cadmium equaled or exceeded the EP Toxicity limit of 1,000 ug/L at eight of the ten sites. Only the upstream reference site (US01) exhibited cadmium concentrations well below the EP Toxicity limits. Other metals were detected in the EP Tox test, including Barium, Chromium, Mercury, and Silver, but were below the quantification level. Nickel Copper and Zinc are not included in the standard EP Toxicity Test.

Total organic carbon (TOC) concentrations are listed in Table 6. Concentrations ranged from 5.0% at site US01 to 15.0% at site C9. A summary of the grain size analysis are also listed and indicate that seven of the sites' sediments were composed of predominantly silts while the remaining three were composed of predominantly sands. Only site US 01 exhibited a greater than 10% composition of clay.

The toxicity testing results are summarized in Table 7 with the complete report located in Appendix C. The acute fathead minnow testing results indicate that toxicity (96 hr. LC50) was evident in six of the ten sediments examined. Values for the 96 hr. LC50 in those samples which showed toxicity ranged from less than 6.25% at site E3 to 54.5% at site D2. Values are expressed as percent of elutriate. Site G5 exhibited a value of 100 indicating that 100% elutriate caused mortalities of 50% in the tests. The remaining four sediments exhibited LC50s of greater than 100.

The chronic toxicity test using the algae Selenastrum capricornutum was more sensitive to the sediment elutriates. This test measures inhibition of growth as compared to a control. The 96-hr. EC50 for the sediments were generally lower as compared to the acute fathead minnow test. The 96-hr. EC50s ranged from 5.3 at site D4 to 37.0 at site C9 as 8 of the 10 sediments were toxic to the algae. Only sediments from site DS01 and US01 exhibited no toxicity (EC50 greater than 100).

However, a closer examination of the data reveals that the 48-hr. EC50 for DS01 indicates a value of less than 6.25. As with all of the samples (except US01) there was a lag in growth or greater inhibition of growth at 48 hours when compared to 96 hours. Biostimulation occurred in sample US01 as growth was 118% of the control.

The chronic fathead minnow fry growth test results did not reveal any toxicity as compared to the control. Growth of the fry exposed to the samples did not differ significantly from the controls. However, interpretation of the sublethal response (growth) was clouded by the lack of growth in all test treatments and controls.

QUALITY ASSURANCE / QUALITY CONTROL

All field sampling conducted during this project was completed in accordance with EPA accepted methodology. All samples were individually documented with a field data sheet and were packed and transported to subcontractor laboratories under chain-of-custody and custody seal methods. Laboratory testing and toxicity testing utilized methodology approved by the EPA. Subcontractor reports and all REAC reports generated by this project received an internal QA/QC review by REAC Sampling and Analytical, Operations and Assessment, and/or Quality Assurance Staff.

DISCUSSION

The extent of contamination and contaminants present at this site have been previously documented. The objective of this investigation was to determine what contaminants may be causing toxicity, in what concentrations or combinations they are toxic.

The results do indicate severe contamination of the sediments in this wetland by metals and cyanide. The results, however, do not exactly match the analytical results of Region V TAT (April 1987). A comparison of data indicates differences in concentrations from less than an order of magnitude to several orders of magnitude at the same approximate sampling location. The reasons for these differences probably result from the passage of eight months during which the Oconomowoc Electroplating Co. Inc. was still discharging to the wetland. Additional differences may have resulted from variations in sampling technique, exact sample location, and analytical variation. Depositional patterns of the contaminants from the OECI outfall exhibit definite spatial differences which have been caused by water levels, run-off, wind, and the physical characteristics of the wetland. In addition, the physical and chemical interactions of the contaminants, water and sediment will all affect deposition.

An attempt was made to examine the various metals and cyanide in terms of toxicity to aquatic life. Almost all of the contaminants are toxic depending on the chemical species, concentration, and location in the environment. Examining the concentrations found in this investigation, the following six contaminants are of most concern: cadmium, copper, cyanide, zinc, chromium, and nickel. Further examination of these contaminants indicates that a complex situation exists concerning the interactions of the metals, cyanide, sediments, and water. The fate of each contaminant is dependent upon both physical and chemical characteristics of the site's sediment and water. At this point it is obvious that large concentrations of these contaminants have adsorbed to the sediments. What is not known are the water quality characteristics of the site, their effect on the contaminants, and the contaminants solubility and ultimate bioavailability.

The literature indicates that the metals present on site can act either antagonistically or synergistically in relation to one another in terms of toxicity (Table 8). Zinc is antagonistic to cadmium for plants while selenium is synergistic. Zinc and copper are synergistic to cadmium when looking at fish toxicity. Other interactions are also listed. Table 8 lists the acute toxicity values and the National Water Quality Criteria for the Protection of Aquatic Organisms for six of the contaminants. All of the contaminants can cause acute effects at concentrations of less than 1 mg/L, a few at much lower concentrations. Chronic effects could occur at even lower concentrations. Based on the National Water Quality Criteria, a ranking of the contaminants from most toxic to least toxic would be: cadmium, cyanide, chromium (VI), copper, zinc, and nickel assuming a hardness of 100 mg/L as CaCO3. Increasing or decreasing hardness will normally decrease or increase toxicity, respectively, of these metals.

The EP Toxicity data, indicates that cadmium concentrations are far in excess of the National Water Quality Criteria and exceed the minimum acute toxicity concentrations. EP Toxicity data is only available for cadmium and chromium, so the concentrations of copper, zinc, cyanide, and nickel are not known. Cyanide was detected in the form of HCN gas during the preparation of elutriate for toxicity testing. Concentrations released from the sediment during elutriate preparation ranged up to 6 ppm.

Statistical analysis of the data should give a better indication as to which contaminants are responsible for the toxicity. Depending on EPA needs, these results may be used to delineate the wetlands to be remediated at the OECI site. This report will be submitted under separate cover.

CONCLUSIONS

The contamination of the wetlands to the south of the Oconomowoc Electroplating Company Incorporated has been proven to be a significant hazard to the environment. The levels of toxicity demonstrated in the sediments from several points exceed what is accepted as highly toxic (Porcella 1983).

Wetland sediments have a large capacity for binding heavy metals and not allowing these metals to become available to the environment and it's biota. In the present case, the high levels of metal contamination (Table 4) have been partially bound to the sediments (EP Toxicity results) but the high levels of contamination have overwhelmed the capacity of the wetland and toxic metals are available.

The toxicity tests revealed that samples E3, D/E2, F6, D2, D4, and G5 were acutely toxic to fathead minnows. In addition to these sites, C9 was chronically toxic to the algae. The chemical or precise combination of chemicals which are causing the toxicity are unknown. Each chemical or metal in our analysis can be toxic when presented in appropriate concentrations. They can also act as synergists or antagonists when presented with other metals. The presentation of the actual concentrations and combinations present at the site is the only way to assess the actual toxic potential. In this case the levels or combination of chemicals and metals has exceeded the minimum which is toxic to the two species tested.

The toxicity data collected on fathead minnows and algae showed conclusively that the contamination in the wetland is toxic. The use of two species one fish and one plant has demonstrated that the contamination of chemicals and metals on site is toxic to both species.

RECOMMENDATIONS

The statistical analysis is at this point incomplete. The statistician for International Technologies is to compete the analysis before the 14th of April. Recommendations will be included in the report which will accompany the report.

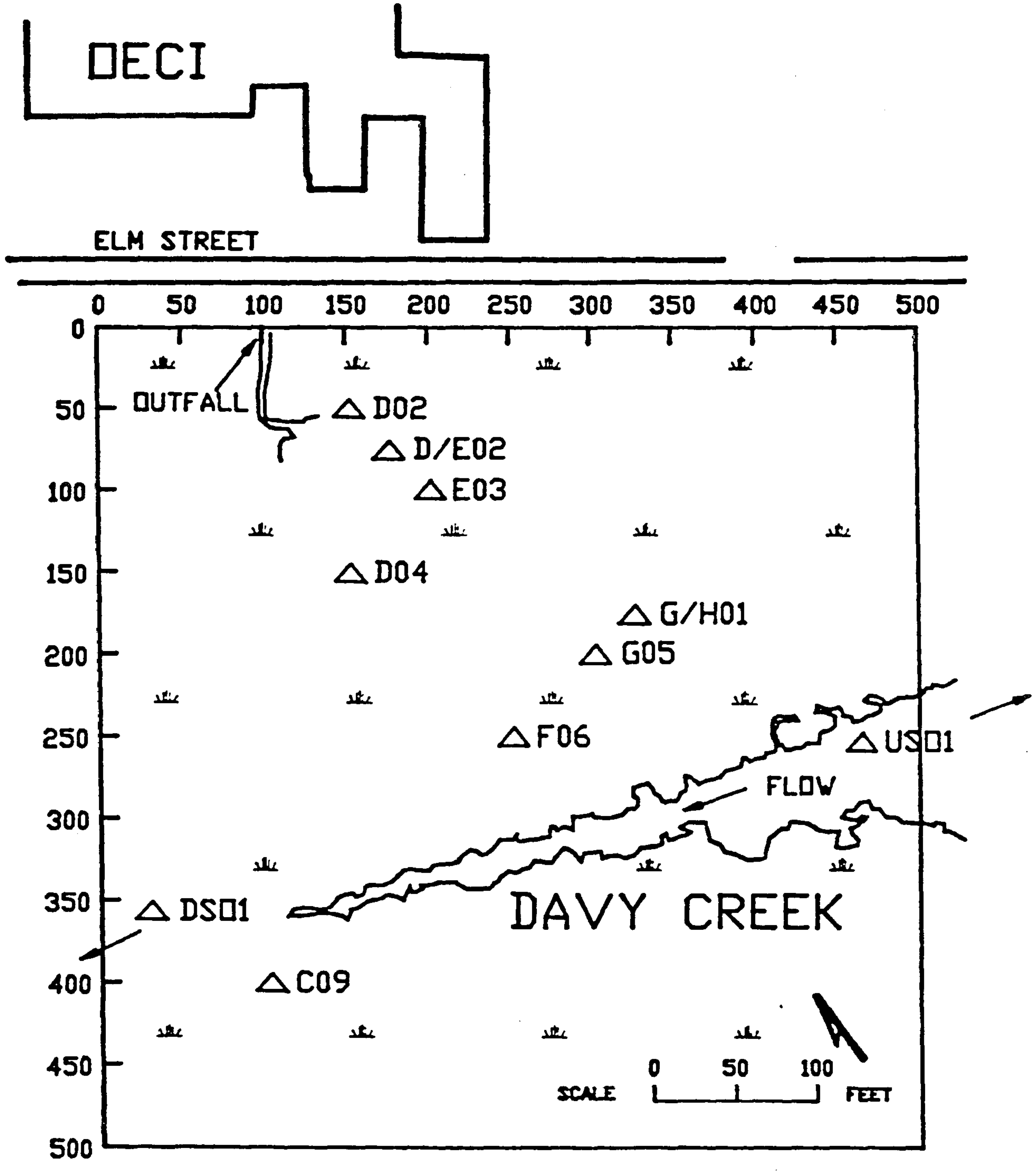
REFERENCES CITED

Horning, W.B. and C.I. Weber, eds., 1985. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. USEPA Office of Research and Development, Cincinnati, Ohio. EPA/600/4-85/014.

Moore, S.W. and S. Ramamoorthy, 1984. Heavy Metals in Natural Waters. Springer-Verlag, New York. 268 pp.

