

DRILLING WASTE LANDSPREADING FIELD TRIAL

**A JOINT RESEARCH PROJECT
OF
ALBERTA RESEARCH COUNCIL
ESSO RESOURCES CANADA LIMITED**

Report prepared by

T.M. MACYK

F.I. NIKIFORUK

Z.W. WIDTMAN

**ENVIRONMENTAL RESEARCH AND ENGINEERING DEPARTMENT
Alberta Research Council**

February 1993

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EXECUTIVE SUMMARY

Drilling associated with the oil and gas industry generates wastes that must be disposed of in an environmentally safe manner. In 1988 a joint research program was developed and implemented by the Alberta Research Council and ESSO Resources Canada Limited to identify the impact of different loading rates of KCl, NaCl, and freshwater gel drilling wastes landspread on Luvisolic soils occurring in the Cold Lake area.

During 1992 four site visits were made to complete various tasks. The plots were harvested on June 22 and 23 and, again, on August 17 and 18 at which time soil sampling was also completed. Plant tissue was collected for analytical purposes on June 22.

Observations, relative to the brome grass growth on the various plot treatments, were made throughout the growing season. The yields obtained in 1992 were relatively similar for the three waste types. There were apparent yield differences between the different treatments for each of the waste types, however only differences for a few of the NaCl treatments were statistically significant.

The soil and soil/waste samples obtained were analyzed for a number of parameters, including pH, CaCO_3 equivalent, soluble ions in saturated paste extracts, and total elemental content.

In 1992 the highest mean pH value recorded was 7.5 for treatment FW5 which represents the upper limit of the good rating when considering soil quality associated with a forage crop end land use. The CaCO_3 equivalent values indicated that none of the treatments would be limiting to plant growth as a result of CaCO_3 levels.

The saturated paste extract data illustrated the changes that occurred in the soils as a result of waste application and the changes that occurred between the 1988, 1989, 1990, 1991, and 1992 sampling events. The mean EC values for all plots and all depths prior to waste application were well below 1.0 dS/m suggesting that there was no limitation to plant growth on the basis of EC (Alberta Soils Advisory Committee 1977). Data from the 1992 sampling program indicated that no limitations to plant growth should occur in the 0 to 15 cm depth interval for any of the treatments as a result of EC level.

The mean SAR values for all plots and all depths, prior to waste application, were below 1.0, suggesting that on the basis of SAR levels, the soils presented no limitation to plant growth. The 1992 data indicated that there were no limitations to plant growth on the basis of SAR for all treatments, except a slight limitation associated with the NaCl 10 treatment.

Elemental content levels increased or decreased slightly as a result of waste addition. Mean values, for the various elements determined, were within the range of values normally found in soils.

The effect of the addition of drilling wastes on the elemental enrichment of the brome grass was demonstrated by the enrichment ratio (ER). The tissue from the treated plots exhibited slightly elevated levels of sodium and chloride for all waste types. Tissue copper and zinc levels were improved (increased) by the addition of the drilling waste materials.

The application of the different wastes at various rates had both positive and negative impacts on the soils and the plants grown thereon. Some conclusions with respect to waste application rates that can be applied were drawn. Determining maximum tolerable loading rates was difficult to do in the absence of guidelines as to how "tolerable" is defined. It was also concluded that liming potential as well as chloride addition should be used for assessing application rates for freshwater gel wastes.

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ACKNOWLEDGEMENTS

The authors would like to thank Mr. M. Moir of ESSO Resources Canada Limited Research Laboratory (Calgary) and ESSO Resources Canada Limited Cold Lake Operations staff for their assistance and input to the project. We would also like to thank J. Beres, P. Chong, M. Huemmert, C. Mascher and T. Pojasok for their assistance in conducting the field work and the Environmental Research and Engineering Laboratory staff of the Alberta Research Council for conducting the analytical work.

1. INTRODUCTION

Drilling associated with the oil industry generates wastes that must be disposed of in an environmentally safe manner. Drilling in the Cold Lake area generates a number of different types of wastes dominated by freshwater gel wastes and potassium chloride (KCl) and sodium chloride (NaCl) types to a lesser extent. Landspreading is one of the disposal options available and loading rate guidelines have been established by the Energy Resources Conservation Board (ERCB 1975).

The Alberta Research Council had conducted research into sampling and characterization strategies to characterize major drilling waste types on a province wide basis (Macyk et al. 1989b). Greenhouse work was conducted to assess the impact of these wastes on soils and plants. Field studies designed to validate and calibrate the greenhouse results are very helpful from an operations standpoint to define maximum or tolerable loading on the basis of waste type.

As a result a joint program was developed by the Alberta Research Council and ESSO Resources Canada Limited and undertaken in the Cold Lake area in 1988. This report describes the results of the research conducted in 1992.

2. OBJECTIVE

The objective of the experiment is to identify the impact of different loading rates of KCl, NaCl, and freshwater gel drilling wastes landspread on Luvisolic soils commonly occurring in the Cold Lake area. Emphasis was placed on determining maximum tolerable loading rates.

3. MATERIALS AND METHODS

This section describes the procedures used in collecting tissue samples, determining yield and sampling the soils and waste/soil mixtures associated with the plots established in 1988 (Macyk et al. 1989a).

Figures 1 to 4 illustrate the location of the study area as well as the experimental design and key to plot layout for the purposes of sample collection and data reporting.

3.1 PLOT MAINTENANCE

Four site visits were made during the year to complete various tasks. While on site, weed control particularly in the border areas between plots was undertaken. During harvest operations additional rock and root picking was undertaken.

Fertilizer was applied at a rate of 130 kg/ha of 35-15-0 on April 15, 1992.

3.2 PLANT TISSUE COLLECTION

Tissue from the brome grass was collected on June 22, 1992. Approximately 40 percent of the crop was headed at the time of sampling. Again in 1992, a larger proportion of the crop was headed in the plots with the higher waste application rates as compared to the lower rate and control plots.

Plant material was collected from several locations within each plot and the samples were transported to the laboratory in paper bags and dried at 70°C for 24 hours prior to grinding and analysis.

3.3 YIELD DETERMINATION

The plots were harvested on June 22 and 23, 1992. A second harvest was completed August 17 and 18 to ensure that the plots are relatively residue free in the spring of 1993.

The harvesting was done by use of a lawn mower so that all plant material from each plot could be removed. Harvesting the entire plot removed any bias from randomly selecting smaller unit areas within each plot and the use of a mower set at a given height ensured, to the greatest extent possible, uniformity in harvest. Furthermore, harvesting entire plots results in a neat and tidy experimental area for subsequent monitoring events.

All material from each plot was weighed to determine the fresh weight. A subsample of this fresh material was weighed and transported to the laboratory for drying so that a dry weight could be determined for each plot.

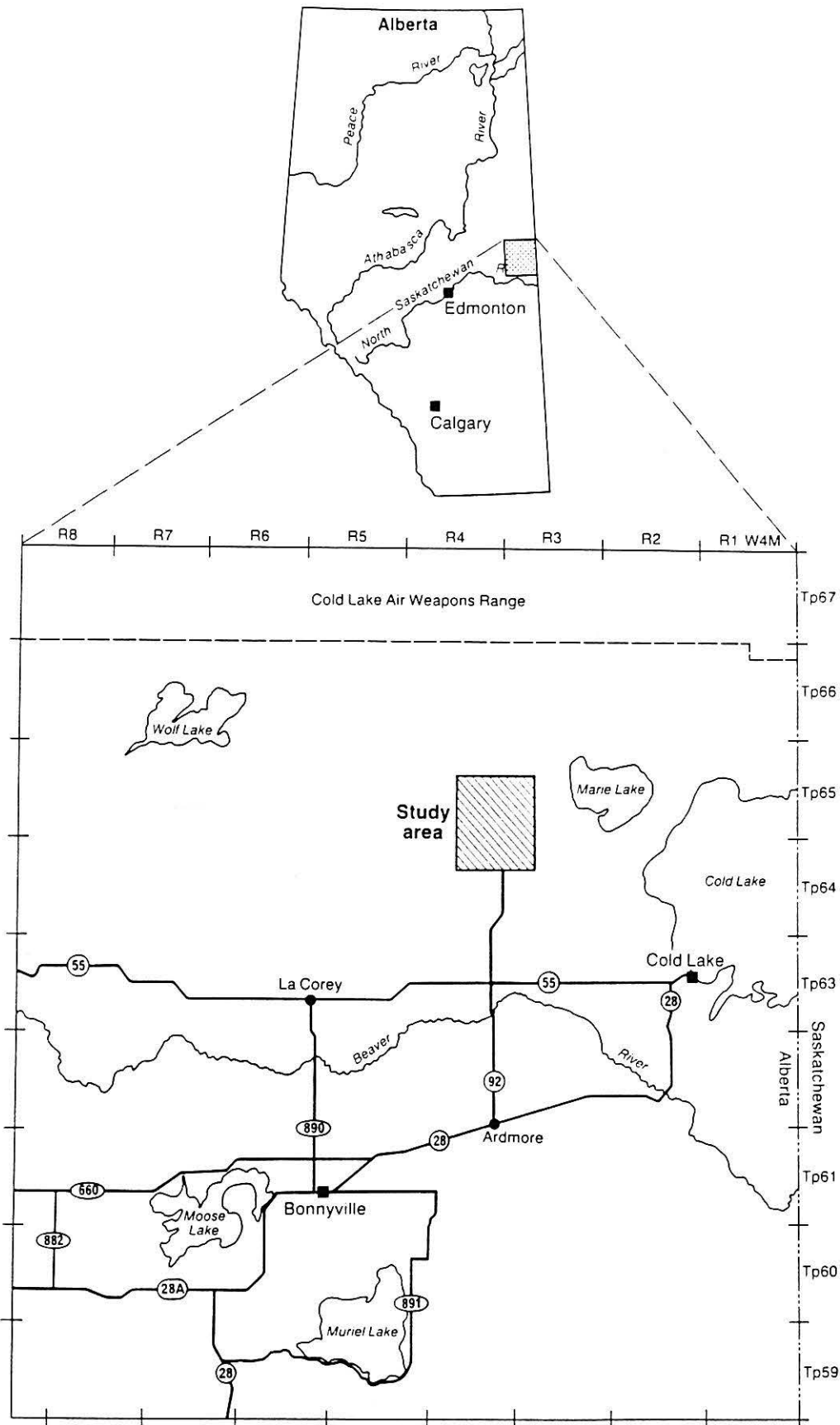


Figure 1. Location of drilling waste landspreading study area.

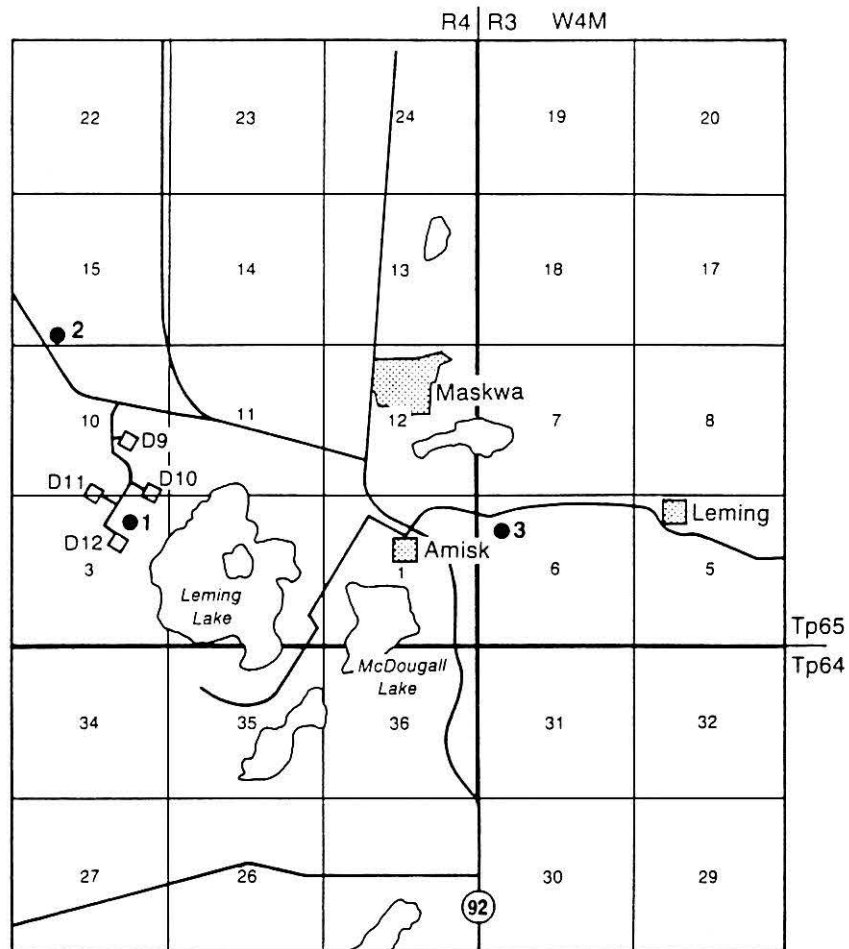


Figure 2. Location of plot area and waste source sites.

- 1 - Plot location
- 2 - NaCl sump site
- 3 - Freshwater gel sump site

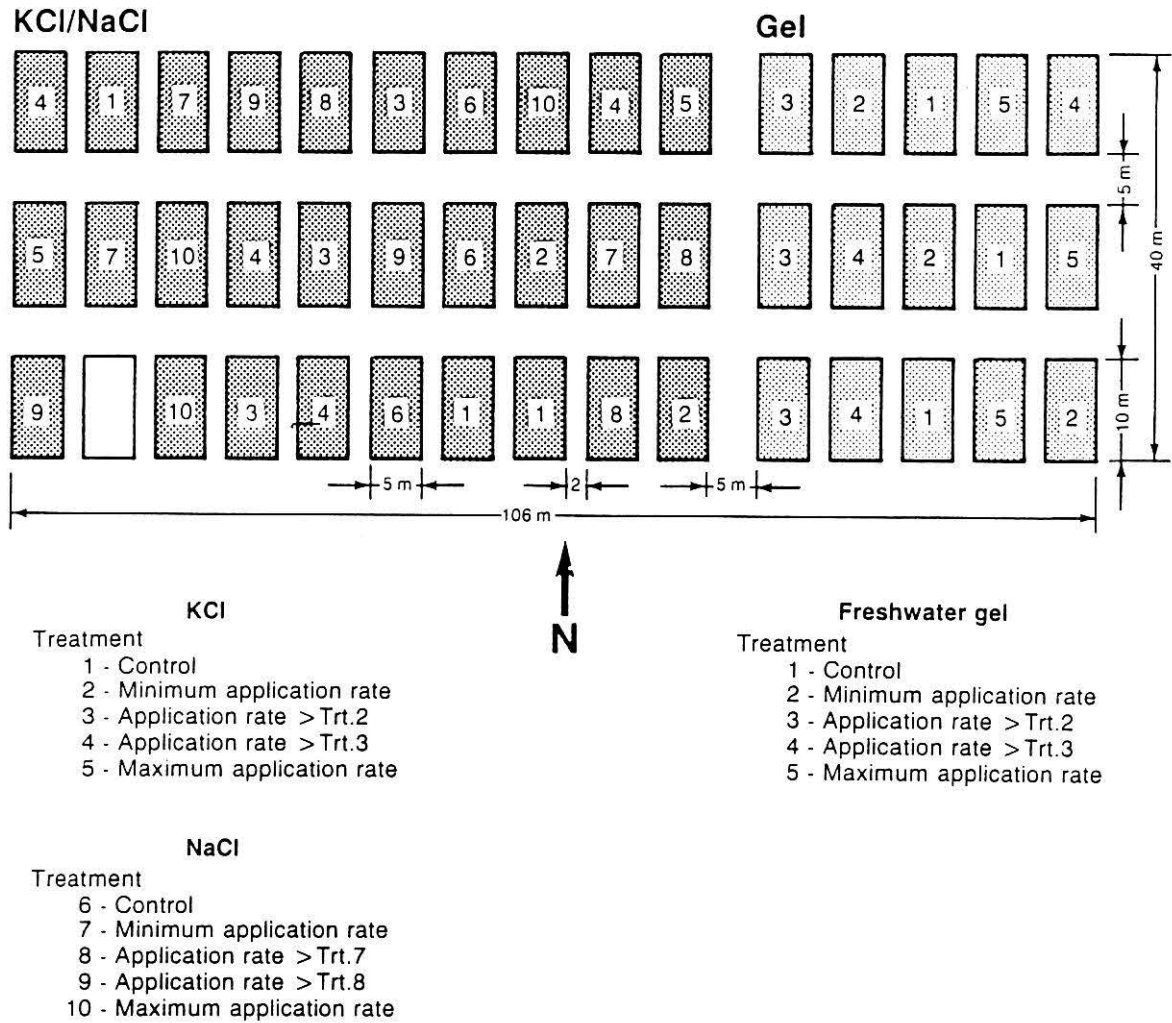


Figure 3. Schematic diagram of experimental design.

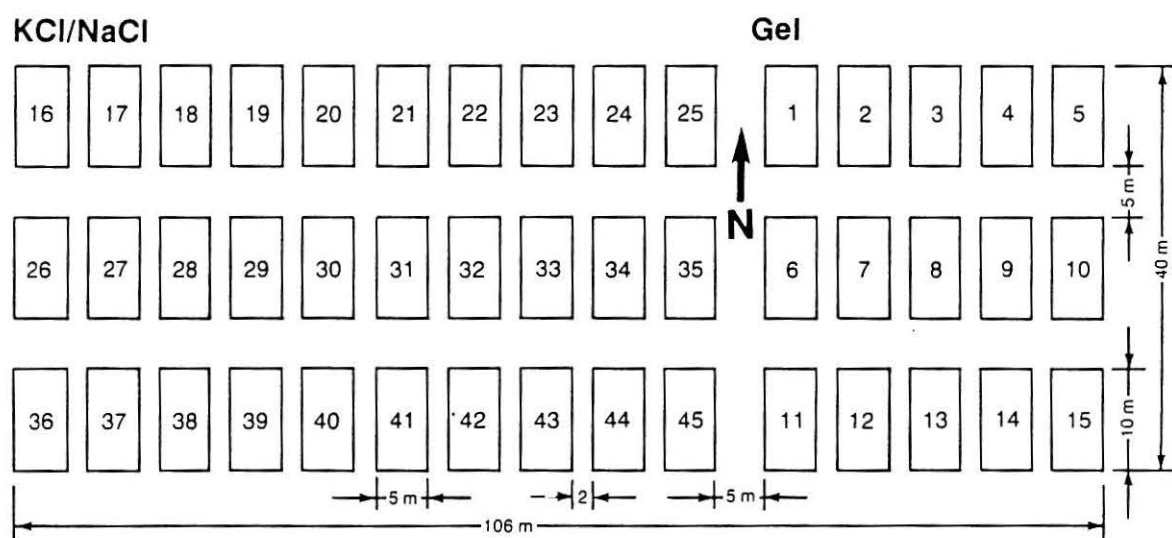


Figure 4. Key to plot layout for sample collection and data reporting.

3.4 SOIL SAMPLING

Soil sampling was completed August 17 and 18, 1992. Samples from the 0 to 15 cm depth interval were taken from each plot. In some plots a composite sample of five locations was obtained and in selected plots five individual samples were collected to assess degree of variability of the chemical parameters. Use of a truck mounted core sampling unit allowed for sampling of the 15 to 30 cm, 30 to 45 cm, 45 to 60 cm, 60 to 75 cm, 75 to 90 cm, and additional depth intervals to 150 cm at some locations. Details regarding sample distribution are provided in Table 1.

3.5 CLIMATE MONITORING

Climate monitoring equipment installed at the experimental site in 1989 was maintained during 1992. Data collection included the measurement of air temperature, precipitation, wind speed and direction, solar radiation and relative humidity. Rainfall amount and intensity were also measured.

3.6 METHODS OF ANALYSIS

This section describes the methods used for analysis of the soils, soil and waste mixtures, and the tissue collected.

3.6.1 Drilling Waste and Soil Analyses

Soil pH was measured in a paste (Doughty 1941) and in a 2:1 slurry of 0.01 M CaCl_2 (Peech 1965). Total carbon content was measured with a LECO CR12 carbon analyser (Leco Corporation 1979), and CaCO_3 equivalent by acid dissolution (Bascomb 1961). Saturated pastes were prepared according to the USDA Soil Salinity Laboratory method (USDA 1954; Rhoades 1982); were extracted and the extracts filtered through a 0.45 mm filter and analyzed for pH, electrical conductivity, alkalinity, chloride, and for soluble salts (Na, K, Ca, Al, Cr, Fe, V, Ti, Cd, Cu, Pb, Zn, Mn, Mg, Li, Sr, B, Ba, P, S, Mo, Ni, Se, As, Co, Si) using an ARL model 3680 Simultaneous Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES). Cation exchange capacity (CEC) and extractable cations were determined by extraction with a normal (1 M at pH 7.0) ammonium acetate solution (Holmgren et al. 1977), where NH_4 ions were determined by a Tecator Kjeltac Auto 1030 Analyser distillation and titration unit and the exchangeable ions by the ICP-AES.

Table 1. Soil samples collected from the individual plots.

PLOT	RATE	DEPTH	1992 Sample Number
1	FWG 3	0 to 15	TME 1
1		15 to 30	TME 2
1		30 to 45	TME 3
1		45 to 60	TME 4
1		60 to 75	TME 5
2	FWG 2	0 to 15	TME 6
3	FWG 1	0 to 15	TME 7
4*	FWG 5	0 to 15	TME 8
5	FWG 4	0 to 15	TME 9
5		15 to 30	TME 10
6	FWG 3	0 to 15	TME 11
7	FWG 4	0 to 15	TME 12
7		15 to 30	TME 13
7		30 to 45	TME 14
7		45 to 60	TME 15
7		60 to 75	TME 16
7		75 to 90	TME 17
7		90 to 110	TME 18
8	FWG 2	0 to 15	TME 19
8		15 to 30	TME 20
9	FWG 1	0 to 15	TME 21
10*	FWG 5	0 to 15	TME 22 To TME 26
10*		15 to 30	TME 27
10		30 to 45	TME 28
10		45 to 60	TME 29
10		60 to 75	TME 30
10		75 to 90	TME 31
10		90 to 105	TME 32
10		105 to 115	TME 33
11*	FWG 3	0 to 15	TME 34
12	FWG 4	0 to 15	TME 35

Table 1 (continued).

PLOT	RATE	DEPTH	1992 Sample Number
13	FWG 1	0 to 15	TME 36
13		15 to 30	TME 37
13		30 to 45	TME 38
13		45 to 60	TME 39
13		60 to 75	TEM 40
13		75 to 90	TEM 41
13		90 to 105	TME 42
14	FWG 5	0 to 15	TME 43
14		15 to 30	TME 44
14		30 to 45	TME 45
14		45 to 60	TME 46
14		60 to 75	TME 47
14		75 to 90	TME 48
14		90 to 105	TME 49
15	FWG 2	0 to 15	TME 50
16*	KCl 4	0 to 15	TME 51 to TME 55
16*		15 to 30	TME 56
16		30 to 45	TME 57
16		45 to 60	TME 58
16		60 to 75	TME 59
16		75 to 90	TME 60
16		90 to 110	TME 61
17	KCl 1	0 to 15	TME 62
18	NaCl 7	0 to 15	TME 63
19*	NaCl 9	0 to 15	TME 64 to TME 68
19*		15 to 30	TME 69
19		30 to 45	TME 70
19		45 to 60	TME 71
19		60 to 75	TME 72
19		75 to 90	TME 73
19		90 to 110	TME 74
19		105 to 120	TME 75
19		120 to 140	TME 76
20	NaCl 8	0 to 15	TME 77
21*	KCl 3	0 to 15	TME 78

Table 1 (continued).

PLOT	RATE	DEPTH	1992 Sample Number
22	NaCl 6	0 to 15	TME 79
22		15 to 30	TME 80
22		30 to 45	TME 81
22		45 to 60	TME 82
22		60 to 75	TME 83
22		75 to 90	TME 84
22		90 to 105	TME 85
22		105 to 120	TME 86
22			
23*	NaCl 10	0 to 15	TME 87 to TME 91
23*		15 to 30	TME 92 to TME 96
23		30 to 45	TME 97
23		45 to 60	TME 98
23		60 to 75	TME 99
23		75 to 90	TME 100
23		90 to 105	TME 101
23		105 to 120	TME 102
23		120 to 140	TME 103
24	KCl 4	0 to 15	TME 104
25*	KCl 5	0 to 15	TME 105 to TME 109
25*		15 to 30	TME 110 TO TME 114
25		30 to 45	TME 115
25		45 to 60	TME 116
25		60 to 75	TME 117
25		75 to 90	TME 118
25		90 to 105	TME 119
25		105 to 120	TME 120
25		120 to 135	TME 121
25		135 to 150	TME 122
25		150 to 165	TME 123
25		165 to 180	TME 124
25			
25			
26	KCl 5	0 to 15	TME 125
26		15 to 30	TME 126
27*	NaCl 7	0 to 15	TME 127
27		15 to 30	TME 128

Table 1 (continued).

PLOT	RATE	DEPTH	1992 Sample Number
28*	NaCl 10	0 to 15	TME 129 to TME 133
28*		15 to 30	TME 134 to TME 138
28		30 to 45	TME 139
28		45 to 60	TME 140
28		60 to 75	TME 141
28		75 to 90	TME 142
28		90 to 105	TME 143
28		105 to 120	TME 144
28		120 to 135	TME 145
28		135 to 150	TME 146
29	KCl 4	0 to 15	TME 147
29		15 to 30	TME 148
29		30 to 45	TME 149
29		45 to 60	TME 150
29		60 to 75	TME 151
29		75 to 90	TME 152
29		90 to 105	TME 153
29		105 to 120	TME 154
29		120 to 135	TME 155
30	KCl 3	0 to 15	TME 156
31*	NaCl 9	0 to 15	TME 157 to TME 161
31*		15 to 30	TME 162 to TME 166
31		30 to 45	TME 167
31		45 to 60	TME 168
31		60 to 75	TME 169
31		75 to 90	TME 170
31		90 to 105	TME 171
31		105 to 120	TME 172
31		120 to 135	TME 173
31		135 to 150	TME 174
32	NaCl 6	0 to 15	TME 175
33	KCl 2	0 to 15	TME 176
34*	NaCl 7	0 to 15	TME 177 to TME 181
34		15 to 30	TME 182

Table 1 (continued).

PLOT	RATE	DEPTH	1992 Sample Number
35*	NaCl 8	0 to 15	TME 183 to TME 187
35		15 to 30	TME 188
35		30 to 45	TME 189
35		45 to 60	TME 190
35		60 to 75	TME 191
35		75 to 90	TME 192
35		90 to 105	TME 193
35		105 to 120	TME 194
35		120 to 135	TME 195
36*	NaCl 9	0 to 15	TME 196
36		15 to 30	TME 197
37	KCl	0 to 15	TME 198
38*	NaCl 10	0 to 15	TME 199 to TME 203
38*		15 to 30	TME 204 to TME 208
38		30 to 45	TME 209
38		45 to 60	TME 210
38		60 to 75	TME 211
38		75 to 90	TME 212
38		90 to 105	TME 213
38		105 to 120	TME 214
38		120 to 140	TME 215
39	KCl 3	0 to 15	TME 216
40	KCl 2	0 to 15	TME 217
41	NaCl 6	0 to 15	TME 218
42*	KCl 1	0 to 15	TME 219
43	KCl 1	0 to 15	TME 220
43		15 to 30	TME 221
43		30 to 45	TME 222
43		45 to 60	TME 223
43		60 to 75	TME 224
43		75 to 90	TME 225
43		90 to 105	TME 226
43		105 to 120	TME 227
43		120 to 135	TME 228

Table 1 (concluded).

PLOT	RATE	DEPTH	1992 Sample Number
44*	NaCl 8	0 to 15	TME 229 to TME 233
44*		15 to 30	TME 234 to TME 238
44		30 to 45	TME 239
44		45 to 60	TME 240
44		60 to 75	TME 241
44		75 to 90	TME 242
44		90 to 105	TME 243
44		105 to 120	TME 244
44		120 to 135	TME 245
44		135 to 150	TME 246
	KCl 2	0 to 15	TME 247
45*		15 to 30	TME 248
45		30 to 45	TME 249
45		45 to 60	TME 250
45		60 to 75	TME 251
45		75 to 90	TME 252
45		90 to 105	TME 253
45		105 to 120	TME 254
45		120 to 135	TME 255

DTPA- NH_4HCO_3 extractable elements (Fe, Cd, Cu, Pb, Zn, Mn, Ca, Mg, Na, K, B, P, Mo, Ni, Se) were determined by the method of Soltanpour and Workman (1981). Total elemental analysis of the samples was done by digestion in a CEM microwave digestion system. The procedure used included ashing the material overnight in a 425°C muffle furnace, digestion in a teflon bomb in the microwave oven with 1.5 mL HNO_3 , 4.5 mL HCl , and 10 mL HF for 10 min at 100% power, 20 min at 50% power, and 10 min at 100% power. The digested solutions were transferred and made up with saturated H_3BO_3 to 50 mL, and the metal concentrations measured using ICP-AES.

3.6.2 Methods of Plant Analysis

The grass samples were digested with a concentrated HNO_3 - HClO_4 acid mixture in a teflon bomb heated in a CEM microwave digestion unit and the solution concentration of Al, Fe, Zn, Mn, Ca, Mg, Na, K, Sr, P, Ba, Mo, B, S, Si, and As measured by ICP-AES and Cd and Pb by graphite furnace atomic absorption. Chloride content was determined by the sodium nitrate extraction procedure of Gaines et al. (1984).

4. RESULTS AND DISCUSSION

Data pertinent to the properties of the soils prior to waste application and subsequent to waste application were reported by Macyk et al. (1989a). Data regarding the climatic parameters measured, the properties of the soils and soil/waste mixtures, and the elemental composition of the brome grass tissue for the individual plots in 1990 and 1991 were reported in Macyk et al. (1990, 1991). Data pertinent to the 1992 assessments are provided in this section of the report.

4.1 PLOT TREATMENTS

The plot treatments illustrated in Figure 3 represent various application rates of waste based on chloride concentration. Initially, the objective of the experiment was to apply 0 (control), 450 kg Cl/ha, 900 kg Cl/ha, 1800 kg Cl/ha, and 3600 kg Cl/ha. It was not possible to achieve anywhere near the suggested rates using the freshwater gel simply because of its low chloride content relative to the other waste types. Levels very close to the target values were achieved with the use of the KCl and NaCl materials. Table 2 provides the chloride levels applied for each of the treatments.

Table 2. Waste application treatments.

Treatment	Chloride Addition (kg Cl/ha)
Freshwater gel 1	0
Freshwater gel 2	15
Freshwater gel 3	30
Freshwater gel 4	60
Freshwater gel 5	120
KCl 1	0
KCl 2	500
KCl 3	1000
KCl 4	2000
KCl 5	4000
NaCl 6	0
NaCl 7	350
NaCl 8	700
NaCl 9	1400
NaCl 10	2800

4.2 CLIMATE DATA

Climate data were obtained for most of the calendar year 1992. Data pertinent to air temperature, relative humidity, solar radiation, wind direction, wind speed, and rainfall intensity are available in hard copy form from the authors.

It is important to note that all data are recorded on a mean value per hour basis. Measurements are made every three minutes and mean values computed and recorded hourly. For example, a value recorded at 14:00 hr represents the scans and mean value for the time elapsed between 13:00 and 14:00 hr. Time is always expressed as Mountain Standard Time.

4.2.1 Precipitation

The total amount of precipitation that occurs during the growing season is critical, however, the distribution of rainfall throughout the season is important for effective plant establishment and growth. The tipping bucket rain gauge is useful for assessing the distribution and intensity of rainfall events. A total of 144 mm occurred during the period April 15 to August 18, 1992. More specifically:

· April 15 to April 30	- 13 mm
· May 1 to May 31	- 43 mm
· June 1 to June 30	- 54 mm
· July 1 to July 31	- 33 mm
· August 1 to August 18	- 2 mm

One-half of the growing season precipitation occurred in May and June with rainfall recorded on seven different days in May and only four days in June. A total of 31 mm occurred on June 2, 10 mm on June 3 with the remainder of the monthly total occurring on June 22 and 23. Because of the lengthy dry spell in June yields were below 1990 and 1991 levels.

4.3 PLOT YIELD

Observations relative to the brome grass growth on the various plot treatments were made throughout the growing season. The brome grass was harvested on June 22 and 23, 1992 to obtain yield values for the different treatments. A second harvest was undertaken August 17 and 18. Again as in previous years, yield was extremely poor due to the lack of moisture in July and August.

The 1992 yield values for the individual plots are provided in Table 3 and mean values illustrated in Figure 5. A comparison of the mean yield values is presented in Table 4. The mean yield values for the different waste treatments for 1989, 1990, 1991 and 1992 are presented in Figures 6, 7, and 8.

The 1989 data indicated that the freshwater gel plot yields were at least two fold higher than the KCl and NaCl plot yields. Furthermore, for each of the waste types the yield from lower waste application rates exceeded the control yield and the two highest application rates resulted in yield values below the respective control values (Macyk et al., 1990).

In 1990 the yields for the KCl and NaCl amended plots were only slightly below the freshwater gel yields. The FW2, FW3 and FW4 treatments had mean yields greater than the control. All of the KCl waste amended plots had mean yields less than the control whereas the NaCl 8 and NaCl 9 treatments had mean yields greater than the respective control (NaCl 6) plots (Macyk et al., 1991).

In 1991 the mean yields were relatively similar for all three waste types. Furthermore, it was apparent that for each of the three waste types, the amended plots had higher mean yields than the respective controls with the exception of the KCL 2 and NaCl 7 treatments (Macyk et al., 1992).

In 1992, the prolonged dry periods in May and June significantly reduced yields compared to 1991 values, however the trends in terms of the comparison between treatments for a given waste type remained similar. For the freshwater gel plots the mean yields for the FW4 and FW5 treatments were equivalent to the FW1 (control) yields. The FW2 and FW3 yields were greater than the FW1 values. There were no significant differences in yield between the freshwater gel treatments.

The KCl3 and KCl 5 mean yields exceeded the values for the remaining treatments which were similar. There were no significant differences in yield between the KCl treatments. The NaCl 9 and NaCl 10 treatments had mean yields greater than the remaining treatments and there were significant differences between some of the NaCl treatments.

Table 3. Yield for the ESSO Field Trial Plots in June, 1992.

Treatment	Plot No:	June Harvest	
		Dry Weight (g)	Dry Weight (g) Mean value
FWG1	3	4,670	5,389
FWG1	9	5,618	
FWG1	13	5,878	
FWG2	2	8,670	6,152
FWG2	8	4,927	
FWG2	15	4,860	
FWG3	1	9,147	6,349
FWG3	6	4,016	
FWG3	11	5,884	
FWG4	5	5,494	5,478
FWG4	7	4,127	
FWG4	12	6,812	
FWG5	4	5,814	5,484
FWG5	10	5,276	
FWG5	14	5,361	
KCI1	17	5,314	6,457
KCI1	42	7,122	
KCI1	43	6,934	
KCI2	33	5,292	6,181
KCI2	40	7,884	
KCI2	45	5,367	
KCI3	21	6,382	6,853
KCI3	30	5,497	
KCI3	39	8,679	
KCI4	16	6,564	6,303
KCI4	24	6,248	
KCI4	29	6,097	
KCI5	25	9,524	7,725
KCI5	26	5,926	

Table 3 (Concluded). Yield for the ESSO Field Trial Plots in June, 1992.

