Publication No. 74-e97

WA-08-1110

January 10, 1974

Memo To: John Glynn

From: Ron C. Devitt

Subject: Cedar Hills Survey

INTRODUCTION: King County operates Cedar Hills sanitary landfill near Issaquah, Washington. Leachate, runoff and contaminated ground and spring water merge with a small unnamed creek and flow to Mason Creek. In the spring of 1972, a heavy slime growth developed in Mason Creek and downstream in Issaquah Creek at the Washington State Department of Fisheries hatchery at Issaquah.

Several studies were initiated to examine the problem.* The Washington State Department of Ecology undertook an independent survey to characterize the leachate and to determine the effect of the leachate on the water quality of Mason Creek.

SUMMARY: The flow originating from the disposal site is grossly polluted. As the distance from the fill increases, chemical, physical, and biological changes generally improve the quality of the leachate. In addition, the unnamed creek has a dilutional effect on the leachate before reaching Mason Creek.

During dry weather, the combined flow is so small that these is no direct above ground flow to Mason Creek. However, during wet weather flow, the aestethic and chemical nature of Mason Creek is significantly affected.

A similar discharge would not be permitted to such a small waterway by a Washington State industrial waste discharge permit.

The adverse effect of slime growth at the fish hatchery will be eliminated when the use of water from Issaquah Creek is discontinued and well water is employed.

*AN INVESTIGATION OF LANDFILL LEACHATE PROBLEMS AT KING COUNTY'S CEDAR HILLS SITE, John W. Mellor, University of Washington Masters thesis 1972.

CEDAR HILLS LANDFILL STUDY MUNICIPALITY OF METROPOLITAN SEATTLE, Feb. 1 thru June 21, 1972, J. T. Clark, R. J. Morrice, R. I. Matsuda, and R. S. Domenowske.

STATION LOCATIONS

Primary stations were established at the following locations and are pinpointed on the attached map.

STATION #1: Combined leachate and spring water in ravine as it emerges from ground.

STATION #1A: 10 yards downstream - comprised of flow from Station #1 and surface runoff.

STATION #1B: Flow from 1A after passing downstream.

STATION #2: Control to be compared to 1A, spring water and runoff from an uncontaminated area.

STATION #3: Three combined flows from 1B and 2 in field at gun club.

STATION #3A: Flow from station #3 ten yards above confluence with Mason Creek.

STATION #4: Control for Mason Creek; Mason Creek at bridge about ten yards above confluence with flow from 3A.

STATION #5: Mason Creek at bridge about 100 yards below confluence with flow from #3a.

In addition, two secondary stations were sampled sporatically.

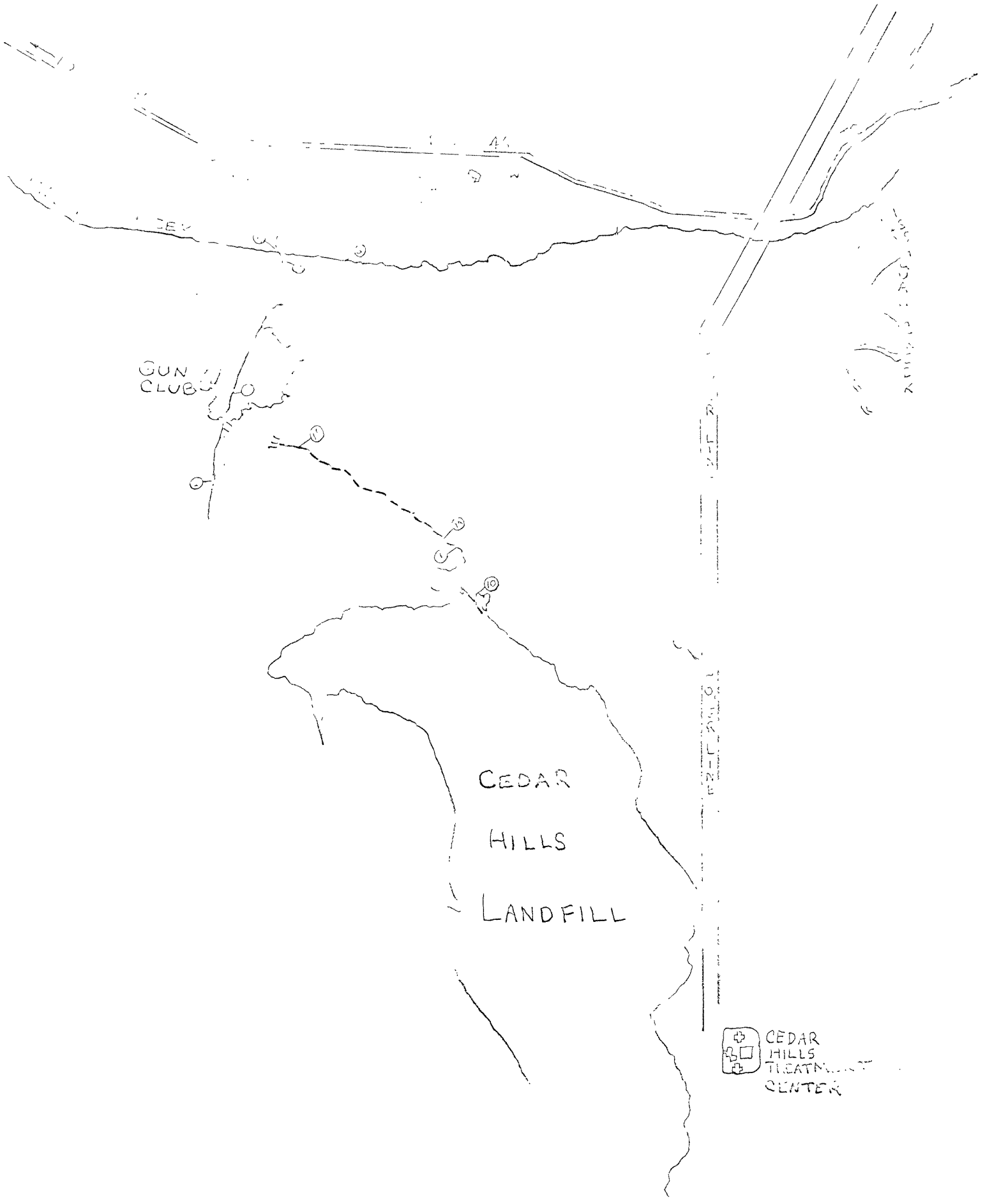
STATION #9: Leachate and runoff originating in the south and east area of the fill at the powerline road.