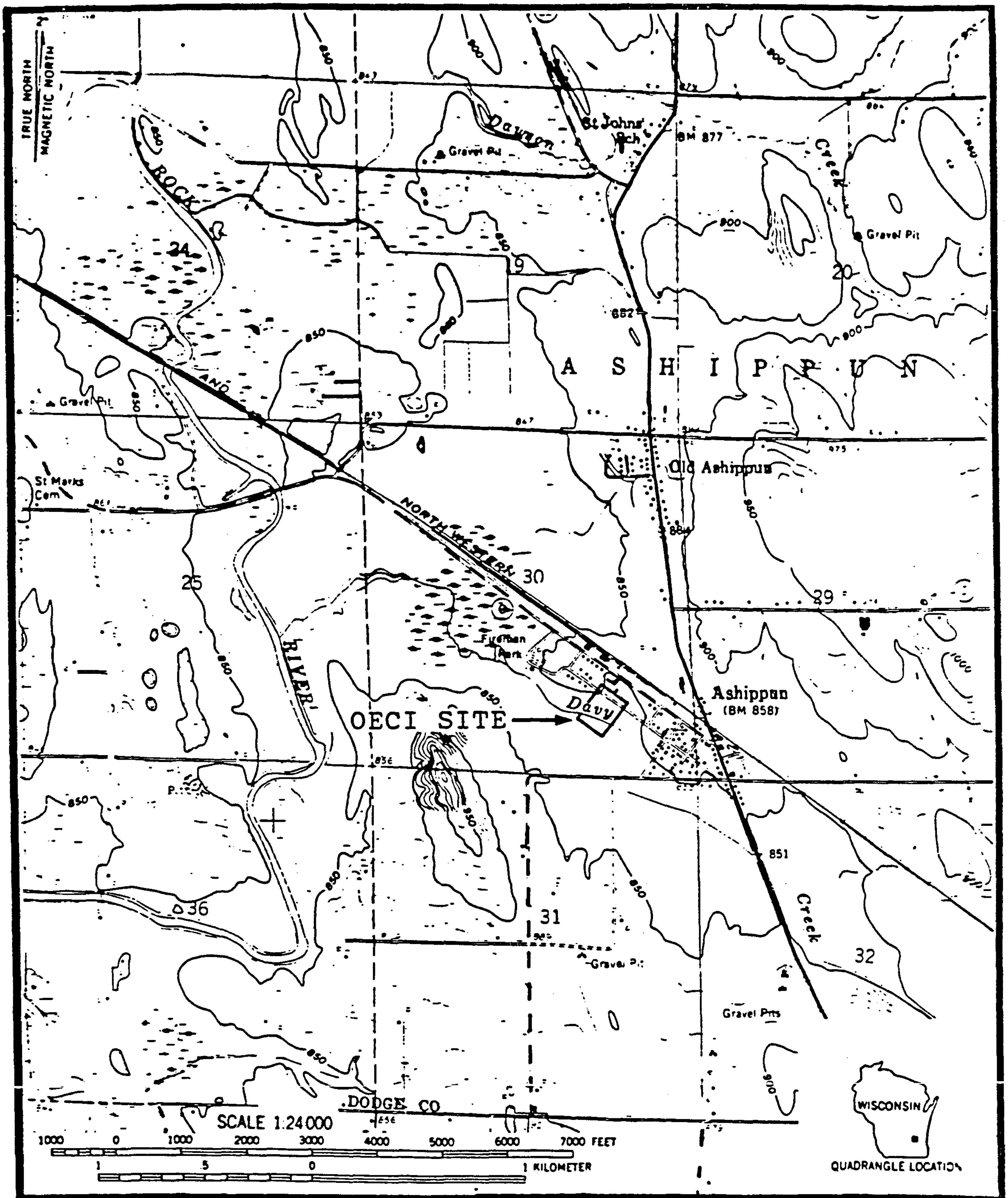
Peltier, W.H. and C.I. Weber, eds., 1985. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. USEPA Office of Research and Development, Cincinnati, Ohio. EPA/600/4-85/013.

U.S. Environmental Protection Agency, 1986. Quality Criteria for Water, 1986. Office of Water Regulations and Standards, Washington, DC. EPA/440/5-86-001.



DECI SAMPLE LOCATION GRID

RESPONSE ENGINEERING AND ANALYTICAL CONTRACT	EPA WAM CHARTERS	FIGURE 2 SAMPLING LOCATIONS
In Association with International Technology Corporation	REAC TL BUCHANAN	DECI SITE ASHIPPUN, WISCONSIN



WESTON RESPONSE ENGINEERING AND ANALYTICAL CONTRACT	EPA WAM CHARTERS	FIGURE 1 LOCATION MAP
In Association with International Technology Corporation	REAC TL BUCHANAN	OECI SITE ASHIPPUN, WISCONSIN

TABLE 1. SAMPLE LOCATION WITH CORRESPONDING SAMPLE NUMBER FOR SEDIMENT SAMPLES AT THE OECI SITE, ASHIPPUN, WISCONSIN

SAMPLE LOCATION	SAMPLE ID NO.
D 02	7576
D 04	7577
E 03	7578
D/E 02	7579
G 05	7580
F 06	7581
G/H 01	7582
C 09	7583
US 01	7584
DS 01	7585

TABLE 2. PLANT TAXA ENCOUNTERED AT THE OECI SITE

ASHIPPUN, WISCONSIN

Acer rubrum	Red maple
Carex stricta	Tussock sedge
Carex spp.	Sedge
Chlorophyta cf. Ulotrichales	Filamentous green algae
Cornus stoloniferia	Red-osier dogwood
Fraxinus cf. *pennsylvanica*	Green ash
Lemna minor	Duckweed
Lemna cf. *trisculca*	Duckweed
Panicum spp.	Panic grass
Phalaris arundinacea	Reed canary grass
Quercus cf. *macrocarpa*	Bur oak
Salix sp.	Shrub willow
Scirpus sp.	Bulrush
Typha latifolia	Cattail
Ulmus sp.	Elm

TABLE 3. BIOTA OBSERVED AT THE OECI SITE

ASHIPPUN, WISCONSIN

Invertebrates	
Goniobasis sp.	Snail
Helisoma sp.	Ram's horn snail
Physa sp.	Pond snail
Fish	
Umbra sp.	Mudminnnow
Birds	
Parus atricapillus	Black-capped chickadee
Dendrocopos pubescens	Downy woodpecker
Corvus brachyrhynchos	Common crow
Mammals	
Cricetidae	Vole
Ondatra zibethica	Muskrat

TABLE 4. METAL AND CYANIDE CONCENTRATIONS (mg/Kg) FOR THE OECI SITE SEDIMENTS, ASHIPPUN, WISCONSIN

	Site (Sample Number)									
Parameter	D2(7576)	E3(7578)	F6(7581)	D/E2(7579)	C9(7581)	G/H01(7582)	D4(7577)	G5(7580)	DS01(7585)	US01(7584)
	CONCENTRATION (mg/Kg)									
Arsenic	41	26	24	24	54	5.6 u	13	25	21	10
Cadmium	1,400	2,700	4,700	1,500	1,200	1,000	1,400	990	350	12
Chromium	15,000	12,000	10,000	5,100	9,700	3,400	2,400	5,400	880	27
Copper	5,500	5,300	4,900	3,500	4,900	2,400	2,100	1,700	620	30
Lead	910	580	270	250	610	67 u	140	56 u	120 u	26 u
Mercury	0.5	0.65 J	0.95 J	0.6	2.4	0.87 J	0.31	0.14 J	0.19 J	0.11
Nickel	9,300	14,000	18,000	6,800	7,100	5,100	2,600	3,700	790	18
Selenium	15	18	4.3J	30	16	5.6 J	5.3 u	6.3	19	1.9 J
Silver	54	35	25 u	71	70	33u	26u	28 u	59 u	13 u
Zinc	59,000	39,000	15,000	13,000	9,800	4,600	4,300	2,700	2,220	72
Cyanide	590	820	2,800	1,200	65	24	680	100	10	0.26u

J - Compound was detected at levels below the practical quantification limit. Value is approximate.

u - Compound was not detected. The preceding number is the practical quantification limit for the compound.

TABLE 5. EP TOXICITY RESULTS (ug/L) FOR THE OECI SITE SEDIMENTS, ASHIPPUN, WISCONSIN

Parameter	EP Toxicity Limits	Site (Sample Number)										Detection Limits
		D2(7576)	E3(7578)	F6(7581)	D/E2(7579)	C9(7581)	G/H01(7582)	D4(7577)	G5(7580)	DS01(7585)	US01(7584)	
						CONCENTRATION (ug/L)						
Arsenic	5,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	230J	500
Barium	100,000	1,800J	1,700J	1,200J	1,200J	530J	550J	1,300J	1,000J	790J	460J	2,000
Cadmium	1,000	8,000*	16,000*	9,200*	7,500*	1,100*	1,500*	10,000*	800	1,000	33J	100
Chromium	5,000	300J	85J	46J	37J	59J	19J	30J	57J	ND	20J	500
Lead	5,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	500
Mercury	200	1.1J	1.3J	1.3J	1.4J	0.9J	1.5J	1.0J	1.2J	1.7J	1.2J	20
Selenium	1,000	ND	ND	ND	ND	ND	ND	ND	360	ND	ND	300
Silver	5,000	100J	ND	ND	ND	70J	ND	ND	ND	ND	ND	500

* - Exceeds EP Toxicity limits.

J - Compound was detected at levels below the practical quantification limit. Value is approximate.

ND - Compound was not detected.

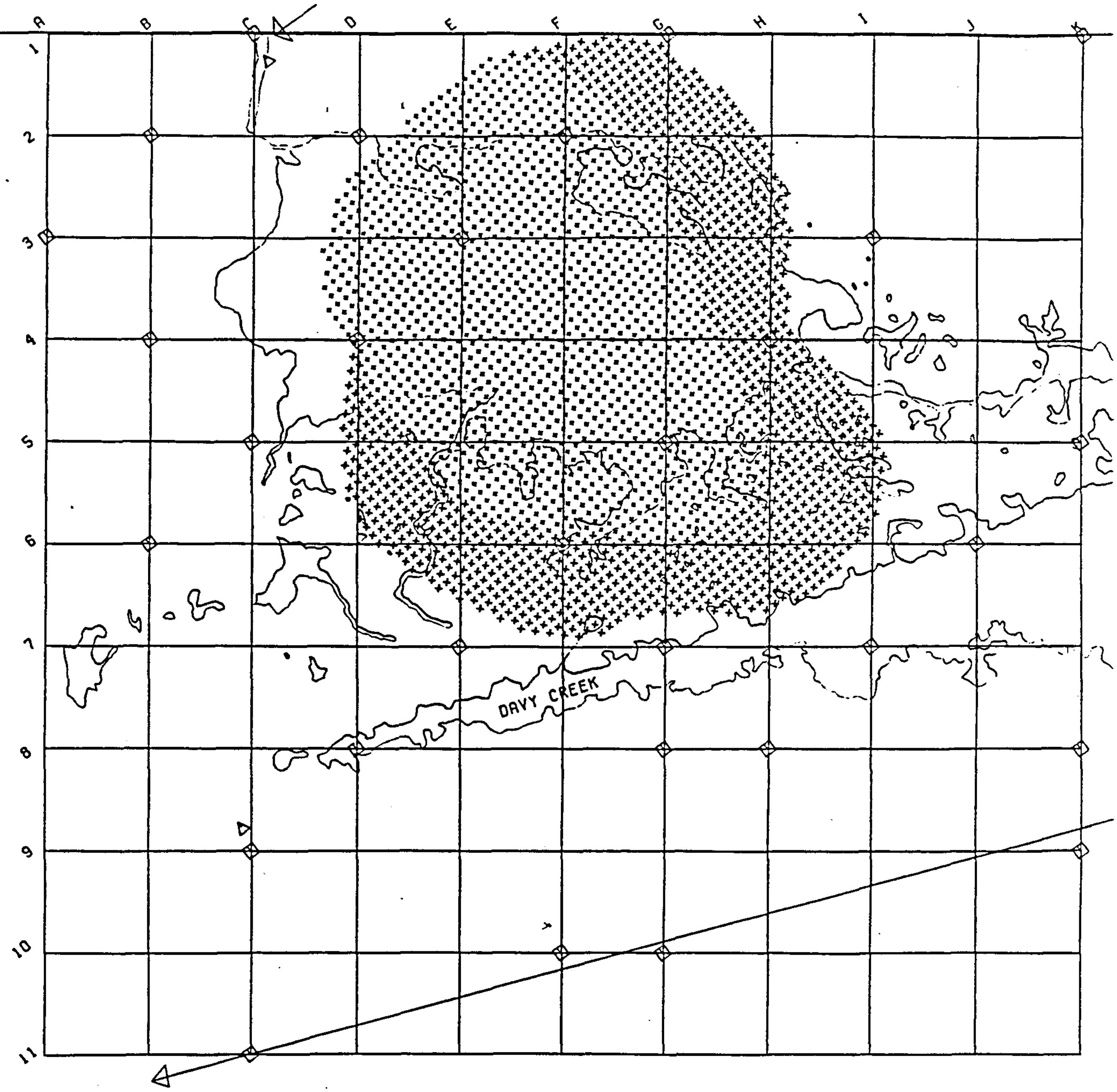
TABLE 6. APPROXIMATE GRAIN SIZE, TOTAL ORGANIC CARBON, AND TOTAL SOLIDS FOR THE OECI SITE SEDIMENT, ASHIPPUN, WISCONSIN

	Parameter					
	Grain Size					
Site (Sample #)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Total Organic Carbon (%)	Total Solids (%)
D2 (7576)	2	59	38	1	6.5	26
E3 (7578)	0	33	66	1	7.0	20
F6 (7581)	0	32	59	9	6.0	20
D/E2 (7579)	0	23	77	0	8.1	16
C9 (7583)	0	60	34	6	15.0	8.9
G/H01 (7582)	0	21	70	9	8.7	15
D4 (7577)	0	19	81	0	5.3	19
G5 (7580)	0	32	62	6	8.9	18
DS01 (7585)	5	47	42	6	13.0	8.5
US01 (7584)	0	13	67	20	5.0	38

TABLE 7. LC_{50} AND LC_{30} VALUES FOR THE FATHEAD MINNOW (*PIMEPHALES PROMELAS*) TOXICITY TESTS, AND THE EC_{50} VALUES FOR THE GREEN ALGAE TOXICITY TESTS.
OECI SITE, ASHIPPUN, WISCONSIN

Fathead Minnows 96 hr LC_{50}		Fathead Minnows 96 hr LC_{30}*		Algae (*Selenastrum capricornutum*) 96 hr EC_{50}	
Site	% Elutriate	Site	% Elutriate	Site	% Elutriate
E3	<6.25	E3	<6.25	D4	5.3
D/E2	5.4	D/E2	<6.25	D2	5.4
F6	17.8	F6	11.0	E3	7.5
D4	47.5	D4	25.0	D/E02	9.4
D2	54.5	D2	25.0	F6	9.4
G5	100	G5	76.0	GH/01	10.4
G/H 01	>100	G/H01	90	G5	27.2
C9	>100	C9	>100	C9	37.0
DS01	>100	DS01	>100	DS01	>100
US01	>100	US01	>100	US01	>100

* - Graphical Interpolation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DAVY CREEK

OCONOMOWOC ELECTROPLATING COMPANY

EXTENT-OF-CONTAMINATION STUDY

DAVY CREEK WETLANDS

ASHIPPUN, WISCONSIN

Prepared for:

U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604

Contract No. 68-01-7367

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TDD# 5-8702-35

Prepared By:

WESTON-SPER
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Region V

December, 1987

Supplemental Report on the Statistical Analysis of Toxicity Tests and Removal Volume Estimates

Oconomowoc Electroplating Co. Inc.
Ashippun, Wisconsin

Prepared by
David W. Charters, Ph.D.
Environmental Response Team
Edison, New Jersey

Report on the Utilization of Toxicity Testing in Conjunction with Soil and Water Chemistry to Address Appropriate Volumes to be Removed at the Oconomowoc Electroplating Co. Inc. Site (OECI), Ashippun, Wisconsin

As previously reported, the wetland to the south of the OECI site is a significant environmental hazard. The levels of toxicity demonstrated in some of the sediment samples exceed what is accepted as highly toxic (Porcella, 1983). The statistical analysis is complete and the maps based on the interpretations have been delivered to you by your TAT contractor. This report will specifically address the statistical procedures and the process for determining specific areas to be remediated.