Treatment	Plot No:	June	Harvest
		Dry Weight (g)	Dry Weight (g) Mean value
NaCl6	22	6,203	6,319
NaCl6	32	6,090	
NaCl6	41	6,664	
NaCl7	18	6,630	5,977
NaCl7	27	6,507	
NaCl7	34	4,793	
NaCl8	20	5,694	5,845
NaCl8	35	5,887	
NaCl8	44	5,954	
NaCl9	19	6,843	6,876
NaCl9	31	5,787	
NaCl9	36	7,997	
NaCl10	23	7,948	8,757
NaCl10	28	9,177	
NaCl10	38	9,147	

Figure 5. Mean Yield Values (Dry Weight in 1000g) in 1992.

Application	Freshwater	KCl	NaCl
Rate 1	5.4	6.5	6.3
Rate 2	6.2	6.2	6.0
Rate 3	6.3	6.9	5.8
Rate 4	5.5	6.3	6.9
Rate 5	5.5	7.7	8.8

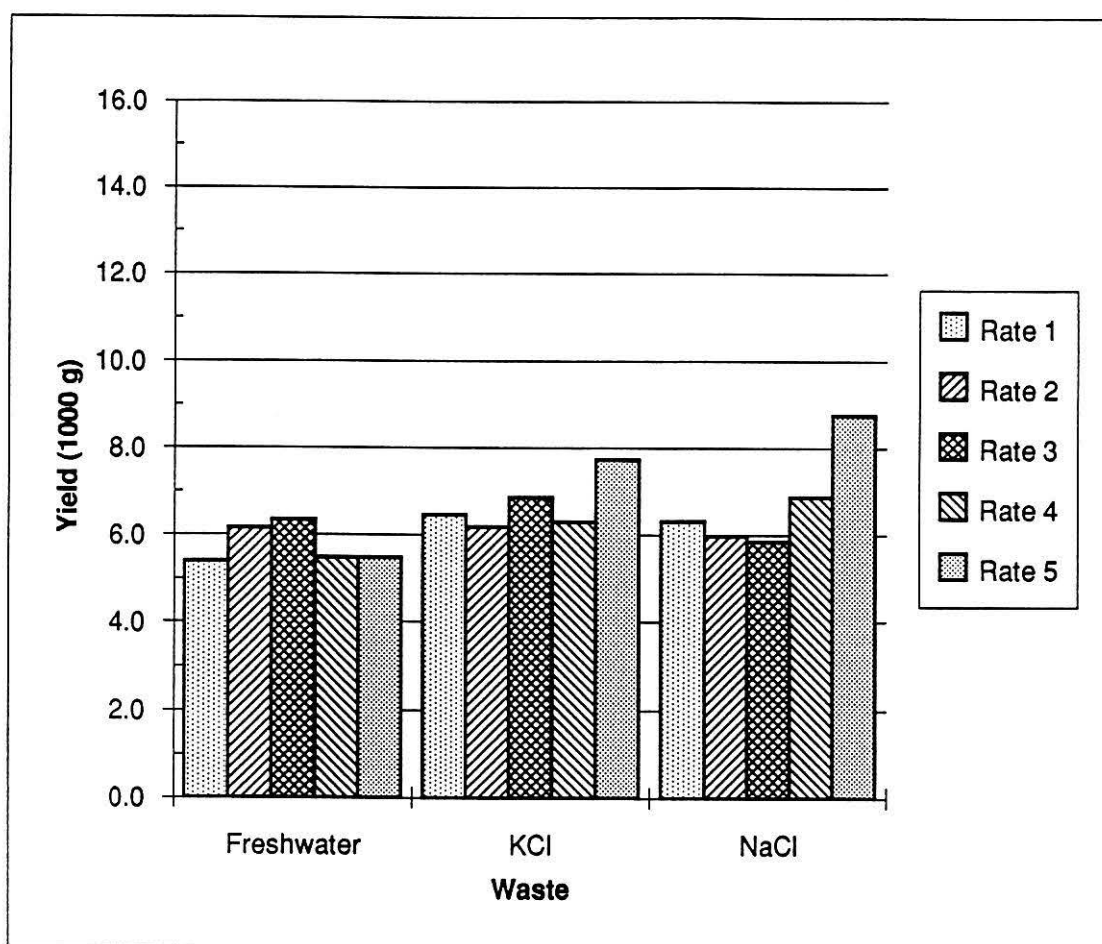


Table 4. Comparison of the Mean Yield Values for the Esso Field Trial Plots in June, 1992.

Waste	Rate	N	Yield (g)
Freshwater	1	3	5390 a*
Freshwater	2	3	6150 a
Freshwater	3	3	6350 a
Freshwater	4	3	5480 a
Freshwater	5	3	5480 a
KCl	1	3	6460 a
KCl	2	3	6180 a
KCl	3	3	6850 a
KCl	4	3	6300 a
KCl	5	2	7730 a
NaCl	6	3	6320 ab
NaCl	7	3	5980 b
NaCl	8	3	5850 b
NaCl	9	3	6880 ab
NaCl	10	3	8760 a

* Treatment means of each waste in any one column not followed by a common letter are significantly different at 0.01 probability by Tukey's Studentized Range (HSD) Test.

Figure 6. Mean Yield Values (Dry Weight in 1000g) for Freshwater Gel Treatments in 1989, 1990, 1991 and 1992.

Application	1989	1990	1991	1992
Rate 1	5.8	8.4	9.9	5.4
Rate 2	7.7	9.3	11.9	6.2
Rate 3	5.9	9.0	13.0	6.3
Rate 4	4.2	8.5	12.1	5.5
Rate 5	2.8	7.5	12.0	5.5

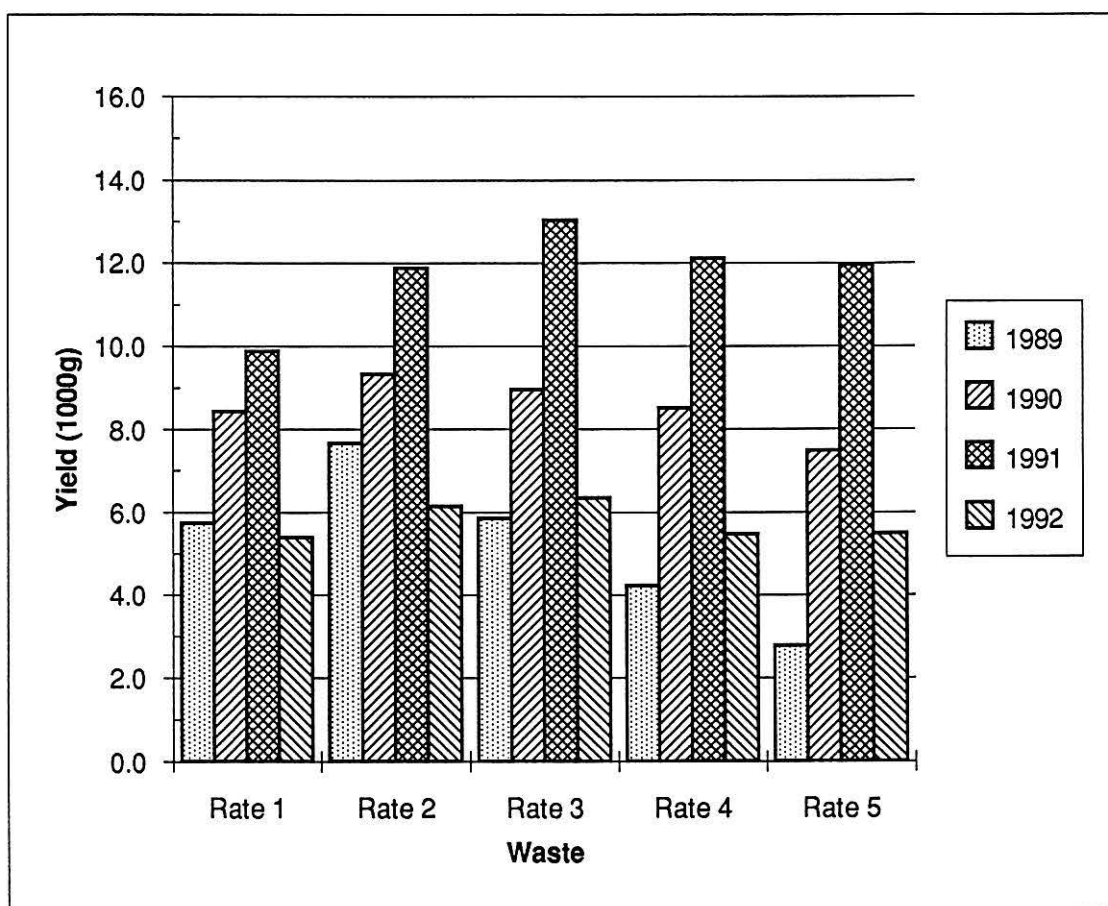


Figure 7. Mean Yield Values (Dry Weight in 1000 g) for KCl Treatments in 1989,1990,1991 and 1992.

Application	1989	1990	1991	1992
Rate 1	2.2	7.7	11.2	6.5
Rate 2	2.7	7.6	11.0	6.2
Rate 3	1.9	7.3	13.1	6.9
Rate 4	1.6	6.8	11.3	6.3
Rate 5	1.4	7.3	13.9	7.7

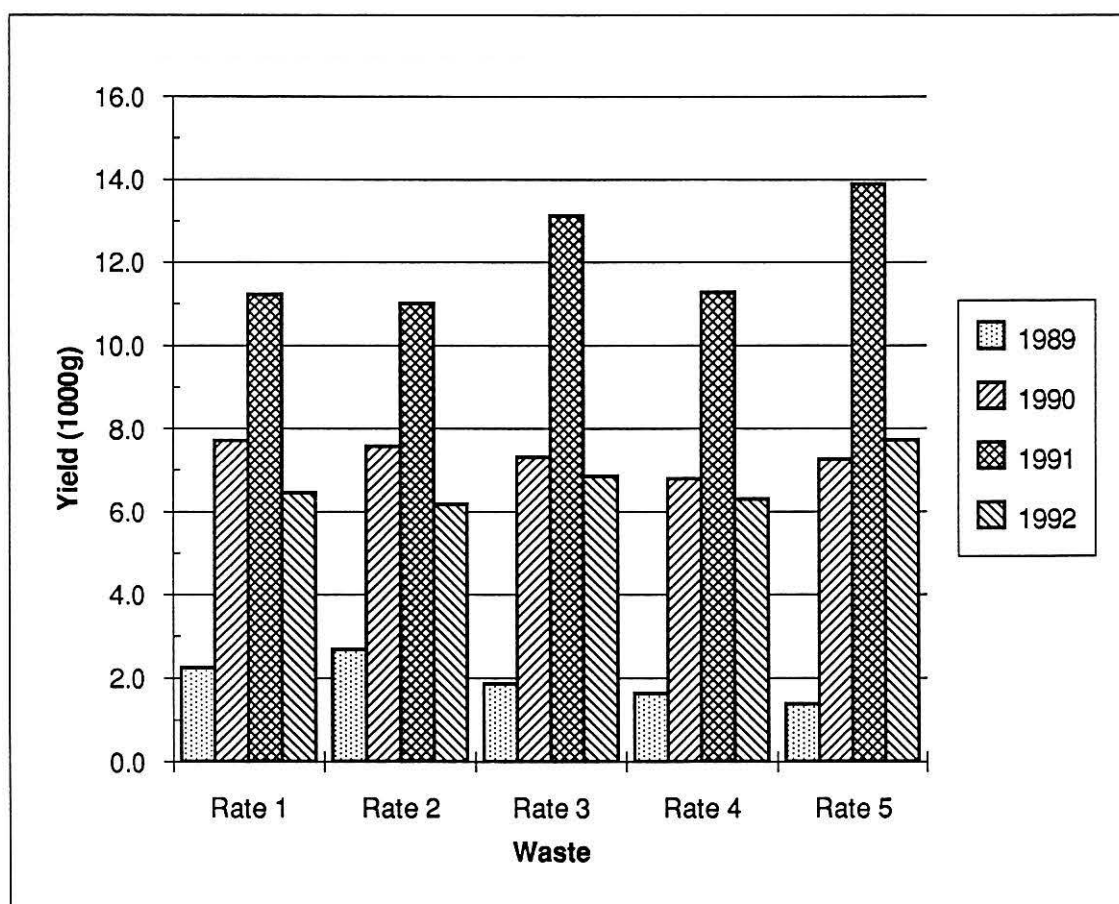
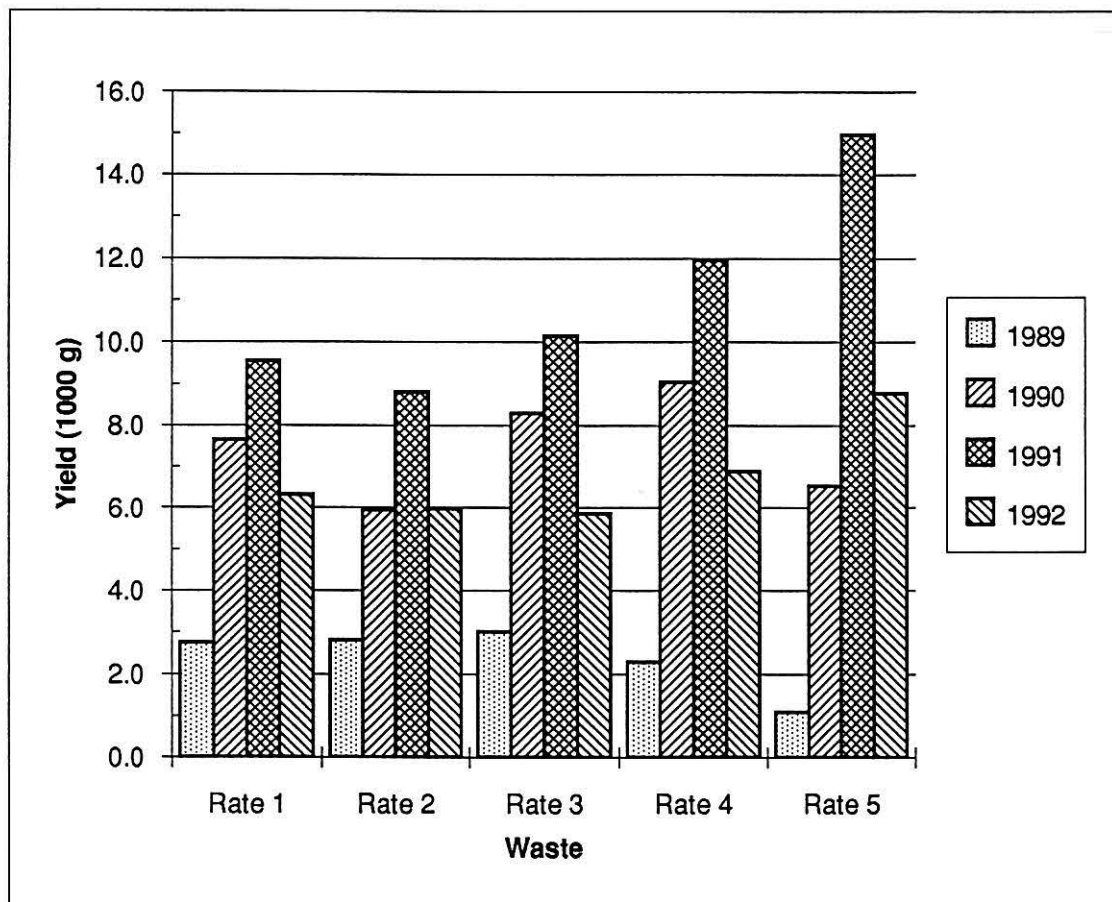


Figure 8. Mean Yield Values (Dry Weight in 1000 g) for NaCl Treatments in 1989,1990,1991 and 1992.

Application	1989	1990	1991	1992
Rate 1	2.7	7.6	9.5	6.3
Rate 2	2.8	6.0	8.8	6.0
Rate 3	3.0	8.3	10.1	5.8
Rate 4	2.3	9.0	11.9	6.9
Rate 5	1.1	6.5	15.0	8.8



The changes in trends and yield relationships with time described above can be attributed to at least two factors. First of all, the limitations to growth due to chemical properties within the upper 30 cm of the soil have changed with time since the waste was applied in 1988. For example, the high chloride concentrations evident in the surface soil following waste application (Macyk et al. 1989) have been reduced with time (Macyk et al. 1992). This topic will be addressed in more detail in the section of the report dealing with the analytical data pertinent to the plot treatments.

Secondly, the addition of the macroelements and microelements contained in the waste material continues to manifest itself in the enhanced growth at the higher waste application rates.

Plates 1 to 6 inclusive allow for a visual assessment of the growth achieved in selected plots.

4.4 FIELD PLOT SOIL PROPERTIES

A total of 77 soil samples were collected at the 45 plots prior to waste application and 207 samples were collected in mid-September 1988 approximately two months following waste application and incorporation (Macyk et al. 1989a). A total of 224 samples were collected in mid-August 1990 and 294 samples were collected in mid-August 1991. A total of 246 samples were collected in mid-August 1992.

Samples representing the 0 to 15 cm depth were collected at all plots and additional samples representing the 15 to 30 cm, 30 to 45 cm, 45 to 60 cm, 60 to 75 cm, 75 to 90 cm, 90 to 105 cm and additional depth intervals where possible were obtained at selected plots. For most plots the surface or 0 to 15 cm depth interval sample represented a composite of five sampling locations. In selected plots a total of five individual samples were collected from the 0 to 15 cm and the 15 to 30 cm depth intervals to assess variability within individual plots.

The samples obtained in 1988 and 1989 were analyzed for several chemical and physical properties, soluble ions in saturated paste extracts, plant available trace elements (DTPA extractable), and total elemental content (Macyk et al. 1989a). The samples obtained in 1990 and 1991 and 1992 were analyzed for some chemical properties as well as soluble ions in saturated paste extracts and total elemental content to assess the extent of change in salt concentration (EC and chloride levels) and elemental levels at the various depths in the different treatments.

Plate 1. Grass growth in the FW1 (control) treatment.

Plate 2. Grass growth in the FW5 (highest rate) treatment.

Plate 3. Grass growth in the KCl 1 (control) treatment.

Plate 4. Grass growth in the KCl 5 (highest rate) treatment.

Plate 5. Grass growth in the NaCl 7 (lowest rate) treatment.

Plate 6. Grass growth in the NaCl 10 (highest rate) treatment.

4.4.1 Chemical Properties

Data for chemical properties including pH and CaCO_3 equivalent are presented in Appendix 1. Table 5 provides mean values for pH (CaCl_2) and CaCO_3 equivalent for the individual depths within the various treatments for 1988 to 1991 inclusive.

The Alberta Soils Advisory Committee (1977) suggests that no limitations to plant growth occur at pH levels of 6.5 to 7.5 in the surface soil and that slight limitations occur at levels of 5.5 to 6.4 and 7.6 to 8.4. The mean pH values in the 0 to 15 cm depth interval of the freshwater gel plots ranged from 6.5 to 7.0 prior to waste application which indicates that these soils exhibited no limitation to plant growth. Following waste application, the 0 to 15 depth interval for the FW5 treatments had a mean pH value of 8 which could result in slight limitations to plant growth. The mean value in 1992 was 7.5 which is the upper limit for the "good" rating when considering a forage crop end land use.

The mean pH values in the 0 to 15 cm depth interval of the KCl plots ranged from 6.7 to 7.2 prior to waste application and 7.2 to 7.4 following waste application. In 1992 the mean pH values in the 0 to 15 cm depth interval ranged from 7.2 to 7.3 for the KCl treatments.

The mean pH values in the 0 to 15 cm depth interval of the NaCl plots ranged from 6.6 to 7.0 prior to waste application and 6.9 to 7.6 following waste application. These values indicate that the NaCl waste additions did not result in pH values that could be considered limiting to plant growth except for the NaCl 10 treatment which had a mean pH of 7.6 in the fall of 1988 and 7.4 in the fall of 1989 and 1990. In 1992 the mean pH values in the 0 to 15 cm depth interval ranged from 6.9 to 7.1 for the NaCl treatments which indicate that pH should not be a limiting factor to plant growth.

Despite the fact that pH values for the 0 to 15 cm depth for most of the treatments exceeded a value of 7.0 there is no visual indication that pH is of concern to forage growth.

The Alberta Soils Advisory Committee (1987) suggests that a CaCO_3 equivalent value of less than 2% is rated as good in terms of evaluating the suitability of surface material for revegetation in the Northern Forest Region. Values of 2 to 20% would result in a "fair" rating. The mean CaCO_3 equivalent values in the 0 to 15 cm depth interval of the freshwater gel plots ranged from 0.44 to 1.40% prior to waste application and 0.39 to 1.90% following waste application. The FW5 treatment had a mean value of 1.35% in 1992 indicating that CaCO_3 equivalent levels of the treatments prior to and following waste application would result in a "good" rating in terms of soil suitability for plant growth. Even lower values were recorded for the KCl and NaCl treatments.

Table 5. pH (CaCl₂) and CaCO₃ Equivalent (%) for the Various Treatments.

Waste	Rate	Depth cm	pH						CaCO ₃					
			Pre	Post	1989	1990	1991	1992	Pre	Post	1989	1990	1991	1992
Freshwater	1	0-15	6.5	7.0	7.1	7.2	7.3	6.9	0.44	0.39	0.72	0.48	0.20	0.17
	1	15-30	-	-	7.3	7.5	7.8	7.5	-	-	2.31	3.32	1.95	4.79
	1	30-45	-	-	7.6	7.6	7.8	7.6	-	-	4.30	5.27	4.95	-
	1	45-60	-	-	7.6	7.7	8.1	7.6	-	-	4.50	5.19	5.21	-
	1	60-75	-	-	-	7.7	7.9	7.6	-	-	-	6.07	5.34	-
	1	75-90	-	-	-	7.7	7.9	7.6	-	-	-	5.27	4.75	-
	1	90-105	-	-	-	7.6	7.9	7.6	-	-	-	4.91	3.91	-
	2	0-15	6.6	7.3	7.3	7.2	7.5	7.2	1.40	1.24	1.29	1.25	1.20	1.02
	2	15-30	-	7.3	-	6.9	7.4	7.3	-	0.40	-	0.96	0.63	0.16
	3	0-15	6.7	7.4	7.3	7.2	7.6	7.1	0.62	0.82	0.94	0.64	0.69	0.58
	3	15-30	5.0	5.8	6.9	5.4	6.3	5.9	-	0.02	0.26	0.20	0.12	-
	3	30-45	-	-	-	5.4	6.2	5.3	-	-	-	0.16	0.16	-
	3	45-60	-	-	-	4.6	5.3	4.7	-	-	-	0.02	0.12	-
	3	60-75	-	-	-	4.4	5.0	4.3	-	-	-	0.02	0.28	-
	4	0-15	6.9	7.7	7.6	7.6	7.7	7.4	0.49	0.97	1.07	0.85	1.02	0.83
	4	15-30	7.5	7.0	7.5	7.4	7.8	7.6	5.89	0.92	1.57	1.50	3.62	3.01
	4	30-45	7.7	7.8	7.8	7.9	8.1	7.8	4.81	5.69	6.84	7.15	5.94	-
	4	45-60	7.7	7.8	7.9	7.9	8.1	7.8	4.81	-	4.50	4.93	4.48	-
	4	60-75	-	-	-	7.9	8.1	7.8	-	-	-	5.02	5.01	-
	4	75-90	-	-	-	7.9	8.1	7.8	-	-	-	0.12	4.88	-
	4	90-105	-	-	-	7.9	8.1	7.8	-	-	-	5.50	4.48	-
	5	0-15	7.0	8.0	7.9	7.6	7.9	7.5	0.88	1.69	1.90	2.74	1.51	1.35
	5	15-30	7.5	7.5	7.4	7.5	7.6	7.4	4.38	1.94	1.63	1.85	2.17	2.09
	5	30-45	7.5	7.5	7.6	7.7	7.8	7.6	4.86	3.45	2.77	4.50	4.36	-
	5	45-60	7.5	7.5	7.7	7.7	7.8	7.6	4.86	3.45	4.33	5.05	4.51	-
	5	60-75	-	-	-	7.7	7.8	7.7	-	-	-	5.54	4.93	-
	5	75-90	-	-	-	7.7	7.9	7.6	-	-	-	3.94	4.57	-
	5	90-105	-	-	-	7.7	7.9	7.6	-	-	-	5.68	4.37	-
	5	105-120	-	-	-	7.7	7.8	7.6	-	-	-	4.89	3.75	-

Pre = Sampled prior to waste application

Post = Sampled September 1988

1989 = Sampled August 1989

1990 = Sampled August 1990

1991 = Sampled August 1991

1992 = Sampled August 1992

Table 5 (Continued). pH (CaCl₂) and CaCO₃ Equivalent (%) for the Various Treatments.

Waste	Rate	Depth cm	pH						CaCO ₃					
			Pre	Post	1989	1990	1991	1992	Pre	Post	1989	1990	1991	1992
KCl	1	0-15	7.2	7.3	7.4	7.3	7.8	7.2	1.73	1.25	2.02	1.98	1.64	1.41
	1	15-30	-	-	-	7.4	7.6	7.5	-	-	-	0.91	2.06	3.15
	1	30-45	-	-	-	7.6	7.9	7.5	-	-	-	3.82	3.80	-
	1	45-60	-	-	-	7.8	7.9	7.7	-	-	-	4.97	5.14	-
	1	60-75	-	-	-	7.8	8.0	7.7	-	-	-	6.10	6.28	-
	1	75-90	-	-	-	7.8	8.0	7.7	-	-	-	5.50	6.12	-
	1	90-105	-	-	-	7.8	8.0	7.7	-	-	-	5.42	5.16	-
	1	105-120	-	-	-	7.7	8.0	7.7	-	-	-	5.10	5.48	-
	1	120-135	-	-	-	7.7	8.0	7.6	-	-	-	4.68	4.99	-
	2	0-15	7.2	7.3	7.4	7.2	7.4	7.2	1.73	1.25	2.02	1.52	0.35	0.72
	2	15-30	-	-	-	6.5	6.5	-	-	-	-	2.53	0.23	-
	2	30-45	-	-	-	5.3	5.4	-	-	-	-	-	0.16	-
	2	45-60	-	-	-	5.4	5.7	-	-	-	-	-	0.22	-
	2	60-75	-	-	-	5.4	5.5	-	-	-	-	-	0.20	-
	2	75-90	-	-	-	5.4	5.5	-	-	-	-	-	0.31	-
	2	90-105	-	-	-	5.3	5.6	-	-	-	-	-	0.20	-
	2	105-120	-	-	-	5.8	5.8	-	-	-	-	-	0.16	-
	2	120-135	-	-	-	5.8	6.3	-	-	-	-	-	0.16	-
	3	0-15	6.7	7.2	7.3	7.3	7.4	7.2	0.66	0.47	0.87	1.11	0.52	0.77
	4	0-15	6.8	7.4	7.4	7.4	7.5	7.2	0.19	1.09	0.64	0.68	0.65	0.57
	4	15-30	6.5	7.4	6.3	7.3	7.5	6.8	1.64	1.36	0.49	0.73	0.69	1.62
	4	30-45	7.1	6.9	6.1	7.4	6.7	6.5	0.46	0.71	1.86	0.22	0.65	-
	4	45-60	7.1	6.9	5.9	7.1	6.7	6.5	0.46	0.35	3.41	0.39	1.80	-
	4	60-75	6.5	5.9	5.4	6.7	6.8	6.6	0.73	-	-	0.04	2.16	-
	4	75-90	6.5	5.9	5.4	6.6	6.8	6.6	0.73	-	-	0.07	1.02	-
	4	90-105	-	-	-	7.1	7.0	6.6	-	-	-	0.50	1.03	-
	4	105-120	-	-	-	6.4	6.1	6.9	-	-	-	0.08	0.00	-
	4	120-135	-	-	-	7.4	7.6	7.6	-	-	-	2.84	1.52	-
	5	0-15	6.7	7.4	7.4	7.5	7.6	7.3	0.53	0.83	1.20	0.42	0.60	0.47
	5	15-30	6.3	6.0	-	6.9	6.5	6.2	0.22	-	-	0.55	0.07	0.80
	5	30-45	5.2	4.9	-	4.6	5.1	4.8	-	-	-	0.18	0.16	-
	5	45-60	5.2	-	-	4.6	4.8	4.7	-	-	-	0.04	0.08	-
	5	60-75	5.4	-	-	4.6	5.0	4.7	0.04	-	-	-	0.16	-

Pre = Sampled prior to waste application

Post = Sampled September 1988

1989 = Sampled August 1989

1990 = Sampled August 1990

1991 = Sampled August 1991

1992 = Sampled August 1992

Table 5 (Continued). pH (CaCl₂) and CaCO₃ Equivalent (%) for the Various Treatments.

Waste	Rate	Depth cm	pH						CaCO ₃					
			Pre	Post	1989	1990	1991	1992	Pre	Post	1989	1990	1991	1992
KCl	5	75-90	5.4	-	-	4.8	5.7	4.8	-	-	-	-	0.23	-
	5	90-105	-	-	-	4.9	5.5	4.8	-	-	-	0.08	0.08	-
	5	105-120	-	-	-	5.0	5.6	4.9	-	-	-	-	0.19	-
	5	120-135	-	-	-	5.2	5.4	5.1	-	-	-	0.02	0.16	-
	5	135-150	-	-	-	-	5.7	5.2	-	-	-	-	0.08	-
	5	150-165	-	-	-	-	5.7	5.3	-	-	-	-	0.16	-
	5	165-180	-	-	-	-	5.7	5.4	-	-	-	-	0.14	-
	5	180-195	-	-	-	-	5.8	-	-	-	-	-	0.12	-
	5	195-210	-	-	-	-	5.8	-	-	-	-	-	0.04	-
NaCl	6	0-15	6.9	6.9	7.1	7.0	7.4	7.0	2.04	0.57	1.10	2.00	0.82	0.99
	6	15-30	-	-	7.3	7.5	8.0	7.4	-	-	2.49	3.76	5.44	3.42
	6	30-45	-	-	7.9	7.8	8.1	7.7	-	-	4.77	4.95	4.52	-
	6	45-60	-	-	7.9	7.8	8.1	7.7	-	-	4.69	6.24	4.13	-
	6	60-75	-	-	-	7.8	8.2	7.7	-	-	-	5.39	4.79	-
	6	75-90	-	-	-	7.8	8.1	7.7	-	-	-	4.79	5.05	-
	6	90-105	-	-	-	7.8	8.0	7.7	-	-	-	4.75	4.76	-
	6	105-120	-	-	-	7.8	8.1	7.7	-	-	-	5.15	5.15	-
	6	120-135	-	-	-	7.8	8.1	7.7	-	-	-	4.71	4.06	-
	7	0-15	6.7	7.2	7.1	7.1	7.3	6.9	1.00	0.84	0.76	0.65	0.50	0.72
	7	15-30	-	-	7.2	7.2	7.4	6.9	-	-	2.61	0.74	0.38	0.95
	8	0-15	6.6	7.6	7.4	7.2	7.5	7.0	0.37	1.27	1.00	0.92	0.54	0.50
	8	15-30	6.6	7.1	6.9	7.5	7.7	7.3	0.36	0.64	0.85	4.21	1.62	2.34
	8	30-45	6.6	6.6	7.1	7.7	7.9	7.7	4.28	3.78	5.29	4.38	4.20	-
	8	45-60	6.6	6.6	7.2	7.7	7.8	7.7	4.28	4.73	2.55	3.04	4.48	-
	8	60-75	5.5	5.4	6.3	7.8	7.9	7.7	-	-	-	3.70	4.58	-
	8	75-90	5.5	5.4	6.3	7.8	8.0	7.7	-	-	-	3.54	5.19	-
	8	90-105	-	-	-	7.8	8.0	7.7	-	-	-	3.12	5.18	-
	8	105-120	-	-	-	7.6	7.9	7.6	-	-	-	5.72	4.78	-
	8	120-135	-	-	-	7.7	8.0	7.7	-	-	-	5.36	5.11	-
	8	135-150	-	-	-	7.7	7.8	7.7	-	-	-	12.47	5.77	-

Pre = Sampled prior to waste application

Post = Sampled September 1988

1989 = Sampled August 1989

1990 = Sampled August 1990

1991 = Sampled August 1991

1992 = Sampled August 1992

Table 5 (Concluded). pH (CaCl₂) and CaCO₃ Equivalent (%) for the Various Treatments.

Waste	Rate	Depth cm	pH						CaCO ₃					
			Pre	Post	1989	1990	1991	1992	Pre	Post	1989	1990	1991	1992
NaCl	9	0-15	7.0	7.3	7.4	7.2	7.6	7.0	0.78	0.69	0.74	0.39	0.56	0.36
	9	15-30	6.4	6.2	6.9	6.8	7.3	6.7	0.11	0.21	1.19	1.10	0.39	0.27
	9	30-45	6.2	6.2	6.2	6.3	6.4	6.2	0.16	0.16	0.68	2.79	0.22	-
	9	45-60	6.2	6.1	6.3	6.3	6.4	6.1	0.16	0.08	2.18	3.03	0.43	-
	9	60-75	6.9	6.9	-	6.5	6.4	6.1	0.16	0.08	-	4.25	0.79	-
	9	75-90	6.9	6.9	-	7.6	6.6	6.2	0.16	0.08	-	4.13	0.43	-
	9	90-105	-	-	-	7.6	6.8	6.5	-	-	-	3.15	0.48	-
	9	105-120	-	-	-	-	7.3	6.5	-	-	-	-	0.67	-
	9	120-135	-	-	-	-	7.7	7.4	-	-	-	-	2.83	-
	9	135-150	-	-	-	-	7.8	7.4	-	-	-	-	4.53	-
	10	0-15	6.6	7.6	7.4	7.4	7.8	7.1	0.37	1.27	1.00	0.93	0.91	0.61
	10	15-30	6.6	7.1	6.9	7.2	7.3	6.9	0.36	0.64	0.85	1.57	0.39	0.80
	10	30-45	6.6	6.6	7.1	6.9	6.3	6.3	4.28	3.78	5.29	5.01	1.63	-
	10	45-60	6.6	6.6	7.2	6.5	6.3	6.3	4.28	4.73	2.55	1.24	1.66	-
	10	60-75	5.5	5.4	7.3	6.4	6.4	6.3	-	-	-	4.93	1.48	-
	10	75-90	5.5	5.4	7.3	6.4	6.5	6.3	-	-	-	5.37	1.58	-
	10	90-105	-	-	-	6.6	6.5	6.2	-	-	-	5.25	1.51	-
	10	105-120	-	-	-	7.1	6.8	6.5	-	-	-	5.33	1.70	-
	10	120-135	-	-	-	7.6	7.5	6.9	-	-	-	4.29	1.94	-
	10	135-150	-	-	-	7.5	7.7	7.6	-	-	-	4.63	4.14	-

Pre = Sampled prior to waste application

Post = Sampled September 1988

1989 = Sampled August 1989

1990 = Sampled August 1990

1991 = Sampled August 1991

1992 = Sampled August 1992

4.4.2 Saturated Paste Extract Data

Data for the saturated paste extract analyses are presented in Appendix 2. These data indicate the magnitude of the soluble components in a saturated solution of these materials and can be used to assess the suitability of these materials for plant growth and the possibility of trace element transport. The data include values for the soils sampled in May 1988 prior to waste application and then in September 1988, August 1989, 1990, 1991, and 1992. Waste application and incorporation was completed in July 1988 (Macyk et al. 1989a).

These data illustrate the changes that occurred resulting from the waste application and the subsequent change with time. These data can be compared to existing criteria to assess soil quality or the extent of limitation to plant growth that may occur.

4.4.2.1 Electrical conductivity (EC) values. The Alberta Soils Advisory Committee (1977) suggests that no limitations to plant growth occur at EC levels of 0 to 2 dS/m, slight limitations occur at 2 to 4 dS/m, moderate limitations occur at 4 to 8 dS/m, and severe limitations occur at values greater than 8 dS/m.