STATION #10: Runoff in leachate ditch (about 30 yards above Station 1A).

GENERAL DRAINAGE: Contaminated ground water emerges in a spring and combines with surface runoff and leachate at station #1. It proceeds down the ravine and merges with the uncontaminated water from Station #2. This combined flow enters Mason Creek at Station #3A.

SAMPLING PROCEDURES: From 10-31-72 to 5-29-73, six sets of grab samples were taken from the drainage from the landfill site from the control drainage and Mason Creek.

The samples were iced and analyzed by DOE water quality lab in Tumwater. Appropriate preservation was added to COD, nutrients, and iron samples. Dissolved oxygen samples were fixed in the field and determination was made by the azide modification of the Winkler method.


GUN CLUB
CEDAR HILLS LANDFILL
CEDAR HILLS TREATMENT CENTER

UNITS OF MEASUREMENT:

pH: pH units
Turbidity: Jackson Turbidity Units
Conductivity: μmhos/cm @ 25°C.
NO_3-N: ppm filtered
NO_2-N: ppm filtered
O-PO4-P: ppm filtered
Total alkalinity: ppm as $CaCO_3$
Hardness: ppm as $MgCo_3$ + $CaCO_3$
Temperature: degrees Centigrade

All remaining results are report as parts per million.

DISCUSSION OF DATA:

Values obtained at the leachate-effected stations vary significantly. The amount of snowmelt and precipitation were the main factors in determining the amount of runoff. The more runoff, the more adversely the water quality was affected. Specifically on 10-31-72, the flow was so low that there was no above ground discharge to Mason Creek. Between Station #3 and #3A, about 10 yards below the gun club road, the flow (<1 cfs) was entering a pool and joining either ground water and/or underground creek. It would have been desirous to dye this subsurface flow in an attempt to determine if it did reach Mason Creek, but flow levels were not observed to be as low again. On subsequent dates, there was always a surface flow preventing the effective use of dye.

In contrast, it had been raining for three days preceeding the sampling on 4-18-73. Definite changes in water quality are due to the leachate.

Assuming that the differences between Station #2 and Station #1A are due to the leachate, a definite trend can be observed by comparing the mean values of selected parameters:

	Control (#2)	Contaminated (#1A)
pH (range)	7.0 - 7.8	6.8 - 6.5
turbidity	1	173
conductivity	88	1290
COD	10	790
Iron	<.1	79
Total Solids	67	1144
Total Non Vol. Solids	31	620
Total Suspended Solids	4	124
Total Suspended Non Vol. Solids	1	98
Alkalinity	22	494
Chlorides	14	89
Calcium	2.8	161
Magnesium	2.5	32
Hardness	17	532

The maximum values at Station #1A occurred during periods of high run-off.

Another significant observation is the general improvement in water quality due to natural purification of the combined leachate and runoff by travelling from Station #1A to 1B.