Statistical Methods

Determination of Toxic Areas

The initial report delivered to ERT on the determination of toxic areas was incomplete and many of the assumptions of the statistician were not appropriately biologically based. The resulting report, while showing that the method of determining areas to be remediated was valid, was for the most part rendered useless by invalid assumptions. One of the problems was that physical parameters were given equal weight with chemical measurements.

The statistical analysis was reassessed and a second report was issued. Using Pearson's product-moment correlation Selanastrum data was correlated to the eleven primary constituents of concern. The constituents were arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, cyanide, total organic carbon and grain size. The highest correlations of the results of the toxicity data and the metals were copper, nickel, cyanide, chromium, and zinc (Table 1). One assumption of parametric analysis is that the data assumes a bivariate normal distribution. The data did not fit this assumption. Therefore, the data was transformed using the arc sine of the square root of Y/100, the most common transformation used to normalize percent data (Table 2). The constituent concentrations were also not normally distributed and were transformed using a (log(Y+1)) transformation (Table 3).

The most applicable analysis for this data is a nonparametric method. Nonparametric methods do not assume any particular distribution, but are based on ranked variables. The results using Spearman's coefficient of rank correlation are given in Table 4.

In order to use the data collected by TAT when they conducted a more extensive sampling plan, multiple regression analyses were run to characterize the biological response. The regression equations were generated based only on the data ERT data and were completely independent of the TAT data (Table 7). The multiple regression equations were then used to predict the biological response based on the TAT data. Using the chemical data from each sample site for the six major constituents of concern (determined by correlation coefficients), a number was generated which can then be kriged and plotted as contour maps. It should be noted that the number is relational and not a real biological response measure.

Thirty stations were sampled by TAT at the OECI site. Unfortunately, all six contaminants of concern were not measured at each location. If data for all six contaminants were not available, the locations were not contoured. Station E3 showed high levels of contaminants, but some parameters were not measured and therefore, the point was not included in the contours (E3 was included in the area to be remediated).

Because of deficiencies in the statistical manipulations it would not be appropriate to base a clean-up solely on the biological results. However, the data from the toxicity tests performed on samples collected at the site is valuable data and specifically addresses ecological hazards. The visual correlation of contours of chemical contaminants and the contours of environmental concern can delineate areas that describe the environmental from both the scientific literature and actual toxicity tests. Areas which did not show a union chemistry concerns and environmental concern isopleths were analyzed on the toxicity tests specific for that individual area. If specific data was not available in an area of concern, the area was included in the remediated area, and clean up lines were derived.

The procedures for the inclusion or exclusion or specific areas in the area to be remediated were as follows:

1. Toxicological maps were overlaid with maps of specific metal or cyanide data.

2. Points which there was both specific chemical and toxicological data were used as the base points and other areas were derived from these points.

3. Areas where there were disagreements on whether the area should be included in the area to be remediated were excluded only if there was specific chemical information or toxicological information which brought the results of the statistical manipulations into question.

The assessment was also based on the organic content of the soil. Organics bind significant volumes of metals making them unavailable to the environment.

Once clean up lines were derived, volume estimates were obtained by Region V TAT. The area that is enclosed by the clean up lines contains 35,600 cubic feet (1281.5 cubic yards). A second area which is includes a more liberal volume to be removed is also estimated. This more liberal area was derived by moving further out from the centers of contamination. The second area encompasses an additional 25,025 cubic feet (927 cubic yards). We are at the present time not recommending that this area be remediated. The area is not considered to be an environmental hazard despite the presence of heavy metal and cyanides. This area was assessed using the method expressed above. While the areas have been well delineated for the purpose of volume estimates do not let the precision of the numbers infer a greater level actual precision. I would suggest a minimum of 500 to 1000 cubic yards be added to the cost estimate to incorporate any unforseen undulations in topography of the wetland.

Conclusions

The method described above, has demonstrated that volumes of materials can be significantly reduced while still addressing the "How Clean is Clean" question relative to the environment. The specific question of human health was not addressed in this report the results of the clean up have been analyzed by human health risk experts in Region V. The determination of specific toxicological goals and determination of clean up goals has been based not on specific chemical goals, which have been extrapolated from biological data, but rather from actual biological goals derived from the actual site data. The use of these goals has resulted in significant reduction of removal volumes.

TABLE 1

Pearson's Product-Moment Correlation Results for Selenastrum capricornutum

	NOEC	LOEC	CHV	96-HR EC50
cadmium	-.59448	-.61698	-.60918	-.58612
zinc	-.43090	-.46420	-.44718	-.46975
chromium	-.62217	-.59103	-.61339	-.60530
copper	-.71318	-.66248	-.69687	-.71539
nickel	-.62019	-.61788	-.62479	-.61730
cyanide	-.46217	-.51931	-.48996	-.47053

NOTE: parametric analyses with no transformations

TABLE 2

Pearson's Product-Moment Correlation Results for *Selenastrum capricornutum*

	NOEC	LOEC	CHV	96-HR EC50
cadmium	-.62605	-.62310	-.62887	-.58026
zinc	-.44617	-.46394	-.45526	-.47325
chromium	-.63253	-.60518	-.62371	-.61302
copper	-.72330	-.68342	-.70953	-.72233
nickel	-.64506	-.62534	-.64086	-.61371
cyanide	-.49437	-.51722	-.50720	-.46147

NOTE: parametric analyses with an arc sine transformation of bioassay results

TABLE 3

Pearson's Product-Moment Correlation Results for Selenastrum capricornutum

	NOEC	LOEC	CHV	96-HR EC50
cadmium	-.84648	-.82747	-.84087	-.82736
zinc	-.76575	-.75022	-.76139	-.77630
chromium	-.82983	-.79612	-.81764	-.81087
copper	-.83880	-.80495	-.82654	-.83655
nickel	-.84652	-.81523	-.83561	-.83512
cyanide	-.86699	-.88478	-.87700	-.84261

NOTE: parametric analyses with an arc sine transformation of bioassay results and a log (Y+1) transformation of the chemical contaminant concentrations

TABLE 4

Spearman's Rank Correlation Results for Selenastrum capricornutum

	NOEC	LOEC	CHV	96-HR EC50
cadmium	-.90520	-.83181	-.83181	-.75230
zinc	-.73782	-.62806	-.62806	-.68904
chromium	-.66465	-.53050	-.53050	-.53050
copper	-.66361	-.55964	-.55964	-.62691
nickel	-.72560	-.56708	-.56708	-.51221
cyanide	-.90246	-.85367	-.85367	-.73782

NOTE: nonparametric analyses with no transformations

TABLE 5

Canonical Correlation Variates of Bioassay Results and Contaminant Concentrations

	transformed S.capricornutum NOEC	transformed S.capricornutum LOEC	transformed S.capricornutum CHV	transformed P.promelas 96-HR LC50
arsenic	-.2322	-.1681	-.2061	-.0572
cadmium	-.6136	-.6295	-.6289	-.6958
chromium	-.6146	-.6152	-.6237	-.4805
copper	-.7070	-.6923	-.7095	-.6040
lead	-.3759	-.3763	-.3834	-.3619
mercury	-.2499	-.1330	-.2006	-.0639
nickel	-.6236	-.6375	-.6409	-.6853
selenium	-.0635	-.0785	-.0744	-.4056
silver	-.0427	-.0157	-.0146	-.0856
zinc	-.0422	-.4778	-.4553	-.5187
cyanide	-.4962	-.5146	-.5072	-.7516

NOTE: all bioassay results are transformed with an arc sine transformation

TABLE 6

Multiple Regression Correlation Matrix Results

	transformed S.capricornutum NOEC	transformed S.capricornutum LOEC	transformed S.capricornutum CHV	transformed S.capricornutum 96-HR EC50	transformed P.promelas 96-HR LC30
copper	-.7070	-.6923	-.7095	-.7223	-.6015
nickel	-.6236	-.6375	-.6409	-.6137	-.6716
chromium	-.6146	-.6152	-.6237	-.6130	-.5224
cadmium	-.6136	-.6295	-.6289	-.5803	-.6932
cyanide	-.4962	-.5146	-.5072	-.4615	-.7216
zinc	-.4221	-.4778	-.4553	-.4732	-.5530

NOTE: all bioassay results are transformed with an arc sine transformation

Extent of Contamination Study

EXECUTIVE SUMMARY

The United States Environmental Protection Agency (U.S. EPA) tasked the Region V Technical Assistance Team (TAT) to determine the extent of heavy metal and cyanide contamination in the Davy Creek wetland adjacent to Oconomowoc Electroplating Company, Inc. (OEC) in Ashippun, Wisconsin. The heavy metal/cyanide contamination is believed to have resulted from discharge of plating wastes directly into the wetland by OEC during the past twenty years.

Sediment and surface water samples were collected within a gridded area adjacent to OEC. Additional samples were collected at various intervals along Davy Creek, beginning at a point approximately 3,700 feet up-stream of the gridded area, and continuing to the Rock River, which is approximately 5,500 feet down-stream of the grid. One hundred and eighty-four sediment samples were collected from sixty locations at various depths ranging from one to five feet. Thirty of these locations were within the gridded 250,000 square foot area adjacent to the OEC plant. The grid area was suspected to be highly contaminated based upon preliminary investigations. Samples were analyzed for total Hazardous Substances List (HSL) metals and total and reactive cyanide. Selected samples were also analyzed for EP-Toxicity metals, total organic carbon and full-scan HSL organic parameters. Surface water samples were collected at seven locations within the wetland, including one from the OEC plant discharge area. These water samples were analyzed for HSL metals, cyanide (total) and full scan HSL organics.

The analytical results for the sediment samples indicated that an approximately 75,000 square-foot area, confined to the central and upper-central parts of the grid, is contaminated with metals and cyanide associated with the electroplating process at OEC. This contamination appears to extend more than three feet beneath the sediment surface. Concentration isopleth maps for cyanide, cadmium, chromium, nickel, and zinc were constructed to display both the lateral and vertical distribution of these elements within the grid.

The higher metal and cyanide concentrations found in the central and upper-central parts of the grid may have been caused by either accumulation of plating wastes in originally low-lying areas near OEC's discharge, or by dumping of plating wastes in these sections of the grid. In either case, limited mobilization of sediment by natural surface processes may have distributed contaminants to the peripheral sections of the grid. EP-Toxicity

results for metals in sediments and the absence of significant concentrations of contaminants in surface waters suggest that the metals and cyanides are strongly bound to the sediments, resulting in limited migration.

Sediments in the Davy Creek up-stream and down-stream parts of the wetland appear to be devoid of any contamination except near the municipal sewage treatment plant discharge, where metal concentrations were relatively higher than those of the adjacent locations.

Because of the large volume of contaminated sediment present at the site, a carefully determined action level that incorporates all the short-term and long-term environmental impacts must be developed before a cost-effective clean-up action can be initiated at the OEC site. A current bioassay investigation conducted by the U.S. EPA Emergency Response Team (ERT) is expected to provide information that will help determine criterion for clean-up levels at the OEC site.

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1.0 INTRODUCTION

The Oconomowoc Electroplating Company (OEC), located at 2573 West Oak Street in Ashippun, Wisconsin (Figure 1) is allegedly responsible for the presence of heavy metals and cyanides in the adjacent wetland sediments. During a period of more than twenty years, OEC reportedly discharged plating wastes via a ditch into the adjacent wetland. The facility, which has been in operation since 1957, has been an active plater of cadmium, chromium, copper, nickel, tin, and zinc. Tin plating was suspended at the facility in 1981 and chromium, copper and nickel in 1982. Plating of cadmium was stopped in October 1984. Cyanide has not been used in any of the processes at OEC since 1984. Currently, the only processes at OEC are electroplating using zinc and black oxide processes in anodizing.