The mean EC values for all plots and all depths prior to waste application were well below 1.0 dS/m with the highest values of about 0.6 dS/m in the 0 to 15 cm depth interval (Tables 6, 7, 8). This indicated that on the basis of EC values the soils presented no limitation to plant growth. Following the application of waste materials the soil EC values increased at all locations. In the freshwater gel plots the maximum EC values were in the 1.39 to 1.44 dS/m range. These values suggested that the EC levels of the plot soils would present no limitation to plant growth. Changes in EC levels for the freshwater gel treatments are illustrated in Figure 9.

Changes in EC levels in the KCl plots were greater than those in the freshwater gel plots and are illustrated in Figure 10. For all treatments the EC values in the 0 to 15 cm depth interval decreased from the fall of 1988 to August 1989 and similarly from 1989 to 1990 with the exception of the KCl 5 treatments. Further decreases were evident from 1990 to 1991 with the exception of the KCl 2 treatments. Slight but insignificant increases in EC occurred for the KCl 3, KCl 4 and KCl 5 treatments. On the basis of the soil quality criteria described above, treatments 3, 4, and 5 would have had slight limitations to plant growth on the basis of EC for the 0 to 15 cm depth in the fall of 1988. By the fall of 1991 none of the treatments had a limitation to plant growth on the basis of EC. It should be noted that EC values for the 15 to 30, 30 to 45, 45 to 60 and 60 to 75 cm intervals in the KCl treatments increased from 1991 to 1992. This increase could be due to variability associated with sampling and possibly the upward migration of salts, however the data for the depths below 75 cm do not support the latter.

Table 6. Mean EC Values for the Various Freshwater Gel Treatments.

Rate	Depth (cm)	EC					
		Pre	Post	1989	1990	1991	1992
1	0-15	0.62	0.76	1.06	0.40	0.50	0.52
1	15-30	-	-	-	0.32	0.34	0.38
1	30-45	-	-	-	0.23	0.30	0.27
1	45-60	-	-	-	0.25	0.25	0.25
1	60-75	-	-	-	0.23	0.26	0.25
1	75-90	-	-	-	0.22	0.27	0.24
1	90-105	-	-	-	0.22	0.26	0.22
2	0-15	0.51	0.91	1.17	0.54	0.66	0.54
2	15-30	-	0.53	-	0.65	0.53	0.75
3	0-15	0.59	1.14	1.37	0.59	0.70	0.65
3	15-30	0.25	0.36	0.93	0.35	0.65	0.48
3	30-45	0.31	-	-	0.21	0.22	0.17
3	45-60	0.31	-	-	0.25	0.24	0.26
3	60-75	-	-	-	0.13	0.14	0.15
4	0-15	0.59	1.10	1.11	0.66	0.58	0.59
4	15-30	0.45	0.58	0.49	0.54	0.45	0.51
4	30-45	0.36	0.35	0.39	0.34	0.39	0.58
4	45-60	0.36	0.35	0.39	0.28	0.33	0.34
4	60-75	-	-	-	0.27	0.32	0.33
4	75-90	-	-	-	0.30	0.36	0.28
4	90-105	-	-	-	0.28	0.30	0.26
5	0-15	0.58	1.39	1.44	0.79	0.79	0.69
5	15-30	0.31	0.80	0.73	0.61	0.63	0.39
5	30-45	0.26	0.32	0.54	0.45	0.42	0.47
5	45-60	0.26	0.32	0.46	0.44	0.38	0.41
5	60-75	-	-	-	0.38	0.42	0.33
5	75-90	-	-	-	0.41	0.39	0.34
5	90-105	-	-	-	0.39	0.37	0.35
5	105-120	-	-	-	0.52	0.51	0.45

Pre = Sampled prior to waste application

Post = Sampled September 1988

EC (dS/m)

Table 7. Mean EC Values for the Various KCl Treatments.

Rate	Depth (cm)	EC					
		Pre	Post	1989	1990	1991	1992
1	0-15	0.51	0.86	0.72	0.42	0.39	0.44
1	15-30	-	-	-	0.42	0.46	0.38
1	30-45	-	-	-	0.32	0.32	0.31
1	45-60	-	-	-	0.25	0.34	0.27
1	60-75	-	-	-	0.26	0.32	0.24
1	75-90	-	-	-	0.25	0.31	0.24
1	90-105	-	-	-	0.25	0.28	0.26
1	105-120	-	-	-	0.24	0.27	0.24
1	120-135	-	-	-	0.24	0.26	0.25
2	0-15	0.54	1.20	1.09	0.51	0.55	0.47
2	15-30	-	-	0.88	0.61	0.57	-
2	30-45	-	-	0.25	0.32	0.29	-
2	45-60	-	-	-	0.24	0.20	-
2	60-75	-	-	-	0.16	0.18	-
2	75-90	-	-	-	0.12	0.13	-
2	90-105	-	-	-	0.10	0.13	-
2	105-120	-	-	-	1.70	0.11	-
2	120-135	-	-	-	0.09	0.08	-
3	0-15	0.52	2.60	2.02	0.68	0.55	0.69
4	0-15	0.61	2.87	2.75	0.99	0.55	0.62
4	15-30	0.31	0.47	1.09	0.71	0.56	0.54
4	30-45	0.41	0.80	0.72	0.63	0.47	0.69
4	45-60	0.41	0.54	0.72	0.37	0.35	0.51
4	60-75	0.23	0.13	0.09	0.24	0.29	0.31
4	75-90	0.23	0.13	0.09	0.26	0.31	0.25
4	90-105	-	-	-	0.26	0.28	0.21
4	105-120	-	-	-	-	0.23	0.23
4	120-135	-	-	-	-	0.34	0.21
5	0-15	0.47	3.54	1.59	2.68	1.02	1.14
5	15-30	0.55	2.51	-	1.51	1.29	1.40
5	30-45	0.19	1.65	-	0.49	0.65	1.45
5	45-60	0.19	-	-	0.39	0.46	2.25
5	60-75	0.10	-	-	0.21	0.31	0.46
5	75-90	0.10	-	-	0.20	0.26	0.15
5	90-105	-	-	-	0.14	0.16	0.12
5	105-120	-	-	-	0.11	0.14	0.11
5	120-135	-	-	-	0.08	0.14	0.11
5	135-150	-	-	-	-	0.18	0.11
5	150-165	-	-	-	-	0.14	0.09
5	165-180	-	-	-	-	0.12	0.10
5	180-195	-	-	-	-	0.10	-
5	195-210	-	-	-	-	0.12	-

Pre = Sampled prior to waste application

Post = Sampled September 1988

EC (dS/m)

Table 8. Mean EC Values for the Various NaCl Treatments.

Rate	Depth (cm)	EC					
		Pre	Post	1989	1990	1991	1992
6	0-15	0.53	0.70	0.89	0.42	0.39	0.53
6	15-30	-	-	0.76	0.45	0.35	0.42
6	30-45	-	-	0.24	0.26	0.29	0.27
6	45-60	-	-	0.23	0.25	0.29	0.26
6	60-75	-	-	-	0.24	0.30	0.25
6	75-90	-	-	-	0.24	0.30	0.25
6	90-105	-	-	-	0.24	0.29	0.24
6	105-120	-	-	-	0.23	0.29	0.25
6	120-135	-	-	-	0.22	0.29	-
7	0-15	0.57	1.95	1.20	0.51	0.55	0.61
7	15-30	-	-	0.58	0.97	0.84	0.72
8	0-15	0.61	1.38	1.80	0.55	0.53	0.55
8	15-30	0.55	0.49	2.01	0.62	0.60	0.64
8	30-45	0.34	0.28	0.43	0.43	0.40	1.07
8	45-60	0.34	0.27	0.33	0.56	0.50	0.84
8	60-75	0.36	-	-	0.63	0.58	0.53
8	75-90	0.36	-	-	0.60	0.52	0.41
8	90-105	-	-	-	0.42	0.41	0.36
8	105-120	-	-	-	0.25	0.34	0.33
8	120-135	-	-	-	0.24	0.28	0.29
8	135-150	-	-	-	0.24	0.32	0.28
9	0-15	0.60	3.01	1.80	0.72	0.60	0.67
9	15-30	0.39	-	1.26	0.69	0.68	0.67
9	30-45	0.21	-	0.61	0.69	0.88	1.03
9	45-60	0.21	-	0.47	0.52	0.85	0.84
9	60-75	0.16	-	-	0.36	0.75	0.56
9	75-90	0.16	-	-	0.37	0.61	0.37
9	90-105	-	-	-	0.39	0.56	0.29
9	105-120	-	-	-	-	0.48	0.20
9	120-135	-	-	-	-	0.52	0.32
9	135-150	-	-	-	-	0.57	0.23
10	0-15	0.51	7.27	5.36	2.39	1.27	0.93
10	15-30	0.46	0.96	1.98	2.03	1.67	1.27
10	30-45	0.25	0.31	1.12	0.92	1.28	1.26
10	45-60	0.25	0.22	0.82	0.38	0.85	0.76
10	60-75	0.12	0.11	1.51	0.22	0.55	0.45
10	75-90	0.12	0.11	1.51	0.21	0.49	0.31
10	90-105	-	-	-	0.26	0.39	0.27
10	105-120	-	-	-	0.26	0.35	0.28
10	120-135	-	-	-	0.28	0.40	0.32
10	135-150	-	-	-	0.25	0.35	0.26

Pre = Sampled prior to waste application

Post = Sampled September 1988

EC (dS/m)

Figure 9. Change in EC values for the Freshwater Gel plots at the 0 - 15 cm depth.

Application Rate	E C					
	Pre	Post	1989	1990	1991	1992
FW1	0.6	0.8	1.1	0.4	0.5	0.5
FW 2	0.5	0.9	1.2	0.5	0.7	0.5
FW 3	0.6	1.1	1.4	0.6	0.7	0.7
FW 4	0.6	1.1	1.1	0.7	0.6	0.6
FW 5	0.6	1.4	1.4	0.8	0.8	0.7

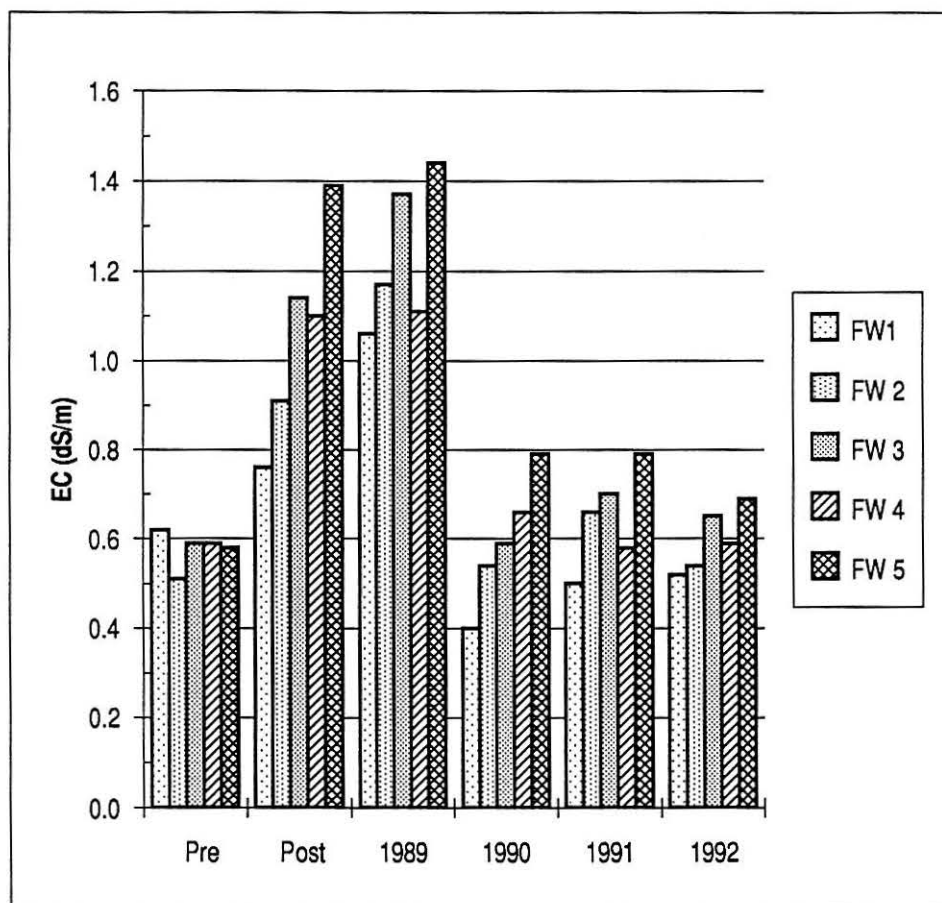
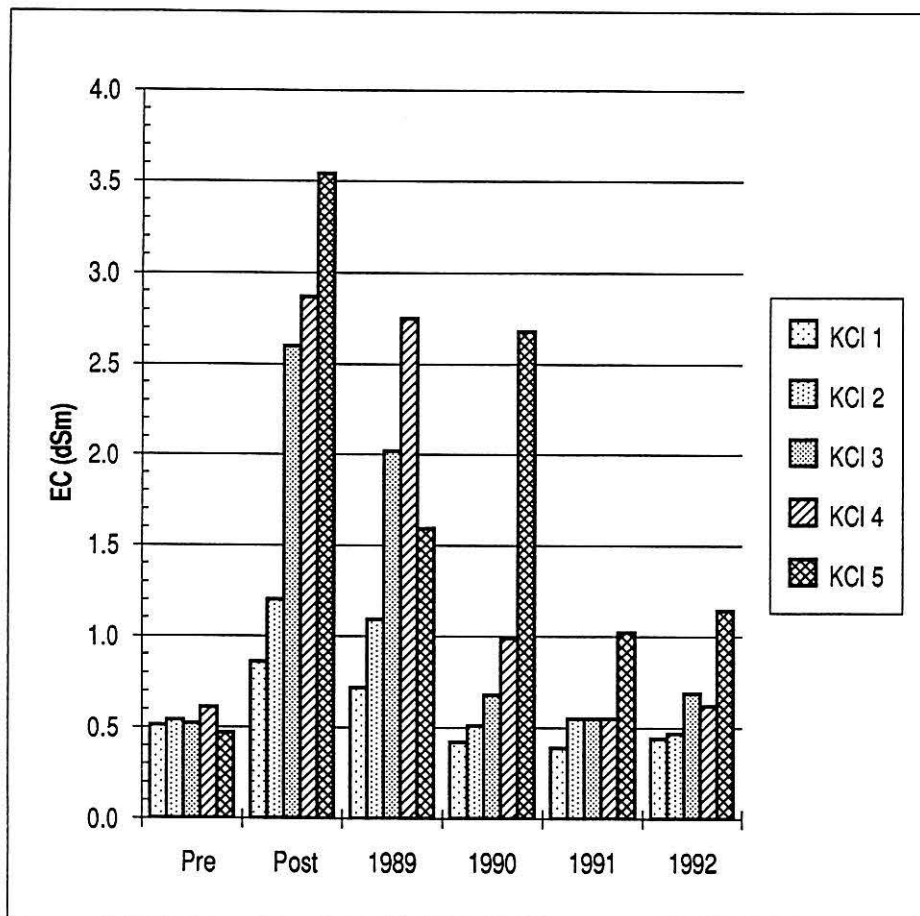


Figure 10. Change in EC values for the KCl plots at the 0 - 15 cm depth.

Application	E C					
Rate	Pre	Post	1989	1990	1991	1992
KCl 1	0.5	0.9	0.7	0.4	0.4	0.4
KCl 2	0.5	1.2	1.1	0.5	0.6	0.5
KCl 3	0.5	2.6	2.0	0.7	0.6	0.7
KCl 4	0.6	2.9	2.8	1.0	0.6	0.6
KCl 5	0.5	3.5	1.6	2.7	1.0	1.1



In the NaCl plots the mean EC values were somewhat higher than in the freshwater gel and KCl plots. The trends regarding the changes that occurred with time are similar to the freshwater gel and KCl treatments. The highest application rate of NaCl waste resulted in EC levels that suggested a moderate limitation to plant growth. The mean EC value for the NaCl 10 treatment was 7.27 dS/m in the fall of 1988 and decreased to; 5.36 dS/m by the fall of 1989, 2.39 dS/m by the fall of 1990, 1.27 dS/m by the fall of 1991, and 0.93 dS/m by the fall of 1992 (Figure 11).

It should be noted that for almost all treatments except for the highest waste application rates, EC values in the 0 to 15 cm depth interval have decreased to baseline or pre-application levels. Subsoil EC values in the various treatments are still somewhat higher than baseline values.

4.4.2.2 Sodium adsorption ratio (SAR) values. The Alberta Soils Advisory Committee (1977) presented the following criteria for SAR levels in soil:

	<u>SAR Value</u>
No limitation	<4
Slight limitation	4 to 8
Moderate limitation	8 to 12
Severe limitation	>12

The mean SAR values for all plots and all depths prior to waste application were below 1.0 suggesting that on the basis of SAR levels the soils presented no limitation to plant growth. Following waste application the soil SAR values increased at almost all depths and all plots (Table 9, 10, 11). In the freshwater gel plots the maximum SAR values were in the range of 2 to 3 which suggest that the SAR levels of the plot soils would present no limitation to plant growth. For all treatments the mean SAR values in the 0 to 15 cm depth interval decreased between the fall of 1988 and 1989, and the fall of 1989 and 1990. There was also a measurable decrease in the SAR level for the FW5 treatments between 1991 and 1992. Changes in SAR levels for the upper depth intervals in the freshwater gel treatments are illustrated in Figure 12.

The maximum mean SAR value was 2 in the 0 to 15 cm depth interval for all of the KCl treatments following waste application indicating that the KCl plot treatments would not be limiting to plant growth on the basis of SAR levels. Changes in SAR levels for the 0 to 15 cm depth intervals in the KCl treatments are illustrated in Figure 13.

Table 9. Mean SAR Values for the Various Freshwater Gel Treatments.

Rate	Depth (cm)	SAR					
		Pre	Post	1989	1990	1991	1992
1	0-15	0.3	0.5	0.3	0.2	0.2	0.2
1	15-30	-	-	-	0.3	0.4	0.4
1	30-45	-	-	-	0.4	0.4	0.4
1	45-60	-	-	-	0.4	0.4	0.4
1	60-75	-	-	-	0.4	0.4	0.4
1	75-90	-	-	-	0.4	0.5	0.7
1	90-105	-	-	-	0.4	0.5	0.4
2	0-15	0.3	1.9	1.2	0.6	0.5	0.5
2	15-30	-	0.7	-	1.0	0.7	0.9
3	0-15	0.3	2.6	1.2	0.8	0.7	0.5
3	15-30	0.4	0.7	0.8	1.0	1.2	0.9
3	30-45	0.4	-	-	0.7	0.4	0.4
3	45-60	0.4	-	-	1.7	0.3	0.4
3	60-75	-	-	-	0.9	0.3	0.3
4	0-15	0.3	2.0	1.4	0.9	0.7	0.7
4	15-30	0.6	0.6	1.1	0.8	0.9	0.9
4	30-45	0.7	0.7	0.6	0.5	0.8	0.7
4	45-60	0.7	0.7	0.7	0.5	0.7	0.6
4	60-75	-	-	-	0.6	0.8	0.6
4	75-90	-	-	-	0.6	0.6	0.6
4	90-105	-	-	-	0.5	0.6	0.5
5	0-15	0.3	3.5	2.4	1.4	1.2	0.7
5	15-30	0.4	1.7	1.3	1.0	1.2	1.3
5	30-45	0.4	0.6	0.9	0.6	1.5	1.4
5	45-60	0.4	0.6	0.4	0.5	1.0	1.3
5	60-75	-	-	-	0.3	0.6	0.8
5	75-90	-	-	-	0.3	0.5	0.5
5	90-105	-	-	-	0.4	0.4	0.4
5	105-120	-	-	-	0.4	0.5	0.4

Pre = Sampled prior to waste application

Post = Sampled September 1988

Table 10. Mean SAR Values for the Various KCl Treatments.

Rate	Depth (cm)	SAR					
		Pre	Post	1989	1990	1991	1992
1	0-15	0.3	0.5	0.3	0.3	0.3	0.3
1	15-30	-	-	-	0.3	0.3	0.4
1	30-45	-	-	-	0.4	0.5	0.4
1	45-60	-	-	-	0.4	0.5	0.4
1	60-75	-	-	-	0.4	0.6	0.4
1	75-90	-	-	-	0.4	0.5	0.4
1	90-105	-	-	-	0.4	0.5	0.4
1	105-120	-	-	-	0.4	0.5	0.4
1	120-135	-	-	-	0.4	0.4	0.5
2	0-15	0.3	0.8	0.7	0.4	0.3	0.3
2	15-30	-	-	0.5	0.5	0.5	-
2	30-45	-	-	0.4	0.4	0.6	-
2	45-60	-	-	-	0.5	0.7	-
2	60-75	-	-	-	0.5	0.6	-
2	75-90	-	-	-	1.1	0.6	-
2	90-105	-	-	-	0.6	0.6	-
2	105-120	-	-	-	0.5	0.6	-
2	120-135	-	-	-	0.5	0.5	-
3	0-15	0.3	2.0	1.5	0.7	0.3	0.4
4	0-15	0.3	1.8	1.6	0.8	0.3	0.3
4	15-30	0.4	0.4	0.9	0.6	0.4	0.5
4	30-45	0.3	0.5	0.5	0.4	0.5	0.4
4	45-60	0.3	0.3	0.5	0.5	0.5	0.4
4	60-75	0.5	0.6	1.1	0.5	0.5	0.4
4	75-90	0.5	0.6	1.1	0.6	0.5	0.5
4	90-105	-	-	-	0.5	0.4	0.4
4	105-120	-	-	-	-	0.5	0.5
4	120-135	-	-	-	-	0.3	0.3
5	0-15	0.3	1.9	1.1	1.3	0.7	0.7
5	15-30	0.3	0.8	-	0.9	0.9	0.9
5	30-45	0.5	0.6	-	0.5	0.5	0.5
5	45-60	0.5	-	-	0.4	0.5	0.8
5	60-75	0.5	-	-	0.4	0.4	0.4
5	75-90	0.5	-	-	0.5	0.5	0.5
5	90-105	-	-	-	0.5	0.5	0.6
5	105-120	-	-	-	0.6	0.5	0.5
5	120-135	-	-	-	0.5	0.5	0.7
5	135-150	-	-	-	-	0.5	0.5
5	150-165	-	-	-	-	0.5	0.5
5	165-180	-	-	-	-	0.6	0.5
5	180-195	-	-	-	-	0.6	-
5	195-210	-	-	-	-	0.5	-

Pre = Sampled prior to waste application

Post = Sampled September 1988

Table 11. Mean SAR Values for the Various NaCl Treatments.

Rate	Depth (cm)	SAR					
		Pre	Post	1989	1990	1991	1992
6	0-15	0.4	0.5	0.3	0.4	0.4	0.3
6	15-30	-	-	0.3	0.4	0.5	0.4
6	30-45	-	-	0.4	0.5	0.4	0.5
6	45-60	-	-	0.5	0.4	0.4	0.4
6	60-75	-	-	-	0.4	0.5	0.4
6	75-90	-	-	-	0.5	0.4	0.4
6	90-105	-	-	-	0.5	0.4	0.4
6	105-120	-	-	-	0.4	0.4	0.4
6	120-135	-	-	-	0.5	0.4	-
7	0-15	0.3	4.7	2.9	1.1	1.4	0.8
7	15-30	-	-	1.1	2.2	2.2	1.7
8	0-15	0.3	5.2	4.5	1.7	1.4	1.0
8	15-30	0.3	0.5	2.7	2.1	2.8	4.9
8	30-45	0.3	0.4	0.7	0.8	1.3	1.1
8	45-60	0.3	-	0.5	0.5	0.6	0.5
8	60-75	0.4	-	-	0.4	0.4	0.4
8	75-90	-	-	-	0.4	0.5	0.4
8	90-105	-	-	-	0.4	0.4	0.4
8	105-120	-	-	-	0.4	0.5	0.5
8	120-135	-	-	-	0.4	0.5	0.5
8	135-150	-	-	-	0.4	0.4	0.5
9	0-15	0.6	8.5	5.3	3.4	2.4	2.1
9	15-30	0.4	1.3	2.6	3.4	3.7	3.4
9	30-45	0.2	2.1	1.6	0.8	2.1	2.2
9	45-60	0.2	4.1	1.7	0.6	1.7	1.2
9	60-75	0.2	5.6	-	0.6	1.5	1.1
9	75-90	-	-	-	0.6	1.2	1.0
9	90-105	-	-	-	0.4	0.9	1.1
9	105-120	-	-	-	-	0.8	0.9
9	120-135	-	-	-	-	0.7	0.6
9	135-150	-	-	-	-	0.6	0.4
10	0-15	0.5	23.5	15.2	11.4	8.3	6.2
10	15-30	0.5	0.9	4.4	6.5	6.9	6.2
10	30-45	0.3	0.7	2.8	0.9	1.4	2.1
10	45-60	0.3	0.8	2.8	0.5	0.8	1.1
10	60-75	0.1	0.9	4.8	0.4	0.6	1.0
10	75-90	0.1	0.9	4.8	0.6	0.5	1.0
10	90-105	-	-	-	0.4	0.5	0.9
10	105-120	-	-	-	0.4	0.4	0.7
10	120-135	-	-	-	0.4	0.4	0.5
10	135-150	-	-	-	0.3	0.4	0.4

Pre = Sampled prior to waste application

Post = Sampled September 1988

Figure 11. Change in EC values for the NaCl plots at the 0 - 15 cm depth.

Application Rate	E C					
	Pre	Post	1989	1990	1991	1992
NaCl 1	0.5	0.7	0.9	0.4	0.4	0.5
NaCl 2	0.6	2.0	1.2	0.5	0.6	0.6
NaCl 3	0.6	1.4	1.8	0.6	0.5	0.6
NaCl 4	0.6	3.0	1.8	0.7	0.6	0.7
NaCl 5	0.5	7.3	5.4	2.4	1.3	0.9

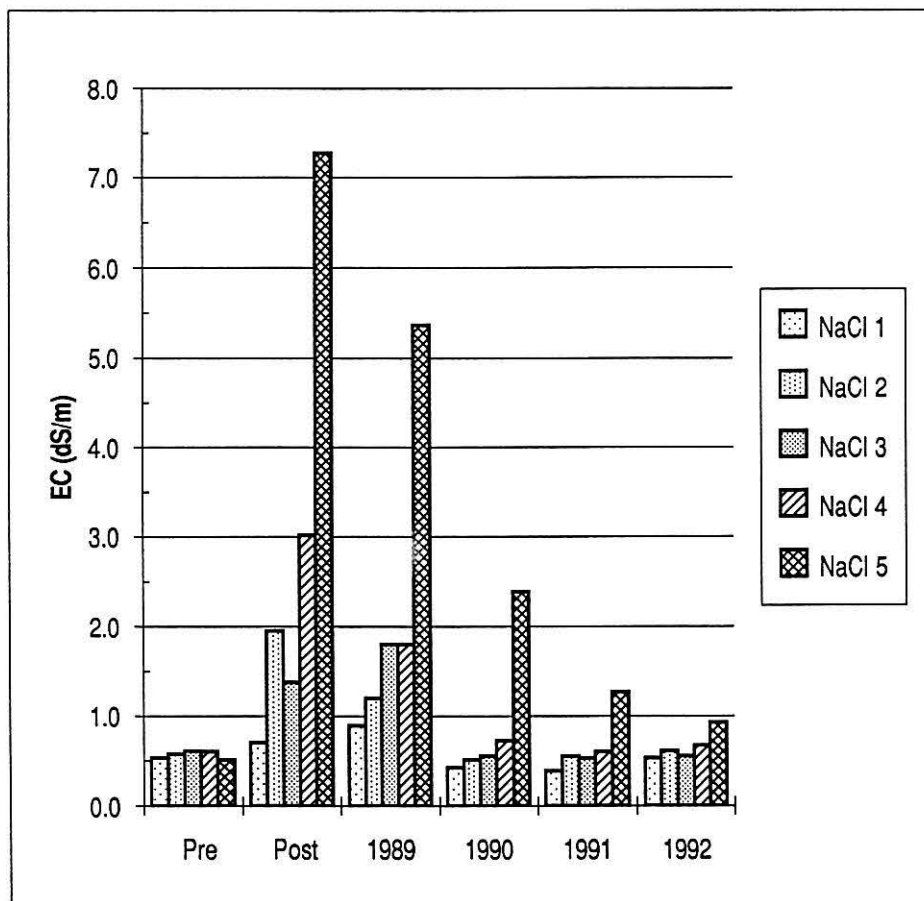


Figure 12. Change in SAR values for the Freshwater Gel plots at the 0 - 15 cm depth.

Application Rate	S A R					
	Pre	Post	1989	1990	1991	1992
FW 1	0.3	0.5	0.3	0.2	0.2	0.2
FW 2	0.3	1.9	1.2	0.6	0.5	0.5
FW 3	0.3	2.6	1.2	0.8	0.7	0.5
FW 4	0.3	2.0	1.4	0.9	0.7	0.7
FW 5	0.3	3.5	2.4	1.4	1.2	0.7

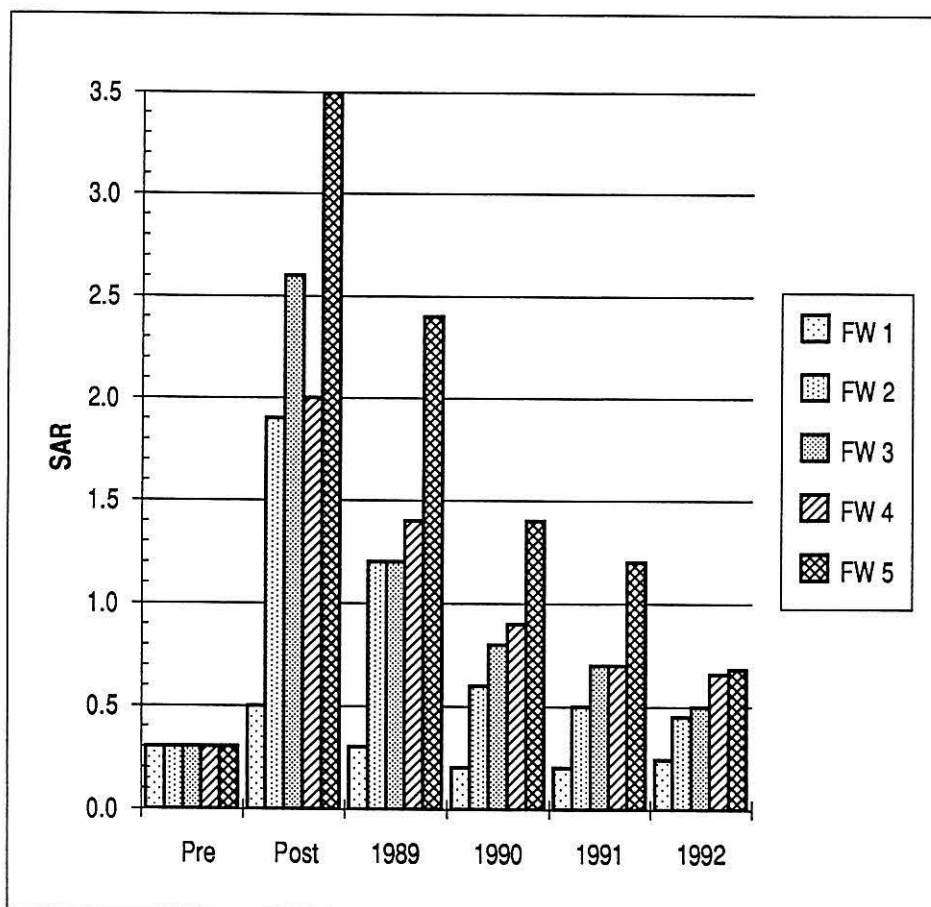
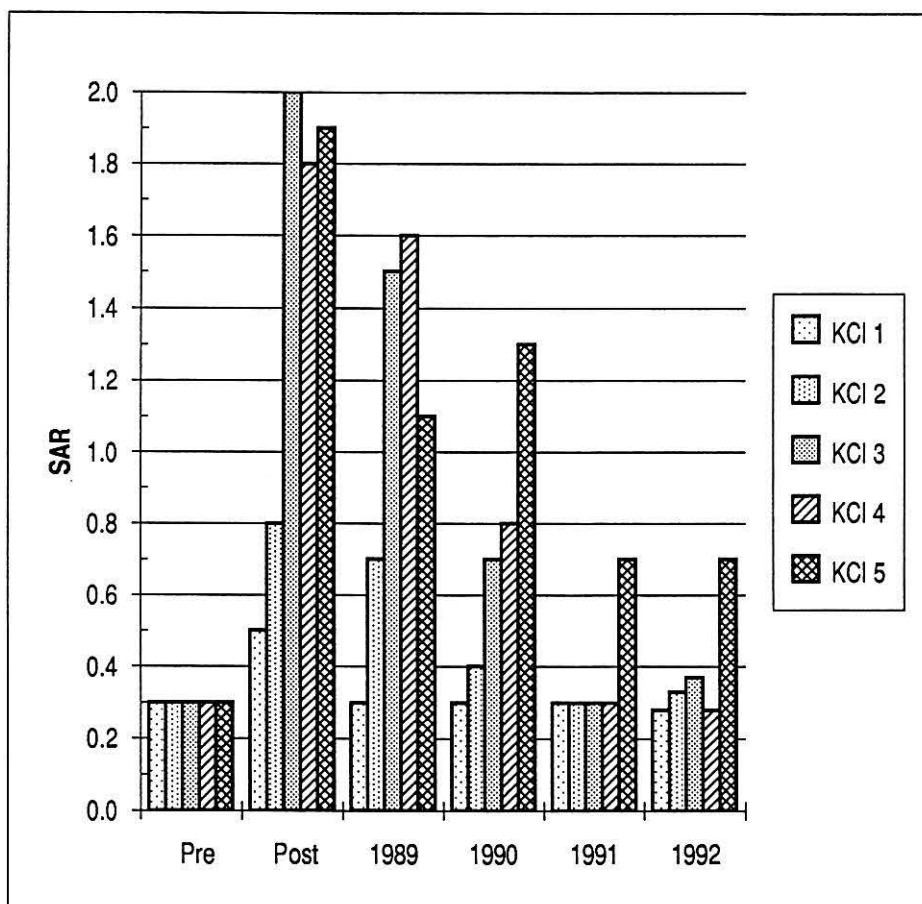


Figure 13. Change in SAR values for the KCl plots at the 0 - 15 cm depth.

Application Rate	S A R					
	Pre	Post	1989	1990	1991	1992
KCl 1	0.3	0.5	0.3	0.3	0.3	0.3
KCl 2	0.3	0.8	0.7	0.4	0.3	0.3
KCl 3	0.3	2.0	1.5	0.7	0.3	0.4
KCl 4	0.3	1.8	1.6	0.8	0.3	0.3
KCl 5	0.3	1.9	1.1	1.3	0.7	0.7



In the NaCl plots the mean SAR values were somewhat higher than in the freshwater gel and KCl plots. Following waste application, treatments 8, 9, and 10 had mean SAR levels of 5, 9, and 24 respectively in the 0 to 15 cm depth interval. These SAR values reflected the potential for slight to severe limitations to plant growth. The changes that occurred from the fall of 1988 to the fall of 1992 indicate that only the NaCl 10 treatment still has the potential for slight limitation to plant growth due to SAR level (Figure 14).