	Station #1A	Station #1B*
pH (range)	6.8 - 6.5	8.1 - 7.1
turbidity	173	85
conductivity	1290	865
COD	790	432
Iron	79	35
Total Solids	1144	676
Total Suspended Solids	620	371
Total Non Vol. Solids	124	50
Total Suspended Non Vol. Solids	98	38
Alkalinity	494	338
Chlorides	89	64
Calcium	161	122
Magnesium	32	24
Hardness	532	404

*Data from 4-18-73 not included in calculation because of increased flow before sampling.

The most drastic effect on the water quality of Mason Creek was reported on 4-18-73.

Washington State water quality criteria include Implementation and Enforcement Plan for Water Quality Regulations Department of Ecology 1970:

1. Turbidity shall not exceed 5 JTU over natural conditions. The natural conditions (Sta. #4) was 7 JTU; downstream (Sta. #5) the turbidity of Mason Creek was 30 JTU, or an increase of 23 JTU.

2. pH shall be within the range of 6.5 to 8.5 with an induced variation of less than 0.25 units. Station #4 was 6.9, Station #5 was 6.6 or an induced variation of 0.3.

3. Aesthetic values shall not be impaired . . . which offend the senses of sight, smell, touch, or taste. By this definition the aesthetics of Mason Creek were impaired.

4. Deleterious material concentrations shall be below those of public health significance, . . . or which may adversely affect any water use.

The characteristic uses of Class A water include domestic, industrial, and agricultural water supply.

Water quality criteria[1] say that concentrations of 0.3 mg/l and 0.1 mg/l should not be deleterious to the uses of water for domestic and industrial water supplies, respectively. It is also reported that all of the waters in the United States which support good fish populations have iron concentrations below 0.7 mg/l. The concentrations of iron at Station #5 was 6.8 ppm.

Metro's survey documented that Mason Creek was substandard for total coliform although this fact was not due to effects of the leachate.

BIOLOGICAL SAMPLING:

To evaluate the effect of the leachate on biological colonization, artificial substrates were placed at Station #4 and #5 on December 5, 1972.

The substrate was similar to that developed by Britt[2]; a 12"x12"x3" concrete anchor was poured inside a plywood frame. A redwood lattice was attached to the anchor. A modificiation was made in an attempt to quantilatively evaluate slime growth development. A 9-1/2"x4"x1/8" piece of transite was attached to a corner of the wooden lattice.

Although slime growth developed on some of the vegetation at Station #5, it failed to establish on either the wood or transite.

Invertebrates did colonize the substrates. On 5-29-73, the specimens were collected, preserved in ethanol, identified, and enumerated at the water quality laboratory in Tumwater.

The results are reported below:

	Station #4	Station #5
Tubifex	31	268
Chironomids	13	140
Leeches	8	1
Fingernail Clams	4	1
Tabanidae	1	0
Total	57	410

As indicators of water quality, neither population would typify a "clean water" situation. The increased numbers of tubifex ("sludge worms") and chironomids ("blood worms") and decreased diversity at Station #5 would

1. Water Quality Criteria, 2nd Edition State Water Quality Control Board, Sacramento, California, 1963.
2. New Methods of Collecting Bottom Fauna from Shoals or Rubble Bottoms of Lake and Streams, Ecology 36(3): 524-525 Britt, N.W. 1955.

tend to indicate an enrichment of the creek not demonstrated by chemical sampling. Conditions were present which promoted the growth of "polluted water" macroorganisms.

The difference between the populations at Station #4 and #5 are considered to be due to the leachate. The water velocity and depth were similar; the substrate was identical. The development of these populations over a period of six months is a significant method of evaluating biological conditions in situ.

RCD:lt
4/1

Cedar Hills Leachate and Mason Creek - December 5, 1972

Station:	1	1A	1B	2	3	3A	4	5	9	10
Parameter										
pH	6.6	6.8	7.5	7.5		7.4	6.7	6.8	6.8	
Conductivity	410	890	850	75		65	82	85	240	
COD	62	520	450	8		8			110	
NO_3-N										
NO_2-N										
NH_3-N	ND	1.7	1.6	ND		ND	ND	ND	ND	
Total Kjeldahl-N	ND	2.2	1.8	ND		ND	.04	.04	ND	
O-PO_4-P										
Total Phos.-P										
Total Solids *										
Total Non Vol. Solids*										
Total Suspended Solids										
Total Sus N.Vol Solids										
Total Alkalinity										
Calcium	40	116	106	2.9		2.8	3.0	2.7	31	
Magnesium	8.2	28	24	2.7		2.3	2.8	2.5	9.0	
Chlorides	32	77	77	29		25	27	27	38	
Iron	18	60	24	0.1		0.1	0.4	0.3	3.6	
Sulfates	ND	ND	ND	3		6	5	6	3	
Hardness	130	400	360	18		15	17	16	110	
Turbidity	20	20	20	1		3	5	5	6	