The Wisconsin Department of Natural Resources (WDNR) and other state and local agencies have records of investigations of the OEC facility dating back to the 1950s. Repeated violations of discharge permit requirements by OEC prompted the WDNR to take litigative actions against OEC in 1983. Currently, the Wisconsin Attorney General's office is in litigation with OEC for its alleged Resource Conservation Recovery Act (RCRA) violations.

Continued siltation and growth of dense vegetation over many years have restricted the flow of Davy Creek. Diminished flow resulted in flooded basements and damage to farmland in the surrounding area. In order to alleviate this problem, the Dodge County Drainage Board (DCDB) proposed, in 1983, to dredge and rechannelize a 5,000-foot stretch of Davy Creek which is a tributary of the Rock River (Figure 2). The U.S. Environmental Protection Agency (U.S. EPA) and the Army Corps of Engineers opposed this proposal based on the belief that contaminants present in the wetland could be "flushed" into the Rock River.

The initial assessment of the OEC site was conducted by the Field Investigation Team (FIT) for the U.S. EPA in 1983. Based on the FIT assessment, the OEC site received a Hazard Ranking Score (HRS) of 31.86 and was placed on the National Priorities List (NPL). Subsequently, on a request made by the U.S. EPA Region V Remedial Response Branch, the U.S. EPA Emergency Response Branch tasked the Technical Assistance Team (TAT) to conduct a preliminary sampling survey in the wetland with the intention of evaluating the immediate threats posed by the site to human health and the environment.

The TAT collected a limited number of sediment samples from the wetland on June 12 and 13, 1986. Analytical results for these samples indicated the presence of elevated levels of heavy metals and cyanide in the wetland immediately south of OEC, an area which is also near residential homes and a recreational park. Results of this preliminary sampling were submitted to the U.S. EPA in August, 1986 (TDD# 5-8605-21).

FIGURE 1

LOCATION MAP

OCONOMOWOC ELECTROPLATING COMPANY, INC.

ASHIPPUN, WI

SCALE: 1"=15 MI

WESTON
MANAGERS DESIGNERS/CONSULTANTS

DRAWN BY RADACK	DATE 10/20/87	PCS # 1221
APPROVED SAM	DATE 12/23/87	TDD # 5-8702-35A

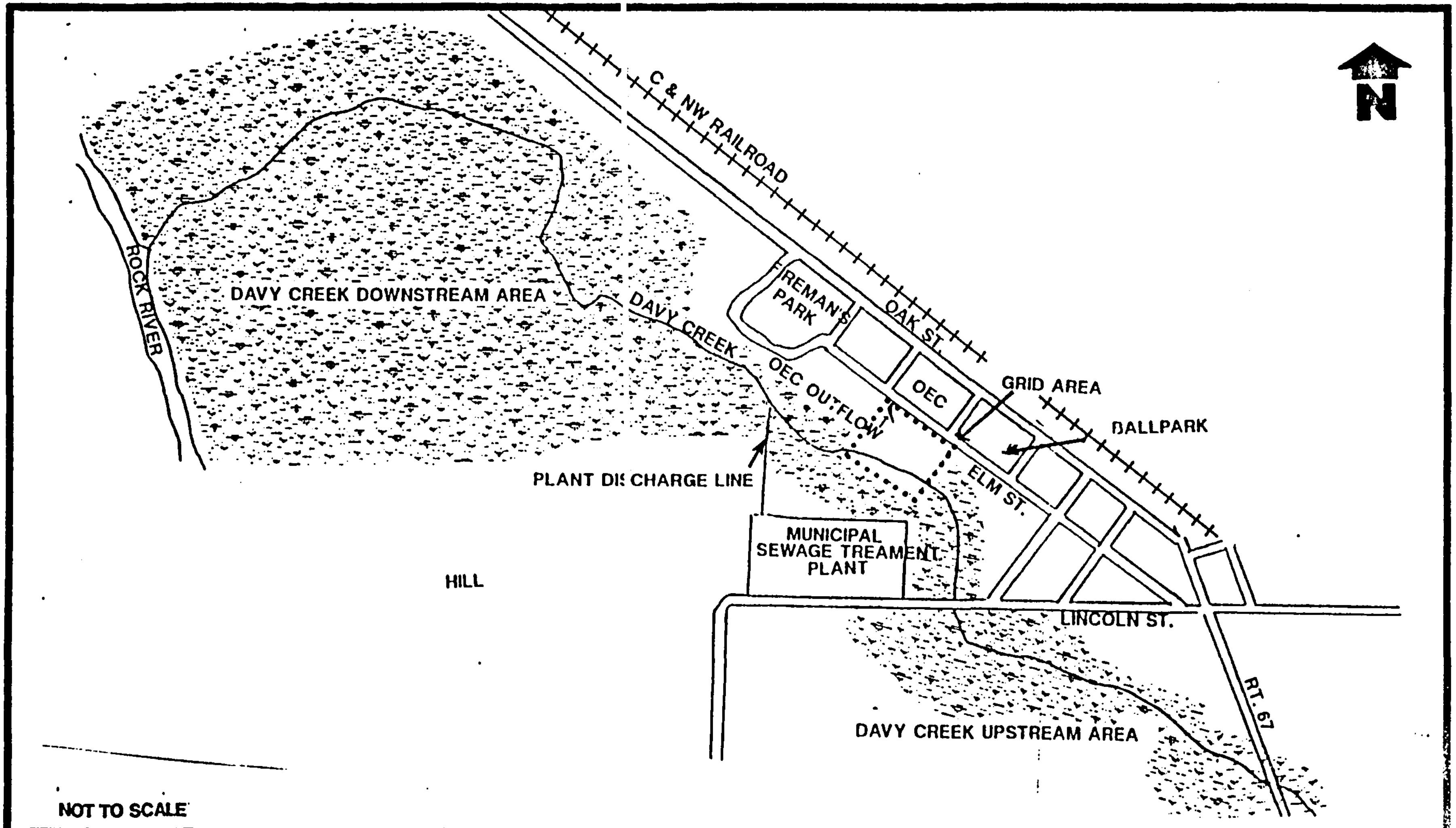


FIGURE 2
SITE MAP

OCONOMOWOC ELECTROPLATING COMPANY (OEC)/
DAVY CREEK WETLAND

ASHIPPUN, WI

WESTON
ENVIRONMENTAL CONSULTANTS-DESIGNERS

DRAWN BY RADACK	DATE 10/21/87	PCS # 1221
APPROVED JAM	DATE 12/23/87	TDD # 5-8702-35A

Based on the results of the preliminary sampling, the U.S. EPA tasked the TAT to develop a detailed sampling plan to determine the extent-of-contamination of the wetland adjacent to OEC (TDD# 5-8702-35). This sampling plan was submitted to the U.S. EPA in February 1987. In March and April of 1987, the TAT conducted an extensive sampling program which covered approximately 300 acres of wetland along Davy Creek; this program and the results it produced are detailed in the following sections.

2.0 SAMPLING PROGRAM

The primary objective of the sampling effort was to determine the extent of metal, cyanide and organic contamination in the wetland associated with Davy Creek. Soil samples from a nearby ballpark and sludge samples from the OEC lagoons were also collected (Figures 2 and 3).

The sampling was conducted by the TAT between March 11 and April 1, 1987, with a total of 184 sediment samples collected from 60 locations in the wetland. These samples were collected at various depths ranging from 0 to 5 feet. In addition, seven surface water samples were collected from different locations within the wetland. The sediment and surface water sample locations are shown in Figures 3 and 4.

For ease of description, and also based on preliminary sampling experience, the wetland under investigation was subdivided into three areas: the grid; the Davy Creek up-stream area; and, the Davy Creek down-stream area (Figure 2).

The 25,000 square foot grid located south of OEC was established by placing stakes at 50-foot intervals determined during a pre-sampling survey (Figure 3). The up-stream area consisted of fourteen sample locations along Davy Creek (east of the grid) for a distance of approximately 3/4 mile (Figure 3). The down-stream area is the stretch of Davy Creek between the grid and the confluence point of Davy Creek with the Rock River (Figure 4). A summary of the number of samples collected from different areas and the number of samples analyzed for various parameters are presented in Table 1.

Sediment surface elevations were determined at 26 locations in the grid and are given in Appendix J. These elevations will also be utilized when estimating the contaminated sediment volume.

2.1 Sediment Samples

Sediment samples were collected using 1, 2 and 2.5-foot long split-spoon samplers with 2-inch core diameters. The samplers were manually driven into the sediment to their maximum length. Upon withdrawal of the samplers, the core barrels were split, the surface of the sample scraped, and the portions of sample from each required depth placed into separate stainless steel bowls. After homogenization, the samples were placed in 8-ounce glass

TABLE 1
Summary of TAT Sampling and Analytical Program
OEC Extent of Contamination
April 1987

SAMPLING AREA	Samples Collected	Number of Samples Analyzed for Each Parameter						
		Total Metals	Hexavalent Chromium	Total Cyanide	Reactive Cyanide	Full Scan Organics	EP-Toxicity Metals	Total Organic Carbon
Grid Area Sediment	94	69 (5)	24 (3)	51 (3)	17	2 (1)	15 (2)	5 (2)
Davy Creek Upstream Sediment	45	13 (2)	7 (1)	7 (1)	-	2	3 (1)	1 (1)
Davy Creek Downstream Sediment	45	21 (2)	13 (2)	13 (2)	2	1	4 (1)	-
Ball Park Soil	3	3 (1)	3 (1)	3 (1)	-	1	-	-
OEC Lagoon Sludge (East and West)	2	2	2	2	2	1	-	-
Grid Area and Davy Creek Surface Water	7	7 (1)	7 (1)	7 (1)	-	2 (1)	-	-

( ) = Number of duplicate samples.

jars. Additional borings were conducted in the same location when sample recovery was poor or analytical procedures required additional material.

Whenever samples from deeper than three feet were required, the original hole was cased using a PVC pipe to prevent the walls of the bore-holes from collapsing. A 2-foot sampler was then driven to deeper levels in the same hole. A PVC-casing was also used at wet sampling locations. Wherever the sediment was unconsolidated (or not cohesive enough to be retained in the samplers), a PVC-pipe was driven into the ground and the open end was sealed with an air-tight cap. This aided in the recovery of unconsolidated sediment by creating a vacuum in the pipe retaining the sample. The split-spoon samplers were decontaminated between uses, and new PVC-pipes were used at each location to prevent sample cross-contamination.

2.1.1 Grid

The sampling density within the grid was greater than the up-stream and down-stream areas of Davy Creek to reflect the higher levels of metals and cyanide contamination expected. These sampling locations were selected based on the areas interpreted as having stressed vegetation in aerial photographs and on the sampling results from preliminary investigations. The sample locations within the grid also encompassed the Davy Creek relocation path originally proposed by DCDB (Figure 3). The sediment sample locations in the grid are shown in Figure 3. The grid columns are designated with letters and the rows with numbers so that each sample location has an alpha-numeric denotation.

Sample locations along column "C" were believed to be along the original discharge ditch from the OEC out-fall. Thus, samples at these locations were collected at depths of up to 5 feet (maximum depth in the grid). In the remaining locations within the grid, samples were collected at depths of up to 3 feet. Water depths within the grid ranged from 0 to 5 feet.

Selected sediment samples were analyzed for total Hazardous Substance List (HSL) metals. Samples were also analyzed for hexavalent chromium, total and reactive cyanide, metal EP-Toxicity (metals), full-scan HSL organics and total organic carbon (Table 1).

2.1.2 Davy Creek Up-stream Area

The number of samples collected from Davy Creek up-stream of the grid and the parameters analyzed for are presented in Table 1. Locations marked along the creek (Figure 4) indicate the center of the creek, measured from Location C9 of the grid area. For example, Location 7+50U is 750 feet from Location C9 measured along Davy Creek in the up-stream direction. At each of these Davy Creek locations, samples were collected at three points along lines transecting the creek. Each transect was 50 feet long, centered at the deepest part of the creek, and was sampled at either end of the transect and at the center of the creek. Sampling was conducted to a maximum depth of 3 feet from the sediment surface at each sample location. A background sample was collected at 37+00u (approximately 3,700 feet up-stream along Davy Creek from C9), a location that was assumed far enough in the up-stream area not to be contaminated by OEC's Plating wastes. The water depths at the locations in the up-stream area ranged from 0 to 6 feet.

2.1.3 Davy Creek Down-stream Area

The majority of sediment samples collected from the down-stream area were along transects similar to the up-stream area. A total of 36 samples were collected along 4 transects from 12 locations. As shown in Figure 4, samples were collected from locations immediately above (5+00D) and below (7+50D) the municipal sewage plant discharge to verify its impact. The Davy Creek is highly braided and therefore does not exhibit a well defined path in the immediate stretch down-stream of the grid. As such, the approximate center points at locations 5+00D, 10+00D and 12+50D had to be estimated. In addition, three samples were collected from locations 37+50D to a depth of 3 feet. These samples were collected from the center of a well-defined part of Davy Creek. Sediment from 2 locations along the Rock River near to the Davy Creek confluence were also collected: one 125 feet up-stream of the confluence, and one 250 feet down-stream of the confluence. Both locations were along the eastern bank of the Rock River, and the samples were from a maximum depth of 3 feet. Water depths in the down-stream area ranged from 0 to 4.5 feet.