4.4.2.3 Chloride values. Maas (1986) indicated that the maximum chloride content that could be present in saturated extracts without loss of yield in grasses ranges from 1000 to 2600 ppm. Tables 12, 13, and 14 indicate that the mean chloride values for the various depths in the plot soils ranged from 6.0 to 25.9 mg/L (ppm) prior to waste application. Following the application of waste materials the Cl values increased at most depths in all plot treatments. The smallest change in Cl content occurred in the freshwater gel plots simply because of the low Cl levels in the gel wastes applied (Figure 15). Leaching of the Cl was evident by the changes that occurred between 1988 and 1991. Using the criteria of Maas (1986) indicates that the chloride concentration in the plots should have no negative impact on plant growth.

The KCl treatments had considerably higher Cl additions than the freshwater gel treatments. The rapid leaching of the Cl following waste application is illustrated in Figure 16. Using the value of 1000 ppm Cl as the level in soil that begins to impact plant growth, suggested that some limitation was possible for treatment KCl 4 and definitely a problem for treatment KCl 5 in the fall of 1988. The mean Cl values for the 0 to 15 cm depth decreased in 1989, 1990, 1991 and 1992. As indicated in the discussion relative to EC values, there was an increase in chloride content for the 30 to 45, 45 to 60 and 60 to 75 cm depth intervals for the KCl 4 and KCl 5 treatments.

The trends associated with Cl levels in the KCl waste treated plots were repeated in the NaCl waste treated plots. The rapid leaching of Cl in the KCl plot treatment is illustrated in Figure 17. Using the value of 1000 ppm Cl as the level in soil that begins to impact plant growth indicated that by the fall of 1991 there was not a limitation associated with any of the plot treatments.

Figure 14. Change in SAR values for the NaCl plots at the 0 - 15 cm depth.

Application Rate	S A R					
	Pre	Post	1989	1990	1991	1992
NaCl 1	0.4	0.5	0.3	0.4	0.4	0.3
NaCl 2	0.3	4.7	2.9	1.1	1.4	0.8
NaCl 3	0.3	5.2	4.5	1.7	1.4	1.0
NaCl 4	0.6	8.5	5.3	3.4	2.4	2.1
NaCl 5	0.5	23.5	15.2	11.4	8.3	6.2

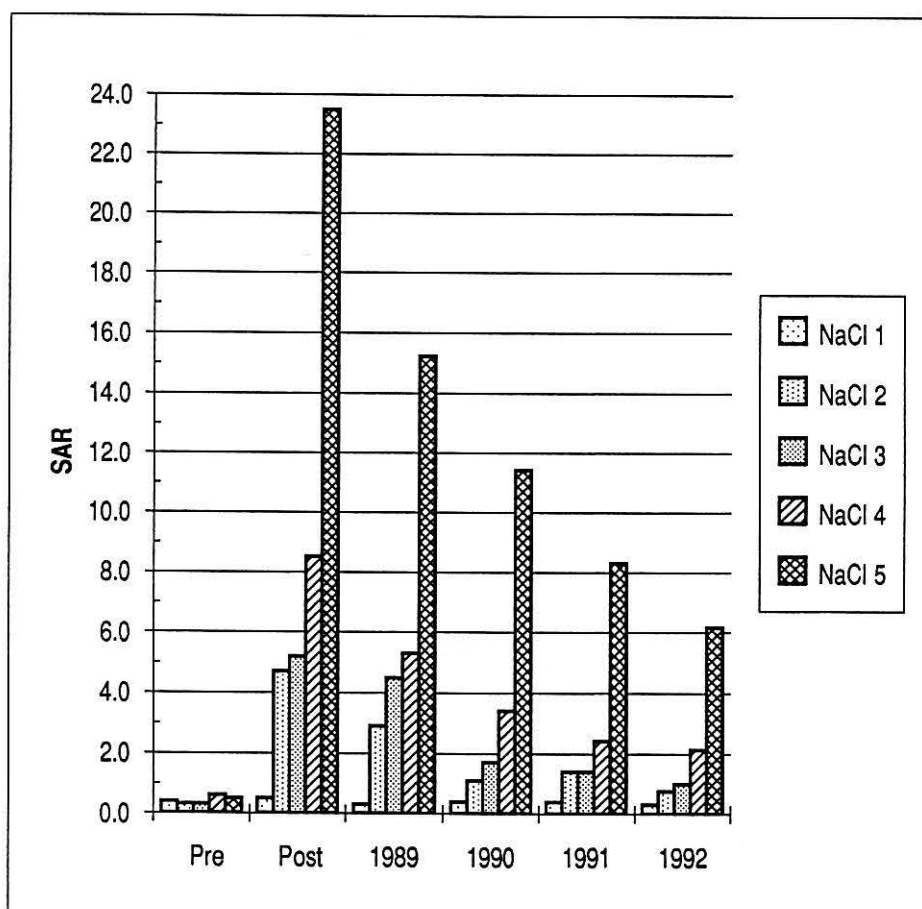


Table 12. Mean CI Values for the Various Freshwater Gel Treatments.

Rate	Depth (cm)	CI					
		Pre	Post	1989	1990	1991	1992
1	0-15	20.3	25.1	12.2	8.8	8.3	8.7
1	15-30	-	-	-	5.3	6.2	5.6
1	30-45	-	-	-	4.2	5.5	4.6
1	45-60	-	-	-	7.1	4.4	3.9
1	60-75	-	-	-	5.4	4.8	5.2
1	75-90	-	-	-	4.9	5.7	5.4
1	90-105	-	-	-	5.5	6.2	4.2
2	0-15	18.7	22.3	19.8	10.7	8.2	9.2
2	15-30	-	11.7	-	11.9	8.5	8.0
3	0-15	17.8	33.0	22.4	16.1	10.2	11.7
3	15-30	15.9	15.8	19.3	11.5	28.6	8.1
3	30-45	15.5	-	-	9.8	4.3	9.4
3	45-60	15.5	-	-	13.8	8.9	12.5
3	60-75	-	-	-	9.9	8.2	6.6
4	0-15	18.2	36.3	16.0	17.5	8.6	10.0
4	15-30	8.8	15.9	7.9	8.1	1.4	5.7
4	30-45	11.3	11.6	6.9	5.7	0.1	4.4
4	45-60	11.3	11.6	6.9	7.0	3.4	4.6
4	60-75	-	-	-	6.0	0.1	6.3
4	75-90	-	-	-	7.7	8.3	5.8
4	90-105	-	-	-	8.6	14.8	4.6
5	0-15	16.3	40.0	32.1	16.6	9.2	9.2
5	15-30	9.6	37.9	13.5	10.9	8.8	5.4
5	30-45	8.9	15.8	11.0	9.5	8.9	5.4
5	45-60	8.9	15.8	9.9	18.2	5.6	4.8
5	60-75	-	-	-	6.5	6.8	5.4
5	75-90	-	-	-	7.3	6.0	4.5
5	90-105	-	-	-	9.4	6.0	4.8
5	105-120	-	-	-	12.0	6.8	4.7

Pre = Sampled prior to waste application

Post = Sampled September 1988

CI (mg/L)

Table 13. Mean CI Values for the Various KCl Treatments.

Rate	Depth (cm)	CI					
		Pre	Post	1989	1990	1991	1992
1	0-15	19.1	22.7	13.1	13.4	12.5	13.6
1	15-30	-	-	-	5.8	10.6	11.1
1	30-45	-	-	-	6.2	7.1	5.5
1	45-60	-	-	-	5.1	10.1	5.6
1	60-75	-	-	-	4.7	7.1	5.1
1	75-90	-	-	-	5.4	12.3	5.2
1	90-105	-	-	-	6.9	8.5	5.6
1	105-120	-	-	-	6.6	6.5	4.9
1	120-135	-	-	-	6.2	5.6	5.6
2	0-15	0.6	396.0	18.8	49.5	27.5	14.8
2	15-30	-	-1.0	57.6	102.4	83.6	-
2	30-45	-	-	51.4	87.8	60.2	-
2	45-60	-	-	-	57.9	37.2	-
2	60-75	-	-	-	36.8	24.8	-
2	75-90	-	-	-	18.2	13.5	-
2	90-105	-	-	-	17.8	7.8	-
2	105-120	-	-	-	53.0	4.1	-
2	120-135	-	-	-	5.5	5.1	-
3	0-15	20.3	740.0	403.0	62.5	24.3	28.1
4	0-15	22.7	1070.0	863.0	147.4	25.1	17.8
4	15-30	11.5	69.1	386.0	150.5	24.1	68.7
4	30-45	7.9	281.1	221.0	158.7	64.2	161.4
4	45-60	7.9	52.5	43.2	74.8	49.9	117.4
4	60-75	6.0	17.9	10.2	43.0	36.8	49.4
4	75-90	6.0	17.9	10.2	50.5	30.7	32.4
4	90-105	-	-	-	56.3	27.7	16.1
4	105-120	-	-	-	-	45.5	5.8
4	120-135	-	-	-	-	32.9	5.0
5	0-15	18.2	3135.0	353.0	1214.0	120.0	95.6
5	15-30	17.6	889.0	-	630.0	261.0	261.1
5	30-45	6.7	555.0	-	146.5	146.0	474.4
5	45-60	-	-	-	115.7	93.7	724.9
5	60-75	-	-	-	56.8	56.8	136.3
5	75-90	-	-	-	45.9	38.0	34.5
5	90-105	-	-	-	29.5	23.3	22.1
5	105-120	-	-	-	19.2	19.8	13.3
5	120-135	-	-	-	12.3	14.1	13.8
5	135-150	-	-	-	-	22.2	8.7
5	150-165	-	-	-	-	13.7	7.1
5	165-180	-	-	-	-	10.8	6.5
5	180-195	-	-	-	-	10.2	-
5	195-210	-	-	-	-	12.0	-

Pre = Sampled prior to waste application

Post = Sampled September 1988

CI (mg/L).

Table 14. Mean Cl Values for the Various NaCl Treatments.

Rate	Depth (cm)	Cl					
		Pre	Post	1989	1990	1991	1992
6	0-15	25.9	35.6	37.2	26.7	14.0	12.6
6	15-30	-	-	18.2	-	14.3	11.2
6	30-45	-	-	8.2	-	9.5	9.3
6	45-60	-	-	7.0	-	9.7	7.1
6	60-75	-	-	-	-	8.3	6.8
6	75-90	-	-	-	-	7.2	6.8
6	90-105	-	-	-	-	6.8	5.7
6	105-120	-	-	-	-	6.6	6.8
6	120-135	-	-	-	-	5.8	-
7	0-15	22.2	480.0	151.0	57.0	60.2	25.3
7	15-30	-	-	75.0	190.8	145.0	93.2
8	0-15	20.8	870.0	331.0	78.9	30.6	21.0
8	15-30	13.1	85.1	496.5	134.9	73.3	70.8
8	30-45	9.1	90.3	51.0	62.0	40.4	296.1
8	45-60	9.1	9.7	41.1	113.9	87.0	224.2
8	60-75	6.9	-	-	146.6	124.0	109.1
8	75-90	6.9	-	-	136.7	105.0	62.9
8	90-105	-	-	-	71.1	65.5	47.3
8	105-120	-	-	-	20.1	35.0	31.8
8	120-135	-	-	-	13.8	16.5	17.8
8	135-150	-	-	-	7.6	15.1	5.5
9	0-15	23.4	876.0	325.0	104.2	47.1	32.8
9	15-30	19.2	168.0	307.0	129.6	90.1	89.4
9	30-45	12.8	114.2	135.4	229.9	234.0	289.6
9	45-60	12.8	188.2	116.5	120.0	256.0	263.3
9	60-75	16.4	144.1	-	124.5	205.0	168.6
9	75-90	-	144.1	-	59.0	160.0	91.0
9	90-105	-	-	-	68.4	139.0	57.4
9	105-120	-	-	-	-	113.0	34.0
9	120-135	-	-	-	-	112.0	34.0
9	135-150	-	-	-	-	125.0	6.1
10	0-15	24.4	3352.0	1728.0	956.5	253.0	112.7
10	15-30	14.6	206.1	539.0	598.0	415.0	274.3
10	30-45	7.5	42.6	306.0	332.0	412.0	409.6
10	45-60	7.5	25.4	192.0	129.2	261.0	220.0
10	60-75	8.2	20.2	454.0	56.8	157.0	100.7
10	75-90	8.2	20.2	454.0	58.6	130.0	59.4
10	90-105	-	-	-	46.4	96.5	47.7
10	105-120	-	-	-	34.3	80.8	46.7
10	120-135	-	-	-	24.2	73.0	52.3
10	135-150	-	-	-	20.0	48.9	22.9

Pre=Sampled prior to waste application

Post=Sampled September 1988

Cl (mg/L)

Figure 15. Change in Cl values for the Freshwater Gel plots at the 0 - 15 cm depth.

Application Rate	C l					
	Pre	Post	1989	1990	1991	1992
FW 1	20	25	12	9	8	9
FW 2	19	22	20	11	8	9
FW 3	18	33	22	16	10	12
FW 4	18	36	16	18	9	10
FW 5	16	40	32	17	9	9

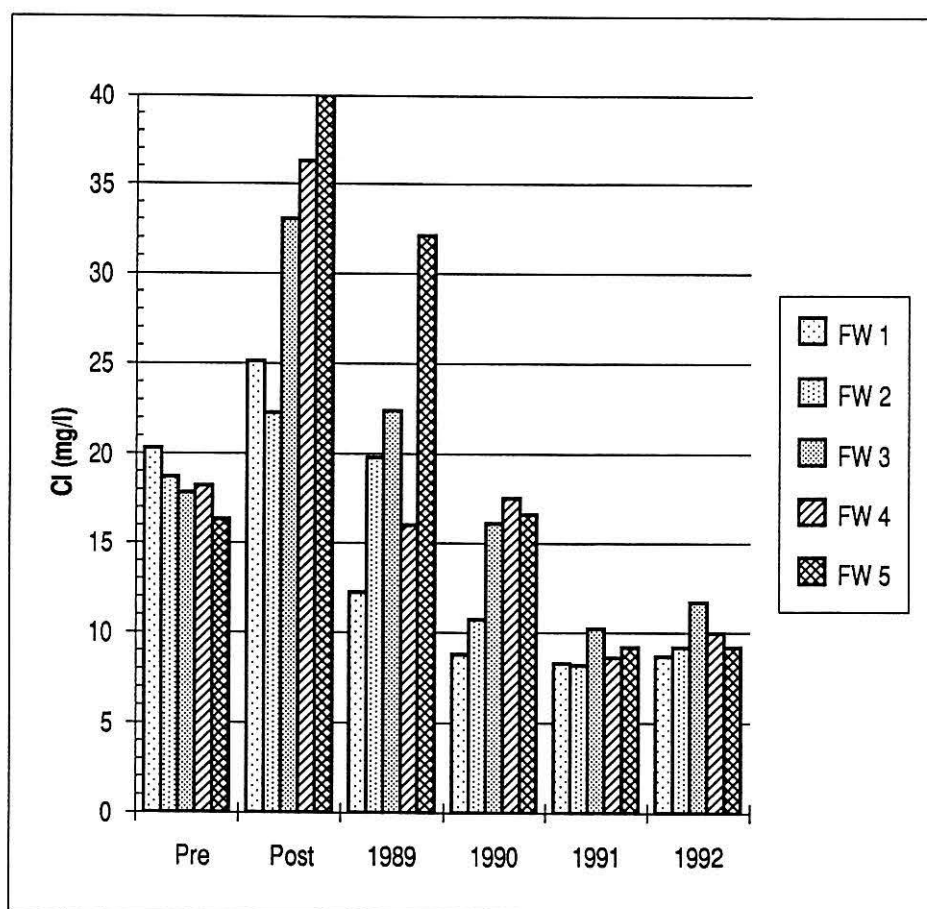
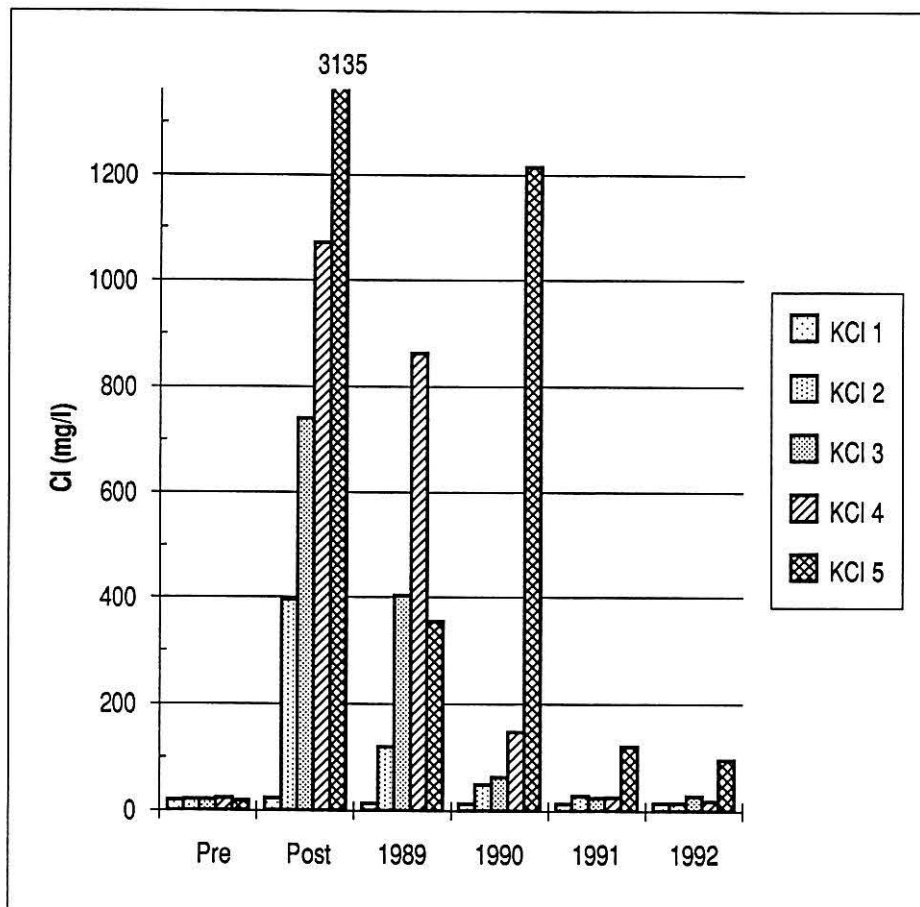
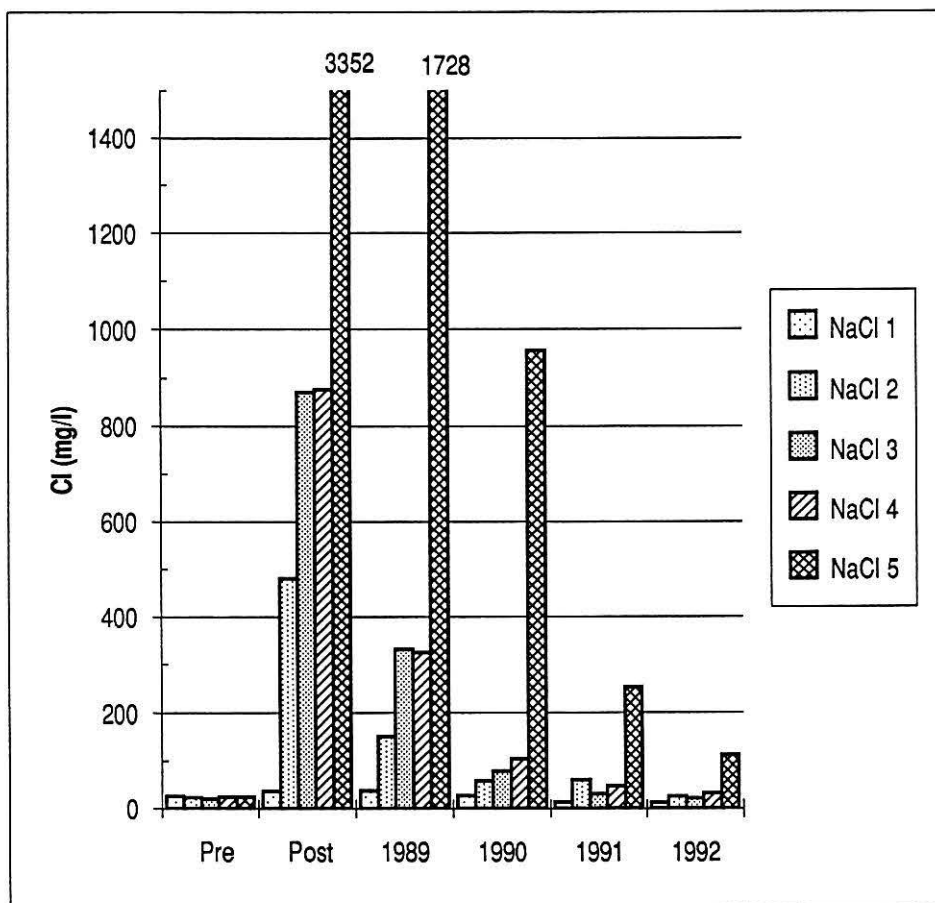


Figure 16. Change in Cl values for the KCl plots at the 0 - 15 cm depth.

Application Rate	C l					
	Pre	Post	1989	1990	1991	1992
KCl 1	19	23	13	13	13	14
KCl 2	21	396	119	50	27	15
KCl 3	20	740	403	63	24	28
KCl 4	23	1070	863	147	25	18
KCl 5	18	3135	353	1214	120	96



Application Rate	C I					
	Pre	Post	1989	1990	1991	1992
NaCl 1	26	36	37	27	14	13
NaCl 2	22	480	151	57	60	25
NaCl 3	21	870	331	79	31	21
NaCl 4	23	876	325	104	47	33
NaCl 5	24	3352	1728	957	253	113



4.4.3 Total Elemental Analysis Data

Data for the total elemental analyses are presented in Appendix 3. These data can be used to assess the potential for heavy metal and other trace element contamination. Elemental content levels increased or decreased slightly as a result of waste addition. Values for the total elemental content of the various treatments were compared to the values for total elemental content of soils presented in Table 15 (Lindsay 1979). Values for the various elements provided in Appendix 3 were within the range of values normally found in soils, except for Ca which was slightly below the minimum levels indicated.

4.5 TISSUE ANALYSIS DATA

The total elemental content data for the brome grass tissue collected in 1991 are presented in Table 16.

The effect of the addition of drilling waste on the elemental enrichment of the affected plants can be demonstrated by the enrichment ratio (ER). The ER of a chemical element is calculated by dividing the elemental concentration of the waste affected plant tissue by that of the unaffected plant tissue. The higher ER of a chemical element indicates a greater degree of plant tissue enrichment in the affected soils. An enrichment ratio of <1 would be indicative of the reduced plant uptake of that element by plants. The ER for selected elements for 1988, 1989, 1990, 1991 and 1992 are presented in Table 17.

With the exception of Na and Cl, the ER ratios were either slightly below or slightly above 1.0. The ER values for Cl ranged from 1.0 to 1.8 with the highest value in the freshwater gel treatments. The ER values for Na ranged from 0.7 to 2.6 with the highest values occurring in the NaCl treatments.

Tissue copper levels in brome grass of <5 ppm, 5 to 10 ppm and >10 ppm are considered low, sufficient, and high respectively (Jones et al. 1991). During the initial stage of the project tissue grown in the control plots had copper levels above the mid-point of the low or deficient range. Addition of waste resulted in increased tissue copper values in 1988 and 1989 with some of the values occurring in the normal range for grasses (Macyk et al. 1990). The 1992 data indicate that tissue copper levels were generally at the low end of the sufficient range and that tissue from the waste amended treatments had slightly higher levels than tissue from the control plots. In summary it was apparent that tissue Cu levels were enhanced by the addition of the drilling waste materials.

Table 15. Elemental constituents of soils.

Element	Mean	Maximum	Minimum	Element	Mean	Maximum	Minimum
C (%)	2.00			Li (µg/g)	20.00	200.0	5.000
Ca (mg/g)	13.70	500.0	7.000	Cr (µg/g)	100.00	1000.0	1.000
Mg (mg/g)	5.00	6.0	0.600	Cu (µg/g)	30.00	100.0	2.000
Ti (mg/g)	4.00	10.0	1.000	Hg (µg/g)	0.03	0.3	0.010
Na (mg/g)	6.30	7.5	0.750	Ni (µg/g)	40.00	500.0	5.000
S (mg/g)	0.70	10.0	0.030	Pb (µg/g)	10.00	200.0	2.000
P (mg/g)	0.60	5.0	0.200	Co (µg/g)	8.00	40.0	1.000
Sr (mg/g)	0.20	1.0	0.050	Mo (µg/g)	2.00	5.0	0.200
Al (mg/g)	71.00	300.0	10.000	Cd (µg/g)	0.06	0.7	0.010
Si (mg/g)	320.00	350.0	230.000	Se (µg/g)	0.30	2.0	0.100
B (mg/g)	0.01	0.1	0.002	Ag (µg/g)	0.05	5.0	0.010
Ba (mg/g)	0.43	3.0	0.100	Zn (µg/g)	50.00	300.0	10.000
Fe (mg/g)	38.00	550.0	7.000	V (µg/g)	100.0	500.0	20.000
K (mg/g)	8.30	30.0	0.400	As (µg/g)	5.00	50.0	1.000
Mn (mg/g)	0.60	3.0	0.020	Zr (µg/g)	300.0	2000.0	60.0

From Lindsay (1979).

Table 16. Total Elemental Analysis Data for the Brome Grass Tissue Collected in the Field Trial Plots in 1992.

Waste	Rate	Plot	Ca	Mg	K	P	S	Cl	Cu	Zn	Fe	Mn	Na	Sr	Ba	Mo	Si	B
		No:	mg/g						ug/g									
Freshwater	1	3	3.02	1.21	25.0	2.82	2.40	1.74	6.00	19.8	36.0	37.8	19.8	4.20	2.40	1.80	1122	7.20
Freshwater	1	9	2.87	1.09	22.4	2.44	1.84	1.42	5.22	18.3	30.7	33.9	5.9	3.26	1.96	1.31	1172	3.92
Freshwater	1	13	3.08	1.31	25.7	2.86	2.32	3.17	6.28	19.5	39.8	37.7	9.1	3.49	2.09	1.40	1266	9.07
Freshwater	2	2	2.84	1.05	27.8	3.05	2.47	3.46	6.26	20.0	36.9	35.1	25.7	5.01	1.88	1.88	1112	19.41
Freshwater	2	8	3.22	1.15	24.9	2.65	2.21	2.77	5.71	19.0	31.1	31.7	15.2	5.08	1.90	1.27	1096	7.62
Freshwater	2	15	3.76	1.32	23.2	2.66	2.11	2.49	6.35	22.6	36.0	31.0	10.6	4.23	1.41	1.41	1251	13.40
Freshwater	3	1	3.35	1.26	29.3	2.80	2.21	3.54	7.46	21.7	35.2	52.9	23.0	6.10	2.03	0.68	1452	11.52
Freshwater	3	6	3.01	1.12	25.2	2.70	2.15	3.85	5.99	22.0	34.0	32.0	14.6	5.33	2.66	2.00	1508	10.65
Freshwater	3	11	3.13	1.19	27.9	2.92	2.16	3.75	5.76	23.6	35.2	38.0	20.2	5.76	2.31	1.15	1063	9.22
Freshwater	4	5	3.07	1.03	26.0	2.90	2.01	1.81	6.26	23.0	47.3	34.1	42.5	4.87	1.39	0.70	998	32.71
Freshwater	4	7	3.24	1.15	23.1	2.63	1.99	2.26	5.98	24.6	35.9	33.2	21.3	4.65	1.33	0.66	1173	9.97
Freshwater	4	12	3.62	1.26	28.2	2.95	2.34	2.72	7.25	24.4	35.6	34.9	17.8	5.27	1.32	0.66	1325	12.52
Freshwater	5	4	2.72	0.99	24.5	2.63	1.90	2.73	6.12	19.6	34.3	30.6	33.0	4.28	0.61	0.61	1214	11.01
Freshwater	5	10	3.57	1.15	24.9	2.55	2.08	3.52	5.95	21.2	33.7	32.4	13.9	6.62	2.65	1.32	1387	7.94
Freshwater	5	14	3.59	1.20	25.0	2.59	2.05	3.27	7.02	22.5	37.2	28.1	9.8	4.91	1.40	0.70	1354	11.93
KCl	1	17	3.05	1.16	23.7	2.52	1.75	4.75	6.06	21.8	32.7	38.2	15.2	4.24	1.82	1.21	648	15.16
KCl	1	42	2.73	1.08	22.5	2.38	1.62	3.90	5.51	17.2	33.1	42.7	2.1	3.44	2.07	2.07	1048	4.82
KCl	1	43	2.92	1.08	22.7	2.30	1.84	2.12	5.00	18.9	30.0	38.9	3.3	3.33	2.78	1.67	992	5.56
KCl	2	33	3.15	1.16	21.8	2.24	1.81	3.35	4.79	19.2	30.5	36.5	4.2	3.59	2.40	2.40	1005	8.98
KCl	2	40	3.15	1.07	23.8	2.42	1.83	4.03	6.10	17.6	34.6	39.3	4.7	4.74	2.71	0.68	1032	4.74
KCl	2	45	3.06	1.04	23.9	2.33	1.53	5.04	5.06	17.1	32.2	62.6	5.7	5.06	4.42	1.26	888	6.95
KCl	3	21	3.13	1.15	26.3	2.76	2.11	3.90	6.28	23.0	34.2	30.7	3.5	4.88	2.79	2.09	1236	8.37
KCl	3	30	2.82	1.00	24.9	2.55	1.82	5.02	5.66	20.5	32.5	48.1	8.5	5.66	4.24	1.41	1159	6.37
KCl	3	39	3.10	1.04	24.9	2.35	1.78	4.59	5.40	16.8	35.4	35.4	4.2	5.40	4.20	0.60	937	6.00
KCl	4	16	3.21	1.05	23.0	2.52	1.92	4.01	5.53	21.4	33.2	29.0	29.7	5.53	2.77	1.38	957	8.30
KCl	4	24	3.23	1.06	26.1	2.49	1.66	4.74	6.58	27.6	34.2	48.7	7.2	5.92	2.63	0.66	1236	9.21
KCl	4	29	2.58	0.91	24.8	2.31	1.50	4.87	5.61	20.2	35.9	53.3	6.2	5.61	4.49	1.12	901	6.17
KCl	5	25	2.80	0.95	27.7	2.57	1.56	5.44	6.39	23.0	39.6	79.9	40.9	6.39	0.64	1.28	985	20.45
KCl	5	26	2.22	0.83	22.5	2.15	1.21	4.78	4.62	19.1	29.0	34.3	10.6	3.96	3.96	1.32	872	5.28

Table 16 (Concluded). Total Elemental Analysis Data for the Brome Grass Tissue Collected in the Field Trial Plots in 1992.

Waste	Rate	Plot No:	Ca	Mg	K	P	S	Cl	Cu	Zn	Fe	Mn	Na	Sr	Ba	Mo	Si	B
mg/g									ug/g									
NaCl	6	22	3.40	1.36	28.0	2.75	1.89	3.72	6.40	23.5	36.3	44.8	3.6	4.27	2.13	3.56	1229	11.38
NaCl	6	32	3.30	1.25	23.9	2.43	1.84	2.68	4.90	19.0	33.7	43.4	7.3	4.28	2.45	2.45	928	7.34
NaCl	6	41	3.03	1.14	22.4	2.26	1.66	4.66	6.07	16.7	34.1	39.5	6.8	3.79	4.55	1.52	1485	6.07
NaCl	7	18	3.02	1.10	25.3	2.57	1.65	5.09	6.26	22.2	34.1	34.8	11.1	3.48	1.39	2.09	1130	11.82
NaCl	7	27	3.53	1.32	27.1	2.52	1.68	5.54	6.36	24.8	34.3	54.7	15.9	5.09	3.18	1.27	1064	17.17
NaCl	7	34	3.16	1.10	23.8	2.25	1.50	4.67	5.34	20.7	31.3	40.7	4.7	5.34	4.67	2.00	1202	7.34
NaCl	8	20	3.10	1.18	28.1	2.80	1.92	4.63	7.06	24.4	39.2	34.0	4.5	3.85	1.28	1.93	1115	10.28
NaCl	8	35	3.08	1.20	25.4	2.48	1.64	4.60	5.31	18.6	33.2	46.5	3.3	5.31	4.65	3.32	1305	12.61
NaCl	8	44	3.06	1.08	25.6	2.38	1.61	4.96	6.16	18.5	33.3	40.6	19.7	4.93	2.46	0.62	990	17.25
NaCl	9	19	2.98	1.19	27.1	2.82	1.94	4.88	7.78	24.9	66.1	35.8	31.1	3.89	1.56	2.33	1587	10.89
NaCl	9	31	2.86	1.12	23.8	2.48	1.75	5.26	5.56	21.0	35.8	59.3	5.6	4.32	3.70	1.23	1210	6.79
NaCl	9	36	2.90	1.07	23.2	2.43	1.65	4.78	5.32	17.7	34.9	49.7	3.5	4.73	3.55	1.77	914	5.91
NaCl	10	23	3.03	1.22	28.8	2.79	1.82	5.16	6.92	25.6	38.8	53.3	6.2	4.15	1.38	1.38	1102	12.46
NaCl	10	28	2.26	0.92	26.3	2.40	1.35	5.85	6.08	23.7	35.3	90.7	14.0	3.65	1.83	0.61	1011	12.78
NaCl	10	38	2.76	0.98	22.9	2.41	1.65	5.04	5.67	17.0	33.4	44.7	26.4	4.41	3.15	1.26	827	6.30

Elements (Al, As, Co, Cr, Li, Ni, Pb, Se, Ti, V) below the detection limit are excluded from this table.

Table 17. ER (Enrichment Ratio) Values for Elements in the Brome Grass Tissue for 1988, 1989, 1990, 1991 and 1992.

Waste	Rate	Post	1989	1990	1991	1992	Post	1989	1990	1991	1992	Post	1989	1990	1991	1992
		Ca					Cl					Cu				
Freshwater	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Freshwater	2	1.0	1.0	0.9	1.0	1.1	1.8	1.4	1.5	1.6	1.4	1.1	1.3	1.4	1.2	1.0
Freshwater	3	1.0	0.9	0.9	1.0	1.1	2.1	1.3	1.5	1.5	1.8	1.1	0.9	0.9	1.0	1.1
Freshwater	4	1.1	1.1	1.0	0.9	1.1	2.1	1.4	1.5	1.5	1.1	1.0	1.2	1.1	1.1	1.1
Freshwater	5	1.2	1.1	1.0	1.0	1.1	2.2	1.4	1.5	1.8	1.5	1.0	1.0	0.9	1.1	1.1
KCl	1	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0
KCl	2	1.0	1.0	1.0	1.0	1.1	1.0	1.1	1.2	1.5	1.2	1.0	0.9	1.2	1.4	1.0
KCl	3	1.1	1.0	1.0	0.8	1.0	1.2	1.2	1.2	2.0	1.3	0.8	2.6	1.2	1.2	1.0
KCl	4	-	1.2	0.8	0.7	1.0	-	1.3	1.3	1.9	1.3	-	2.9	1.1	1.3	1.1
KCl	5	-	1.0	1.0	0.9	0.9	-	1.1	1.5	2.0	1.4	-	1.2	0.9	1.3	1.0
NaCl	6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
NaCl	7	0.9	0.9	0.9	1.0	1.0	2.3	1.1	1.3	1.2	1.4	1.4	1.7	0.6	1.3	1.0
NaCl	8	1.1	0.9	0.9	1.1	1.0	2.1	1.1	1.2	1.1	1.3	1.2	1.9	0.8	1.2	1.1
NaCl	9	1.1	0.8	0.9	0.9	0.9	2.1	1.1	1.2	1.2	1.3	1.3	1.6	0.8	1.4	1.1
NaCl	10	-	0.8	0.8	0.9	0.8	-	1.3	1.4	1.3	1.4	-	1.1	0.6	1.2	1.1

Waste	Rate	Post	1989	1990	1991	1992	Post	1989	1990	1991	1992	Post	1989	1990	1991	1992
		K					Mg					Na				
Freshwater	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Freshwater	2	1.0	1.1	1.0	1.0	1.0	0.9	0.9	0.9	0.9	1.0	2.4	1.0	1.0	1.2	1.5
Freshwater	3	1.1	1.1	1.0	1.1	1.1	0.9	0.9	0.9	0.9	1.0	3.2	0.9	2.1	1.0	1.7
Freshwater	4	1.0	1.0	1.0	1.1	1.1	0.9	1.0	1.0	0.9	1.0	2.4	0.9	0.5	1.1	1.7
Freshwater	5	1.0	1.0	0.9	1.1	1.0	0.9	1.0	0.9	0.9	0.9	9.5	1.3	1.4	1.1	1.6
KCl	1	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.0	-	1.0	1.0
KCl	2	1.0	1.0	0.9	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0	1.2	-	1.2	0.7
KCl	3	0.9	1.1	1.0	1.0	1.1	0.9	0.9	0.9	0.8	1.0	2.6	2.0	-	1.0	0.8
KCl	4	-	1.5	1.0	1.0	1.1	-	1.0	0.8	0.7	0.9	-	1.4	-	1.1	1.0
KCl	5	-	1.0	1.1	1.1	1.1	-	1.0	0.8	0.9	0.8	-	1.4	-	1.4	1.5
NaCl	6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	1.0	1.0
NaCl	7	1.1	1.0	1.0	1.1	1.0	0.8	0.9	0.9	1.0	1.0	9.4	1.1	-	1.4	1.8
NaCl	8	1.0	1.0	1.0	1.0	1.1	1.0	0.9	0.9	1.0	0.9	21.8	1.3	-	1.4	1.6
NaCl	9	0.9	1.0	1.0	1.0	1.0	0.9	0.9	0.9	1.0	0.9	29.0	2.3	-	1.7	2.3
NaCl	10	-	1.0	0.9	1.0	1.0	-	0.7	0.8	0.9	0.8	-	10.9	-	1.2	2.6

Post = Sampled in September 1988; 1989, 1990, 1991, 1992 = Sampled in August 1989, 1990, 1991, 1992.