* Insufficient sample

Cedar Hills Leachate and Mason Creek - January 2, 1973

Station:	1	1A	1B	2	3	3A	4	5	9	10
Parameter										
pH	6.5	6.7	7.1	7.0		7.3	6.4	6.6	7.0	
Conductivity	260	406	490	63		140	59	73	150	
COD	31	360	270	12		51	20	12	54	
NO_3-N										
NO_2-N										
NH_3-N	.30	2.40	2.46	.14		.28	.06	.06	.10	
Total Kjeldahl-N	.54	2.70	3.00	.16		.40	.32	.24	.30	
O-PO_4-P										
Total Phos.-P										
Total Solids	140	528	419	49		71	40	50	126	
Total Non Vol. Solids	120	328	231	38		42	7	19	88	
Total Suspended Solids	2	104	48	1		6	3	4	4	
Total Sus N.Vol Solids	2	71	40	1		6	1	3	2	
Total Alkalinity	100	240	190	14		40	16	41	54	
Calcium	23	74	64	2.1		10	2.3	--	15	
Magnesium	5.3	16	11	1.8		3.6	1.7	--	4.7	
Chlorides	15	40	34	9		12	9	10	--	
Iron	16	35	25	ND		2.5	<0.1	--	2.8	
Sulfates										
Hardness	79	250	200	13		40	13	--	56	

-- Insufficient sample
ND None Detected

Cedar Hills Leachate and Mason Creek - March 8, 1973

Station:	1	1A	1B	2	3	3A	4	5	9	10
Parameter										
pH	6.5	6.5	7.5	7.3	7.1	7.1	6.5	6.7		6.5
Conductivity	385	955	820	90	180	190	84	105		2500
COD	110	631	490	8	59	59	16	12		2490
NO_3-N	.010	.010	.030	.038	1.63	1.21	1.18	.68		.77
NO_2-N	.01	.02	ND	ND	ND	ND	ND	ND		.01
NH_3-N	.01	.15	.12	.01	.01	<.01	.01	.01		.65
Total Kjeldahl-N	.02	.16	.13	.01	.01	.01	.01	.01		.75
O-PO_4-P	.01	.01	.01	.01	.01	.01	.01	.01		.01
Total Phos.-P	.05	.05	.05	.05	.05	.05	.05	.05		.05
Total Solids	254	814	620	67	117	5130	69	78		2570
Total Non Vol. Solids	162	430	318	51	100	5100	60	60		1090
Total Suspended Solids	39	74	37	4	2	10	2	5		180
Total Sus N.Vol Solids	26	54	25	4	0	2	0	2		140
Total Alkalinity	150	384	294	20	58	60	24	34		860
Calcium	46	150	135	2.7	17	17	5.7	7.6		440
Magnesium	9.6	26	25	2.0	4.5	4.5	1.9	2.4		76
Chlorides	21	58	54	18	15	15	11	9.7		165
Iron	25	75	50	0.1	2.4	1.7	0.6	0.6		160
Sulfates										
Hardness	155	480	440	15	60	60	22	29		1400

Cedar Hills Leachate and Mason Creek - April 18, 1973

Station:	1	1A	1B	2	3	3A	4	5	9	10
Parameter										
pH	6.4	6.5	6.8	7.2	6.5	6.6	6.9	6.6	6.9	
Conductivity	1050	1900	270	83	520	590	85	230	310	
COD	730	1770	200	23	440	500	23	143	60	
NO_3-N	ND	ND	.03	1.07	.39	.35	.35	.43	.03	
NO_2-N	.04	.04	.01	.01	.01	.01	.01	.01	.01	
NH_3-N										
Total Kjeldahl-N										
O-PO_4-P	.02	.02	.02	ND	ND	ND	ND	ND	ND	
Total Phos.-P	.12	.28	.76	.20	.32	.24	.24	.24	.16	
Total Solids	922	2024	1040	76	682	814	95	231	210	
Total Non Vol. Solids	430	1050	862	33	385	473	36	108	105	
Total Suspended Solids	121	184	932	1	239	180	4	20	20	
Total Sus N.Vol Solids	91	156	781	0	209	152	1	20	4	
Total Alkalinity	340	690	60	24	160	180	28	74	100	
Calcium	150	250	24	2.6	75	90	2.7	35	40	
Magnesium	26	50	8.5	2.2	13.6	15.6	2.1	6.3	8.2	
Chlorides	51	120	16	7	33	37	8	15	22	
Iron	105	120	27.5	<0.1	25	20	0.6	6.8	4.6	
Sulfates	<5	<5	<5	<5	<5	<5	<5	9	6	
Hardness	480	830	95	16	245	290	15	115	135	
Turbidity(JTU)	40	200	500	1	175	150	7	30	20	