2.2 Surface Water Samples

Seven surface water samples were analyzed to determine if contaminants were migrating via surface water (Figures 3 and 4). These samples were collected starting from down-stream, and prior to any sediment sampling activities to minimize the amount of suspended sediments in the water. All water samples, including a duplicate and a blank, were analyzed for HSL metals and cyanide content. Full scan HSL organic analysis was performed on two water samples. All surface water samples analyzed for inorganic parameters were filtered before being placed in jars to eliminate suspended solids. Preservatives were added to these water samples appropriately.

2.3 Sludge Samples

Two composite sludge samples were collected, one from the east lagoon and the other from the west lagoon at the OEC facility. These samples were collected as requested by the U.S. EPA for comparison with the wetland samples, at three locations on each side close to a wall that divides the lagoons, to a maximum depth of 3 feet from the sludge surface. The sludge samples were analyzed for total HSL metals, hexavalent chromium, and total and reactive cyanide. Full-scan HSL organic analysis was also conducted on the sludge samples.

2.4 Soil Samples

Three soil samples (0'-.5' depth) were collected at three locations in a frequently used ballpark adjacent to OEC (Figure 2). One of these samples was analyzed for total cyanide and for full-scan HSL organic parameters. These samples were collected to determine if any contaminants were present in the ballpark soils.

3.0 ANALYTICAL RESULTS

The samples were sent to the laboratories in two separate phases. All samples in Phase I were analyzed for total HSL metals and total cyanides under the U.S. EPA Contract Laboratory Program (CLP). Phase I consisted of analyzing the majority of the samples collected from the 0'-1' level and selected samples collected from the 1'-2' and 2'-3' levels at those locations suspected to contain high levels of metal and cyanide. Based on results from the initial Phase I analyses, additional samples from those areas having elevated levels of contamination were submitted for analysis.

Phase II analyses consisted of conducting total and reactive cyanide analyses on selected samples. These were conducted by non-CLP laboratories. Hexavalent chromium analyses were also conducted by non-CLP laboratories. Total metals analyses under Phase II were conducted by the CLP laboratory.

3.1 Metals and Cyanide

A total of 103 sediment samples from the wetland were analyzed for HSL metals, and 71 for total cyanides (Table 1). A complete list of the metal and cyanide analytical results are provided in Appendices A, B and C for the grid, Davy Creek up-stream area and the Davy Creek down-stream area, respectively. For comparative purposes, typical ranges of metal concentrations in natural soils, and analytical results of the background sample are also included in Appendices A, B and C. The total metal and cyanide analytical results of the surface water samples are listed in Appendix D. Metal and cyanide analytical results of the ballpark soils and OEC sludges are presented in Appendices E and F respectively.

3.2 EP-Toxicity Parameters

Twenty-two samples including 15 from the grid area were analyzed for EP-Toxicity metals. The results of the EP-Toxicity analyses are presented in Appendix G along with Resource Conservation Recovery Act (RCRA) EP-Toxicity limits.

3.3 Organic Parameters

Full scan HSL organic analysis was performed on five sediment samples and two surface water samples from the wetland, ballpark soil sample and the OEC sludge samples (Table 1). The analyses included volatiles, acid/base neutrals, pesticides and PCBs. The results of all organic analyses are presented in Appendix H.

3.4 Total Organic Carbon

Total organic carbon was analyzed in seven sediment samples from the wetland. The results are presented in Appendix I.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC) OF SAMPLE ANALYSES

All samples were collected, preserved, packaged, stored and shipped in accordance with U.S. EPA protocol as outlined in the Region V TAT Sample Handling Protocol. Samples were analyzed by both CLP laboratories and non-CLP laboratories. All laboratories utilized U.S. EPA accepted methodologies and adhered to strict QA/QC protocol. Analytical results received from the CLP laboratories were reviewed by the U.S. EPA Central Regional Laboratory (CRL) following U.S. EPA CLP guidelines. Data from non-CLP laboratories were reviewed by the TAT QA/QC officer.

Some quality assurance samples indicated low matrix spike recovery, poor reproducibility or serial dilution interferences. In accordance with U.S. EPA CLP guidelines, analytical results in such cases were considered as estimated values. For example, when the spike recovery for a parameter was less than 75 percent, all other samples within a given data set were assumed to have matrix interferences. These interferences were approximated by the spiked sample recovery, and corrections of the parameter values were made accordingly. Sample matrix effects can also cause poor reproducibility and serial dilution errors. Values were designated as estimated when replicate analyses differed by greater than 35 percent or when serial dilutions of a sample yielded different analytical results. Estimated values are indicated by "J" adjacent to the values in tables and appendices of this report.

The variation in the detection limits for metals results from variation in the weight of sample extracted. In addition, detection limits were elevated when spike recovery was low. Quality assurance samples consisted of field duplicates (listed in parentheses in Table 1), field blanks and a background sediment sample. A field duplicate is a second sample of one location submitted to the laboratory. This sample verifies the laboratory's analytical precision by acting as an external check and also provides an indication of variation in sample collection procedures.

Field duplicate samples were collected from homogenized sediment and were sent either "blind" or labeled as a duplicate to the laboratories. Analyzed concentrations of field duplicate samples indicated consistent sample collection procedures and analysis. The average difference between duplicate analytical results for metal concentration was 21.7 percent. Natural soils and sediment have a high potential for heterogeneous distribution of metals. Therefore, an average variation of 21.7 percent can be considered reasonable, indicating consistent sample collection procedures and analysis. A field blank for the water samples was transported to the sampling site and back; carried through the entire sampling procedure; and, shipped and stored with the samples. Analytical results for the field blank verify that no contaminant was introduced in shipment, during sampling or during storage of samples.

5.0 EXTENT OF CONTAMINATION

5.1 Introduction

Sediment samples collected from the central and upper-central sections of the grid contained the highest concentrations of metals and cyanide. Results also indicated that the concentrations of metals and cyanide may be at elevated levels at depths greater than three feet.

The Davy Creek up-stream area sediments do not appear to be contaminated with metals or cyanide. In the Davy Creek down-stream area, sediment samples collected immediately down-stream of the sewage treatment plant's discharge area had elevated concentrations of metals and cyanide relative to the remaining Davy Creek sample locations.

None of the sediment samples analyzed for EP-Toxicity metals exceeded the RCRA standard concentrations. However, detectable levels of cadmium, chromium, lead and arsenic were measured in extracts of a few samples. Full-scan HSL organic analytical results of sediments showed no significant contamination. Analytical results also indicate that surface waters in the wetland do not appear to contain any significant concentrations of metals, cyanides or organics.

The following sections describe the extent-of-contamination at the OEC site with particular attention to the contaminated sediments from the grid. Computer generated concentration isopleth maps for cyanide, cadmium, chromium, nickel and zinc aid in displaying the distribution of these contaminants both laterally and vertically within the grid sediments.

5.2 Metals and Cyanide Concentrations in the Grid Sediments

The contaminants of primary concern in the grid sediments are cadmium, chromium, copper, nickel, tin and zinc, hereafter referred to as index metals and cyanide. These index metals and cyanide are associated with past OEC electroplating processes. The grid, which is located adjacent to the OEC's discharge ditch was suspected to be a potential sink for these contaminants. Table 2 summarizes index metal and cyanide concentrations for the grid sediments. These concentrations are compared to typical metal concentrations in natural soils and the background sample analytical results. A complete list of HSL metals, and cyanide analyses results are presented in Appendix A.

In order to graphically display the concentrations of selected contaminants in the grid, Weston Technical Information Management System (TIMS) was utilized to produce contamination isopleth maps for five selected parameters. Initially, a base map (1"=50') containing the grid was digitalized and installed on the VAX computer system at the Weston headquarters in West Chester, Pennsylvania. The analytical data was installed on LOTUS format diskettes by TAT which were then batch loaded onto the VAX. After reviewing the results, the TAT in consultation with the U.S. EPA identified five parameters for the construction of isopleth maps. The parameters selected were cyanide, cadmium, nickel, chromium, and zinc. These five elements were chosen because they were associated with the plating process at the OEC facility, are well-known toxicants, and were suspected to be widely distributed within the grid. The contaminant isopleth for these selected parameters were developed and overlaid on the base maps. These isopleth maps are displayed in Figures 5 (a) through 9 (c). Separate maps were produced for the three depth intervals of 0-1', 1'-2', and 2'-3'. The contour intervals of the isopleth maps vary depending on the ranges of contaminant concentrations. The different contour intervals were chosen in order to achieve the best resolution in illustrating variation in concentrations. When the analytical laboratory determined parameter values as "below detection limits", 1/2 the value of the detection limit was used in constructing the isopleth maps. Because the number of samples analyzed for each depth interval differed, the resolution of the isopleths also varied for different depth intervals. The following sections briefly describe the distribution and concentration ranges of cyanide and each index metal in the grid.

5.2.1 Cyanide

Detectable concentrations of total cyanide were found in 20 of the 30 grid locations and ranged from 0.25 to 2,690 mg/kg. Total cyanide concentrations above 1,000 mg/kg were found in samples from locations E3, F6 and G5, including the maximum concentration of 2,690 mg/kg at location E3 (Figure 5). Levels of cyanide above 200 mg/kg were found in 7 other locations within the grid from samples collected to a depth of up to 3 feet. Although the areas of highest cyanide concentrations correlated with those of metals, cyanide concentration in samples from location C9 were low relative to the metal contamination observed there.

TABLE 2
Index Metals and Cyanide - Grid Sediments
OEC Extent of Contamination
Analytical Results of TAT Sampling
April 1987

(All values reported as mg/kg dry weight)

			Sample Location and Depth										
Parameter	Natural Soil Range*	Background**	A3 0'-1'	A3 1'-2'	A3 2'-3'	B2 0'-1'	B2 1'-2'	B2 2'-3'	B4 0'-1'	B4 1'-2'	B4 2'-3'	B6 0'-1'	B6 1'-2'
Cyanide (Total)	-	<0.20	1.8	NA	<0.78	0.90	<0.20	<0.20	37	0.25	<0.20	1.4	<1.5
Cyanide (Reactive)	-	NA	<0.20	NA	NA	NA	NA	NA	<0.20	NA	NA	NA	NA
Cadmium	0.1-0.7	<2.7	<6.3	<8.3	<3.9	<10	<3.4	<3	83	8.3	4.4	50	17
Chromium	1-1,000	14	135	12	9.9	208	14	10	965	33	45	378	99
Hexavalent Chromium	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	2-100	18	49	44	19	74	29	14	467	44	35	361	106
Lead	2-200	9.6	9	12	7.5	27	7.8	5.4	57	8.4	6.9	33	15
Nickel	5-500	12	40	17	9	94	21	11	538	25	21	296	110
Tin	2-200	64	<25	<33	<16	<42	<19	<16	<33	<26	<19	71	<30
Zinc	10-300	47	469	36	28	856	38	27	2,270	72	87	891	265

	Natural Soil Range*	Background**	B6 2'-3'	C1 0'-1'	C1 1'-2'	C1 2'-3'	C1 3'-5'	C5 0'-1'	C5 1'-2'	C5 2'-3'	C5 3'-5'	C9 0'-1'	C9 1'-2'
Cyanide (Total)	-	<0.20	NA	21	NA	26	11.55	7.4	NA	<0.59	NA	24	NA
Cyanide (Reactive)	-	NA	NA	<0.65	NA	<0.2	<0.2	<0.2	NA	NA	NA	<0.2	NA
Cadmium	0.1-0.7	<2.7	<3.4	143	231	163	109	248	<3.1	<2.9	<2.9	172	86
Chromium	1-1,000	14	16	916	858	396	284	353	30	9.2	4.1	1340	397
Hexavalent Chromium	-	NA	NA	<2	NA	<2	NA	<2	NA	<2	NA	<2	NA
Copper	2-100	18	21	332	397	181	205	264	12	6.8	9.1	719	295
Lead	2-200	9.6	5.9	77	53	34	13	11	3.5	<2.9	<2.9	86	48
Nickel	5-500	12	45	581	895	554	363	814	20	10	9.3	847	368
Tin	2-200	64	<14	149	113	34	16	<16	<13	<12	<12	161	46
Zinc	10-300	47	48	1,550	1,370	524	239	304	29	11	14	1,210	552

*Ref: Hazardous Waste Land Management, USEPA, SW-874 (April 1983), p. 273.
**Background sample collected at location 37+00U (Center; depth 0'-1').
NA = No analysis performed.
J = Sample matrix interference noted, therefore analytical result an estimate.
D = Duplicate Sample.