Table 17 (Concluded). ER (Enrichment Ratio) Values for Elements in the Brome Grass Tissue for 1988, 1989, 1990, 1991 and 1992.

Waste	Rate	Post	1989	1990	1991	1992	Post	1989	1990	1991	1992	Post	1989	1990	1991	1992
		P					S					Zn				
Freshwater	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Freshwater	2	1.0	1.0	1.0	1.1	1.0	1.3	1.1	1.1	1.3	1.0	1.0	1.0	1.1	1.1	1.1
Freshwater	3	1.1	1.0	1.0	1.0	1.0	1.3	1.1	1.0	1.2	1.0	1.0	0.9	1.0	1.0	1.2
Freshwater	4	0.9	1.0	1.1	1.0	1.0	1.2	1.0	1.1	1.2	1.0	0.9	0.8	1.0	0.9	1.3
Freshwater	5	0.8	1.0	0.9	1.0	1.0	1.1	1.0	1.0	1.3	0.9	0.9	0.8	0.9	1.1	1.1
KCl	1	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0	-	1.0	1.0	1.0	1.0
KCl	2	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.2	1.0	1.0	1.0	1.1	1.1	0.9
KCl	3	0.6	1.1	1.0	1.1	1.1	0.9	1.0	1.1	1.2	1.1	1.0	1.0	1.2	1.0	1.0
KCl	4	-	1.2	1.0	1.0	1.0	-	1.2	0.9	1.1	1.0	-	1.3	1.1	1.1	1.2
KCl	5	-	1.1	1.0	1.0	1.0	-	1.0	1.0	1.2	0.8	-	1.0	1.1	1.2	1.1
NaCl	6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
NaCl	7	1.1	1.0	1.0	1.1	1.0	1.4	1.0	1.0	1.1	0.9	1.3	1.0	1.0	1.3	1.1
NaCl	8	1.1	1.0	1.0	1.1	1.0	1.2	1.0	0.9	1.1	1.0	1.2	2.1	1.1	1.1	1.0
NaCl	9	1.2	1.0	1.0	1.0	1.0	1.2	1.0	0.9	1.2	1.0	1.1	1.1	1.0	1.2	1.1
NaCl	10	-	1.1	1.0	1.0	1.0	-	1.0	1.0	1.2	0.9	-	1.0	1.1	1.1	1.1

Post = Sampled in September 1988; 1989, 1990, 1991, 1992 = Sampled in August 1989, 1990, 1991, 1992.

Waste addition initially resulted in significant increases in tissue Na particularly for the NaCl treatments. Substantial differences in tissue Na between 1988 and 1989 were evident from the ER values reported in Table 17. Normal and excessive levels of sodium in grasses are 300 to 1100 ppm and 3200 to 43 700 ppm, respectively (Chapman 1966). The values reported over five years of measurement indicated that Na levels were generally below the normal values and that only tissue from the NaCl amended plots had any real measurable increase in Na over the control plot values.

Tissue chloride values for 1988 ranged from 3.82 mg/g (3820 ppm) to 18.45 mg/g (19450 ppm), and for 1989 ranged from 2.89 mg/g (2890 ppm) to 6.01 mg/g (6010 ppm) (Macyk et al. 1990). Chapman (1966) reports an intermediate range of 7000 ppm and a high range of 8700 to 15400 ppm for chloride in grasses. Using these values as a guideline suggests that the application of all wastes resulted in high levels of chloride in the tissue in 1988 particularly the tissue from the KCl and NaCl treated plots. It is difficult to assess the impact of chloride levels on plant health and growth, because the only consistent or general symptom of excess chloride is reduced leaf size and slower growth rate. However, for many plants sharply reduced growth occurs without leaf symptoms (Chapman 1966). The chloride levels in the tissue in 1989 and 1990 were considerably lower than those in 1988 and decreased even more in 1991 and 1992. The decrease in tissue chloride levels in 1989 and 1990 is directly related to the decrease in soil/waste chloride levels.

Tissue Zn values of <20 ppm, 20 to 50 ppm, and >50 ppm are considered low, sufficient, and high respectively (Jones et al. 1991). The tissue Zn values reported in Table 16 are in the top of the low range and bottom of the sufficient ranges. It is apparent that although ER values for Zn are near 1.0, the addition of waste did slightly improve the tissue Zn status of the waste amended grass.

5. SUMMARY

5.1 PLOT YIELD

In 1992, the prolonged dry periods in May and June significantly reduced yields compared to 1991 values, however the trends in terms of the comparison between treatments for a given waste type remained similar.

A major shift in trend occurred during the 1989 to 1992 interval. The 1989 data indicated that the freshwater gel plot yields were at least two fold higher than the KCl and NaCl plot yields. Furthermore, for each of the waste types the yield from lower application rates exceeded the control yield and the two highest application rates resulted in yield values below the respective control values (Macyk et al. 1990).

In 1990 the yields for the KCl and NaCl amended plots were only slightly below the freshwater gel yields. In 1991 the mean yields were relatively similar for all three waste types. Furthermore, it was apparent that for each of the three waste types, the amended plots had higher mean yields than the respective controls with the exception of the KCl 2 and NaCl 7 treatments (Macyk et al., 1992).

The yield data for the four growing seasons indicate that drilling waste application resulted in increased yield over control values and that the increased yields were sustained for the four year period of measurement.

5.2 FIELD PLOT SOIL PROPERTIES

A total of 77 soil samples were collected at the 45 plots prior to waste application and 207 samples were collected in mid-September 1988, approximately two months following waste application and incorporation (Macyk et al. 1989a). A total of 224, 294 and 246 samples were collected in mid-August 1990, 1991, and 1992 respectively. Samples representing the 0 to 15 cm depth were collected at all plots, and additional samples representing the 15 to 30 cm, 30 to 45 cm, 45 to 60 cm, 60 to 75 cm, 75 to 90 cm, 90 to 105 cm and additional depth intervals where possible were obtained at selected plots.

The samples obtained were analyzed for several chemical and physical properties, soluble ions in saturated paste extracts, plant available trace elements (DTPA extractable), and total elemental content.

5.2.1 Chemical Properties

The highest mean pH value in the 0 to 15 cm depth interval in 1992 was 7.5 in the FW5 treatments. This value represents the upper end of the “good” rating when considering a forage crop end land use. In 1992 the mean pH values in the 0 to 15 cm depth interval ranged from 7.2 to 7.3 for the KCl treatments and from 6.9 to 7.1 for the NaCl treatments. Overall, the addition of drilling waste did not appear to result in any problems or limitations associated with soil pH.

The CaCO_3 equivalent values indicated a “good” rating in terms of soil suitability for plant growth for all treatments prior to and following waste application.

5.2.2 Saturated Paste Extract Data

Table 18 provides a summary of the degree of limitation associated with the EC, SAR and Cl status of the plot treatments in 1988 to 1992 inclusive for the 0 to 15 cm depth or zone of incorporation. The degree of limitation declined annually for a number of the parameters and the respective treatments. For EC, the KCl 5 treatment had a slight limitation which was diminished to no limitation by 1991. An initial moderate limitation in the NaCl 10 was also reduced to no limitation by 1991.

SAR was initially potentially limiting in the 0 to 15 cm depth for most of the NaCl treatments. The NaCl 10 treatment was reduced from severe to slight by 1992.

Chloride content in the 0 to 15 cm depth was not limiting for any of the freshwater gel treatments. In the KCl 5 treatment a potentially severe limitation in 1988 was reduced to no limitation in 1990. Similarly, a potentially severe limitation in the NaCl 10 treatment was reduced to no limitation in 1991.

5.2.3 Total Elemental Analysis Data

Elemental content levels increased or decreased slightly as a result of waste addition. Mean values for the various elements determined were within the ranges of values normally reported for soils, except for Ca which in some instances was below the minimum levels reported (Lindsay 1979).

Table 18. Summary of degree of limitation relative to EC, SAR, and Cl levels in 1988, 1989, 1990, 1991 and 1992 for the 0 to 15 cm depth (zone of waste incorporation).

Waste Treatment	Degree of Limitation*														
	EC					SAR					Cl				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
FW 1	N*	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FW 2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FW 3	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FW 4	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FW 5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
KCl 1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
KCl 2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
KCl 3	SL	SL	N	N	N	N	N	N	N	N	SL	N	N	N	N
KCl 4	SL	SL	N	N	N	N	N	N	N	N	SL	N	N	N	N
KCl 5	SL	SL	SL	N	N	N	N	N	N	N	SV	SL	N	N	N
NaCl 6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
NaCl 7	N	N	N	N	N	SL	N	N	N	N	N	N	N	N	N
NaCl 8	N	SL	N	N	N	SL	SL	N	N	N	N	N	N	N	N
NaCl 9	SL	N	N	N	N	M	SL	N	N	N	N	N	N	N	N
NaCl 10	M	M	SL	N	N	SV	SV	M	M	SL	SV	M	SL	N	N

*N = No limitation
 SL = Slight limitation
 M = Moderate limitation
 SV = Severe limitation

5.3 TISSUE ANALYSIS DATA

The effect of the addition of drilling waste on the elemental enrichment of the plants grown on the control and waste amended plots was demonstrated by the enrichment ratio (ER). With the exception of Na and Cl, the ER ratios were either slightly below or slightly above 1.0 in 1992.

During the measurement period (1988 to 1992) the highest ER values were recorded in the tissue from the NaCl waste amended plots. Ratios as high as 29 in 1988 were reduced significantly in subsequent years.

Tissue Cu and Zn levels were improved (increased) by the addition of the drilling waste materials.

6. CONCLUSIONS

Observations made and results obtained from the field study form the basis for the conclusions presented herein. The application of the different wastes at various rates had both positive and negative impacts on the soils and the plants grown thereon. The project objective was to identify the impact of different loading rates of the wastes on the soils and plants grown thereon with emphasis to be placed on determining maximum tolerable loading rates.

The project reports including this report of the 1992 field season results describe the impact of the different loading rates of the wastes. Determining maximum tolerable loading rates is difficult to do in the absence of some guidelines as to how "tolerable" may be defined. Furthermore, the time at which the characteristics of the soil/waste mixtures are characterized to evaluate the "degree of limitation" or impact of the waste is critical. The results of an assessment days or weeks after waste application will be considerably different from the results of an assessment made one, two or more years hence.

It is important to note that the trend established relative to yield was completely reversed from 1989 to 1991 with the 1991 trend continuing in 1992. In 1989 the highest application rate for each waste type resulted in the lowest yield whereas by 1991 the highest yields occurred on the highest waste rate plots. During the next few years it will be vital to evaluate whether the trend of change from 1989 to 1991 and 1992 will continue.

Comments will be provided regarding the impact of the application of the three different wastes at the various rates.

6.1 FRESHWATER GEL

The current guideline for maximum loading rate for Cl is 450 kg Cl/ha (ERCB 1975) however this guideline is subject to change imminently as a result of the work of the joint government industry "Drilling Wastes Review Committee (DWRC).

In this study the maximum rate of Cl applied was 120 kg Cl/ha which translated into a layer about 10 cm thick. This maximum rate resulted in a slight limitation to soil quality as a result of pH. There were no limitations due to EC, SAR or Cl levels in the soil. Yield increases compared to the control plots were realized as a result of the freshwater gel waste application, however these increases were not statistically significant.

One can conclude that freshwater gel wastes with properties similar to the waste used in this experiment can be added to soil with minimal negative impact and some positive potential benefit depending upon the amount applied. One could also suggest that Cl addition is

not the most appropriate parameter for developing freshwater gel additions and that liming potential in combination with chloride content would likely be more suitable.

6.2 POTASSIUM CHLORIDE

The addition of KCl wastes in this experiment resulted in Cl additions of 500, 1000, 2000, and 4000 kg Cl/ha. Initially yield declined from control levels as waste application rate increased, however the values obtained were not statistically significant (lower). In 1992 the KCl 3 and KCl 5 treatment yields exceeded control values. Limitations relative to EC and Cl levels in the 0 to 15 cm depth interval were evident following waste application and declined with time. For example, slight limitations due to EC for the KCl 3, 4 and 5 treatments were evident in the fall of 1988. By the fall of 1991 there was no limitation due to EC.

It appears that in this experiment, the KCl waste could be applied at 500 kg Cl/ha with no negative impact on soil quality. In fact, the rate that could be applied with no apparent impact, likely lies somewhere between 500 and 1000 kg Cl/ha. Even higher rates could be applied if a slight to moderate impact was acceptable for a 2 to 4 year period following waste application.

6.3 SODIUM CHLORIDE

The addition of NaCl wastes in this experiment resulted in Cl additions of 350, 700, 1400 and 2800 kg Cl/ha. The addition of these waste materials resulted in some increases in yield, particularly in 1991 when the NaCl 8, NaCl 9 and NaCl 10 treatment yields exceeded control values and in 1992 when the NaCl 9 and NaCl 10 treatment yields also exceeded control values. The 1992 results indicated only a slight limitation for the 2800 kg Cl/ha rate (NaCl 10) due to SAR levels. Initially the NaCl 10 (2800 kg Cl/ha) rate resulted in moderate and severe limitations for EC, SAR and Cl respectively following waste application. In 1990 the limitations for these parameters ranged from slight to moderate.

For the NaCl wastes the material could be applied with no negative impact at the equivalent rate of 350 kg Cl/ha or more likely between the 350 and 700 kg Cl/ha rate. Higher rates could be applied if slight to moderate limitations were acceptable.

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APPENDIX I. Chemical properties of the soils and soil/waste mixtures in the ESSO field plots in 1992.

Chemical Properties of the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	----- H2O	pH ---- CaCl2	CaCO3 Eq(%)
Freshwater	1	3	7	0-15	7.30	6.90	0.20
Freshwater	1	9	21	0-15	7.40	7.00	0.20
Freshwater	1	13	36	0-15	7.20	6.90	0.12
Freshwater	1	13	37	15-30	7.80	7.50	4.79
Freshwater	1	13	38	30-45	7.80	7.60	-
Freshwater	1	13	39	45-60	7.90	7.60	-
Freshwater	1	13	40	60-75	8.00	7.60	-
Freshwater	1	13	41	75-90	7.90	7.60	-
Freshwater	1	13	42	90-105	7.80	7.60	-
Freshwater	2	2	6	0-15	7.20	6.80	0.24
Freshwater	2	8	19	0-15	7.60	7.30	0.40
Freshwater	2	8	20	15-30	7.60	7.30	0.16
Freshwater	2	15	50	0-15	7.75	7.40	2.42
Freshwater	3	1	1	0-15	7.20	6.80	0.16
Freshwater	3	1	2	15-30	6.30	5.90	-
Freshwater	3	1	3	30-45	5.80	5.30	-
Freshwater	3	1	4	45-60	5.20	4.70	-
Freshwater	3	1	5	60-75	4.90	4.30	-
Freshwater	3	6	11	0-15	7.60	7.20	0.80
Freshwater	3	11	34	0-15	7.60	7.30	0.80
Freshwater	4	5	9	0-15	7.90	7.50	1.29
Freshwater	4	5	10	15-30	7.60	7.30	0.20
Freshwater	4	7	12	0-15	7.60	7.30	0.56
Freshwater	4	7	13	15-30	8.00	7.80	5.83
Freshwater	4	7	14	30-45	8.10	7.80	-
Freshwater	4	7	15	45-60	8.10	7.80	-
Freshwater	4	7	16	60-75	8.10	7.80	-
Freshwater	4	7	17	75-90	8.00	7.80	-
Freshwater	4	7	18	90-105	8.10	7.80	-
Freshwater	4	12	35	0-15	7.60	7.40	0.64
Freshwater	5	4	8	0-15	7.90	7.60	1.37
Freshwater	5	10	22	0-15	7.90	7.50	1.52
Freshwater	5	10	23	0-15	7.60	7.40	1.20
Freshwater	5	10	24	0-15	7.60	7.40	0.88
Freshwater	5	10	25	0-15	7.90	7.70	2.35
Freshwater	5	10	26	0-15	7.70	7.40	1.28
Freshwater	5	10	27	15-30	7.90	7.60	3.75
Freshwater	5	10	28	30-45	8.00	7.60	-
Freshwater	5	10	29	45-60	7.90	7.60	-
Freshwater	5	10	30	60-75	7.90	7.70	-
Freshwater	5	10	31	75-90	7.80	7.60	-
Freshwater	5	10	32	90-105	7.90	7.60	-
Freshwater	5	10	33	105-120	7.80	7.60	-
Freshwater	5	14	43	0-15	7.60	7.30	0.89
Freshwater	5	14	44	15-30	7.40	7.20	0.44
Freshwater	5	14	45	30-45	7.70	7.50	-
Freshwater	5	14	46	45-60	7.80	7.60	-

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	----- H2O	pH ---- CaCl2	CaCO3 Eq(%)
Freshwater	5	14	47	60-75	7.80	7.60	-
Freshwater	5	14	48	75-90	7.80	7.60	-
Freshwater	5	14	49	90-105	7.80	7.60	-
KCl	1	17	62	0-15	7.20	6.80	0.16
KCl	1	42	219	0-15	7.70	7.40	1.64
KCl	1	43	220	0-15	7.60	7.40	2.43
KCl	1	43	221	15-30	7.70	7.50	3.15
KCl	1	43	222	30-45	7.80	7.45	-
KCl	1	43	223	45-60	7.90	7.70	-
KCl	1	43	224	60-75	7.90	7.70	-
KCl	1	43	225	75-90	8.00	7.70	-
KCl	1	43	226	90-105	8.00	7.70	-
KCl	1	43	227	105-120	7.90	7.70	-
KCl	1	43	228	120-135	7.90	7.60	-
KCl	2	33	176	0-15	7.30	7.00	0.48
KCl	2	40	217	0-15	7.60	7.30	0.96
KCl	3	21	78	0-15	7.50	7.40	0.76
KCl	3	30	156	0-15	7.30	6.90	0.36
KCl	3	39	216	0-15	7.60	7.40	1.20
KCl	4	16	51	0-15	7.50	7.20	0.44
KCl	4	16	52	0-15	7.60	7.20	0.83
KCl	4	16	53	0-15	7.40	7.00	0.63
KCl	4	16	54	0-15	7.60	7.10	0.59
KCl	4	16	55	0-15	7.60	7.30	0.67
KCl	4	16	56	15-30	7.70	7.50	1.62
KCl	4	16	57	30-45	7.80	7.50	-
KCl	4	16	58	45-60	7.90	7.60	-
KCl	4	16	59	60-75	7.90	7.50	-
KCl	4	16	60	75-90	7.80	7.50	-
KCl	4	16	61	90-105	7.80	7.50	-
KCl	4	24	104	0-15	7.50	7.20	0.52
KCl	4	29	147	0-15	7.40	7.20	0.36
KCl	4	29	148	15-30	6.10	6.00	-
KCl	4	29	149	30-45	5.40	5.40	-
KCl	4	29	150	45-60	5.70	5.40	-
KCl	4	29	151	60-75	5.80	5.70	-
KCl	4	29	152	75-90	5.80	5.60	-
KCl	4	29	153	90-105	6.00	5.80	-
KCl	4	29	154	105-120	7.10	6.90	-
KCl	4	29	155	120-135	7.80	7.60	-
KCl	5	25	105	0-15	7.50	7.40	0.60
KCl	5	25	106	0-15	7.60	7.40	0.52
KCl	5	25	107	0-15	7.50	7.30	0.44
KCl	5	25	108	0-15	7.50	7.30	0.60
KCl	5	25	109	0-15	7.20	7.00	0.20
KCl	5	25	110	15-30	4.90	4.90	-

(Continued). Chemical Properties of the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	---- H2O	pH --- CaCl2	CaCO3 Eq(%)	Waste	Rate	Plot	FSN (TME-)	Depth (cm)	---- H2O	pH --- CaCl2	CaCO3 Eq(%)
KCl	5	25	111	15-30	5.40	5.30	-	NaCl	8	35	194	105-120	7.90	7.60	-
KCl	5	25	112	15-30	6.20	6.00	-	NaCl	8	35	195	120-135	8.00	7.70	-
KCl	5	25	113	15-30	7.00	7.00	-	NaCl	8	44	229	0-15	7.60	7.20	0.86
KCl	5	25	114	15-30	7.00	6.70	0.04	NaCl	8	44	230	0-15	7.60	7.30	0.78
KCl	5	25	115	30-45	4.80	4.80	-	NaCl	8	44	231	0-15	7.80	7.40	1.32
KCl	5	25	116	45-60	4.70	4.70	-	NaCl	8	44	232	0-15	7.60	7.20	0.42
KCl	5	25	117	60-75	4.90	4.70	-	NaCl	8	44	233	0-15	7.60	7.10	0.16
KCl	5	25	118	75-90	5.20	4.80	-	NaCl	8	44	234	15-30	7.80	7.60	5.06
KCl	5	25	119	90-105	5.30	4.80	-	NaCl	8	44	235	15-30	7.60	7.30	0.96
KCl	5	25	120	105-120	5.30	4.90	-	NaCl	8	44	236	15-30	7.80	7.40	1.04
KCl	5	25	121	120-135	5.40	5.10	-	NaCl	8	44	237	15-30	7.30	6.65	0.12
KCl	5	25	122	135-150	5.60	5.20	-	NaCl	8	44	238	15-30	7.60	7.00	0.16
KCl	5	25	123	150-165	5.60	5.30	-	NaCl	8	44	239	30-45	7.90	7.70	-
KCl	5	25	124	165-180	5.60	5.40	-	NaCl	8	44	240	45-60	7.90	7.70	-
KCl	5	26	125	0-15	7.50	7.20	0.52	NaCl	8	44	241	60-75	8.00	7.70	-
KCl	5	26	126	15-30	7.60	7.30	1.56	NaCl	8	44	242	75-90	8.00	7.70	-
KCl	5	37	198	0-15	7.50	7.20	0.44	NaCl	8	44	243	90-105	7.90	7.70	-
NaCl	6	22	79	0-15	6.80	6.50	0.20	NaCl	8	44	244	105-120	8.00	7.60	-
NaCl	6	22	80	15-30	7.60	7.40	3.42	NaCl	8	44	245	120-135	7.90	7.70	-
NaCl	6	22	81	30-45	7.90	7.70	-	NaCl	8	44	246	135-150	7.90	7.70	-
NaCl	6	22	82	45-60	7.90	7.70	-	NaCl	9	19	64	0-15	7.10	6.80	0.24
NaCl	6	22	83	60-75	8.00	7.70	-	NaCl	9	19	65	0-15	7.40	6.95	0.20
NaCl	6	22	84	75-90	7.80	7.70	-	NaCl	9	19	66	0-15	7.40	6.90	0.24
NaCl	6	22	85	90-105	8.10	7.70	-	NaCl	9	19	67	0-15	7.40	7.00	0.43
NaCl	6	22	86	105-120	8.10	7.70	-	NaCl	9	19	68	0-15	7.40	7.10	0.59
NaCl	6	32	175	0-15	7.60	7.10	0.83	NaCl	9	19	69	15-30	7.60	7.20	0.39
NaCl	6	41	218	0-15	7.60	7.40	1.95	NaCl	9	19	70	30-45	7.70	7.40	-
NaCl	7	18	63	0-15	7.50	7.20	0.91	NaCl	9	19	71	45-60	7.50	6.90	-
NaCl	7	27	127	0-15	6.70	6.30	-	NaCl	9	19	72	60-75	7.50	7.00	-
NaCl	7	27	128	15-30	6.80	6.50	-	NaCl	9	19	73	75-90	7.40	7.00	-
NaCl	7	34	177	0-15	7.35	7.00	0.40	NaCl	9	19	74	90-105	7.30	7.00	-
NaCl	7	34	178	0-15	6.60	6.30	-	NaCl	9	19	75	105-120	7.30	7.00	-
NaCl	7	34	179	0-15	7.10	6.70	0.12	NaCl	9	19	76	120-135	7.80	7.40	-
NaCl	7	34	180	0-15	7.60	7.40	1.50	NaCl	9	31	157	0-15	7.70	7.20	0.75
NaCl	7	34	181	0-15	7.50	7.30	0.71	NaCl	9	31	158	0-15	7.40	6.90	0.12
NaCl	7	34	182	15-30	7.60	7.20	0.95	NaCl	9	31	159	0-15	7.10	6.80	0.10
NaCl	8	20	77	0-15	7.20	6.90	0.30	NaCl	9	31	160	0-15	7.40	7.00	-
NaCl	8	35	183	0-15	7.40	7.10	0.36	NaCl	9	31	161	0-15	7.40	7.00	0.32
NaCl	8	35	184	0-15	7.10	6.80	0.10	NaCl	9	31	162	15-30	5.80	5.60	-
NaCl	8	35	185	0-15	7.00	6.60	-	NaCl	9	31	163	15-30	7.30	6.70	0.12
NaCl	8	35	186	0-15	7.30	7.00	0.28	NaCl	9	31	164	15-30	7.10	6.60	0.12
NaCl	8	35	187	0-15	7.10	6.70	-	NaCl	9	31	165	15-30	7.20	6.80	-
NaCl	8	35	188	15-30	7.90	7.70	6.74	NaCl	9	31	166	15-30	7.30	6.90	0.04
NaCl	8	35	189	30-45	7.70	7.70	-	NaCl	9	31	167	30-45	5.10	5.00	-
NaCl	8	35	190	45-60	7.70	7.70	-	NaCl	9	31	168	45-60	5.20	5.30	-
NaCl	8	35	191	60-75	7.80	7.60	-	NaCl	9	31	169	60-75	5.30	5.20	-
NaCl	8	35	192	75-90	7.80	7.60	-	NaCl	9	31	170	75-90	5.50	5.40	-
NaCl	8	35	193	90-105	7.80	7.60	-	NaCl	9	31	171	90-105	5.90	5.90	-
								NaCl	9	31	172	105-120	6.20	6.00	-
								NaCl	9	31	173	120-135	7.60	7.30	-

(Concluded). Chemical Properties of the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	---- H2O	pH --- CaCl2	CaCO3 Eq(%)
NaCl	9	31	174	135-150	7.70	7.40	-
NaCl	9	36	196	0-15	7.70	7.30	0.64
NaCl	9	36	197	15-30	7.70	7.30	0.68
NaCl	10	23	87	0-15	7.40	6.90	0.24
NaCl	10	23	88	0-15	7.40	6.90	0.16
NaCl	10	23	89	0-15	7.70	7.20	0.76
NaCl	10	23	90	0-15	7.20	6.80	0.36
NaCl	10	23	91	0-15	7.10	6.60	0.40
NaCl	10	23	92	15-30	7.10	7.20	2.21
NaCl	10	23	93	15-30	7.00	6.80	0.68
NaCl	10	23	94	15-30	8.00	7.60	3.01
NaCl	10	23	95	15-30	6.90	6.40	0.16
NaCl	10	23	96	15-30	5.90	5.60	-
NaCl	10	23	97	30-45	7.70	7.70	-
NaCl	10	23	98	45-60	7.70	7.80	-
NaCl	10	23	99	60-75	7.90	7.70	-
NaCl	10	23	100	75-90	7.80	7.70	-
NaCl	10	23	101	90-105	7.80	7.70	-
NaCl	10	23	102	105-120	7.80	7.70	-
NaCl	10	23	103	120-135	7.80	7.60	-
NaCl	10	28	129	0-15	7.60	7.10	0.40
NaCl	10	28	130	0-15	7.70	7.30	0.75
NaCl	10	28	131	0-15	7.50	7.00	0.32
NaCl	10	28	132	0-15	7.60	7.00	0.24
NaCl	10	28	133	0-15	7.60	7.10	0.20
NaCl	10	28	134	15-30	7.00	6.80	0.47
NaCl	10	28	135	15-30	7.30	6.90	0.28
NaCl	10	28	136	15-30	7.30	6.90	0.20
NaCl	10	28	137	15-30	7.40	6.90	0.28
NaCl	10	28	138	15-30	7.40	6.90	0.12
NaCl	10	28	139	30-45	5.40	5.40	-
NaCl	10	28	140	45-60	5.40	5.40	-
NaCl	10	28	141	60-75	5.50	5.40	-
NaCl	10	28	142	75-90	5.80	5.60	-
NaCl	10	28	143	90-105	5.70	5.50	-
NaCl	10	28	144	105-120	6.20	6.00	-
NaCl	10	28	145	120-135	7.30	7.10	-
NaCl	10	28	146	135-150	7.80	7.60	-
NaCl	10	38	199	0-15	7.70	7.30	0.64
NaCl	10	38	200	0-15	7.70	7.40	1.60
NaCl	10	38	201	0-15	7.70	7.40	1.12
NaCl	10	38	202	0-15	7.60	7.30	0.72
NaCl	10	38	203	0-15	8.10	7.60	1.24
NaCl	10	38	204	15-30	7.30	6.90	-
NaCl	10	38	205	15-30	7.70	7.40	1.20
NaCl	10	38	206	15-30	7.70	7.30	1.04
NaCl	10	38	207	15-30	7.40	7.05	0.36
NaCl	10	38	208	15-30	7.80	7.40	0.48
NaCl	10	38	209	30-45	6.30	5.90	-
NaCl	10	38	210	45-60	6.00	5.80	-

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	---- H2O	pH --- CaCl2	CaCO3 Eq(%)
NaCl	10	38	211	60-75	6.10	5.90	-
NaCl	10	38	212	75-90	5.90	5.60	-
NaCl	10	38	213	90-105	5.80	5.50	-
NaCl	10	38	214	105-120	6.00	5.70	-
NaCl	10	38	215	120-135	6.10	5.90	-

APPENDIX II. Saturated paste extract data for the soils and soil/waste mixtures in the ESSO field plots in 1992.

Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Sat'n (%)	E.C. (dS/m)	pH	Cl	Alk	HCO3	CO3	OH (mg/L)	Al	Fe	Ti	Cu
Freshwater	1	3	7	0-15	41.5	0.460	7.10	8.05	190.0	189.8	0.225	0.006	<0.20	0.12	<0.01	0.02
Freshwater	1	9	21	0-15	40.3	0.510	6.70	9.25	174.0	173.9	0.082	0.003	<0.20	<0.01	<0.01	<0.01
Freshwater	1	13	36	0-15	45.0	0.590	6.90	8.76	273.0	272.8	0.204	0.004	<0.20	0.05	<0.01	<0.01
Freshwater	1	13	37	15-30	35.0	0.380	7.40	5.61	170.0	169.6	0.400	0.013	<0.20	<0.01	<0.01	0.03
Freshwater	1	13	38	30-45	32.0	0.270	7.50	4.61	121.0	120.6	0.359	0.016	<0.20	<0.01	<0.01	<0.01
Freshwater	1	13	39	45-60	34.5	0.250	7.70	3.86	125.0	124.4	0.586	0.025	<0.20	<0.01	<0.01	<0.01
Freshwater	1	13	40	60-75	32.0	0.250	7.60	5.23	116.0	115.5	0.432	0.020	<0.20	<0.01	<0.01	<0.01
Freshwater	1	13	41	75-90	28.5	0.240	7.50	5.35	118.0	117.6	0.350	0.016	<0.20	<0.01	<0.01	<0.01
Freshwater	1	13	42	90-105	32.0	0.220	7.60	4.19	112.0	111.6	0.417	0.020	<0.20	<0.01	<0.01	<0.01
Freshwater	2	2	6	0-15	42.5	0.520	6.60	8.51	191.0	190.9	0.071	0.002	<0.20	0.18	<0.01	0.02
Freshwater	2	8	19	0-15	36.5	0.650	7.10	9.11	170.0	169.8	0.201	0.006	<0.20	0.05	<0.01	0.02
Freshwater	2	8	20	15-30	33.5	0.750	7.20	7.96	168.0	167.7	0.250	0.008	<0.20	0.02	<0.01	0.04
Freshwater	2	15	50	0-15	39.5	0.460	7.10	9.93	178.0	177.8	0.210	0.006	<0.20	0.06	<0.01	0.02
Freshwater	3	1	1	0-15	39.0	0.660	6.90	11.80	193.0	192.9	0.144	0.004	<0.20	0.11	<0.01	<0.01
Freshwater	3	1	2	15-30	35.0	0.480	6.40	8.13	93.9	93.9	0.022	0.001	0.20	0.44	0.02	0.03
Freshwater	3	1	3	30-45	32.0	0.170	6.30	9.38	59.7	59.7	0.011	0.001	6.10	14.84	1.01	0.05
Freshwater	3	1	4	45-60	124.0	0.260	5.70	12.50	72.7	72.7	0.003	0.000	3.89	7.39	0.26	0.03
Freshwater	3	1	5	60-75	382.2	0.150	5.30	6.61	41.8	41.8	0.001	0.000	0.71	0.35	<0.01	0.02
Freshwater	3	6	11	0-15	38.0	0.650	6.50	11.10	192.0	191.9	0.057	0.002	<0.20	<0.01	<0.01	0.02
Freshwater	3	11	34	0-15	38.3	0.630	7.05	12.15	170.0	169.8	0.179	0.006	<0.20	0.04	<0.01	0.03
Freshwater	4	5	9	0-15	39.5	0.570	7.20	10.70	203.0	202.7	0.302	0.008	<0.20	0.06	<0.01	0.03
Freshwater	4	5	10	15-30	35.0	0.450	7.20	7.23	162.0	161.8	0.241	0.008	<0.20	0.03	<0.01	0.03
Freshwater	4	7	12	0-15	41.5	0.530	7.15	7.71	179.0	178.8	0.237	0.007	<0.20	0.08	<0.01	0.02
Freshwater	4	7	13	15-30	36.5	0.570	7.30	4.06	142.0	141.7	0.266	0.010	<0.20	<0.01	<0.01	0.02
Freshwater	4	7	14	30-45	35.5	0.580	7.40	4.36	142.0	141.7	0.334	0.013	<0.20	<0.01	<0.01	0.02
Freshwater	4	7	15	45-60	32.5	0.340	7.60	4.63	133.0	132.5	0.496	0.020	<0.20	<0.01	<0.01	0.02
Freshwater	4	7	16	60-75	30.5	0.330	7.70	6.32	136.0	135.3	0.638	0.025	<0.20	<0.01	<0.01	<0.01
Freshwater	4	7	17	75-90	30.5	0.280	7.70	5.83	143.0	142.3	0.670	0.025	<0.20	<0.01	<0.01	<0.01
Freshwater	4	7	18	90-105	32.0	0.260	7.80	4.58	133.0	132.2	0.784	0.032	<0.20	<0.01	<0.01	<0.01
Freshwater	4	12	35	0-15	40.5	0.680	7.00	11.50	195.0	194.8	0.183	0.005	<0.20	0.04	<0.01	0.02
Freshwater	5	4	8	0-15	41.0	0.880	7.20	11.40	205.0	204.7	0.305	0.008	<0.20	0.08	<0.01	0.02
Freshwater	5	10	22	0-15	43.5	0.560	7.20	11.10	188.0	187.7	0.280	0.008	<0.20	0.06	<0.01	0.02
Freshwater	5	10	23	0-15	48.0	0.850	6.90	7.30	194.0	193.9	0.145	0.004	<0.20	0.07	<0.01	0.02
Freshwater	5	10	24	0-15	46.5	0.710	7.20	6.87	188.0	187.7	0.280	0.008	<0.20	0.03	<0.01	0.02
Freshwater	5	10	25	0-15	46.0	0.710	7.30	9.57	203.0	202.6	0.380	0.010	<0.20	0.04	<0.01	0.02
Freshwater	5	10	26	0-15	44.0	0.540	7.20	7.98	169.0	168.7	0.251	0.008	<0.20	0.08	<0.01	0.02
Freshwater	5	10	27	15-30	32.0	0.370	7.50	5.46	141.0	140.6	0.418	0.016	<0.20	0.01	<0.01	0.02
Freshwater	5	10	28	30-45	31.5	0.350	7.60	4.52	126.0	125.5	0.470	0.020	<0.20	0.03	<0.01	<0.01
Freshwater	5	10	29	45-60	30.0	0.410	7.50	5.58	132.0	131.6	0.391	0.016	<0.20	<0.01	<0.01	<0.01
Freshwater	5	10	30	60-75	31.5	0.420	7.60	6.23	117.0	116.5	0.436	0.020	<0.20	<0.01	<0.01	<0.01
Freshwater	5	10	31	75-90	30.5	0.450	7.50	5.42	110.0	109.7	0.326	0.016	<0.20	<0.01	<0.01	<0.01
Freshwater	5	10	32	90-105	31.5	0.470	7.30	5.19	107.0	106.8	0.200	0.010	<0.20	<0.01	<0.01	<0.01
Freshwater	5	10	33	105-120	33.5	0.450	7.50	4.65	88.0	87.7	0.261	0.016	<0.20	<0.01	<0.01	<0.01
Freshwater	5	14	43	0-15	39.5	0.550	7.00	10.00	186.0	185.8	0.175	0.005	<0.20	0.03	<0.01	0.02
Freshwater	5	14	44	15-30	32.0	0.400	7.15	5.38	101.0	100.9	0.134	0.007	<0.20	<0.01	<0.01	0.02

Sat'n = Saturation Percent; E.C. = Electrical Conductivity; Alk = Alkalinity mg CaCO3/L; HCO3, CO3, OH reported as mg CaCO3/L.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Zn	Mn	Ca	Mg	Na	K	Sr	B	Ba	P	S	Si
											(mg/L)					
Freshwater	1	3	7	0-15	0.09	0.040	91.86	20.83	9.95	4.50	0.16	<0.04	0.13	0.23	28.29	5.49
Freshwater	1	9	21	0-15	0.19	0.040	103.20	20.68	8.70	5.78	0.16	<0.04	0.18	0.40	44.10	8.34
Freshwater	1	13	36	0-15	0.11	0.090	117.60	27.97	12.44	8.23	0.19	0.05	0.15	0.30	23.86	8.09
Freshwater	1	13	37	15-30	0.06	<0.006	67.49	16.04	13.59	3.44	0.09	<0.04	0.08	0.12	19.63	5.21
Freshwater	1	13	38	30-45	0.04	<0.006	43.01	10.45	11.91	2.44	0.06	<0.04	0.07	<0.10	9.87	7.64
Freshwater	1	13	39	45-60	0.03	<0.006	37.67	11.82	9.95	2.56	0.06	<0.04	0.07	<0.10	7.85	7.79
Freshwater	1	13	40	60-75	0.04	<0.006	37.86	10.31	9.97	2.64	0.05	<0.04	0.07	<0.10	7.22	8.27
Freshwater	1	13	41	75-90	0.04	<0.006	30.45	9.97	16.50	3.28	0.11	<0.04	0.06	<0.10	6.89	8.29
Freshwater	1	13	42	90-105	0.03	<0.006	29.69	10.89	9.80	3.33	0.06	<0.04	0.07	<0.10	5.07	8.33
Freshwater	2	2	6	0-15	0.11	0.060	107.50	18.02	15.97	6.87	0.23	0.10	0.18	0.36	39.20	8.34
Freshwater	2	8	19	0-15	0.20	0.030	129.00	21.77	27.53	5.98	0.27	0.12	0.19	0.29	80.78	8.99
Freshwater	2	8	20	15-30	0.16	0.020	144.80	23.13	41.77	8.95	0.21	<0.04	0.17	0.26	109.75	3.26
Freshwater	2	15	50	0-15	0.09	0.010	97.31	15.61	15.47	4.39	0.17	0.10	0.10	0.39	30.56	12.27
Freshwater	3	1	1	0-15	0.13	0.140	126.80	23.24	28.88	11.40	0.26	0.11	0.19	0.29	71.11	8.52
Freshwater	3	1	2	15-30	0.19	0.210	73.38	19.21	32.48	7.35	0.15	0.14	0.17	0.28	64.37	7.56
Freshwater	3	1	3	30-45	0.19	1.090	30.61	6.66	9.96	5.75	0.09	0.14	0.14	0.53	8.15	24.70
Freshwater	3	1	4	45-60	0.12	1.290	31.32	5.85	9.36	10.17	0.07	0.08	0.14	1.46	15.63	17.81
Freshwater	3	1	5	60-75	0.07	0.070	23.56	3.76	6.50	3.63	0.04	0.06	0.09	0.86	5.62	5.01
Freshwater	3	6	11	0-15	0.12	0.050	136.10	22.38	20.98	6.85	0.31	0.15	0.18	0.52	74.35	12.21
Freshwater	3	11	34	0-15	0.11	0.165	126.00	20.48	20.65	7.25	0.31	0.11	0.15	0.16	75.91	8.79
Freshwater	4	5	9	0-15	0.14	0.030	112.00	16.63	28.06	11.83	0.26	0.22	0.17	0.67	55.03	13.78
Freshwater	4	5	10	15-30	0.10	0.020	77.07	12.76	35.86	7.28	0.12	<0.04	0.13	0.18	37.39	2.84
Freshwater	4	7	12	0-15	0.07	0.020	95.27	17.94	34.19	6.93	0.18	0.10	0.18	0.34	47.34	8.26
Freshwater	4	7	13	15-30	0.09	0.010	62.55	36.34	34.10	6.47	0.18	<0.04	0.12	<0.10	73.92	9.20
Freshwater	4	7	14	30-45	0.14	<0.006	65.90	40.08	26.93	6.34	0.22	<0.04	0.19	<0.10	77.11	9.05
Freshwater	4	7	15	45-60	0.07	<0.006	36.29	21.27	19.08	4.89	0.11	<0.04	0.10	<0.10	22.04	8.58
Freshwater	4	7	16	60-75	0.07	<0.006	36.60	18.91	18.94	5.38	0.11	<0.04	0.10	<0.10	15.80	8.45
Freshwater	4	7	17	75-90	0.07	<0.006	30.43	17.19	16.63	5.42	0.10	<0.04	0.09	<0.10	7.07	8.08
Freshwater	4	7	18	90-105	0.05	<0.006	26.74	16.00	14.21	5.59	0.09	<0.04	0.09	<0.10	4.91	7.71
Freshwater	4	12	35	0-15	0.12	0.030	140.70	23.84	22.95	7.12	0.28	0.11	0.14	0.27	82.66	10.22
Freshwater	5	4	8	0-15	0.14	0.040	175.10	23.30	52.93	10.54	0.41	0.25	0.16	0.52	132.46	14.12
Freshwater	5	10	22	0-15	0.11	0.020	107.30	16.66	26.58	8.43	0.28	0.26	0.15	0.27	52.14	14.58
Freshwater	5	10	23	0-15	0.09	0.070	174.70	28.20	35.23	7.43	0.38	0.21	0.11	0.31	124.42	14.91
Freshwater	5	10	24	0-15	0.07	0.030	147.50	23.13	21.98	6.35	0.32	0.18	0.12	0.29	93.42	12.94
Freshwater	5	10	25	0-15	0.07	0.030	140.80	20.56	35.01	5.68	0.33	0.31	0.13	0.44	89.19	15.07
Freshwater	5	10	26	0-15	0.10	0.310	106.10	17.00	22.87	5.33	0.23	0.19	0.12	0.32	54.68	12.27
Freshwater	5	10	27	15-30	0.04	<0.006	45.78	11.58	36.11	2.51	0.07	0.10	0.06	<0.10	27.67	7.60
Freshwater	5	10	28	30-45	0.02	<0.006	29.25	9.55	51.22	1.82	0.04	0.05	0.05	<0.10	25.52	8.52
Freshwater	5	10	29	45-60	0.04	<0.006	33.66	11.48	59.00	1.86	0.04	<0.04	0.05	<0.10	36.14	8.48
Freshwater	5	10	30	60-75	0.02	<0.006	47.00	15.60	40.57	2.67	0.06	<0.04	0.06	<0.10	44.60	8.67
Freshwater	5	10	31	75-90	0.04	<0.006	61.98	20.98	23.40	3.17	0.08	<0.04	0.07	<0.10	55.34	8.70
Freshwater	5	10	32	90-105	0.04	<0.006	69.87	23.03	16.32	4.40	0.08	<0.04	0.08	<0.10	64.83	8.25
Freshwater	5	10	33	105-120	0.05	0.020	63.46	22.01	15.53	4.26	0.06	<0.04	0.08	<0.10	60.82	8.25
Freshwater	5	14	43	0-15	0.12	0.020	103.20	16.61	30.79	6.13	0.22	0.16	0.10	0.27	46.62	12.08
Freshwater	5	14	44	15-30	0.06	<0.006	43.73	15.67	38.08	2.52	0.06	<0.04	0.08	<0.10	48.28	7.83

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	As	Cr	V	Li	Mo	Ni	Co	Se	Pb	Cd	SAR
----- (mg/L) -----															
Freshwater	1	3	7	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.2
Freshwater	1	9	21	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.2
Freshwater	1	13	36	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
Freshwater	1	13	37	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	1	13	38	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	1	13	39	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	1	13	40	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	1	13	41	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
Freshwater	1	13	42	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	2	2	6	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	2	8	19	0-15	<0.03	<0.02	<0.03	<0.04	0.07	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
Freshwater	2	8	20	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.8
Freshwater	2	15	50	0-15	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	3	1	1	0-15	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
Freshwater	3	1	2	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.9
Freshwater	3	1	3	30-45	<0.03	<0.02	0.05	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	3	1	4	45-60	<0.03	<0.02	0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	3	1	5	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
Freshwater	3	6	11	0-15	<0.03	<0.02	<0.03	<0.04	0.08	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	3	11	34	0-15	<0.03	<0.02	<0.03	<0.04	0.07	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	4	5	9	0-15	<0.03	<0.02	<0.03	<0.04	0.08	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
Freshwater	4	5	10	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.0
Freshwater	4	7	12	0-15	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.8
Freshwater	4	7	13	15-30	<0.03	<0.02	<0.03	0.06	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.8
Freshwater	4	7	14	30-45	<0.03	<0.02	<0.03	0.07	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
Freshwater	4	7	15	45-60	<0.03	<0.02	<0.03	0.05	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
Freshwater	4	7	16	60-75	<0.03	<0.02	<0.03	0.05	0.06	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
Freshwater	4	7	17	75-90	<0.03	<0.02	<0.03	0.05	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
Freshwater	4	7	18	90-105	<0.03	<0.02	<0.03	<0.04	0.06	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
Freshwater	4	12	35	0-15	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
Freshwater	5	4	8	0-15	<0.03	<0.02	<0.03	<0.04	0.11	<0.03	<0.01	<0.30	<0.10	<0.01	1.0
Freshwater	5	10	22	0-15	<0.03	<0.02	<0.03	<0.04	0.07	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
Freshwater	5	10	23	0-15	<0.03	<0.02	<0.03	<0.04	0.07	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
Freshwater	5	10	24	0-15	<0.03	<0.02	<0.03	<0.04	0.06	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	5	10	25	0-15	<0.03	<0.02	<0.03	<0.04	0.09	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
Freshwater	5	10	26	0-15	<0.03	<0.02	<0.03	<0.04	0.08	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
Freshwater	5	10	27	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.2
Freshwater	5	10	28	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.1
Freshwater	5	10	29	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.2
Freshwater	5	10	30	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.3
Freshwater	5	10	31	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
Freshwater	5	10	32	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	5	10	33	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
Freshwater	5	14	43	0-15	<0.03	<0.02	<0.03	<0.04	0.07	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
Freshwater	5	14	44	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.3

SAR = Sodium Adsorption Ratio.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Sat'n (%)	E.C. (ds/m)	pH	Cl	Alk	HCO3	CO3	OH (mg/L)	Al	Fe	Ti	Cu
Freshwater	5	14	45	30-45	33.0	0.580	7.20	6.20	98.1	97.9	0.146	0.008	<0.20	<0.01	<0.01	<0.01
Freshwater	5	14	46	45-60	33.0	0.400	7.35	3.95	98.6	98.4	0.207	0.011	<0.20	<0.01	<0.01	<0.01
Freshwater	5	14	47	60-75	33.5	0.240	7.40	4.65	104.0	103.7	0.245	0.013	<0.20	<0.01	<0.01	<0.01
Freshwater	5	14	48	75-90	33.0	0.220	7.50	3.61	109.0	108.7	0.323	0.016	<0.20	<0.01	<0.01	<0.01
Freshwater	5	14	49	90-105	31.5	0.220	7.55	4.30	111.0	110.6	0.369	0.018	<0.20	<0.01	<0.01	<0.01
KCl	1	17	62	0-15	41.5	0.510	6.90	20.30	181.0	180.9	0.135	0.004	<0.20	0.06	<0.01	0.02
KCl	1	42	219	0-15	35.8	0.420	7.10	10.76	176.5	176.3	0.209	0.006	<0.20	0.01	<0.01	0.04
KCl	1	43	220	0-15	34.0	0.410	7.20	9.75	191.0	190.7	0.284	0.008	<0.20	0.02	<0.01	0.06
KCl	1	43	221	15-30	32.5	0.380	7.40	11.14	196.0	195.5	0.462	0.013	<0.20	<0.01	<0.01	0.03
KCl	1	43	222	30-45	33.0	0.310	6.70	5.47	166.0	165.9	0.078	0.003	<0.20	<0.01	<0.01	0.02
KCl	1	43	223	45-60	32.5	0.270	7.10	5.56	136.0	135.8	0.161	0.006	<0.20	<0.01	<0.01	<0.01
KCl	1	43	224	60-75	35.0	0.240	7.60	5.06	127.0	126.5	0.473	0.020	<0.20	0.02	<0.01	<0.01
KCl	1	43	225	75-90	31.0	0.240	7.60	5.16	130.0	129.5	0.485	0.020	<0.20	<0.01	<0.01	<0.01
KCl	1	43	226	90-105	30.0	0.260	6.70	5.56	140.0	139.9	0.066	0.003	<0.20	<0.01	<0.01	<0.01
KCl	1	43	227	105-120	32.0	0.240	7.60	4.89	130.0	129.5	0.485	0.020	<0.20	0.02	<0.01	<0.01
KCl	1	43	228	120-135	31.5	0.250	7.60	5.63	137.0	136.5	0.511	0.020	<0.20	<0.01	<0.01	<0.01
KCl	2	33	176	0-15	39.0	0.500	7.00	11.96	218.0	217.8	0.205	0.005	<0.20	0.02	<0.01	0.02
KCl	2	40	217	0-15	38.0	0.440	7.10	17.56	193.0	192.8	0.228	0.006	<0.20	0.03	<0.01	0.04
KCl	3	21	78	0-15	41.0	0.680	6.90	28.90	191.0	190.9	0.143	0.004	<0.20	0.07	<0.01	0.02
KCl	3	30	156	0-15	40.3	0.670	7.00	30.24	222.0	221.8	0.208	0.005	<0.20	0.03	<0.01	0.02
KCl	3	39	216	0-15	34.0	0.710	7.20	25.12	205.0	204.7	0.305	0.008	<0.20	0.01	<0.01	0.05
KCl	4	16	51	0-15	37.0	0.590	7.10	13.20	211.0	210.7	0.249	0.006	<0.20	0.06	<0.01	0.02
KCl	4	16	52	0-15	42.5	0.610	7.00	12.60	191.0	190.8	0.179	0.005	<0.20	0.07	<0.01	0.02
KCl	4	16	53	0-15	46.5	0.690	6.90	11.20	199.0	198.8	0.148	0.004	<0.20	0.05	<0.01	<0.01
KCl	4	16	54	0-15	44.0	0.540	7.05	17.75	198.0	197.8	0.209	0.006	<0.20	0.03	<0.01	0.02
KCl	4	16	55	0-15	39.5	0.590	7.20	17.10	201.0	200.7	0.299	0.008	<0.20	0.06	<0.01	0.02
KCl	4	16	56	15-30	30.5	0.360	7.35	8.94	142.0	141.7	0.298	0.011	<0.20	0.01	<0.01	0.02
KCl	4	16	57	30-45	33.5	0.320	7.50	10.20	128.0	127.6	0.379	0.016	<0.20	<0.01	<0.01	0.02
KCl	4	16	58	45-60	33.0	0.290	7.50	13.90	113.0	112.6	0.335	0.016	<0.20	<0.01	<0.01	<0.01
KCl	4	16	59	60-75	35.5	0.260	7.55	11.60	110.0	109.6	0.366	0.018	<0.20	<0.01	<0.01	<0.01
KCl	4	16	60	75-90	32.0	0.290	7.90	19.00	112.0	111.1	0.830	0.040	<0.20	<0.01	<0.01	<0.01
KCl	4	16	61	90-105	37.5	0.280	7.60	17.00	114.0	113.6	0.425	0.020	<0.20	<0.01	<0.01	<0.01
KCl	4	24	104	0-15	41.0	0.650	7.05	28.06	193.0	192.8	0.203	0.006	<0.20	0.07	<0.01	0.03
KCl	4	29	147	0-15	39.0	0.670	7.20	24.85	243.0	242.6	0.361	0.008	<0.20	0.07	<0.01	0.04
KCl	4	29	148	15-30	42.0	0.720	6.60	128.50	50.3	50.3	0.019	0.002	<0.20	<0.01	<0.01	<0.01
KCl	4	29	149	30-45	41.0	1.050	6.25	312.50	25.1	25.1	0.004	0.001	<0.20	<0.01	<0.01	<0.01
KCl	4	29	150	45-60	36.0	0.720	6.40	220.80	30.0	30.0	0.007	0.001	<0.20	<0.01	<0.01	<0.01
KCl	4	29	151	60-75	35.5	0.350	6.60	87.09	33.2	33.2	0.012	0.002	<0.20	<0.01	<0.01	<0.01
KCl	4	29	152	75-90	34.5	0.200	6.70	45.87	27.3	27.3	0.013	0.003	<0.20	<0.01	<0.01	<0.01
KCl	4	29	153	90-105	31.5	0.140	6.90	15.28	51.6	51.6	0.038	0.004	<0.20	<0.01	<0.01	<0.01
KCl	4	29	154	105-120	30.0	0.230	7.60	5.83	128.0	127.5	0.477	0.020	<0.20	<0.01	<0.01	<0.01
KCl	4	29	155	120-135	31.5	0.210	7.50	5.02	116.0	115.6	0.344	0.016	<0.20	<0.01	<0.01	<0.01
KCl	5	25	105	0-15	36.0	1.500	7.40	190.10	196.0	195.5	0.462	0.013	<0.20	0.07	<0.01	0.06
KCl	5	25	106	0-15	35.0	1.520	7.40	130.90	194.0	193.5	0.457	0.013	<0.20	0.06	<0.01	0.06
KCl	5	25	107	0-15	37.5	1.020	7.30	76.20	177.0	176.7	0.331	0.010	<0.20	0.05	<0.01	0.04

Sat'n = Saturation Percent; E.C. = Electrical Conductivity; Alk = Alkalinity mg CaCO3/L; HCO3, CO3, OH reported as mg CaCO3/L.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Zn	Mn	Ca	Mg	Na	K (mg/L)	Sr	B	Ba	P	S	Si
Freshwater	5	14	45	30-45	0.05	0.010	81.98	28.91	25.27	2.86	0.09	<0.04	0.07	<0.10	88.69	7.76
Freshwater	5	14	46	45-60	0.04	<0.006	60.79	19.31	10.82	2.78	0.05	<0.04	0.06	<0.10	48.84	7.01
Freshwater	5	14	47	60-75	0.04	<0.006	35.68	10.71	9.13	1.81	0.03	<0.04	0.06	<0.10	8.49	6.72
Freshwater	5	14	48	75-90	0.03	<0.006	33.94	9.04	8.06	2.57	0.04	<0.04	0.06	<0.10	4.61	6.65
Freshwater	5	14	49	90-105	0.03	<0.006	33.55	9.68	9.12	2.29	0.03	<0.04	0.06	<0.10	4.40	6.64
KCl	1	17	62	0-15	0.08	0.080	98.29	21.43	9.17	16.42	0.16	0.06	0.14	0.26	31.96	6.49
KCl	1	42	219	0-15	0.09	0.010	82.10	16.51	11.11	5.55	0.11	<0.04	0.10	0.22	23.18	7.10
KCl	1	43	220	0-15	0.07	0.010	79.91	17.58	12.61	5.63	0.11	<0.04	0.12	0.15	21.18	7.07
KCl	1	43	221	15-30	0.05	0.010	70.31	17.45	13.68	6.83	0.10	<0.04	0.09	0.10	13.34	6.77
KCl	1	43	222	30-45	0.04	<0.006	53.73	12.84	12.63	6.22	0.07	<0.04	0.07	<0.10	10.60	5.92
KCl	1	43	223	45-60	0.03	<0.006	41.13	10.54	11.47	5.83	0.05	<0.04	0.07	<0.10	7.17	8.02
KCl	1	43	224	60-75	0.02	<0.006	36.16	9.30	9.55	5.53	0.04	<0.04	0.08	<0.10	4.55	8.16
KCl	1	43	225	75-90	0.03	<0.006	37.12	9.34	9.76	5.83	0.05	<0.04	0.08	<0.10	4.49	7.83
KCl	1	43	226	90-105	0.03	<0.006	38.12	9.83	10.52	6.04	0.05	<0.04	0.09	<0.10	4.17	7.71
KCl	1	43	227	105-120	0.03	<0.006	35.66	9.27	9.86	6.23	0.05	<0.04	0.09	<0.10	3.50	7.69
KCl	1	43	228	120-135	0.03	<0.006	35.05	9.43	11.64	6.12	0.04	<0.04	0.08	<0.10	4.27	7.58
KCl	2	33	176	0-15	0.10	0.040	90.18	19.37	9.64	4.93	0.13	<0.04	0.12	0.19	25.68	6.43
KCl	2	40	217	0-15	0.09	0.020	82.48	14.75	15.98	13.19	0.17	<0.04	0.10	0.22	18.78	6.86
KCl	3	21	78	0-15	0.10	0.030	114.80	19.13	12.90	63.11	0.25	0.11	0.19	0.39	58.93	11.57
KCl	3	30	156	0-15	0.07	0.070	91.60	17.03	13.68	49.26	0.19	0.06	0.14	0.21	44.77	6.38
KCl	3	39	216	0-15	0.10	0.040	127.60	20.93	21.64	38.47	0.25	0.05	0.17	0.23	74.55	7.49
KCl	4	16	51	0-15	0.08	0.050	112.10	21.37	11.38	26.95	0.22	0.05	0.16	0.20	47.03	5.35
KCl	4	16	52	0-15	0.08	0.040	110.80	16.66	7.31	50.56	0.27	0.07	0.15	0.23	51.72	8.52
KCl	4	16	53	0-15	0.11	0.080	135.00	21.20	7.50	37.23	0.33	0.09	0.15	0.30	69.56	9.97
KCl	4	16	54	0-15	0.11	0.030	90.60	13.78	8.56	50.92	0.21	0.08	0.16	0.24	29.87	7.45
KCl	4	16	55	0-15	0.09	0.030	90.90	14.05	10.62	70.32	0.20	0.07	0.16	0.22	41.21	5.53
KCl	4	16	56	15-30	0.05	<0.006	63.33	15.08	12.52	5.22	0.09	<0.04	0.07	0.10	23.35	4.04
KCl	4	16	57	30-45	0.05	<0.006	53.76	14.05	11.41	2.64	0.08	<0.04	0.05	<0.10	17.13	5.07
KCl	4	16	58	45-60	0.06	<0.006	41.53	12.68	11.69	3.22	0.05	<0.04	0.05	<0.10	13.64	6.89
KCl	4	16	59	60-75	0.05	<0.006	37.13	11.36	9.98	3.20	0.04	<0.04	0.06	<0.10	10.03	6.98
KCl	4	16	60	75-90	1.42	<0.006	42.32	13.46	12.02	4.29	0.05	<0.04	0.07	<0.10	13.85	7.21
KCl	4	16	61	90-105	0.02	<0.006	39.71	12.27	9.96	3.93	0.05	<0.04	0.06	<0.10	9.54	7.03
KCl	4	24	104	0-15	0.09	0.040	90.48	15.24	15.00	95.99	0.22	0.08	0.18	0.56	46.45	7.89
KCl	4	29	147	0-15	0.11	0.070	95.43	16.44	19.25	95.00	0.21	0.09	0.15	0.34	45.20	7.89
KCl	4	29	148	15-30	0.05	0.070	91.97	22.60	29.13	29.49	0.20	<0.04	0.07	<0.10	60.70	6.84
KCl	4	29	149	30-45	0.12	0.210	130.00	35.60	22.42	30.25	0.32	<0.04	0.20	<0.10	23.42	11.84
KCl	4	29	150	45-60	0.07	0.120	85.87	24.40	16.23	23.93	0.20	0.04	0.18	<0.10	9.08	11.29
KCl	4	29	151	60-75	0.05	0.030	37.20	11.35	10.96	14.36	0.08	<0.04	0.09	<0.10	8.44	11.74
KCl	4	29	152	75-90	0.06	0.010	18.91	5.98	9.94	9.04	0.04	<0.04	0.07	<0.10	4.58	14.15
KCl	4	29	153	90-105	0.06	0.010	13.22	3.65	8.07	6.72	0.03	<0.04	0.07	<0.10	3.00	13.84
KCl	4	29	154	105-120	0.06	<0.006	27.66	10.81	11.95	7.29	0.05	<0.04	0.09	<0.10	3.27	8.50
KCl	4	29	155	120-135	<0.02	<0.006	28.00	9.73	8.23	6.04	0.03	<0.04	0.08	<0.10	2.44	8.01
KCl	5	25	105	0-15	0.06	0.070	152.10	21.17	41.96	273.26	0.46	0.15	0.32	0.27	130.36	6.58
KCl	5	25	106	0-15	0.08	0.040	144.70	24.33	60.13	286.20	0.43	0.13	0.18	0.24	171.23	5.08
KCl	5	25	107	0-15	0.07	0.040	120.70	25.79	35.39	140.40	0.38	0.09	0.12	0.22	111.68	5.15

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	As	Cr	V	Li	Mo	Ni	Co	Se	Pb	Cd	SAR
					(mg/L)										
Freshwater	5	14	45	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
Freshwater	5	14	46	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
Freshwater	5	14	47	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
Freshwater	5	14	48	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
Freshwater	5	14	49	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	1	17	62	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.2
KCl	1	42	219	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	0.3
KCl	1	43	220	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
KCl	1	43	221	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	1	43	222	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	1	43	223	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	1	43	224	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	1	43	225	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	1	43	226	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	1	43	227	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	1	43	228	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	2	33	176	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.2
KCl	2	40	217	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	3	21	78	0-15	<0.03	<0.02	<0.03	<0.04	0.07	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
KCl	3	30	156	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
KCl	3	39	216	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	4	16	51	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
KCl	4	16	52	0-15	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.2
KCl	4	16	53	0-15	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.2
KCl	4	16	54	0-15	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.2
KCl	4	16	55	0-15	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
KCl	4	16	56	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	16	57	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	16	58	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	16	59	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	16	60	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	16	61	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	24	104	0-15	<0.03	<0.02	<0.03	<0.04	0.08	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	29	147	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	4	29	148	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
KCl	4	29	149	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	0.05	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	29	150	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	29	151	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	4	29	152	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	4	29	153	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	4	29	154	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	4	29	155	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
KCl	5	25	105	0-15	<0.03	<0.02	<0.03	<0.04	0.08	<0.03	<0.01	<0.30	<0.10	<0.01	0.8
KCl	5	25	106	0-15	<0.03	<0.02	<0.03	<0.04	0.10	0.03	<0.01	<0.30	<0.10	<0.01	1.2
KCl	5	25	107	0-15	<0.03	<0.02	<0.03	<0.04	0.07	<0.03	<0.01	<0.30	<0.10	<0.01	0.8

SAR = Sodium Adsorption Ratio.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Sat'n (%)	E.C. (dS/m)	pH	Cl	Alk	HCO3	CO3	OH (mg/L)	Al	Fe	Ti	Cu
KCl	5	25	108	0-15	39.5	1.090	7.30	73.68	270.0	269.5	0.505	0.010	<0.20	0.06	<0.01	0.04
KCl	5	25	109	0-15	37.0	1.350	7.20	163.10	224.0	223.7	0.333	0.008	<0.20	0.08	<0.01	0.04
KCl	5	25	110	15-30	37.0	2.520	5.90	672.00	40.8	40.8	0.003	0.000	0.33	0.13	<0.01	0.03
KCl	5	25	111	15-30	40.5	1.420	6.00	228.80	49.3	49.3	0.005	0.001	<0.20	0.08	<0.01	0.02
KCl	5	25	112	15-30	39.0	0.720	6.30	86.19	49.9	49.9	0.009	0.001	<0.20	0.07	<0.01	0.02
KCl	5	25	113	15-30	37.5	1.940	6.80	358.20	118.0	117.9	0.070	0.003	<0.20	0.05	<0.01	0.02
KCl	5	25	114	15-30	35.5	1.110	6.80	206.40	129.0	128.9	0.076	0.003	<0.20	0.17	<0.01	0.03
KCl	5	25	115	30-45	37.5	1.450	5.60	474.40	19.6	19.6	0.001	0.000	<0.20	0.05	<0.01	<0.01
KCl	5	25	116	45-60	43.0	2.250	5.30	724.90	16.8	16.8	0.000	0.000	0.29	0.08	<0.01	<0.01
KCl	5	25	117	60-75	36.0	0.460	6.00	136.30	19.9	19.9	0.002	0.001	<0.20	0.06	<0.01	<0.01
KCl	5	25	118	75-90	36.5	0.150	6.20	34.48	25.8	25.8	0.004	0.001	0.90	5.10	0.55	0.03
KCl	5	25	119	90-105	31.0	0.120	5.80	22.06	25.0	25.0	0.001	0.000	0.50	4.95	0.27	0.03
KCl	5	25	120	105-120	31.0	0.110	6.40	13.26	31.8	31.8	0.008	0.001	0.29	2.01	0.09	0.02
KCl	5	25	121	120-135	29.0	0.110	6.30	13.84	36.8	36.8	0.007	0.001	0.94	0.89	0.06	0.02
KCl	5	25	122	135-150	29.5	0.110	6.80	8.69	41.2	41.2	0.024	0.003	<0.20	0.09	<0.01	0.02
KCl	5	25	123	150-165	32.0	0.090	6.50	7.09	34.1	34.1	0.010	0.002	<0.20	0.08	<0.01	<0.01
KCl	5	25	124	165-180	30.5	0.100	6.90	6.47	39.3	39.3	0.029	0.004	<0.20	0.03	<0.01	<0.01
KCl	5	26	125	0-15	37.5	1.060	7.20	15.64	189.0	188.7	0.281	0.008	<0.20	0.07	<0.01	0.04
KCl	5	26	126	15-30	36.0	0.700	7.25	14.96	223.0	222.6	0.372	0.009	<0.20	0.04	<0.01	0.03
KCl	5	37	198	0-15	38.5	0.450	7.00	19.84	190.0	189.8	0.178	0.005	<0.20	0.06	<0.01	0.04
NaCl	6	22	79	0-15	40.0	0.460	6.95	13.70	217.0	216.8	0.182	0.004	<0.20	0.07	<0.01	0.02
NaCl	6	22	80	15-30	34.5	0.420	7.30	11.20	237.0	236.5	0.444	0.010	<0.20	<0.01	<0.01	0.02
NaCl	6	22	81	30-45	30.5	0.270	7.60	9.31	136.0	135.5	0.507	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	6	22	82	45-60	34.0	0.260	7.60	7.09	131.0	130.5	0.488	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	6	22	83	60-75	30.5	0.250	7.80	6.75	131.0	130.2	0.772	0.032	<0.20	<0.01	<0.01	<0.01
NaCl	6	22	84	75-90	31.0	0.250	7.80	6.81	123.0	122.2	0.725	0.032	<0.20	<0.01	<0.01	<0.01
NaCl	6	22	85	90-105	31.5	0.240	7.60	5.69	122.0	121.5	0.455	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	6	22	86	105-120	30.0	0.250	7.50	6.81	129.0	128.6	0.382	0.016	<0.20	<0.01	<0.01	<0.01
NaCl	6	32	175	0-15	41.0	0.560	7.10	11.05	208.0	207.7	0.246	0.006	<0.20	0.02	<0.01	0.03
NaCl	6	41	218	0-15	38.0	0.570	7.20	13.08	179.0	178.7	0.266	0.008	<0.20	<0.01	<0.01	0.04
NaCl	7	18	63	0-15	42.5	0.570	7.00	22.70	198.0	197.8	0.186	0.005	<0.20	0.04	<0.01	0.02
NaCl	7	27	127	0-15	40.5	0.880	6.60	65.98	160.0	159.9	0.060	0.002	0.24	0.33	0.02	0.02
NaCl	7	27	128	15-30	38.0	0.990	6.80	172.60	173.0	172.9	0.103	0.003	<0.20	0.19	<0.01	0.05
NaCl	7	34	177	0-15	42.0	0.520	6.90	17.18	179.0	178.9	0.134	0.004	<0.20	0.08	<0.01	0.02
NaCl	7	34	178	0-15	38.0	0.530	6.30	18.87	92.8	92.8	0.017	0.001	<0.20	0.14	<0.01	<0.01
NaCl	7	34	179	0-15	40.5	0.760	6.90	25.11	190.0	189.9	0.142	0.004	<0.20	0.09	<0.01	0.03
NaCl	7	34	180	0-15	40.0	0.550	7.10	12.65	187.0	186.8	0.221	0.006	<0.20	0.02	<0.01	0.04
NaCl	7	34	181	0-15	41.0	0.440	7.10	14.85	211.0	210.7	0.249	0.006	<0.20	0.04	<0.01	0.03
NaCl	7	34	182	15-30	38.0	0.450	7.20	13.82	187.0	186.7	0.278	0.008	<0.20	0.02	<0.01	0.04
NaCl	8	20	77	0-15	44.5	0.510	6.80	20.30	208.0	207.9	0.123	0.003	<0.20	0.09	<0.01	<0.01
NaCl	8	35	183	0-15	44.0	0.650	6.80	24.09	240.0	239.9	0.142	0.003	<0.20	<0.01	<0.01	0.02
NaCl	8	35	184	0-15	40.5	0.960	7.00	33.69	251.0	250.8	0.236	0.005	<0.20	0.03	<0.01	0.02
NaCl	8	35	185	0-15	39.5	0.460	6.70	16.49	145.0	144.9	0.068	0.003	<0.20	0.11	<0.01	0.03
NaCl	8	35	186	0-15	44.0	0.450	7.00	12.94	227.0	226.8	0.213	0.005	<0.20	0.06	<0.01	0.04
NaCl	8	35	187	0-15	47.5	0.370	6.70	12.71	107.0	106.9	0.050	0.003	0.27	0.24	0.03	0.02
NaCl	8	35	188	15-30	34.0	1.010	7.20	220.90	138.0	137.8	0.205	0.008	<0.20	<0.01	<0.01	0.03
NaCl	8	35	189	30-45	33.5	1.500	7.25	449.00	84.4	84.3	0.141	0.009	<0.20	<0.01	<0.01	0.02