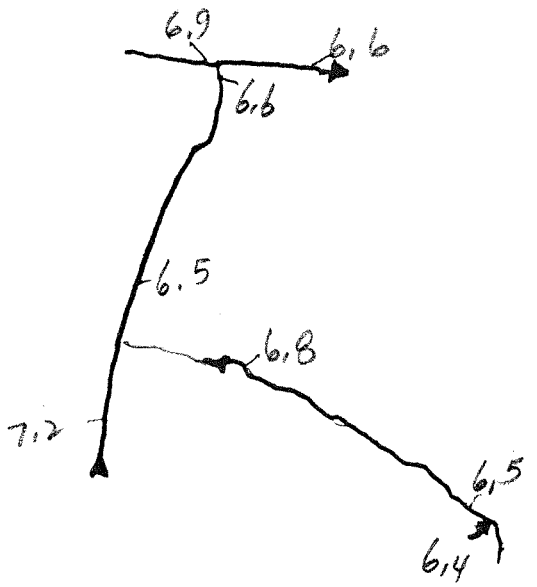
Cedar Hills Leachate and Mason Creek - May 29, 1973

Station:	1	1A	1B	2	3	3A	4	5	9	10
Parameter										
pH	6.4	6.6	8.1	7.8	6.7	7.3		7.0		
Conductivity	1400	2300	1300	120	160	160		98		
COD	772	650	517	4	24	12		8		
NO_3-N	.03	.02	1.04	.36	.24	1.22		.10		
NO_2-N	ND	ND	ND	ND	ND	ND		ND		
NH_3-N	.46	1.02	.64	.14	.24	.10		ND		
Total Kjeldahl-N	1.12	1.26	.94	.14	.26	.10		.02		
O-PO_4-P	.10	.06	.04	.02	.02	.02		.02		
Total Phos.-P	.12	.14	.08	.05	.04	.06		.06		
Total Solids	1158	1208	990	75	208	122		58		
Total Non Vol. Solids	591	673	565	0	144	68		13		
Total Suspended Solids	95	135	66	9	129	10		7		
Total Sus N.Vol Solids	90	111	50	0	101	3		3		
Total Alkalinity	570	620	530	30	62	66		100		
Calcium	210	215	185	3	17	18		11		
Magnesium	36	39	37	2.8	5	4.8		2.3		
Chlorides	94	105	92	12	17	21		16		
Iron	115	105	40	ND	6.5	2.6		0.5		
Sulfates										
Hardness	670	700	615	19	63	65		37		