TABLE 2 (page 2)
Index Metals and Cyanide - Grid Sediments
OEC Extent of Contamination
Analytical Results of TAT Sampling
April 1987

(All values reported as mg/kg dry weight)

Parameter	Natural Soil Range*	Background**	C9 2'-3'	C9 3'-5'	C9 (D) 3'-5'	C11 0'-1'	C11 1'-2'	C11 2'-3'	C11 3'-5'	D2 0'-1'	D2 1'-2'	D2 2'-3'	D4 0'-1'
			Sample Location and Depth										
Cyanide (Total)	-	<0.20	5.4	NA	NA	<0.20	<0.66	NA	<0.68	0.25	0.25	<0.20	183
Cyanide (Reactive)	-	NA	<0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.1-0.7	<2.7	5.4	6.7	4.6	<4.2	<3.3	<2.9	<3.4	27	<2.7	<2.8	648
Chromium	1-1,000	14	40	[illegible]3	40	17	14	17	14	130	15	13	1,550
Hexavalent Chromium	-	NA	<2	NA	NA	NA	<2	NA	<2	NA	NA	NA	<2
Copper	2-100	18	37	[illegible]4	58	26	20	23	18	91	20	16	767
Lead	2-200	9.6	11	10	7.2	12	7.9	10	6.8	22	8.2	4.5	46
Nickel	5-500	12	39	[illegible]9	40	21	16	29	15	140	17	12	2130
Tin	2-200	64	<14	<15	20	<17	<13	<12	<14	<37	17	<15	108
Zinc	10-300	47	82	[illegible]2	70	45	39	39	35	256	35	23	3,430

Parameter	Natural Soil Range*	Background**	D4 (D) 0'-1'	D4 1'-2'	D4 2'-3'	D8 0'-1'	D8 1'-2'	E3 0'-1'	E3 1'-2'	E3 (D) 1'-2'	E3 2'-3'	E7 0'-1'	F2 0'-1'
Cyanide (Total)	-	<0.20	157	58 8	2.95	<1.2	NA	NA	2,690	1,830	67.5	<1.3	1120
Cyanide (Reactive)	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.20
Cadmium	0.1-0.7	<2.7	786	2,3[illegible]0	27	<6.3	<6.8	3,600	2,660	2,990	120	11	317
Chromium	1-1,000	14	1,780	2,7[illegible]0	70	48	24	8,840	6,350	7,160	282	20	537
Hexavalent Chromium	-	NA	<2	NA	NA	<2	NA	NA	NA	<2		<2	<2
Copper	2-100	18	867	2,0[illegible]0	57	38	29	3,550	2,170	2,560	117	36	673
Lead	2-200	9.6	31	1[illegible]0	9.4	7 J	<6.8	153	110	121	16	<6.4	38
Nickel	5-500	12	2,680	6,7[illegible]0	122	34	23	16,500	11,900	13,800	546	40	736
Tin	2-200	64	133	2[illegible]2	20	<25	<27	753	315	426	<14	<26	86
Zinc	10-300	47	3,340	5,5[illegible]0	155	81	64	10,800	8,810	8,780	390	79	859

*Ref: Hazardous Waste Land Management, USEPA, SW-874 (April 1983), p. 273.
**Background sample collected at location 37+00U (Center; depth 0'-1').
NA = No analysis performed.
J = Sample matrix interference noted, therefore analytical result an estimate.
D = Duplicate Sample.

TABLE 2 (page 3)
Index Metals and Cyanide - Grid Sediments
OEC Extent of Contamination
Analytical Results of TAT Sampling
April 1987

(All values reported as mg/kg dry weight)

Parameter	Natural Soil Range*	Background**	F2 1'-2'	F2 2'-3'	F6 0'-1'	F6 1'-2'	F6 (D) 1'-2'	F6 2'-3'	F10 0'-1'	G1 0'-1'	G1 1'-2'	G1 2'-3'
			Sample Location and Depth									
Cyanide (Total)	-	<0.20	23.75	NA	1070	NA	NA	67.5	NA	7.8	3.7	3.75
Cyanide (Reactive)	-	NA	0.55	NA	60	NA	NA	1.7	NA	NA	NA	NA
Cadmium	0.1-0.7	<2.7	264	67	826	162 J	169	42	<4.3	73	41	58
Chromium	1-1,000	14	1,200	275	1,740	362	309	70	13	206	95	121
Hexavalent Chromium	-	NA	NA	NA	<2	NA	NA	NA	NA	NA	NA	NA
Copper	2-100	18	731	134	665	165	176	35	33	121	57	79
Lead	2-200	9.6	41	14	23	12	6.2	4.8	17	12	7.4	8.3
Nickel	5-500	12	864	244	3,230	655 J	930	148	12	206	109	139
Tin	2-200	64	120	34	55	26	<16	<17	<17	<13	17	25
Zinc	10-300	47	714	165	1,190	351 J	349	95	57	134	65	85

	Natural Soil Range*	Background**	G5 0'-1'	G5 1'-2'	G5 2'-3'	G7 0'-1'	G7 (D) 0'-1'	G8 0'-1'	G10 0'-1'	H4 0'-1'	H4 1'-2'	H4 2'-3'	H8 0'-1'
Cyanide (Total)	-	<0.20	1,070 J	92.5	30	<0.82	<0.91	NA	NA	1.1	NA	0.2	13
Cyanide (Reactive)	-	NA	20	2.05	2.15	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.1-0.7	<2.7	1,290 J	533	87	27	48	<3.4	<3.5	125	291	7.6	59
Chromium	1-1,000	14	2,160	1,470	203	99	107	13	11	365	1,650	26	143
Hexavalent Chromium	-	NA	<2	NA	NA	<2	NA	NA	NA	<2	NA	NA	<2
Copper	2-100	18	1,220	706	107	38	44	13	15	468	2,130	30	127
Lead	2-200	9.6	98	100	6.2	9	9.1	5.8	9.9	12	17	3.8	4.2
Nickel	5-500	12	4,260	1,660	261	127	183	14	9	342	1,050	21	227
Tin	2-200	64	240	178	39	<16	28	<14	<14	<22	<28	15	<14
Zinc	10-300	47	4,700 J	2,120	329	81	101	28	36	280	995	33	75

*Ref: Hazardous Waste Land Management, USEPA, SW-874 (April 1983), p. 273.
**Background sample collected at location 37+00U (Center; depth 0'-1').
NA = No analysis performed.
J = Sample matrix interference noted, therefore analytical result an estimate.
D = Duplicate Sample.

TABLE 2 (page 4)
Index Total Metals and Cyanide - Grid Sediments
OEC Extent of Contamination
Analytical Results of TAT Sampling
April 1987

(All values reported as mg/kg dry weight)

			Sample Location and Depth								
Parameter	Natural Soil Range*	Background**	I3 0'-1'	I7 0'-1'	J6 0'-1'	J6 1'-2'	J6 2'-3'	K1 0'-1'	K5 0'-1'	K8 0'-1'	K9 0'-1'
Cyanide (Total)	-	<0.20	<0.20	<0.77 J	<1.1 J	NA	<0.7	<0.20	NA	<0.74	<1.0
Cyanide (Reactive)	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.1-0.7	<2.7	<6.9	<3.8 J	<5.7 J	32 J	<3.5	9	14 J	<3.7	<5
Chromium	1-1,000	14	33	14	22	162	7	19	101	8.4	14
Hexavalent Chromium	-	NA	NA	<2	<2	NA	<2	NA	NA	<2	<2
Copper	2-100	18	51	16	27	79	12	16	34	13	18
Lead	2-200	9.6	13	6.8	11	13	<3.5	6.1	8.5	6.8	14
Nickel	5-500	12	56	13 J	39 J	212 J	11	29	56 J	8.6	14
Tin	2-200	64	<28	<15	<23	<21	<14	<13	<19	<15	<20
Zinc	10-300	47	89	36 J	60 J	85 J	29	27	71 J	28	48

*Ref: Hazardous Waste Land Management, USEPA, SW 874 (April 1983), p. 273.
**Background sample collected at location 37+00U (Center; depth 0'-1').
NA = No analysis performed.
J = Sample matrix interference noted, therefore analytical
result an estimate.
D = Duplicate Sample.

Out of the 15 samples analyzed for reactive (free) cyanide, nine samples had detectable concentrations, which ranged from 0.65 to 60 mg/kg. The highest concentration (60 mg/kg) of reactive cyanide was found in the sample collected from F6 at 0'-1' depth. The total cyanide concentration of this sample was 1,070 mg/kg. Six of the seventeen samples analyzed for reactive cyanide contained greater than 1 mg/kg.

5.2.2 Cadmium

Cadmium was detected at nineteen of the thirty sample locations within the grid. Concentrations ranged from 4.4 to 3,600 mg/kg, compared to typical cadmium concentrations of 0.01-0.7 mg/kg in natural soils. The background sample did not contain any detectable concentration of cadmium (<2.7 mg/kg). Sample locations D4, E3 and G5 had cadmium concentrations greater than 1,000 mg/kg, with 3,600 mg/kg occurring at a depth interval of 0'-1' at location E3 (Figure 6a). Except in locations D4, G5 and H4, where the highest concentrations were detected in the 1'-2' depth interval, the cadmium concentration decreased with increasing depth (Figure 6b). The highest concentrations for samples collected at 3'-5' were found at location C1 (109 mg/kg). All other samples collected at this depth range had less than 6.7 mg/kg. Samples collected along the proposed relocation path of Davy Creek had concentrations of cadmium below detection limits. However, samples collected from location C9 revealed relatively higher levels of cadmium ranging from 6.7 mg/kg at 3'-5' depth to 172 mg/kg at 0'-1' depth.

5.2.3 Chromium

Chromium concentrations ranged from 4.1 mg/kg to 8,840 mg/kg in the 0'-1' depth at E3 (Figure 7a). Two-thirds of the locations sampled had chromium levels greater than 100 mg/kg, the average concentration of chromium in natural soils. Chromium concentration in the background sample was 14 mg/kg.

Among the depth samples analyzed, a maximum of 284 mg/kg of chromium was detected in the 3'- 5' depth interval at location C1. Samples containing greater than 1,000 mg/kg chromium were detected in six locations in the upper central part of the grid at depths up to 2 feet (Figure 7a, 7b). In addition, 1,340 mg/kg chromium was detected in the 0'- 1' depth range of location C9. The majority of the samples collected from the southern section of the grid, including along the Davy Creek relocation path, had chromium concentrations less than 100 mg/kg.

Some evidence exists for oxidation of Cr (III) to Cr (VI) in soils and wetlands (Shotyk, 1986), however, it is not certain whether this conversion occurs at the OEC site. All 27 sediment samples analyzed for hexavalent chromium had concentrations below the detection limit of 2 mg/kg. Most of the hexavalent chromium discharged by the OEC was probably converted to the less toxic form of chromium, Cr(III). The oxidized form of chromium, Cr(IV) is relatively unstable and will readily react with the oxidizable natural organic matter which accumulates in poorly drained systems such as a wetland (NRCC, 1976).

5.2.4 Copper

Copper concentrations ranged from 6.8 to 3,550 mg/kg, with the samples from locations E3, G5 and H4 having concentrations greater than 1,000 mg/kg. Only one-third of the locations had copper values above 100 ppm, the upper end of the range of copper concentration found in most natural soils. All samples collected at the 3'- 5' depth intervals had less than 100 mg/kg. As with cadmium and chromium, copper concentrations were found to be relatively low in the southern section of the grid, except at location C9.

5.2.5 Nickel

Nickel concentrations in the grid ranged from 8.6 mg/kg to 16,500 mg/kg. Samples from one-third of the locations had nickel concentrations in excess of 500 mg/kg, which is the upper limit for most natural soils. Nickel concentration in the background sample was 67 mg/kg.

Concentrations of nickel greater than 1,000 mg/kg were confined to the upper central part of the grid, including locations E3, D4, F6, G5 and H4 (Figure 8a). Levels of nickel greater than the background sample were detected in deeper samples as well, with 363 mg/kg at the 3'-5' depth interval at location C1 and 13,800 mg/kg at the 2'-3'depth interval at location E3 (Figure 8c). As with the other index metals, location C9 had an elevated Ni concentration of 343 mg/kg in the sample collected from the 0'-1' depth interval.

5.2.6 Tin

Tin concentrations varied from non-detectable to 753 mg/kg. The typical range of tin concentrations in natural soils is reported as 2 to 200 mg/kg. Only two locations, E3 and G5, had tin concentration greater than 200 mg/kg. Samples collected at depths of up to three feet at E3 all contained tin concentrations greater than 300 mg/kg. Samples from the 0'-1' depth at locations G5 and E3 had tin concentrations of 240 and 232 mg/kg, respectively. The concentration of tin in the background sample was 64 mg/kg.

5.2.7 Lead

Total lead concentrations in the grid ranged from less than 2.9 to a maximum of 153 mg/kg. While the average concentrations of lead in natural soils is 10 mg/kg, the majority of samples collected in the grid had lead concentration in excess of this amount. As with the other index metals the highest concentrations of lead were confined to the central and upper-central parts of the grid. The concentration of lead in the background sample was 9.6 mg/kg which is comparable to the concentration sample range found in the southern-most sample location, C11 (7 to 12 mg/kg) of the grid.