Sat'n = Saturation Percent; E.C. = Electrical Conductivity; Alk = Alkalinity mg CaCO3/L; HCO3, CO3, OH reported as mg CaCO3/L.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Zn	Mn	Ca	Mg	Na	K (mg/L)	Sr	B	Ba	P	S	Si
KCl	5	25	108	0-15	0.08	0.080	144.50	22.45	28.39	167.45	0.36	0.13	0.16	0.31	96.82	7.74
KCl	5	25	109	0-15	0.13	0.110	174.10	31.44	42.67	172.25	0.40	0.10	0.15	0.25	117.24	5.79
KCl	5	25	110	15-30	0.19	6.370	320.40	94.84	100.68	96.46	0.80	<0.04	0.18	0.18	164.87	13.37
KCl	5	25	111	15-30	0.12	0.620	171.50	42.85	68.72	96.10	0.44	0.08	0.11	<0.10	165.74	10.79
KCl	5	25	112	15-30	0.08	0.280	82.50	25.17	31.26	46.52	0.21	0.07	0.10	0.10	83.03	7.98
KCl	5	25	113	15-30	0.07	0.290	270.50	63.22	69.21	142.75	0.52	0.07	0.19	0.14	188.11	2.70
KCl	5	25	114	15-30	0.10	0.220	145.30	41.42	42.66	79.38	0.30	0.08	0.18	0.17	75.53	4.29
KCl	5	25	115	30-45	0.16	4.480	187.00	50.88	29.30	13.20	0.53	<0.04	0.46	<0.10	10.71	12.92
KCl	5	25	116	45-60	0.13	6.080	285.30	93.47	61.58	12.99	0.71	<0.04	0.25	0.12	45.07	14.58
KCl	5	25	117	60-75	0.09	0.490	54.20	13.92	13.25	8.92	0.15	<0.04	0.18	<0.10	4.52	16.16
KCl	5	25	118	75-90	0.10	0.050	14.93	4.11	8.33	5.13	0.05	<0.04	0.09	0.16	2.95	22.88
KCl	5	25	119	90-105	0.10	0.020	11.88	3.29	9.08	4.79	0.03	<0.04	0.08	0.17	3.32	19.94
KCl	5	25	120	105-120	0.06	0.010	11.63	2.51	7.10	4.03	0.03	<0.04	0.07	<0.10	2.83	18.29
KCl	5	25	121	120-135	0.09	0.010	11.05	2.89	9.78	4.68	0.03	0.04	0.07	<0.10	4.96	19.08
KCl	5	25	122	135-150	0.08	<0.006	10.56	3.88	7.41	4.43	0.03	<0.04	0.07	<0.10	4.80	15.46
KCl	5	25	123	150-165	0.06	<0.006	8.38	2.34	6.28	4.52	0.03	<0.04	0.06	<0.10	3.56	17.06
KCl	5	25	124	165-180	0.08	<0.006	9.02	2.82	6.40	4.65	0.02	<0.04	0.05	<0.10	3.89	16.93
KCl	5	26	125	0-15	0.09	0.020	154.70	21.40	19.92	145.26	0.44	0.18	0.13	0.15	149.46	7.87
KCl	5	26	126	15-30	0.07	0.050	108.10	20.51	25.33	56.58	0.19	0.06	0.13	0.19	68.37	6.68
KCl	5	37	198	0-15	0.07	0.040	86.27	15.77	14.64	17.85	0.17	<0.04	0.13	0.25	18.00	6.72
NaCl	6	22	79	0-15	0.11	0.070	86.94	21.18	12.17	12.10	0.15	0.05	0.14	0.29	18.14	6.48
NaCl	6	22	80	15-30	0.05	<0.006	67.73	23.12	14.82	9.31	0.14	<0.04	0.13	0.16	4.72	9.16
NaCl	6	22	81	30-45	0.02	<0.006	31.93	15.51	12.78	5.69	0.09	0.06	0.10	<0.10	3.39	8.32
NaCl	6	22	82	45-60	0.02	<0.006	30.09	15.95	10.66	5.91	0.09	<0.04	0.11	<0.10	3.24	8.19
NaCl	6	22	83	60-75	0.02	<0.006	28.57	14.48	11.16	6.04	0.08	<0.04	0.10	<0.10	3.34	7.94
NaCl	6	22	84	75-90	0.02	<0.006	28.83	14.23	10.88	6.25	0.08	<0.04	0.10	<0.10	3.49	7.82
NaCl	6	22	85	90-105	0.02	<0.006	28.42	13.24	10.51	6.04	0.06	<0.04	0.11	<0.10	3.50	7.55
NaCl	6	22	86	105-120	0.04	<0.006	29.72	14.06	10.67	6.56	0.10	<0.04	0.09	<0.10	4.19	7.27
NaCl	6	32	175	0-15	0.09	0.020	112.10	23.39	13.80	5.88	0.16	<0.04	0.14	0.20	47.88	7.21
NaCl	6	41	218	0-15	0.07	0.020	114.00	23.94	14.18	5.64	0.16	<0.04	0.12	0.13	63.94	6.87
NaCl	7	18	63	0-15	0.10	0.020	109.50	22.14	19.67	7.56	0.17	0.06	0.14	0.26	37.80	7.54
NaCl	7	27	127	0-15	0.13	0.350	101.90	23.72	122.25	9.54	0.19	0.06	0.12	0.41	97.10	8.94
NaCl	7	27	128	15-30	0.12	0.310	114.50	29.84	121.82	11.40	0.19	0.06	0.17	0.31	58.67	6.71
NaCl	7	34	177	0-15	0.11	0.050	96.09	17.57	19.65	20.47	0.18	0.06	0.14	0.33	35.70	8.04
NaCl	7	34	178	0-15	0.12	0.260	96.53	20.95	11.82	15.55	0.15	0.06	0.13	0.46	65.64	8.79
NaCl	7	34	179	0-15	0.05	0.180	138.10	26.83	31.47	23.67	0.23	0.07	0.15	0.24	91.41	7.72
NaCl	7	34	180	0-15	0.06	0.040	106.50	21.38	15.24	14.72	0.19	<0.04	0.15	0.15	51.14	7.88
NaCl	7	34	181	0-15	0.05	0.040	83.73	15.83	11.75	16.46	0.15	<0.04	0.12	0.20	22.50	6.83
NaCl	7	34	182	15-30	0.05	0.020	78.07	15.83	25.37	11.69	0.13	<0.04	0.10	0.11	25.41	5.89
NaCl	8	20	77	0-15	0.10	0.030	92.97	18.89	25.74	7.85	0.16	0.05	0.13	0.45	26.01	8.23
NaCl	8	35	183	0-15	0.05	0.070	95.11	19.00	75.21	5.40	0.15	<0.04	0.12	0.45	40.90	9.85
NaCl	8	35	184	0-15	<0.02	0.100	98.47	21.23	25.39	3.58	0.15	<0.04	0.07	<0.10	78.42	4.02
NaCl	8	35	185	0-15	0.07	0.140	84.70	16.95	10.20	21.95	0.15	0.04	0.13	0.17	35.36	7.12
NaCl	8	35	186	0-15	0.05	0.060	86.30	19.39	15.18	10.69	0.15	<0.04	0.12	0.21	12.15	7.85
NaCl	8	35	187	0-15	0.06	0.060	68.84	15.40	8.60	16.43	0.13	0.04	0.12	0.43	24.58	8.51
NaCl	8	35	188	15-30	0.03	<0.006	73.80	20.51	160.83	2.06	0.10	<0.04	0.09	<0.10	41.92	7.42
NaCl	8	35	189	30-45	0.04	<0.006	177.50	62.10	70.62	2.78	0.24	<0.04	0.20	<0.10	23.47	8.15

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	As	Cr	V	Li	Mo	Ni (mg/L)	Co	Se	Pb	Cd	SAR
KCl	5	25	108	0-15	<0.03	<0.02	<0.03	<0.04	0.06	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
KCl	5	25	109	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.8
KCl	5	25	110	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	0.14	0.08	<0.30	<0.10	<0.01	1.3
KCl	5	25	111	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	0.04	0.01	<0.30	<0.10	<0.01	1.2
KCl	5	25	112	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	0.04	<0.01	<0.30	<0.10	<0.01	0.8
KCl	5	25	113	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.0
KCl	5	25	114	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.8
KCl	5	25	115	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	0.11	0.05	<0.30	<0.10	<0.01	0.5
KCl	5	25	116	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	0.18	0.11	<0.30	<0.10	<0.01	0.8
KCl	5	25	117	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	5	25	118	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	5	25	119	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
KCl	5	25	120	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	5	25	121	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
KCl	5	25	122	135-150	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	5	25	123	150-165	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	5	25	124	165-180	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
KCl	5	26	125	0-15	<0.03	<0.02	<0.03	<0.04	0.09	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
KCl	5	26	126	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
KCl	5	37	198	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	0.4
NaCl	6	22	79	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
NaCl	6	22	80	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	6	22	81	30-45	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	6	22	82	45-60	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	6	22	83	60-75	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	6	22	84	75-90	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	6	22	85	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	6	22	86	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	6	32	175	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
NaCl	6	41	218	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
NaCl	7	18	63	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	7	27	127	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.8
NaCl	7	27	128	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.6
NaCl	7	34	177	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	7	34	178	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
NaCl	7	34	179	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
NaCl	7	34	180	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	7	34	181	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
NaCl	7	34	182	15-30	0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
NaCl	8	20	77	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
NaCl	8	35	183	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.8
NaCl	8	35	184	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
NaCl	8	35	185	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.3
NaCl	8	35	186	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	35	187	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	0.2
NaCl	8	35	188	15-30	0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	4.3
NaCl	8	35	189	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.2

SAR = Sodium Adsorption Ratio.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Sat'n (%)	E.C. (dS/m)	pH	Cl	Alk	HCO3	CO3	OH (mg/L)	Al	Fe	Ti	Cu
NaCl	8	35	190	45-60	35.0	1.140	7.35	331.00	95.5	95.3	0.201	0.011	<0.20	<0.01	<0.01	0.02
NaCl	8	35	191	60-75	34.5	0.710	7.50	177.50	94.0	93.7	0.279	0.016	<0.20	<0.01	<0.01	0.02
NaCl	8	35	192	75-90	36.0	0.540	7.60	115.60	100.0	99.6	0.373	0.020	<0.20	<0.01	<0.01	0.02
NaCl	8	35	193	90-105	36.0	0.470	7.60	89.87	103.0	102.6	0.384	0.020	<0.20	<0.01	<0.01	0.02
NaCl	8	35	194	105-120	32.5	0.400	7.60	59.49	114.0	113.6	0.425	0.020	<0.20	<0.01	<0.01	0.02
NaCl	8	35	195	120-135	31.5	0.310	7.70	29.83	119.0	118.4	0.558	0.025	<0.20	<0.01	<0.01	0.02
NaCl	8	44	229	0-15	35.5	0.530	7.00	25.83	202.0	201.8	0.190	0.005	<0.20	0.09	<0.01	0.03
NaCl	8	44	230	0-15	39.0	0.530	6.60	22.28	198.0	197.9	0.074	0.002	<0.20	0.06	<0.01	<0.01
NaCl	8	44	231	0-15	34.0	0.520	7.20	23.16	200.0	199.7	0.298	0.008	<0.20	0.10	<0.01	0.03
NaCl	8	44	232	0-15	35.0	0.580	7.15	22.30	212.0	211.7	0.281	0.007	<0.20	0.10	<0.01	0.03
NaCl	8	44	233	0-15	33.0	0.520	7.30	16.97	211.0	210.6	0.395	0.010	<0.20	0.23	<0.01	0.03
NaCl	8	44	234	15-30	33.5	0.630	7.50	83.69	169.0	168.5	0.501	0.016	<0.20	0.19	<0.01	0.28
NaCl	8	44	235	15-30	33.5	0.490	7.30	14.90	205.0	204.6	0.384	0.010	0.47	0.78	0.05	0.36
NaCl	8	44	236	15-30	32.5	0.580	7.15	33.98	213.0	212.7	0.282	0.007	0.76	1.34	0.08	0.31
NaCl	8	44	237	15-30	35.0	0.560	7.20	39.39	211.0	210.7	0.314	0.008	<0.20	0.27	0.02	0.03
NaCl	8	44	238	15-30	33.5	0.620	7.10	31.98	245.0	244.7	0.290	0.006	0.28	1.35	<0.01	0.03
NaCl	8	44	239	30-45	33.0	0.640	7.60	143.20	108.0	107.6	0.403	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	8	44	240	45-60	33.0	0.530	7.50	117.40	131.0	130.6	0.388	0.016	<0.20	<0.01	<0.01	<0.01
NaCl	8	44	241	60-75	33.0	0.340	7.60	40.73	127.0	126.5	0.473	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	8	44	242	75-90	31.0	0.270	7.30	10.14	139.0	138.7	0.260	0.010	<0.20	<0.01	<0.01	<0.01
NaCl	8	44	243	90-105	34.5	0.250	7.50	4.69	126.0	125.6	0.373	0.016	<0.20	0.02	<0.01	<0.01
NaCl	8	44	244	105-120	33.5	0.260	7.60	4.19	129.0	128.5	0.481	0.020	<0.20	0.03	<0.01	<0.01
NaCl	8	44	245	120-135	30.5	0.270	6.00	5.70	138.0	138.0	0.013	0.001	<0.20	<0.01	<0.01	<0.01
NaCl	8	44	246	135-150	32.5	0.280	7.60	5.50	142.0	141.5	0.529	0.020	<0.20	0.03	<0.01	<0.01
NaCl	9	19	64	0-15	51.5	0.630	6.50	32.10	193.0	192.9	0.057	0.002	<0.20	0.11	<0.01	<0.01
NaCl	9	19	65	0-15	46.5	0.620	6.50	27.30	218.0	217.9	0.065	0.002	<0.20	0.49	0.03	0.02
NaCl	9	19	66	0-15	42.0	0.620	7.00	18.90	227.0	226.8	0.213	0.005	<0.20	0.13	<0.01	0.02
NaCl	9	19	67	0-15	49.0	0.630	6.70	24.50	186.0	185.9	0.088	0.003	<0.20	<0.01	<0.01	0.02
NaCl	9	19	68	0-15	48.0	0.750	6.60	17.70	171.0	170.9	0.064	0.002	<0.20	0.08	<0.01	<0.01
NaCl	9	19	69	15-30	47.0	0.810	6.70	93.00	263.0	262.9	0.124	0.003	<0.20	0.32	0.02	0.02
NaCl	9	19	70	30-45	35.0	0.500	7.40	58.20	185.0	184.6	0.436	0.013	<0.20	0.02	<0.01	0.03
NaCl	9	19	71	45-60	26.0	0.160	7.70	11.50	71.5	71.1	0.335	0.025	1.46	4.90	<0.01	0.07
NaCl	9	19	72	60-75	25.5	0.180	7.90	14.20	86.3	85.6	0.639	0.040	0.55	3.24	0.06	0.05
NaCl	9	19	73	75-90	34.0	0.180	7.30	18.10	68.5	68.4	0.128	0.010	0.28	0.96	0.02	0.02
NaCl	9	19	74	90-105	31.5	0.230	7.20	34.40	64.8	64.7	0.096	0.008	<0.20	0.19	<0.01	<0.01
NaCl	9	19	75	105-120	32.5	0.260	7.20	44.50	62.0	61.9	0.092	0.008	<0.20	0.02	<0.01	<0.01
NaCl	9	19	76	120-135	31.5	0.380	7.50	58.50	95.3	95.0	0.282	0.016	<0.20	0.06	<0.01	<0.01
NaCl	9	31	157	0-15	37.5	0.760	7.15	50.71	254.0	253.7	0.337	0.007	<0.20	0.07	<0.01	0.02
NaCl	9	31	158	0-15	39.5	0.600	6.90	35.81	227.0	226.8	0.169	0.004	0.40	2.02	0.15	0.03
NaCl	9	31	159	0-15	36.5	0.700	6.90	17.05	145.0	144.9	0.108	0.004	<0.20	0.05	<0.01	0.02
NaCl	9	31	160	0-15	44.5	0.900	7.00	83.37	257.0	256.8	0.241	0.005	<0.20	0.14	<0.01	0.02
NaCl	9	31	161	0-15	42.5	0.720	7.00	33.85	215.0	214.8	0.202	0.005	<0.20	0.06	<0.01	0.02
NaCl	9	31	162	15-30	37.5	1.030	6.35	306.00	36.9	36.9	0.008	0.001	<0.20	<0.01	<0.01	<0.01
NaCl	9	31	163	15-30	38.0	0.680	7.20	71.37	236.0	235.6	0.351	0.008	0.33	3.53	0.21	0.06
NaCl	9	31	164	15-30	36.5	0.510	7.00	14.92	187.0	186.8	0.176	0.005	<0.20	0.12	<0.01	0.02
NaCl	9	31	165	15-30	46.5	0.670	6.90	94.00	176.0	175.9	0.131	0.004	0.20	0.54	0.06	<0.01
NaCl	9	31	166	15-30	43.5	0.560	7.05	29.78	234.0	233.7	0.247	0.006	<0.20	0.05	<0.01	0.03
NaCl	9	31	167	30-45	37.5	1.570	6.10	521.00	17.6	17.6	0.002	0.001	<0.20	<0.01	<0.01	<0.01
NaCl	9	31	168	45-60	39.0	1.520	6.10	515.00	27.4	27.4	0.003	0.001	<0.20	<0.01	<0.01	<0.01

Sat'n = Saturation Percent; E.C. = Electrical Conductivity; Alk = Alkalinity mg CaCO3/L; HCO3, CO3, OH reported as mg CaCO3/L.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Zn	Mn	Ca	Mg	Na	K (mg/L)	Sr	B	Ba	P	S	Si
NaCl	8	35	190	45-60	0.05	<0.006	143.60	56.58	23.90	3.97	0.21	<0.04	0.18	<0.10	11.84	8.70
NaCl	8	35	191	60-75	0.03	<0.006	83.78	38.17	16.51	3.68	0.14	<0.04	0.11	<0.10	8.32	9.76
NaCl	8	35	192	75-90	0.03	<0.006	62.70	29.76	15.86	3.85	0.12	<0.04	0.09	<0.10	8.06	10.47
NaCl	8	35	193	90-105	0.03	<0.006	51.85	27.41	14.98	3.74	0.10	<0.04	0.10	<0.10	8.09	10.66
NaCl	8	35	194	105-120	0.04	<0.006	43.93	23.90	16.56	3.91	0.09	<0.04	0.08	<0.10	8.68	10.63
NaCl	8	35	195	120-135	0.03	<0.006	34.17	18.91	15.37	4.20	0.07	<0.04	0.08	<0.10	6.40	10.27
NaCl	8	44	229	0-15	0.08	0.050	99.54	18.40	26.19	8.79	0.15	<0.04	0.12	0.34	26.76	6.35
NaCl	8	44	230	0-15	0.04	0.020	69.14	12.84	21.17	4.30	0.11	<0.04	0.07	0.13	30.83	4.11
NaCl	8	44	231	0-15	0.09	0.020	65.40	12.19	71.95	3.74	0.10	<0.04	0.08	0.27	28.07	7.01
NaCl	8	44	232	0-15	0.09	0.030	93.30	17.72	48.67	5.95	0.15	<0.04	0.11	0.26	38.97	5.66
NaCl	8	44	233	0-15	0.11	0.040	64.77	12.23	76.53	1.94	0.11	<0.04	0.08	0.25	32.12	5.15
NaCl	8	44	234	15-30	0.65	0.030	700.20	192.01	652.71	38.15	1.04	0.07	0.85	0.84	279.90	62.39
NaCl	8	44	235	15-30	1.18	0.100	749.70	159.01	463.14	45.94	1.11	0.25	1.00	2.47	244.84	57.64
NaCl	8	44	236	15-30	1.23	0.160	651.90	131.01	927.06	43.46	1.03	0.27	0.87	3.66	288.13	71.85
NaCl	8	44	237	15-30	0.10	0.060	70.56	15.18	77.25	5.68	0.12	<0.04	0.13	0.25	29.08	5.32
NaCl	8	44	238	15-30	0.15	0.070	48.89	10.43	138.73	1.83	0.14	0.04	0.07	0.95	23.14	4.87
NaCl	8	44	239	30-45	0.03	<0.006	71.52	23.50	41.60	3.66	0.12	<0.04	0.09	<0.10	12.60	8.29
NaCl	8	44	240	45-60	0.08	<0.006	58.90	21.12	19.14	3.46	0.10	<0.04	0.08	<0.10	6.70	7.90
NaCl	8	44	241	60-75	0.03	<0.006	45.18	16.52	12.42	3.23	0.08	<0.04	0.08	<0.10	4.60	9.76
NaCl	8	44	242	75-90	0.03	<0.006	36.14	12.99	12.91	3.06	0.06	<0.04	0.09	<0.10	4.44	10.21
NaCl	8	44	243	90-105	0.02	<0.006	34.68	13.62	10.41	3.12	0.06	<0.04	0.08	<0.10	5.03	10.24
NaCl	8	44	244	105-120	0.03	<0.006	34.73	14.07	11.68	3.39	0.06	<0.04	0.07	<0.10	5.76	10.25
NaCl	8	44	245	120-135	0.04	<0.006	36.35	14.39	12.37	3.41	0.07	<0.04	0.07	<0.10	6.84	9.79
NaCl	8	44	246	135-150	0.04	<0.006	36.39	15.17	12.72	3.79	0.06	<0.04	0.07	<0.10	6.85	9.78
NaCl	9	19	64	0-15	0.10	0.040	100.90	19.85	42.33	21.37	0.19	0.11	0.17	0.81	46.23	8.85
NaCl	9	19	65	0-15	0.16	0.070	61.89	11.21	113.97	4.93	0.12	0.07	0.09	1.54	34.76	7.72
NaCl	9	19	66	0-15	0.08	0.040	72.10	15.63	91.72	6.30	0.16	<0.04	0.08	0.32	47.66	7.39
NaCl	9	19	67	0-15	0.07	0.080	123.40	23.41	22.72	13.71	0.24	0.09	0.16	0.44	55.26	9.92
NaCl	9	19	68	0-15	0.07	0.050	151.60	26.42	21.70	9.53	0.26	0.06	0.15	0.31	96.00	8.72
NaCl	9	19	69	15-30	0.09	0.060	71.78	14.95	144.10	26.20	0.13	0.14	0.14	1.32	19.60	7.68
NaCl	9	19	70	30-45	0.03	<0.006	48.20	13.03	67.29	8.41	0.07	0.06	0.09	0.13	7.03	6.02
NaCl	9	19	71	45-60	0.02	0.050	16.92	3.52	29.74	6.21	0.03	<0.04	0.05	0.32	3.24	10.17
NaCl	9	19	72	60-75	<0.02	0.030	19.04	4.07	30.71	5.37	0.04	<0.04	0.05	0.24	4.03	9.80
NaCl	9	19	73	75-90	0.03	<0.006	15.11	3.08	26.49	4.48	0.03	<0.04	0.07	0.14	3.07	9.41
NaCl	9	19	74	90-105	0.04	<0.006	17.87	4.62	32.33	4.36	0.03	<0.04	0.06	<0.10	5.06	8.91
NaCl	9	19	75	105-120	0.04	<0.006	22.17	6.63	29.61	4.33	0.02	<0.04	0.06	<0.10	5.90	8.67
NaCl	9	19	76	120-135	0.03	<0.006	45.93	13.23	22.37	5.79	0.05	<0.04	0.08	<0.10	7.72	7.73
NaCl	9	31	157	0-15	0.06	0.030	67.77	12.29	144.61	6.30	0.12	0.04	0.10	0.30	47.94	6.13
NaCl	9	31	158	0-15	0.10	0.110	52.69	10.68	123.02	2.33	0.09	0.04	0.09	1.02	24.51	6.29
NaCl	9	31	159	0-15	0.10	0.170	119.00	27.51	41.08	6.33	0.18	0.04	0.12	0.21	93.67	5.62
NaCl	9	31	160	0-15	0.05	0.080	89.76	19.39	154.72	8.67	0.16	0.05	0.12	0.41	61.08	7.40
NaCl	9	31	161	0-15	0.07	0.070	115.10	26.01	55.71	7.01	0.20	0.04	0.14	0.21	65.31	6.86
NaCl	9	31	162	15-30	0.07	0.070	47.46	14.07	162.21	17.36	0.12	<0.04	0.09	<0.10	23.26	8.29
NaCl	9	31	163	15-30	0.08	0.040	47.53	9.96	147.62	6.68	0.09	<0.04	0.09	0.42	23.91	5.54
NaCl	9	31	164	15-30	0.10	0.100	71.32	16.11	57.53	6.11	0.11	0.05	0.09	0.24	40.11	5.46
NaCl	9	31	165	15-30	0.08	0.080	53.94	12.82	124.74	7.89	0.10	0.05	0.09	0.52	24.17	7.12
NaCl	9	31	166	15-30	0.07	0.130	77.44	19.87	57.45	7.75	0.13	<0.04	0.12	0.23	25.73	7.15
NaCl	9	31	167	30-45	0.21	0.190	136.10	44.95	111.65	33.31	0.35	<0.04	0.31	<0.10	6.51	13.21
NaCl	9	31	168	45-60	0.13	0.270	165.50	58.24	44.83	32.21	0.39	<0.04	0.46	<0.10	2.45	11.63

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	As	Cr	V	Li	Mo	Ni (mg/L)	Co	Se	Pb	Cd	SAR
NaCl	8	35	190	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	35	191	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	35	192	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	35	193	90-105	0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	35	194	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	8	35	195	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	8	44	229	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
NaCl	8	44	230	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.6
NaCl	8	44	231	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.1
NaCl	8	44	232	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.2
NaCl	8	44	233	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.3
NaCl	8	44	234	15-30	0.08	0.05	<0.03	0.06	0.09	0.09	<0.01	<0.30	<0.10	0.02	5.6
NaCl	8	44	235	15-30	0.08	0.11	0.04	<0.04	0.13	0.07	<0.01	<0.30	0.21	0.01	4.0
NaCl	8	44	236	15-30	0.11	0.08	<0.03	<0.04	0.29	0.17	<0.01	<0.30	<0.10	0.01	8.7
NaCl	8	44	237	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.2
NaCl	8	44	238	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	4.7
NaCl	8	44	239	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.1
NaCl	8	44	240	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	8	44	241	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	44	242	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	8	44	243	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	44	244	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	44	245	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	8	44	246	135-150	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	9	19	64	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.0
NaCl	9	19	65	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	3.5
NaCl	9	19	66	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.6
NaCl	9	19	67	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	9	19	68	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	9	19	69	15-30	<0.03	<0.02	<0.03	<0.04	0.05	<0.03	<0.01	<0.30	<0.10	<0.01	4.0
NaCl	9	19	70	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.2
NaCl	9	19	71	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.7
NaCl	9	19	72	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.7
NaCl	9	19	73	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.6
NaCl	9	19	74	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.8
NaCl	9	19	75	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.4
NaCl	9	19	76	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
NaCl	9	31	157	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	4.2
NaCl	9	31	158	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	4.0
NaCl	9	31	159	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.9
NaCl	9	31	160	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	3.9
NaCl	9	31	161	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.2
NaCl	9	31	162	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	5.3
NaCl	9	31	163	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	5.1
NaCl	9	31	164	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.6
NaCl	9	31	165	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	4.0
NaCl	9	31	166	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.5
NaCl	9	31	167	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	0.08	<0.01	<0.30	<0.10	<0.01	2.1
NaCl	9	31	168	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	0.08	<0.01	<0.30	<0.10	<0.01	0.8

SAR = Sodium Adsorption Ratio.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Sat'n (%)	E.C. (dS/m)	pH	Cl	Alk	HCO3	CO3	OH (mg/L)	Al	Fe	Ti	Cu
NaCl	9	31	169	60-75	39.5	0.940	6.15	323.00	21.0	21.0	0.003	0.001	<0.20	<0.01	<0.01	<0.01
NaCl	9	31	170	75-90	39.5	0.550	6.30	163.80	32.1	32.1	0.006	0.001	<0.20	<0.01	<0.01	<0.01
NaCl	9	31	171	90-105	34.5	0.350	6.65	80.30	63.1	63.1	0.026	0.002	<0.20	<0.01	<0.01	<0.01
NaCl	9	31	172	105-120	32.0	0.140	6.95	23.51	43.5	43.5	0.036	0.004	<0.20	<0.01	<0.01	<0.01
NaCl	9	31	173	120-135	29.5	0.260	7.60	9.41	135.0	134.5	0.503	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	9	31	174	135-150	32.5	0.230	7.55	6.07	124.0	123.6	0.412	0.018	<0.20	0.05	<0.01	<0.01
NaCl	9	36	196	0-15	38.2	0.420	7.10	19.07	194.0	193.8	0.229	0.006	<0.20	0.03	<0.01	0.05
NaCl	9	36	197	15-30	37.0	0.450	7.40	16.87	205.0	204.5	0.483	0.013	<0.20	0.01	<0.01	0.05
NaCl	10	23	87	0-15	36.0	1.200	7.10	219.00	245.0	244.7	0.290	0.006	<0.20	0.25	<0.01	0.02
NaCl	10	23	88	0-15	44.0	0.850	6.50	118.00	203.0	202.9	0.060	0.002	0.39	2.47	0.13	0.03
NaCl	10	23	89	0-15	45.0	0.970	6.30	83.34	259.0	259.0	0.049	0.001	<0.20	0.46	0.03	0.04
NaCl	10	23	90	0-15	51.5	0.550	6.60	26.25	157.0	156.9	0.059	0.002	<0.20	0.15	<0.01	0.02
NaCl	10	23	91	0-15	47.0	1.210	6.60	158.40	271.0	270.9	0.101	0.002	5.44	11.74	0.63	0.05
NaCl	10	23	92	15-30	37.5	2.610	7.20	799.00	203.0	202.7	0.302	0.008	<0.20	0.02	<0.01	0.03
NaCl	10	23	93	15-30	44.0	2.120	6.95	574.00	264.0	263.8	0.221	0.004	<0.20	0.19	<0.01	0.03
NaCl	10	23	94	15-30	34.0	1.030	7.20	188.80	233.0	232.6	0.347	0.008	<0.20	0.02	<0.01	0.05
NaCl	10	23	95	15-30	47.5	0.540	6.60	39.88	168.0	167.9	0.063	0.002	0.83	6.91	0.29	0.03
NaCl	10	23	96	15-30	50.0	1.680	5.30	445.00	116.0	116.0	0.002	0.000	5.58	16.73	0.93	0.07
NaCl	10	23	97	30-45	34.5	1.760	7.60	583.00	75.6	75.3	0.282	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	10	23	98	45-60	34.0	0.990	7.60	270.00	86.4	86.1	0.322	0.020	<0.20	0.01	<0.01	<0.01
NaCl	10	23	99	60-75	34.0	0.610	7.60	135.50	112.0	111.6	0.417	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	10	23	100	75-90	32.0	0.450	7.75	81.56	109.0	108.4	0.573	0.028	<0.20	0.03	<0.01	<0.01
NaCl	10	23	101	90-105	32.0	0.370	7.80	55.41	107.0	106.3	0.631	0.032	<0.20	<0.01	<0.01	0.02
NaCl	10	23	102	105-120	32.0	0.310	7.80	35.44	119.0	118.3	0.701	0.032	<0.20	<0.01	<0.01	0.20
NaCl	10	23	103	120-135	34.0	0.260	7.75	16.94	117.0	116.4	0.615	0.028	<0.20	0.02	<0.01	<0.01
NaCl	10	28	129	0-15	38.5	1.610	7.30	273.00	329.0	328.4	0.616	0.010	0.44	4.50	0.21	0.06
NaCl	10	28	130	0-15	35.0	1.530	7.40	288.50	365.0	364.1	0.860	0.013	0.33	2.88	0.14	0.05
NaCl	10	28	131	0-15	37.5	1.080	7.00	95.62	299.0	298.7	0.281	0.005	<0.20	0.45	0.02	0.02
NaCl	10	28	132	0-15	38.3	0.810	7.00	50.45	274.0	273.7	0.257	0.005	1.02	6.01	0.30	0.05
NaCl	10	28	133	0-15	36.5	1.120	7.20	130.70	319.0	318.5	0.475	0.008	1.02	8.90	0.32	0.05
NaCl	10	28	134	15-30	39.5	2.210	7.20	647.40	243.0	242.6	0.361	0.008	<0.20	0.03	<0.01	0.02
NaCl	10	28	135	15-30	39.5	1.330	7.20	321.60	229.0	228.7	0.341	0.008	<0.20	0.29	0.02	0.03
NaCl	10	28	136	15-30	39.0	1.540	6.80	332.30	271.0	270.8	0.161	0.003	<0.20	0.49	0.02	0.03
NaCl	10	28	137	15-30	36.5	1.050	7.00	102.20	332.0	331.7	0.312	0.005	2.01	16.96	0.70	0.07
NaCl	10	28	138	15-30	34.0	1.455	7.05	260.90	224.5	224.3	0.237	0.006	1.16	12.08	0.53	0.08
NaCl	10	28	139	30-45	35.0	1.620	6.00	559.90	26.5	26.5	0.002	0.001	<0.20	<0.01	<0.01	<0.01
NaCl	10	28	140	45-60	34.5	1.010	6.10	339.00	19.3	19.3	0.002	0.001	<0.20	<0.01	<0.01	<0.01
NaCl	10	28	141	60-75	35.0	0.440	6.30	131.60	31.9	31.9	0.006	0.001	<0.20	<0.01	<0.01	<0.01
NaCl	10	28	142	75-90	33.0	0.250	6.60	60.05	37.4	37.4	0.014	0.002	<0.20	<0.01	<0.01	<0.01
NaCl	10	28	143	90-105	32.0	0.160	6.70	35.55	26.2	26.2	0.012	0.003	<0.20	<0.01	<0.01	<0.01
NaCl	10	28	144	105-120	31.5	0.170	7.00	27.93	35.7	35.7	0.034	0.005	<0.20	<0.01	<0.01	<0.01
NaCl	10	28	145	120-135	32.5	0.240	7.50	25.22	89.5	89.2	0.265	0.016	<0.20	<0.01	<0.01	<0.01
NaCl	10	28	146	135-150	33.0	0.260	7.60	22.85	107.0	106.6	0.399	0.020	<0.20	<0.01	<0.01	<0.01
NaCl	10	38	199	0-15	37.5	0.580	7.20	41.56	261.0	260.6	0.388	0.008	<0.20	0.05	<0.01	0.04
NaCl	10	38	200	0-15	34.5	0.430	7.10	23.72	198.0	197.8	0.234	0.006	<0.20	0.03	<0.01	0.03
NaCl	10	38	201	0-15	37.5	0.400	7.10	15.39	205.0	204.8	0.242	0.006	<0.20	0.02	<0.01	0.03
NaCl	10	38	202	0-15	40.5	0.510	7.15	23.70	240.0	239.7	0.318	0.007	<0.20	0.06	<0.01	0.03
NaCl	10	38	203	0-15	33.5	1.120	7.40	142.90	358.0	357.1	0.843	0.013	0.32	2.83	0.09	0.08
NaCl	10	38	204	15-30	36.0	0.800	7.20	144.20	197.0	196.7	0.293	0.008	0.29	0.98	0.06	0.04

Sat'n = Saturation Percent; E.C. = Electrical Conductivity; Alk = Alkalinity mg CaCO3/L; HCO3, CO3, OH reported as mg CaCO3/L.