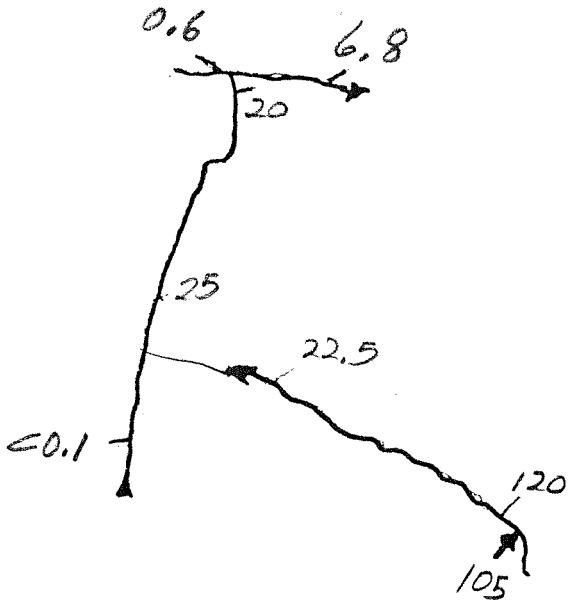
ND = None Detected

SAMPLES TAKEN 4-18-73
Selected parameters

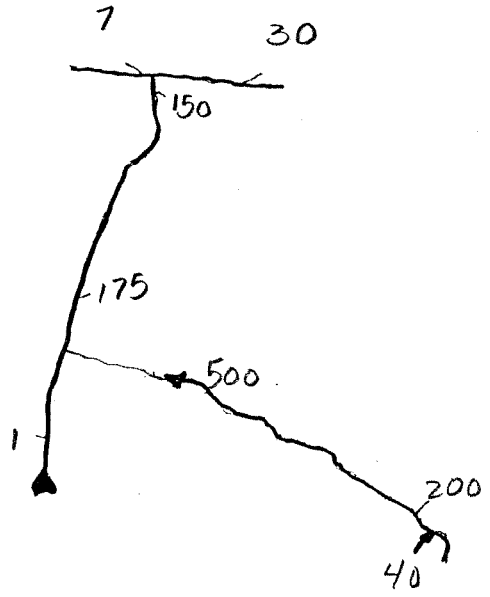
pH



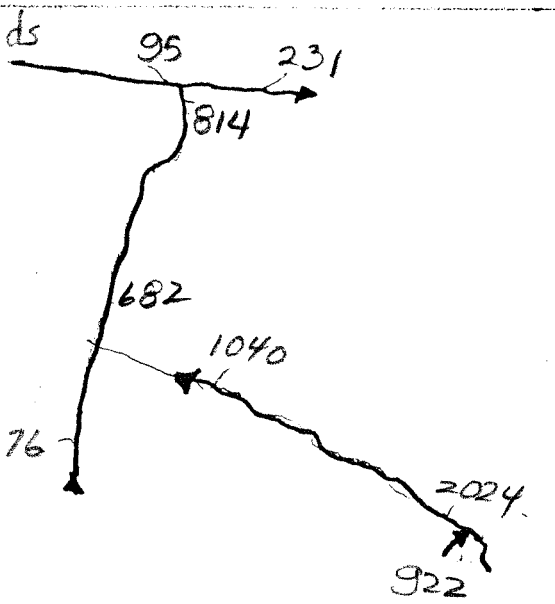
IRON



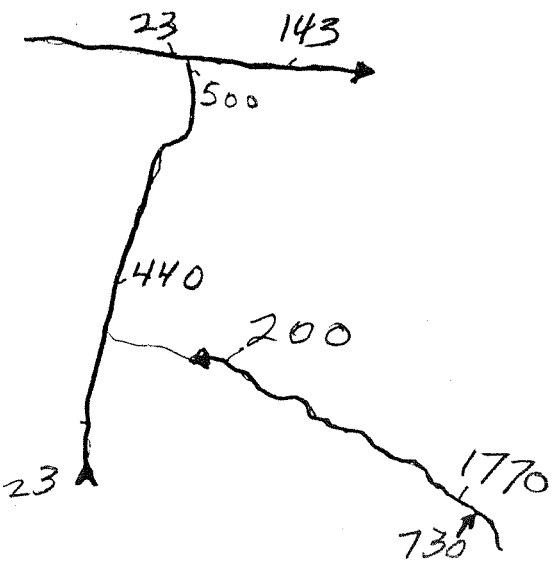
TURBIDITY



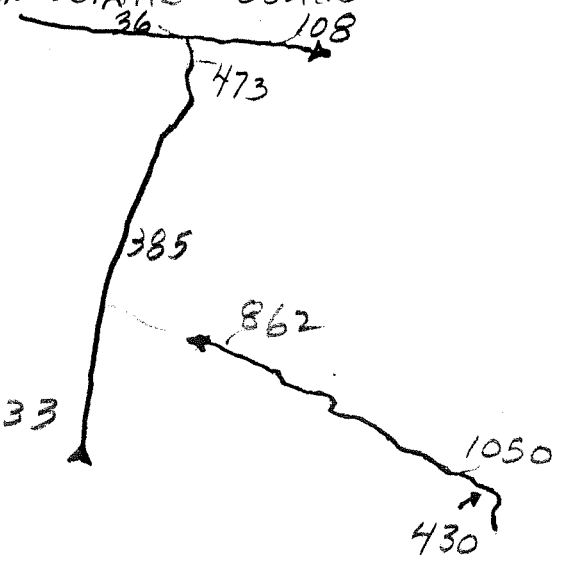
Total Solids