5.2.8 Zinc

Samples collected from the grid had zinc levels ranging from 11 to 10,800 mg/kg (Figure 9a, 9b, 9c). The normal concentration range of zinc in natural soils is 10 to 300 mg/kg. Unlike the remaining index metals, high concentrations of zinc were more widespread in the grid rather than being confined to the upper central portion of the grid area. Zinc concentrations greater than 1,000 mg/kg were found in samples from Location B4, C1, C9, D4, E3, F6, and G5. The highest concentration of zinc found in the 3'-5' depth samples was 239 mg/kg at Location C1.

5.3 Extent-of-Contamination Outside the Grid Area

All the samples from the Davy Creek up-stream area had index metals and cyanide concentrations either comparable to the background sample or well within the range of typical metal concentrations of natural soils (Table 3).

The only location in the Davy Creek down-stream area that had concentrations of contaminants significantly higher was below the municipal sewage treatment plant discharge (7+50D) (Table 4). Cadmium (272 mg/kg), chromium (1,370 mg/kg), copper (714 mg/kg), and nickel (987 mg/kg), were detected in the 1'-2' depth sample at Location 7+50D (center). The sample also contained 11.05 mg/kg of cyanide. These contaminant concentrations exceeded those of the background sample and the typical concentration ranges of metals in natural soils.

5.4 Water Samples

With the exception of zinc, surface water samples in the wetland do not appear to contain contaminants associated with OEC. Among the index metals, only zinc was detectable in the wetland water samples. Zinc concentrations ranged from 11 to 478 ug/l, the latter concentration being from a sample collected at the OEC discharge point (Appendix D). No sample contained zinc concentrations exceeding the maximum drinking water contaminant limit for zinc of 5 mg/l. Zinc concentration of the field blank was 13 ug/l, which may indicate that sample bottles or preservative was slightly contaminated with zinc. Cyanide concentrations in all the water samples were below detection limits. The high concentrations of calcium and magnesium (Ca, 56 to 79 mg/l; Mg, 31 to 40 mg/l) are probably derived from dissolution of carbonate minerals in the area, and indicate the waters have high pH and carbonate alkalinity.

TABLE 3
Index Metals and Cyanide - Upstream Sediments
OEC Extent of Contamination
Analytical Results of TAT Sampling
April 1987

(All values reported as mg/kg dry weight)

Parameter	Natural Soil Range*	Background**	Sample Location and Depth 2[illegible]+00U Center 0'-1'	25+00U Center 1'-2'	12+50U Center 0'-1'	12+50U Center 0'-1'(D)	12+50U Center 1'-2'	10+00U East 0'-1'	10+00U Center 0'-1'	10+00U Center 1'-2'
Cyanide (Total)	-	<0.20	<[illegible].85 J	NA	<1.1 J	<1 J	NA	NA	NA	<0.63 J
Cyanide (Reactive)	-	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.1-0.7	<2.7	5.5 J	<5 J	5.9 J	8.2 J	<4.6	<5.2 J	10 J	<3.2 J
Chromium	1-1,000	14	29	19	26	32	15	17	125	6.9
Hexavalent Chromium	-	NA	<2	NA	<2	<2	NA	NA	NA	<2
Copper	2-100	18	24	19	26	36	21	25	39	15
Lead	2-200	9.6	7.2	11	14	9.4	16	19	7.5	4.3
Nickel	5-500	12	27 J	20 J	49 J	65 J	17	18 J	69 J	14 J
Tin	2-200	64	<17	<20	<21	<20	<19	<21	<17	<13
Zinc	10-300	47	41 J	51 J	40 J	51 J	65	72 J	74 J	29 J

	Natural Soil Range*	Background**	1[illegible]+00U West [illegible]'-1'	7+50U East 0'-1'	7+50U Center 0'-1'	7+50 Cente 1'-2	7+50U Center 1'-2'(D)	7+50U West 0'-1'	37+00U Center 0'-1'
Cyanide (Total)	-	<0.20	<[illegible].91 J	<1.6 J	<1.2 J	NA	NA	NA	<0.20
Cyanide (Reactive)	-	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.1-0.7	<2.7	<4.5 J	<7.8 J	9.5 J	3.9 J	<3.1 J	<4.2 J	<2.7
Chromium	1-1,000	14	35	16	29	11	8.9	36	14
Hexavalent Chromium	-	NA	<2	<2	<2	NA	NA	NA	NA
Copper	2-100	18	25	27	47	12	11	24	18
Lead	2-200	9.6	9.1	9.4	<6.3	4	3.2	8	9.6
Nickel	5-500	12	25 J	19 J	78 J	12 J	10 J	29 J	12
Tin	2-200	64	<18	<31	<25	<13	<13	<17	64
Zinc	10-300	47	57 J	76 J	91 J	28 J	26 J	51 J	47

*Ref: Hazardous Waste Land Management, USEPA, SW-374 (April 1983), p. 273.
**Background sample collected at location 37+00U (Center; depth 0'-1').
NA = No analysis performed.
J = Sample matrix interference noted, therefore analytical result an estimate.
D = Duplicate Sample.

TABLE 4
Index Metals and Cyanide - Downstream Sediments
OEC Extent of Contamination
Analytical Results of TAT Sampling
April 1987

(All values reported as mg/kg dry weight)

			Sample Location and Depth										
Parameter	Natural Soil Range*	Background**	5+000 East 0'-1'	5+000 East 1'-2'	5+000 East 2'-3'	5+000 Center 0'-1'	5+000 Center 1'-2'	5+000 Center 1'-2'(D)	5+000 West 0'-1'	7+500 East 0'-1'	7+500 Center 0'-1'	7+500 Center 1'-2'	7+500 Center 2'-3'
Cyanide (Total)	-	<0.20	<1.1	NA	NA	NA	<0.64	<0.68	NA	NA	3.6	11.05	0.2
Cyanide (Reactive)	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	<0.2	NA
Cadmium	0.1-0.7	<2.7	186	6.5	<2.7	3.5	4	<3.4	6.6	20	149	272	4.6
Chromium	1-1,000	14	141	17	<12	19	19	16	19	70	545	1370	9.1
Hexavalent Chromium	-	NA	<2	NA	NA	NA	<2	<2	NA	NA	4.6	NA	NA
Copper	2-100	18	292	32	20	24	22	19	19	61	249	714	10
Lead	2-200	9.6	47 J	16	6.8	5.5 J	7.1 J	10 J	50 J	8.9 J	8.8 J	29 J	<3.7 J
Nickel	5-500	12	302	23	11	18	23	19	23	89	591	987	20
Tin	2-200	64	<21	<24	16	<13	<13	<14	<15	<14	<14	86	<16
Zinc	10-300	47	819 J	86	38	75 J	37 J	33 J	41 J	157 J	318 J	1,190 J	42 J

	Natural Soil Range*	Background**	7+500 West 0'-1'	10+000 Center 0'-1'	10+000 Center 1'-2'	10+000 Center 2'-3'	12+500 Center 0'-1'	12+500 Center 1'-2'	37+500 Center 0'-1'	37+500 Center 1'-2'	Upstream Rock Rive 0'-2'	Downstrea Rock Rive 0'-2'	Dnstream Rock Rive 0'-2' (D)
Cyanide (Total)	-	<0.20	<1.3	<1.3	NA	NA	NA	<0.71	<0.86	NA	<0.86	<0.72	<0.74
Cyanide (Reactive)	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.1-0.7	<2.7	21	22	21	10	20	<3.6	<4.3	<4.3	<4.3	<3.6	<3.7
Chromium	1-1,000	14	86	94	97	50	48	<3.6	25	11	16	9	11
Hexavalent Chromium	-	NA	<2	<2	NA	NA	NA	<2	<2	NA	<2	<2	NA
Copper	2-100	18	97	90	65	49	97	90	65	54	17	11	16
Lead	2-200	9.6	6.6 J	17 J	11 J	6 J	<4.1 J	<3.6 J	<4.3 J	<3.6 J	16 J	4.6 J	4.1 J
Nickel	5-500	12	67	98	78	41	35	4.3	27	24	11	10	13
Tin	2-200	64	<26	<26	<26	<19	<16	<14	<17	<14	<17	<14	<15
Zinc	10-300	47	171 J	139 J	82 J	76 J	91 J	713 J	37 J	42 J	61 J	29 J	66 J

*Ref: Hazardous Waste Land Management, USEPA, SW-874 (April 1983), p. 273.
**Background sample collected at location 37+00U (Center; depth 0'-1').
NA = No analysis performed.
J = Sample matrix interference noted, therefore analytical result an estimate.
D = Duplicate Sample.

6.0 DISCUSSION

6.1 Distribution of Contamination

Based on the analytical results and as displayed by the contaminant concentration isopleth maps, the highest levels of metal and cyanide contamination are confined to the central and upper-central portions of the grid; this general area, enclosed by columns B and H, and rows 1 and 6 (Figure 3), covers approximately 75,000 square feet. The vertical distribution of contaminants appears to vary with location and is suspected to extend below three feet in some locations. Although the contaminant isopleth maps show highest contamination near the OEC discharge, the distribution of contaminants do not exhibit a well-defined contaminant plume originating from this discharge point. Considering the long period of OEC's discharge, it is probable that flow may have been directed into local depressions of the central and upper-central parts of the grid. Subsequent sedimentation in these depressions and growth of vegetation may have diverted the flows into other parts of the grid. The presence of increased concentrations of contaminants at deeper levels in some of the locations can be indicative of preferred accumulation in such depressions. This can also be a reflection of changes in the OEC effluent composition. At the time of sampling it was observed that some of the locations within the grid where samples revealed elevated contaminant concentrations, were devoid of vegetation. This may be a result of either contaminant toxicities, excessive stagnant water or a combination of both these factors.

On the other hand, it is possible that the elevated concentration levels of metals and cyanide in the central and upper-central portions of the grid could have been caused by direct dumping of plating sludges in the past. Some local residents have claimed to have seen heaps of metal sludges present in the grid section of the site in the past. However, no physical evidence of dumping was observed at this site during the present sampling effort.

The abundance of surface waters probably allowed for some gradual movement of sediments and therefore contaminants over the years. An important finding of the sample results is that, with the exception of cyanide, the relative concentrations of the various metal contaminants remained generally unchanged in most of the sample locations of the grid. The consistency in contaminant distribution should help minimize the number of contaminants considered in the possible cleanup of the site. The mobility of cyanide appears to be less than that of metals, which is exhibited by the more abrupt and limited distribution patterns of cyanide in the grid (Figure 5). Bacterial degradation and/or photodecompostion may also be responsible for the absence of cyanide in areas where relatively high levels of metal contamination occur (Callahan, et.al., 1979).

Samples collected from locations along Column C in the grid, although less contaminated with metals and cyanide relative to the central and upper-central parts of the grid, were higher in metal and cyanide concentrations than samples collected from other grid locations. This may be due to the suspected drainage from OEC along Column C into Davy Creek during some period in the past. However, the higher metal concentrations at location C9 were unexpected because it is located south of Davy Creek. The creek path may have shifted laterally over time, as evidenced by the braided nature of Davy Creek observed in this area. More closely spaced sampling may be required in the vicinity of location C9 to evaluate the source of contaminants there.

Samples collected along the eastern and western boundaries of the grid were relatively free of contamination, which is indicative of limited contaminant migration from the central portion of the grid. No significantly high levels of metals or cyanides were found in the Davy Creek up and down-stream area sediment and surface waters. This may indicate that no significant migration of contaminants from the grid has occurred. The higher concentrations of index metals in sediments at Location 7+50D relative to the other Davy Creek locations may be a result of discharges from the municipal sewage plant. Periodic sampling and analysis of the sewage waste waters will be necessary to verify this.

The absence of detectable metal concentrations in surface waters of the wetland indicates strong adsorption of contaminants by the wetland sediments and/or extremely low solubilities of the metals of concern. Sediments tend to strongly adsorb metal cations, and metal-hydroxide or carbonate precipitates form, when interstitial waters are high in pH and carbonate alkalinity (Forstner and Wittman, 1981; Munawar, et.al., 1984). Metal-sulfide precipitates also form under anaerobic conditions in many wetlands (Shotyk, 1986). Strong adsorption of metals by sediments, and precipitation of metals, probably explains the non-uniform and limited distribution of contaminants within the grid. However, the zinc found in water samples of the grid was elevated relative to other metals (Appendix D). As discussed previously, zinc is the only index metal currently involved in electroplating activities of the OEC.

Although none of the other index metals were detected in the grid water sample, small amounts of metals desorbing from sediments may not have been detected in this study. Only two water samples were collected from the grid area, and having collected these samples in March, may not be representative of conditions during drier seasons. More frequent sampling in the contaminated areas during late summer, for example, would be required to confirm that metals in the sediments do not affect water quality in the wetland.

The low or non-detectable metal concentrations in EP-Toxicity extracts implies that metals are strongly adsorbed to the sediments. Extraction Procedure-Toxicity analyses give an indication of the leachability of metals and therefore their mobilities under a controlled set of conditions. When leachability of metals is less, the availability of metals to certain organisms may also be limited. EP-Toxicity results for OEC sediments, therefore, may imply that the metal contaminants present should have limited effect on organisms living in the water column. However, leachability of metals does not necessarily give an indication of potential toxicity to organisms which ingest sediment such as certain benthic invertebrates.