COD

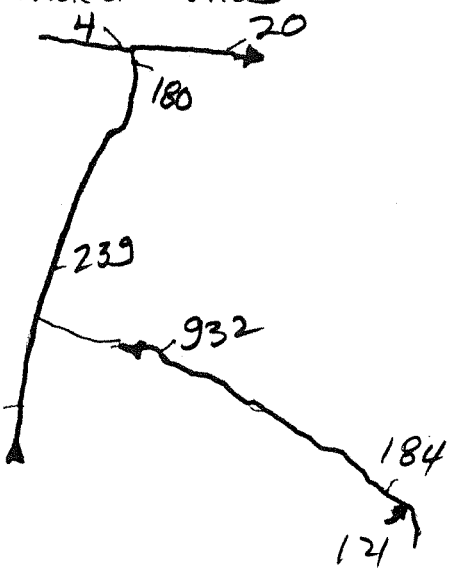


TOTAL NON-VOLATILE SOLIDS

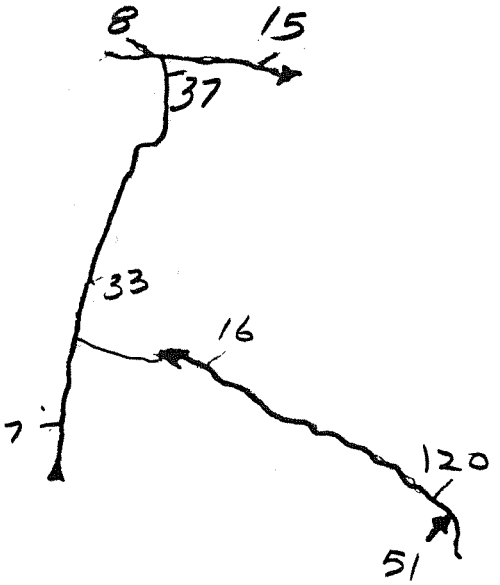


4-18-73 CONTINUED

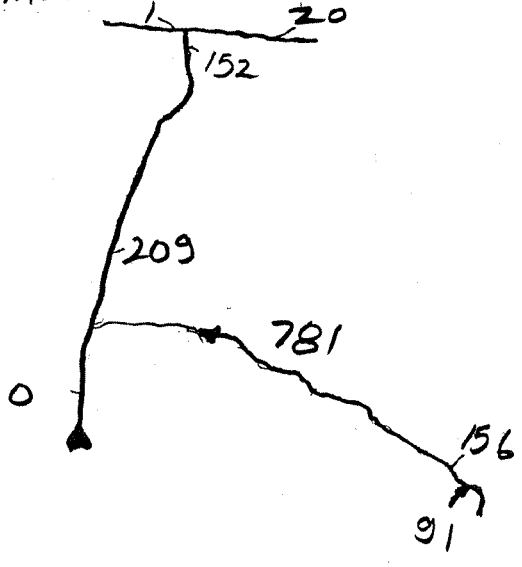
TOTAL Suspended Solids



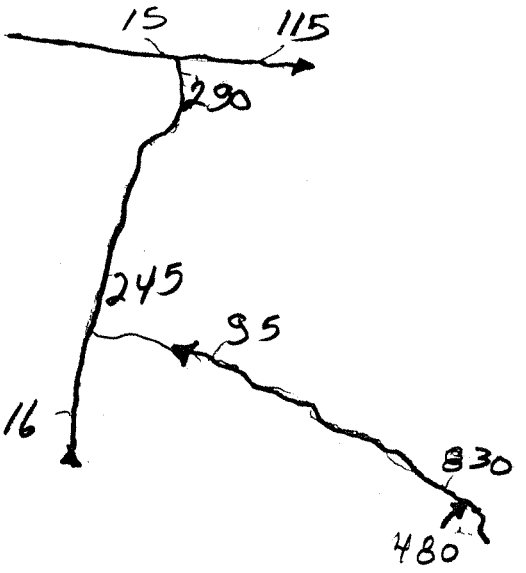
Chlorides



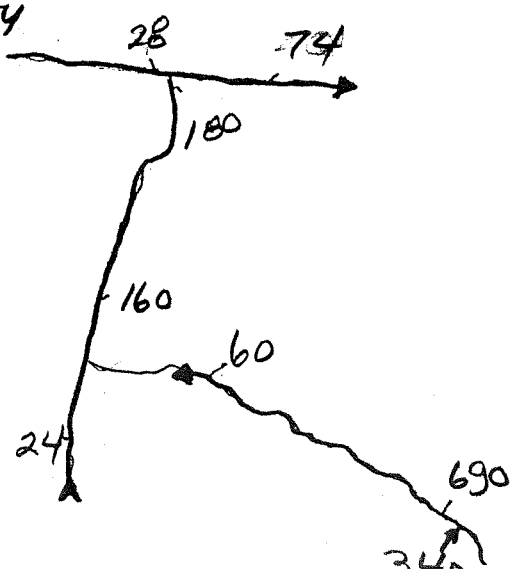
TOTAL Suspended NON-VOLATILE Solids



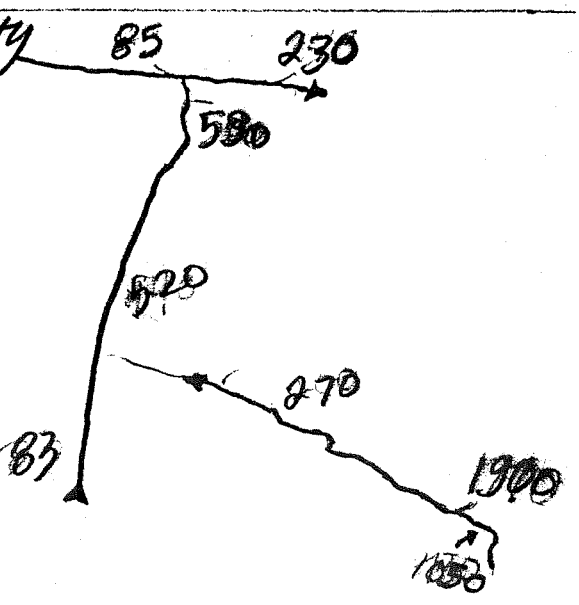
HARDNESS

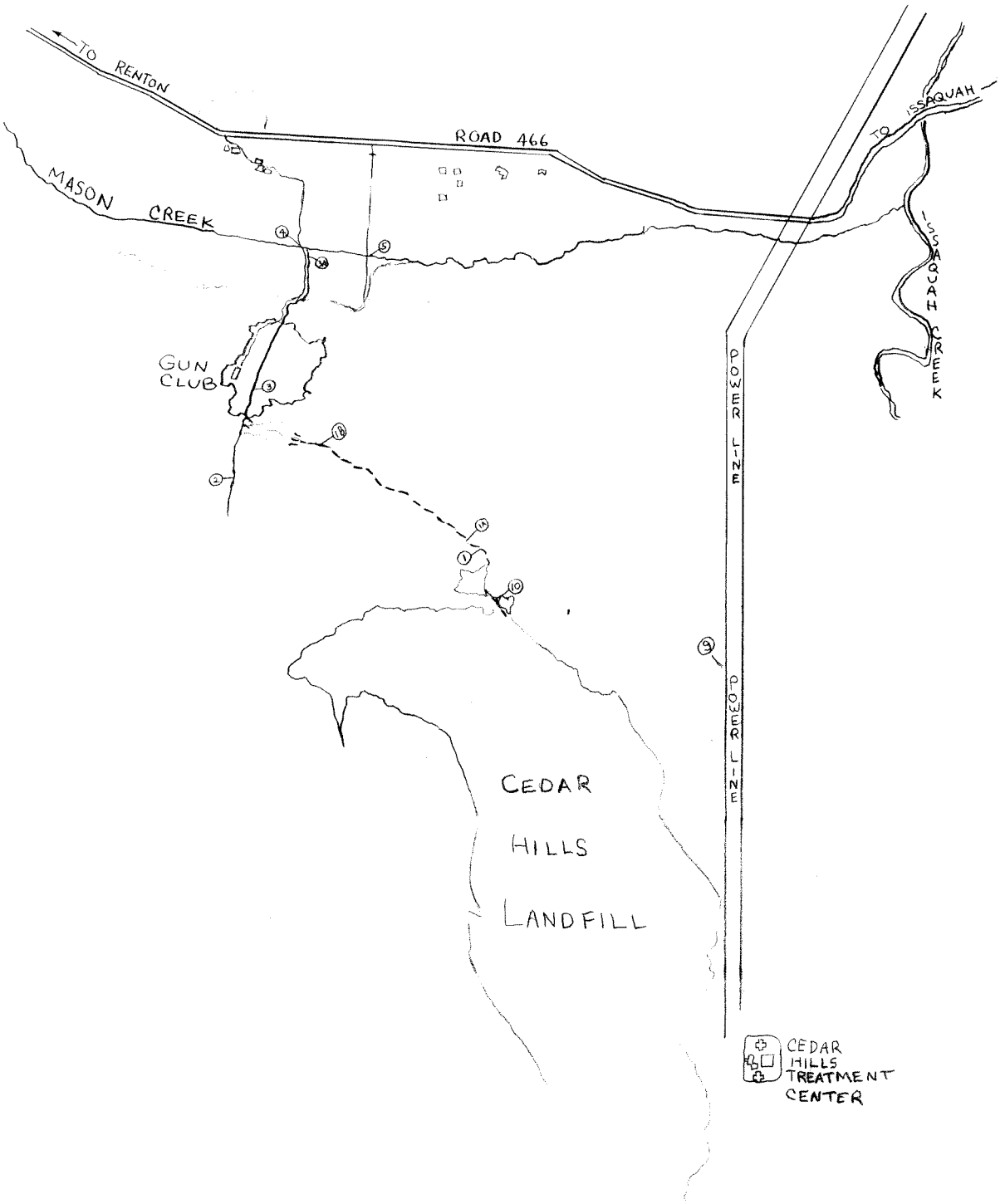


ALKALINITY



Conductivity




TO RENTON
ROAD 466
TO ISSAQUAH
MASON CREEK
ISSAQUAH CREEK
GUN CLUB
POWER LINE
POWER LINE
CEDAR HILLS LANDFILL
CEDAR HILLS TREATMENT CENTER