Copper, nickel, tin and zinc concentration are not routinely determined in EP-Toxicity extracts. However, these metals are four of the contaminants of concern at OEC and their leachability may be important to possible toxic effects on organisms. The TAT therefore recommends that for any future EP-Toxicity analyses of OEC sediments, the extracts be analyzed for these 4 metals in addition to the 8 metals for which there are standards set in 40 CFR 261.

Studies on the effects of metal-contaminated dredged material dumped in open fresh water have shown that the desorption of metals are normally short-term only (Neff, 1978). The strong binding of the metals with the sediments at the OEC site, as demonstrated by the EP-toxicity results, may indicate that even if the Davy Creek is dredged, metal concentration of overlying surface waters should increase only temporarily but subsequently decrease as metals are adsorbed onto particles settling out of the water column.

6.2 Comparative Assessment

No standards have been established to date for metal and cyanide-contaminated soils and sediments. Site-specific criteria have been used in cleaning up other sites with metal-contaminated soils. The criteria for action levels should take into consideration all short and long-term environmental impacts on human health, plants, wildlife, aquatic life and the food chain.

An attempt was made to obtain literature listing fresh-water sediment metal concentration shown to be toxic to plants and animals in other studies. In August of 1987, a literature search was conducted using toxicological data bases available at the Weston Technical Information Center. The search utilized two data bases including TOXNET (part of the National Library of Medicine) and Chemical Information System (CIS). The TAT also contacted Ecological Analysis, Inc., and the Illinois Natural History Survey, however, no literature was located which assessed the biological effects of sediment metal concentrations as high as those found at the wetland near OEC.

Table 5 presents some examples of criteria for metal-contaminated soils and sediments considered in other investigations. Included in this table are criteria used for dredged material disposal in Great Lakes harbors, metal concentrations of "contaminated" sediments from the Ashtabula River in Ohio (used as a shipping canal), and concentrations of metals in soils that were determined to be toxic to agricultural plants. The above criteria are compared to the OEC sediment analytical results along with mean metal concentrations measured in peat cores from a fresh water wetland and typical concentrations of metals in natural soils. The metal concentrations of the background and upstream sediment samples of the OEC site are similar to those found in peat samples from fresh water wetland (a European ground water fen) and are within the range of natural soils. However, sediment metal concentrations of some grid samples range up to 1 to 2 orders of magnitude greater. The Great Lakes Harbor sediments were initially classified as "moderately" and "heavily" polluted primarily according to abundance and diversity of the benthic community. The sediments were then analyzed for their metal concentrations. The sediments from the Ashtabula River were considered polluted with the concentrations listed in Table 5. However, at these levels of metal contamination, bioassays of three species of benthic organisms showed no significant correlations between bioaccumulation of metals and total sediment concentrations. The phytotoxic soil concentrations for agricultural plants are much higher than that of the Great Lakes or Ashtabula River sediments.

The various concentrations listed in Table 5 show that an appropriate action level depends upon specific characteristics of the substrate, overlying surface waters, species of concern and interactions between contaminants and therefore, the total concentrations of contaminants may not necessarily be indicative of their toxicities (Nett, 1978; Munawar, et.al., 1984; Lee, et.al., 1978). In the OEC sediments, the mobility of the metals and cyanide appears to be limited by sediment adsorption and/or low metal solubilities. Therefore, significant impact on the wetland organisms may be confined to only the most contaminated areas. Thus, background sample results and typical metal concentrations in soils may not constitute appropriate action levels. Using these criteria for the OEC site may result in overestimating the volume of "contaminated sediments" and would require excavation and restoration of large areas of ecologically valuable wetland. Site-specific action levels should be determined for the OEC site in order to minimize potential cleanup costs as well as disruption of the wetland.

6.3 Site-Specific Risk Assessments

In June 1987, the Agency for Toxic Substances and Disease Registry (ATSDR) reviewed the OEC analytical data to determine if a potential public health threat existed at the site. Based upon the information made available by the U.S. EPA, ATSDR concluded that the grid sample analytical results were suggestive of inor-

TABLE 5

CRITERIA JSED FOR ASSESSMENT OF CONTAMINATION IN OEC SEDIMENTS

(All values reported as mg/kg·dry weight.)

	Cd	Cr	Cu	Pb	Ni	Zn	Sn	CN
GRID AREA SEDIMENTS	<2.7-3,600	4.1-8,840	6.8-3,550	<2.9-153	8.6-16,500	11-8,780	<12-753	<0.2-2,690
UPSTREAM SEDIMENTS	<2.7-10	<6.2-125	11-47	3.2-19	10-78	5-91	<26	<1.2
BACKGOUND SEDIMENT SAMPLE	<2.7	14	18	9.6	12	47	64	0.20
FRESHWATER WETLAND PEAT (1)	-	80	18	42	43	66	-	-
NATURAL SOILS (2)	0.01-0.7	1-1,000	2-100	2-200	5-500	10-300	-	-
GREAT LAKES' HARBOUR SEDIMENTS (3)								
Moderately Polluted	NE	25-75	25-50	40-60	20-50	90-200	-	-
Heavily Polluted	>6	>75	>50	>60	>50	>200	-	-
ASHTABULA RIVER SEDIMENTS (3)	4.8	175	37	42	52	315	-	-
PHYTOTOXIC SURFACE SOILS (4)	2.5 (5)	2,000-4,000 (6)	125	-	62	250	-	-

NE = Not established.
(1) Shotyk, 1986.
(2) U.S. EPA, April 1983.
(3) Neff, 1978.
(4) Logan and Chaney, 1983.
(5) U.S. EPA, 1979.
(6) Browning, 1969.

Based on report that discusses what *not* to dispose of (in open water) ⇒ *Not* what to remove ganic contamination which could pose a potential public health threat and recommended that the area enclosed by the grid be restricted to the public. ATSDR also concluded that levels of contamination in sediments and surface water of the up-stream and down-stream portions of Davy Creek and the soils from the ballpark cannot be considered a threat to public health. (In July 1987, an 800-foot long fence was constructed by the U.S. EPA along the northern boundary of the grid to restrict public access to the wetland). However, no assessment was made of the risk via ground water contamination due to insufficient information on residential well water quality. Wetlands are generally areas for ground water discharge. If this is true for the Davy Creek wetland, contamination of ground water in the immediate vicinity of the wetland would be unlikely.

In early December 1987, the U.S. EPA Emergency Response Team (ERT) collected surface sediment samples, mainly from the grid, for a bioassay investigation. This investigation was aimed at determining site-specific action levels for sediment metal and cyanide concentrations based on toxicities to selected organisms.

6.4 Generation of Volumetric Estimates of Contaminated Sediment

Once action levels for the various contaminants at the OEC site have been determined, volumetric estimates of contaminated sediments will be generated. These estimates will be calculated based on 3-dimensional isometric maps depicting contaminated sediment for given cut-off levels of contaminants. Construction of these maps and the determination of contaminated sediment volume will be performed by Weston's Technical Information Management System.

REFERENCES

Browning, 1969. Toxicity of Industrial Metals, 2nd Ed., Butterworth Publishers, London.

Callahan, A., et.al., 1979. Water-related Environmental Fate of 129 Priority Pollutants.

Environmental Protection Agency, 1979. Criteria for Classification of Solid Waste Disposal Facilities and Practices. Federal Register 44 (179): 53438-53464.

Environmental Protection Agency, 1983. Hazardous Waste Land Management. SW-874.

Forstner, U., and Wittman, G.T.W., 1981. Metal Pollution in the Acuatic Environment, 2nd Ed. Springer-Verlag, New York, N.Y.

Lee, C.R.; Smart, R.M.; Sturgis, T.C.; Gordon, R.N.; and, Landin, M.C., 1978. Prediction of Heavy Metal Uptake by Marsh Plants Based on Chemical Extraction of Heavy Metals from Dredged Material. Technical Report - U.S. Army Engineer Waterways Expt. Station, 0-78-6.

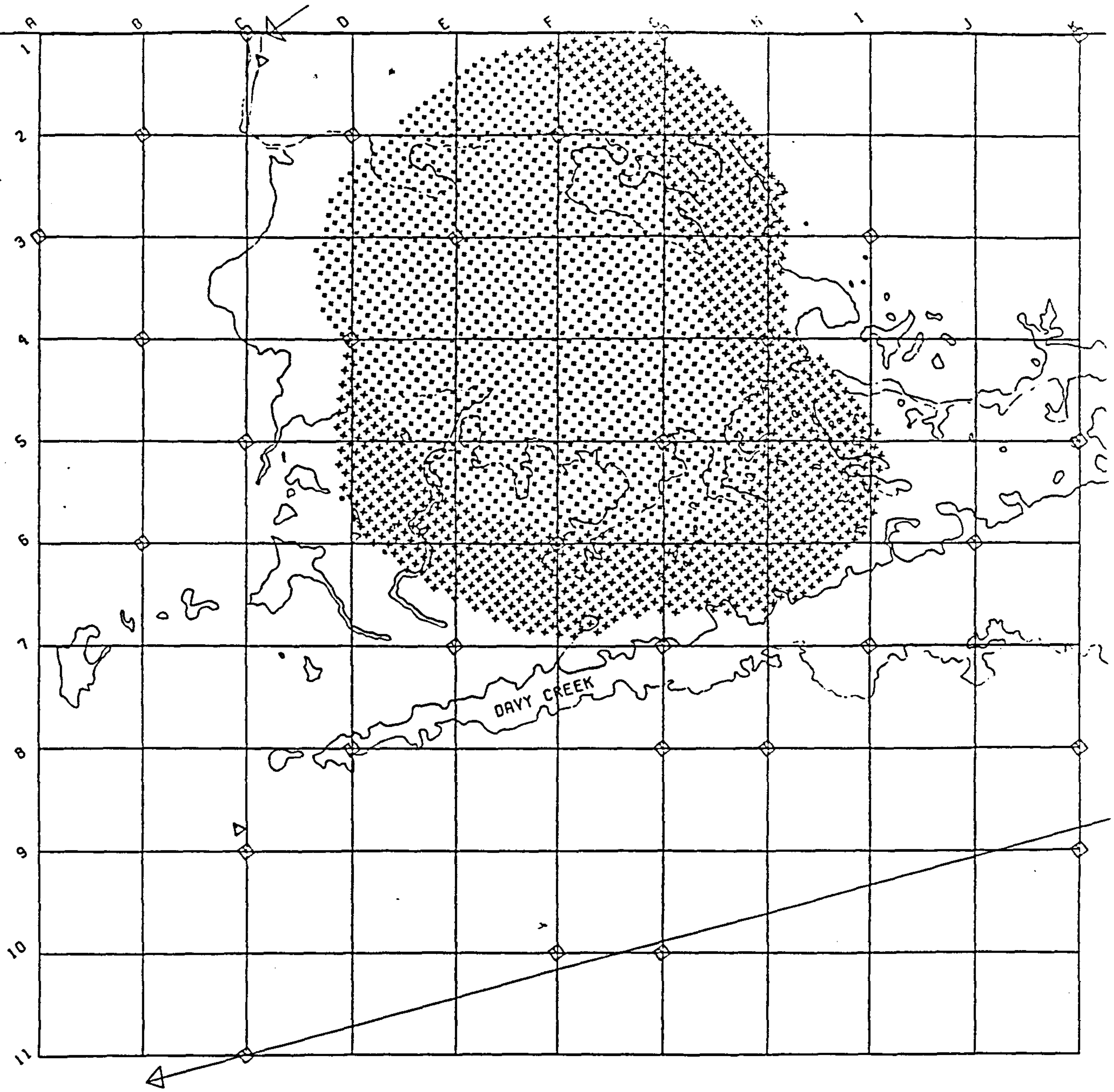
Logan, T.J. and Chaney, R.L., 1983. Utilization of Municipal Wastewater and Sludge on Land Metals. Proceedings of the 1983 Workshop, University of California, Riverside, California.

Munawar, M.; Thomas, R.L.; Shear, H.; McKee, P.; and, Murdoch, A., 1984. An Overview of Sediment-Associated Contaminants and Their Bioassessment. Canadian Technical Report of Fisheries and Aquatic Sciences, No. 1253.

National Research Council of Canada, 1976. Effects of Chromium in the Canadian Environment, No. 15017.

Neff, J.W., 1978. Availability of Sediment-Adsorbed Heavy Metals to Benthos with Particular Emphasis on Deposit-Feeding Infauna. Technical Report - U.S. Army Engineer Waterways Experiment Station, D-78-42.

Shotyk, W., 1986. An overview of the inorganic chemistry of peats. In Advances in Peatlands Engineering, National Research Council Canada, Ottawa. August 25-26, 1986, Carleton University.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DAVY CREEK

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
EDISON, NEW JERSEY 08837

March 17, 1989

MEMORANDUM:

SUBJECT: Transmittal of Supplemental OECI Report

FROM: David W. Charters, Ph.D.
Environmental Response Team

TO: Vernita Simon, OSC
Region V

Please find enclosed the supplemental report on the Oconomowoc Electroplating Co. Inc. site. If you have a need for additional copies of the maps give me a call and additional maps can be generated.

Enclosure