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Zn	Mn	Ca	Mg	Na	K (mg/L)	Sr	B	Ba	P	S	Si
NaCl	9	31	169	60-75	0.45	0.150	98.44	36.64	24.22	23.50	0.25	<0.04	0.33	<0.10	1.66	14.57
NaCl	9	31	170	75-90	0.05	0.070	58.11	21.66	13.80	16.49	0.11	0.05	0.26	<0.10	1.65	14.19
NaCl	9	31	171	90-105	0.04	0.030	36.39	13.47	11.75	11.78	0.07	0.05	0.15	<0.10	2.51	12.71
NaCl	9	31	172	105-120	0.04	<0.006	12.98	5.06	7.63	5.91	0.02	0.04	0.08	<0.10	2.37	14.81
NaCl	9	31	173	120-135	0.03	<0.006	32.27	12.23	10.45	6.99	0.04	<0.04	0.10	<0.10	2.94	8.94
NaCl	9	31	174	135-150	0.02	<0.006	29.65	10.15	9.24	7.14	0.03	<0.04	0.09	<0.10	2.91	8.67
NaCl	9	36	196	0-15	0.05	<0.006	68.00	12.39	40.07	4.68	0.12	<0.04	0.08	0.17	13.48	5.91
NaCl	9	36	197	15-30	0.03	0.010	50.46	11.04	66.54	6.74	0.09	<0.04	0.08	0.10	19.22	3.77
NaCl	10	23	87	0-15	0.12	0.140	74.58	13.89	244.74	6.08	0.15	0.06	0.11	0.70	35.93	6.25
NaCl	10	23	88	0-15	0.12	0.070	58.05	12.48	186.17	1.71	0.17	0.05	0.09	1.80	35.78	7.46
NaCl	10	23	89	0-15	0.10	0.060	75.72	14.73	200.58	7.24	0.14	0.06	0.11	2.88	54.86	9.48
NaCl	10	23	90	0-15	0.12	0.060	85.47	16.57	56.09	4.23	0.17	0.05	0.10	0.97	35.12	9.33
NaCl	10	23	91	0-15	0.09	0.340	61.88	11.48	303.67	4.97	0.15	0.06	0.21	3.39	55.18	18.83
NaCl	10	23	92	15-30	0.08	2.040	240.20	82.74	268.58	16.36	0.50	<0.04	0.40	0.24	25.09	7.10
NaCl	10	23	93	15-30	0.10	0.850	136.50	44.66	376.53	11.10	0.27	0.05	0.22	0.59	30.19	6.78
NaCl	10	23	94	15-30	0.10	0.110	50.91	14.74	214.09	8.24	0.11	<0.04	0.09	0.34	23.59	6.28
NaCl	10	23	95	15-30	0.13	0.140	50.53	11.30	104.44	3.35	0.10	<0.04	0.11	1.65	25.22	9.90
NaCl	10	23	96	15-30	0.24	4.280	68.61	16.59	362.50	11.82	0.17	0.09	0.35	3.22	45.59	20.65
NaCl	10	23	97	30-45	0.03	0.010	161.50	86.38	86.36	12.61	0.47	<0.04	0.34	<0.10	8.79	7.45
NaCl	10	23	98	45-60	0.02	<0.006	94.07	50.08	41.17	9.93	0.27	<0.04	0.19	<0.10	6.79	7.66
NaCl	10	23	99	60-75	0.03	<0.006	62.32	30.81	25.14	8.09	0.17	<0.04	0.14	<0.10	6.24	7.69
NaCl	10	23	100	75-90	0.04	<0.006	49.12	22.82	17.89	7.18	0.12	<0.04	0.12	<0.10	5.10	7.79
NaCl	10	23	101	90-105	0.03	<0.006	42.32	20.13	15.03	6.85	0.12	<0.04	0.09	<0.10	5.11	7.69
NaCl	10	23	102	105-120	0.24	0.100	36.75	16.49	12.80	6.30	0.10	<0.04	0.10	<0.10	4.85	7.02
NaCl	10	23	103	120-135	0.02	<0.006	31.65	13.64	11.09	6.39	0.08	<0.04	0.09	<0.10	4.72	7.02
NaCl	10	28	129	0-15	0.08	0.070	64.57	10.37	385.42	3.93	0.14	0.06	0.15	1.04	68.55	6.19
NaCl	10	28	130	0-15	0.08	0.080	62.46	10.51	352.80	4.17	0.12	0.07	0.11	1.35	44.30	6.78
NaCl	10	28	131	0-15	0.11	0.120	80.46	13.76	235.59	3.83	0.15	0.07	0.08	0.94	68.14	7.14
NaCl	10	28	132	0-15	0.10	0.070	56.70	9.69	288.65	3.26	0.13	0.07	0.14	1.69	42.80	8.40
NaCl	10	28	133	0-15	0.12	0.190	56.59	8.63	296.28	2.44	0.12	0.05	0.09	1.21	68.55	5.79
NaCl	10	28	134	15-30	0.04	0.670	150.70	33.74	365.35	18.01	0.29	<0.04	0.23	<0.10	30.05	3.46
NaCl	10	28	135	15-30	0.09	0.130	78.38	16.96	274.00	5.96	0.13	0.04	0.12	0.41	29.94	4.70
NaCl	10	28	136	15-30	0.13	0.190	97.84	20.46	340.19	9.61	0.15	0.06	0.12	0.84	56.92	5.73
NaCl	10	28	137	15-30	0.16	0.170	66.51	11.57	280.00	6.40	0.14	<0.04	0.23	1.82	52.20	7.39
NaCl	10	28	138	15-30	0.15	0.130	59.00	10.56	362.28	4.60	0.12	0.04	0.17	0.99	76.34	5.62
NaCl	10	28	139	30-45	0.10	0.650	147.50	41.82	146.00	25.30	0.36	0.05	0.38	<0.10	9.37	11.88
NaCl	10	28	140	45-60	0.11	0.160	117.90	35.57	37.05	21.88	0.27	0.05	0.36	<0.10	3.21	12.74
NaCl	10	28	141	60-75	0.08	0.040	48.04	14.73	15.07	13.30	0.10	0.05	0.15	<0.10	2.93	12.64
NaCl	10	28	142	75-90	0.06	0.020	25.82	8.48	11.67	8.83	0.05	0.04	0.12	<0.10	3.22	12.55
NaCl	10	28	143	90-105	0.10	0.020	14.60	4.96	8.63	6.65	0.03	0.04	0.08	<0.10	2.67	15.22
NaCl	10	28	144	105-120	0.08	0.010	18.02	5.52	8.49	5.55	0.04	<0.04	0.08	<0.10	3.07	13.31
NaCl	10	28	145	120-135	0.04	<0.006	28.99	9.94	9.88	5.73	0.03	<0.04	0.09	<0.10	3.14	8.58
NaCl	10	28	146	135-150	0.05	<0.006	34.24	10.67	9.16	6.26	0.03	<0.04	0.11	<0.10	3.03	7.09
NaCl	10	38	199	0-15	0.05	0.030	71.24	12.20	95.59	5.19	0.13	0.04	0.09	0.26	22.29	5.91
NaCl	10	38	200	0-15	0.08	0.030	78.88	13.86	31.89	4.81	0.13	<0.04	0.09	0.23	13.74	6.62
NaCl	10	38	201	0-15	0.05	0.020	83.45	13.67	13.86	6.17	0.15	<0.04	0.10	0.20	15.00	6.42
NaCl	10	38	202	0-15	0.05	0.040	90.85	16.93	40.56	4.72	0.17	0.05	0.12	0.25	21.14	7.26
NaCl	10	38	203	0-15	0.09	0.120	50.02	8.13	299.35	3.38	0.09	0.04	0.09	0.72	53.67	6.20
NaCl	10	38	204	15-30	0.04	0.030	55.64	12.51	164.60	6.86	0.10	<0.04	0.09	0.30	29.73	4.67

(Continued). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	As	Cr	V	Li	Mo	Ni	Co	Se	Pb	Cd	SAR
----- (mg/L) -----															
NaCl	9	31	169	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	0.05	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	9	31	170	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	9	31	171	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	9	31	172	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	9	31	173	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	9	31	174	135-150	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	9	36	196	0-15	0.03	<0.02	<0.03	<0.04	<0.05	0.03	0.01	<0.30	<0.10	<0.01	1.2
NaCl	9	36	197	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	0.03	<0.01	<0.30	<0.10	<0.01	2.2
NaCl	10	23	87	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	6.8
NaCl	10	23	88	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	5.8
NaCl	10	23	89	0-15	<0.03	<0.02	<0.03	<0.04	0.06	<0.03	<0.01	<0.30	<0.10	<0.01	5.5
NaCl	10	23	90	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.5
NaCl	10	23	91	0-15	<0.03	<0.02	0.04	<0.04	0.05	0.03	<0.01	<0.30	<0.10	<0.01	9.3
NaCl	10	23	92	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	3.8
NaCl	10	23	93	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	7.1
NaCl	10	23	94	15-30	<0.03	<0.02	<0.03	<0.04	0.06	<0.03	<0.01	<0.30	<0.10	<0.01	6.8
NaCl	10	23	95	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	3.5
NaCl	10	23	96	15-30	<0.03	<0.02	0.05	<0.04	<0.05	0.06	<0.01	<0.30	<0.10	<0.01	10
NaCl	10	23	97	30-45	<0.03	<0.02	<0.03	0.07	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.4
NaCl	10	23	98	45-60	<0.03	<0.02	<0.03	0.06	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.9
NaCl	10	23	99	60-75	<0.03	<0.02	<0.03	0.05	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
NaCl	10	23	100	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	10	23	101	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	10	23	102	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	0.21	0.20	0.4
NaCl	10	23	103	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	10	28	129	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	0.03	<0.01	<0.30	<0.10	<0.01	12
NaCl	10	28	130	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	0.03	<0.01	<0.30	<0.10	<0.01	11
NaCl	10	28	131	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	6.4
NaCl	10	28	132	0-15	<0.03	<0.02	0.03	<0.04	<0.05	0.03	<0.01	<0.30	<0.10	<0.01	9.3
NaCl	10	28	133	0-15	<0.03	<0.02	0.03	<0.04	<0.05	0.04	0.01	<0.30	<0.10	<0.01	9.7
NaCl	10	28	134	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	0.03	<0.01	<0.30	<0.10	<0.01	7.0
NaCl	10	28	135	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	7.3
NaCl	10	28	136	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	8.2
NaCl	10	28	137	15-30	0.03	<0.02	0.05	<0.04	<0.05	0.04	<0.01	<0.30	<0.10	<0.01	8.3
NaCl	10	28	138	15-30	<0.03	<0.02	0.03	<0.04	<0.05	0.05	0.01	<0.30	<0.10	<0.01	11
NaCl	10	28	139	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	0.07	<0.01	<0.30	<0.10	<0.01	2.7
NaCl	10	28	140	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	0.03	<0.01	<0.30	<0.10	<0.01	0.8
NaCl	10	28	141	60-75	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	10	28	142	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	10	28	143	90-105	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.5
NaCl	10	28	144	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	10	28	145	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	10	28	146	135-150	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	10	38	199	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	2.8
NaCl	10	38	200	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	0.9
NaCl	10	38	201	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.4
NaCl	10	38	202	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	1.0
NaCl	10	38	203	0-15	<0.03	<0.02	<0.03	<0.04	<0.05	0.05	0.01	<0.30	<0.10	<0.01	10
NaCl	10	38	204	15-30	0.03	<0.02	<0.03	<0.04	<0.05	0.03	0.01	<0.30	<0.10	<0.01	5.2

SAR = Sodium Adsorption Ratio.

(Concluded). Saturated Paste Extract Data for the Soils and Soil/Waste Mixtures in the ESSO Field Plots in 1992.

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Sat'n (%)	E.C. (dS/m)	pH	Cl	Alk	HCO3	CO3	OH (mg/L)	Al	Fe	Ti	Cu
NaCl	10	38	205	15-30	33.0	0.540	7.10	43.15	222.0	221.7	0.262	0.006	<0.20	0.03	<0.01	0.04
NaCl	10	38	206	15-30	35.0	0.450	7.15	17.35	217.0	216.7	0.288	0.007	<0.20	0.04	<0.01	0.03
NaCl	10	38	207	15-30	36.5	0.570	7.10	32.16	262.0	261.7	0.310	0.006	<0.20	0.17	0.02	0.04
NaCl	10	38	208	15-30	36.0	1.070	7.30	167.20	326.0	325.4	0.610	0.010	0.39	1.99	0.12	0.05
NaCl	10	38	209	30-45	30.0	0.390	6.70	86.01	38.7	38.7	0.018	0.003	<0.20	<0.01	<0.01	0.02
NaCl	10	38	210	45-60	32.5	0.270	6.80	51.01	47.5	47.5	0.028	0.003	<0.20	0.01	<0.01	0.03
NaCl	10	38	211	60-75	32.5	0.300	6.90	34.97	83.6	83.5	0.062	0.004	<0.20	0.03	<0.01	0.03
NaCl	10	38	212	75-90	32.5	0.240	6.80	36.70	52.5	52.5	0.031	0.003	<0.20	<0.01	<0.01	0.02
NaCl	10	38	213	90-105	35.0	0.270	6.70	52.07	41.3	41.3	0.019	0.003	<0.20	<0.01	<0.01	0.02
NaCl	10	38	214	105-120	35.0	0.350	6.70	76.86	43.9	43.9	0.021	0.003	<0.20	0.02	<0.01	0.02
NaCl	10	38	215	120-135	35.5	0.460	6.80	114.70	35.5	35.5	0.021	0.003	<0.20	0.02	<0.01	0.02

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	Zn	Mn	Ca	Mg	Na	K	Sr	B (mg/L)	Ba	P	S	Si
NaCl	10	38	205	15-30	0.05	0.030	75.97	15.14	66.68	4.77	0.12	<0.04	0.10	0.21	24.34	5.86
NaCl	10	38	206	15-30	0.04	0.010	85.74	16.97	27.60	7.12	0.13	<0.04	0.11	0.19	21.94	5.56
NaCl	10	38	207	15-30	0.05	0.050	75.59	16.02	88.00	7.79	0.13	0.04	0.11	0.27	24.58	5.44
NaCl	10	38	208	15-30	0.07	0.040	59.13	10.67	272.76	4.79	0.10	0.04	0.12	0.89	40.51	5.52
NaCl	10	38	209	30-45	0.06	0.010	27.66	6.97	53.23	8.81	0.06	<0.04	0.06	<0.10	18.34	7.74
NaCl	10	38	210	45-60	0.07	0.010	21.11	5.34	33.05	8.20	0.04	<0.04	0.07	<0.10	11.14	9.46
NaCl	10	38	211	60-75	0.06	0.010	21.97	6.88	39.00	8.07	0.04	<0.04	0.07	<0.10	11.97	7.43
NaCl	10	38	212	75-90	0.11	<0.006	14.12	5.22	32.92	6.83	0.03	<0.04	0.06	<0.10	12.49	11.13
NaCl	10	38	213	90-105	0.10	0.010	16.95	5.70	32.85	7.38	0.03	<0.04	0.07	<0.10	12.67	12.73
NaCl	10	38	214	105-120	0.07	0.010	30.52	10.93	30.87	9.27	0.05	<0.04	0.08	<0.10	14.13	12.29
NaCl	10	38	215	120-135	0.06	0.020	46.48	16.98	23.19	10.59	0.07	<0.04	0.09	<0.10	12.04	13.28

Waste	Rate	Plot	FSN (TME-)	Depth (cm)	As	Cr	V	Li	Mo	Ni (mg/L)	Co	Se	Pb	Cd	SAR
NaCl	10	38	205	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	0.03	<0.01	<0.30	<0.10	<0.01	1.8
NaCl	10	38	206	15-30	0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7
NaCl	10	38	207	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	2.4
NaCl	10	38	208	15-30	<0.03	<0.02	<0.03	<0.04	<0.05	0.04	<0.01	<0.30	<0.10	<0.01	8.6
NaCl	10	38	209	30-45	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	2.3
NaCl	10	38	210	45-60	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	1.7
NaCl	10	38	211	60-75	0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	1.9
NaCl	10	38	212	75-90	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	1.9
NaCl	10	38	213	90-105	0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	1.8
NaCl	10	38	214	105-120	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	0.01	<0.30	<0.10	<0.01	1.2
NaCl	10	38	215	120-135	<0.03	<0.02	<0.03	<0.04	<0.05	<0.03	<0.01	<0.30	<0.10	<0.01	0.7

Sat'n = Saturation Percent; E.C. = Electrical Conductivity; Alk = Alkalinity mg CaCO3/L; HCO3, CO3, OH reported as mg CaCO3/L; SAR = Sodium Adsorption Ratio.

APPENDIX III. Total elemental analysis data for the soils and soil/waste mixtures in the ESSO field plots in 1992.

Total Elemental Analysis Data for the Soils and Soil/Waste Mixtures in the ESSO Fields Plots in 1992.

Field Samp. No:	Waste	Rate	Plot	Depth (cm)	Mn	Na	K	Ca	Mg	P	Al	Fe	Ti
					mg/g								
7	Freshwater	1	3	0-15	0.302	6.53	11.0	4.73	2.217	0.334	25.13	12.24	2.17
21	Freshwater	1	9	0-15	0.314	5.82	9.6	4.58	1.841	0.330	19.15	9.25	1.98
36	Freshwater	1	13	0-15	0.432	6.37	10.3	6.42	2.228	0.343	23.64	10.51	1.98
6	Freshwater	2	2	0-15	0.298	6.96	11.1	5.09	1.816	0.396	23.47	10.74	2.32
19	Freshwater	2	8	0-15	0.267	5.97	9.6	6.30	2.106	0.375	21.70	10.71	1.94
50	Freshwater	2	15	0-15	0.287	6.05	10.5	13.13	4.223	0.466	30.21	13.18	2.02
1	Freshwater	3	1	0-15	0.293	6.88	11.2	4.65	1.819	0.401	22.94	10.97	2.21
11	Freshwater	3	6	0-15	0.350	7.04	11.0	8.02	2.276	0.414	27.26	11.43	2.26
34	Freshwater	3	11	0-15	0.298	6.52	10.7	7.90	2.576	0.361	28.30	12.18	2.06
9	Freshwater	4	5	0-15	0.304	6.72	11.2	10.87	2.737	0.562	30.30	14.88	2.23
12	Freshwater	4	7	0-15	0.430	7.04	11.5	7.64	2.912	0.456	26.75	14.23	2.27
35	Freshwater	4	12	0-15	0.272	5.83	9.4	6.69	1.895	0.334	20.99	11.38	2.01
8	Freshwater	5	4	0-15	0.328	6.92	11.5	12.14	3.407	0.552	32.96	15.25	2.28
22	Freshwater	5	10	0-15	0.290	6.12	10.0	11.34	2.910	0.411	27.63	12.15	1.93
23	Freshwater	5	10	0-15	0.349	6.29	10.0	9.83	2.428	0.378	27.13	10.90	2.03
24	Freshwater	5	10	0-15	0.317	6.13	9.6	8.76	2.095	0.393	22.82	10.66	2.03
25	Freshwater	5	10	0-15	0.303	6.44	10.6	14.63	4.102	0.559	30.04	14.88	2.09
26	Freshwater	5	10	0-15	0.291	6.29	10.3	9.96	2.872	0.456	24.45	12.76	2.10
43	Freshwater	5	14	0-15	0.317	6.52	10.5	8.25	2.727	0.377	27.72	11.63	2.13
62	KCl	1	17	0-15	0.282	5.49	9.5	4.06	1.899	0.280	20.26	10.02	1.82
219	KCl	1	42	0-15	0.412	6.55	10.9	13.34	4.492	0.385	27.28	14.40	2.03
220	KCl	1	43	0-15	0.316	6.90	10.8	13.77	4.566	0.415	27.95	14.18	1.83
176	KCl	2	33	0-15	0.350	6.18	9.8	7.01	2.315	0.366	21.05	11.96	2.13
217	KCl	2	40	0-15	0.371	6.85	10.7	13.20	3.827	0.389	23.75	13.92	2.14
78	KCl	3	21	0-15	0.327	6.29	9.5	7.64	1.530	0.353	19.52	10.79	2.08
156	KCl	3	30	0-15	0.317	6.16	11.0	4.81	1.964	0.372	24.13	12.22	2.09
216	KCl	3	39	0-15	0.305	6.44	9.7	6.49	1.976	0.341	12.32	11.51	1.99
51	KCl	4	16	0-15	0.288	5.73	9.9	5.13	2.129	0.318	21.94	11.36	1.82
52	KCl	4	16	0-15	0.296	5.44	9.4	6.17	2.292	0.362	22.68	10.97	1.75
53	KCl	4	16	0-15	0.329	5.85	9.8	6.10	2.182	0.363	23.06	10.79	1.84
54	KCl	4	16	0-15	0.316	5.76	9.9	5.76	2.213	0.359	23.32	12.02	1.83
55	KCl	4	16	0-15	0.297	5.50	10.0	5.47	2.355	0.342	22.29	12.01	1.82
104	KCl	4	24	0-15	0.298	6.52	11.4	6.21	2.356	0.404	25.37	12.00	2.08
147	KCl	4	29	0-15	0.312	6.26	11.2	4.94	1.941	0.385	23.18	12.88	2.05

(Continued). Total Elemental Analysis Data for the Soils and Soil/Waste Mixtures in the ESSO Fields Plots in 1992.

Field Samp. No.	Waste	Rate	Plot	Depth (cm)	Cu	Zn	Mo	V	Cr	Ba	Sr	Li	Zr	Co
					ug/g									
7	Freshwater	1	3	0-15	7.69	29.7	<1.5	41.7	49.4	401	95.6	17.57	125.2	6.59
21	Freshwater	1	9	0-15	5.94	32.7	<1.5	34.2	40.1	386	78.8	13.37	129.3	5.94
36	Freshwater	1	13	0-15	10.30	32.4	7.35	39.7	57.4	379	91.2	14.71	120.6	10.30
6	Freshwater	2	2	0-15	8.45	33.8	<1.5	39.4	52.1	577	98.5	15.49	140.8	5.63
19	Freshwater	2	8	0-15	8.39	35.0	<1.5	37.8	43.4	597	89.5	15.39	121.7	5.60
50	Freshwater	2	15	0-15	9.34	41.4	<1.5	45.4	46.7	969	109.5	17.35	125.5	5.34
1	Freshwater	3	1	0-15	8.47	35.1	<1.5	41.2	48.4	568	98.1	16.95	128.3	6.05
11	Freshwater	3	6	0-15	9.76	36.3	<1.5	41.8	48.8	780	120.0	16.74	145.1	5.58
34	Freshwater	3	11	0-15	10.11	47.7	<1.5	41.9	47.7	844	114.1	15.89	121.4	5.78
9	Freshwater	4	5	0-15	12.52	42.6	<1.5	56.3	51.3	3150	141.5	20.03	137.7	5.01
12	Freshwater	4	7	0-15	9.97	38.4	<1.5	55.5	64.1	514	109.6	27.05	143.8	7.12
35	Freshwater	4	12	0-15	8.12	29.8	<1.5	40.6	48.7	634	78.5	16.23	123.1	5.41
8	Freshwater	5	4	0-15	12.44	47.3	<1.5	56.0	48.5	2003	138.1	21.15	133.1	6.22
22	Freshwater	5	10	0-15	10.07	34.5	<1.5	44.6	44.6	2577	126.5	17.25	113.6	4.31
23	Freshwater	5	10	0-15	10.69	41.4	<1.5	40.1	46.8	1619	117.6	14.69	128.2	5.34
24	Freshwater	5	10	0-15	8.67	34.7	<1.5	40.5	43.4	1717	105.5	15.90	124.3	4.34
25	Freshwater	5	10	0-15	15.07	40.7	6.03	55.7	63.3	1856	119.0	19.59	129.6	9.04
26	Freshwater	5	10	0-15	9.62	35.7	<1.5	46.7	50.8	1262	100.3	17.87	133.3	5.50
43	Freshwater	5	14	0-15	13.34	42.7	<1.5	40.0	48.0	1020	108.0	16.00	130.7	5.33
62	KCl	1	17	0-15	6.16	32.0	<1.5	33.2	39.4	325	78.8	13.55	114.5	6.16
219	KCl	1	42	0-15	12.02	73.6	3.00	51.1	45.1	341	88.6	21.03	135.2	7.51
220	KCl	1	43	0-15	11.81	63.5	2.95	42.8	59.0	332	94.5	17.71	121.1	7.38
176	KCl	2	33	0-15	5.67	28.4	<1.5	42.5	46.8	299	79.4	17.01	137.5	8.51
217	KCl	2	40	0-15	12.56	48.8	2.79	50.2	48.8	326	78.1	19.53	133.9	8.37
78	KCl	3	21	0-15	8.17	34.0	<1.5	39.5	47.6	459	84.4	14.97	137.5	5.44
156	KCl	3	30	0-15	4.46	29.7	<1.5	41.6	50.5	418	93.6	16.35	138.2	7.43
216	KCl	3	39	0-15	13.47	58.4	<1.5	41.9	52.4	289	55.4	16.46	125.7	5.99
51	KCl	4	16	0-15	8.03	35.6	<1.5	39.0	44.8	413	84.9	14.92	105.6	4.59
52	KCl	4	16	0-15	8.16	39.4	<1.5	39.4	36.7	561	91.1	14.95	108.7	5.44
53	KCl	4	16	0-15	8.62	38.8	<1.5	37.3	43.1	583	97.7	14.36	109.2	5.75
54	KCl	4	16	0-15	8.67	35.9	<1.5	40.9	47.1	585	92.9	14.87	111.5	4.96
55	KCl	4	16	0-15	7.87	32.6	<1.5	42.7	41.6	373	77.6	16.87	121.5	6.75
104	KCl	4	24	0-15	5.39	31.0	2.69	43.1	48.5	527	101.0	17.51	118.6	8.08
147	KCl	4	29	0-15	5.20	29.9	2.60	44.2	58.5	393	87.1	18.20	128.7	7.80

(Continued). Total Elemental Analysis Data for the Soils and Soil/Waste Mixtures in the ESSO Fields Plots in 1992.

Field Samp. No:	Waste	Rate	Plot	Depth (cm)	Mn	Na	K	Ca	Mg	P	Al	Fe	Ti
					mg/g								
105	KCl	5	25	0-15	0.330	6.83	11.0	6.12	1.594	0.360	20.49	12.77	2.00
106	KCl	5	25	0-15	0.309	6.77	12.4	5.73	2.384	0.378	27.72	15.32	2.16
107	KCl	5	25	0-15	0.328	6.68	12.6	5.88	3.029	0.345	30.12	16.19	2.19
108	KCl	5	25	0-15	0.342	6.50	11.2	6.54	2.027	0.363	23.83	12.68	2.13
109	KCl	5	25	0-15	0.274	6.61	11.1	4.41	1.645	0.304	20.89	10.02	2.04
125	KCl	5	26	0-15	0.314	6.39	10.9	6.83	2.042	0.384	25.44	12.50	1.96
79	NaCl	6	22	0-15	0.330	5.98	9.7	4.17	1.566	0.358	19.38	10.30	1.99
175	NaCl	6	32	0-15	0.337	5.91	9.6	7.35	2.636	0.353	22.30	12.44	1.96
218	NaCl	6	41	0-15	0.340	6.38	9.4	11.98	3.069	0.357	20.12	12.55	1.98
63	NaCl	7	18	0-15	0.292	5.15	8.7	5.89	2.410	0.244	19.28	9.16	1.63
127	NaCl	7	27	0-15	0.422	6.16	10.1	3.50	1.428	0.332	18.52	10.00	1.99
177	NaCl	7	34	0-15	0.316	6.26	10.1	5.00	1.625	0.349	19.37	10.26	2.10
178	NaCl	7	34	0-15	0.283	6.17	10.5	3.47	1.654	0.423	20.74	10.21	2.10
179	NaCl	7	34	0-15	0.317	6.28	10.5	4.71	1.688	0.327	21.26	9.86	2.05
180	NaCl	7	34	0-15	0.313	6.29	11.8	11.90	5.146	0.374	31.95	15.68	2.08
181	NaCl	7	34	0-15	0.280	5.47	10.4	6.68	3.293	0.316	26.21	12.83	1.91
77	NaCl	8	20	0-15	0.343	5.94	9.8	5.35	1.954	0.304	20.54	10.23	1.99
183	NaCl	8	35	0-15	0.341	6.21	10.6	7.72	3.012	0.385	26.04	12.18	1.97
184	NaCl	8	35	0-15	0.355	6.43	10.5	4.39	1.813	0.339	21.11	11.39	2.18
185	NaCl	8	35	0-15	0.324	6.05	10.4	3.36	1.599	0.304	18.79	10.17	2.02
186	NaCl	8	35	0-15	0.389	6.61	11.0	5.72	2.198	0.393	21.96	11.72	2.17
187	NaCl	8	35	0-15	0.371	6.99	12.0	4.42	1.885	0.430	23.33	11.56	2.30
229	NaCl	8	44	0-15	0.308	6.87	10.0	6.79	1.994	0.370	13.64	11.89	1.94
230	NaCl	8	44	0-15	0.305	6.79	11.0	7.27	2.608	0.429	15.21	12.05	2.06
231	NaCl	8	44	0-15	0.332	6.94	10.5	11.67	3.143	0.372	22.31	13.67	2.11
232	NaCl	8	44	0-15	0.332	6.78	10.7	5.15	1.897	0.328	13.13	13.72	2.14
233	NaCl	8	44	0-15	0.275	6.82	10.4	2.17	1.295	0.240	7.99	8.59	2.04

(Continued). Total Elemental Analysis Data for the Soils and Soil/Waste Mixtures in the ESSO Fields Plots in 1992.

Field Samp. No:	Waste	Rate	Plot	Depth (cm)	Cu	Zn	Mo	V	Cr	Ba	Sr	Li	Zr	Co
					ug/g									
105	KCl	5	25	0-15	6.20	34.1	3.10	46.5	46.5	563	86.8	17.06	114.7	7.75
106	KCl	5	25	0-15	8.83	35.3	2.52	54.2	49.2	628	102.2	21.44	118.6	8.83
107	KCl	5	25	0-15	8.97	37.2	<1.5	59.0	47.4	545	105.1	23.07	119.2	8.97
108	KCl	5	25	0-15	5.22	31.3	2.61	44.4	49.6	495	92.7	18.27	126.6	7.83
109	KCl	5	25	0-15	3.84	24.3	2.56	37.2	46.1	443	88.4	15.38	117.9	7.69
125	KCl	5	26	0-15	6.51	41.7	2.61	44.3	48.2	564	108.1	16.93	115.9	7.82
79	NaCl	6	22	0-15	6.19	29.7	<1.5	37.1	40.8	341	76.7	14.85	120.0	6.19
175	NaCl	6	32	0-15	4.72	23.6	1.57	40.9	56.7	299	78.7	17.32	119.7	7.87
218	NaCl	6	41	0-15	11.58	43.4	2.89	46.3	49.2	274	66.6	18.81	125.9	8.68
63	NaCl	7	18	0-15	5.99	28.5	<1.5	31.5	34.5	313	76.4	13.49	98.9	4.50
127	NaCl	7	27	0-15	3.97	21.2	2.65	33.1	46.3	335	78.1	14.55	116.4	7.94
177	NaCl	7	34	0-15	5.20	23.4	<1.5	37.7	49.4	362	76.6	15.59	136.4	6.49
178	NaCl	7	34	0-15	2.78	19.5	<1.5	36.2	51.5	369	83.5	15.31	118.3	6.96
179	NaCl	7	34	0-15	3.61	50.6	<1.5	33.7	49.4	381	86.7	14.46	116.9	7.23
180	NaCl	7	34	0-15	7.74	29.7	2.58	52.9	58.1	390	104.5	21.93	125.1	7.74
181	NaCl	7	34	0-15	4.47	25.3	<1.5	44.7	43.2	344	87.8	17.86	111.7	7.44
77	NaCl	8	20	0-15	6.97	30.7	<1.5	33.4	47.4	357	83.6	13.93	121.2	5.57
183	NaCl	8	35	0-15	4.30	31.5	4.30	40.1	71.6	355	91.6	17.18	120.3	7.16
184	NaCl	8	35	0-15	4.88	24.4	2.44	39.0	63.4	344	81.7	17.07	128.0	7.31
185	NaCl	8	35	0-15	2.81	18.3	<1.5	33.8	49.2	343	78.8	15.47	113.9	7.03
186	NaCl	8	35	0-15	3.76	25.0	2.50	40.1	56.4	343	78.9	17.53	126.5	7.51
187	NaCl	8	35	0-15	3.96	25.1	2.64	39.6	60.7	388	92.3	17.15	137.2	7.91
229	NaCl	8	44	0-15	16.49	60.5	2.75	42.6	63.2	271	60.5	16.49	123.7	6.87
230	NaCl	8	44	0-15	11.74	80.7	2.94	45.5	47.0	302	64.6	19.08	123.3	5.87
231	NaCl	8	44	0-15	11.82	48.7	2.95	42.8	70.9	329	79.8	17.72	138.8	7.38
232	NaCl	8	44	0-15	10.32	45.1	2.58	46.4	80.0	301	59.3	18.06	129.0	9.03
233	NaCl	8	44	0-15	6.83	45.1	<1.5	32.8	47.8	310	54.7	13.66	125.7	6.83

(Continued). Total Elemental Analysis Data for the Soils and Soil/Waste Mixtures in the ESSO Fields Plots in 1992.

Field Samp. No:	Waste	Rate	Plot	Depth (cm)	Mn	Na	K	Ca	Mg	P	Al	Fe	Ti
					mg/g								
64	NaCl	9	19	0-15	0.372	5.46	9.4	4.98	1.838	0.393	21.27	9.86	1.83
65	NaCl	9	19	0-15	0.286	5.52	8.5	4.03	1.350	0.280	16.89	8.48	1.80
66	NaCl	9	19	0-15	0.347	5.56	9.1	4.30	1.875	0.289	20.16	10.14	1.81
67	NaCl	9	19	0-15	0.374	5.96	9.5	5.78	1.571	0.298	19.16	9.84	1.95
68	NaCl	9	19	0-15	0.338	5.81	9.3	5.82	1.878	0.291	20.15	9.64	1.93
157	NaCl	9	31	0-15	0.351	6.73	11.6	5.64	2.620	0.426	26.38	13.94	2.18
158	NaCl	9	31	0-15	0.333	6.06	9.7	3.47	1.327	0.312	17.67	8.67	1.94
159	NaCl	9	31	0-15	0.319	6.16	10.5	3.82	1.797	0.319	21.59	10.86	2.13
160	NaCl	9	31	0-15	0.355	6.53	10.9	5.22	2.205	0.354	24.16	12.47	2.17
161	NaCl	9	31	0-15	0.341	5.87	10.1	4.88	2.132	0.310	23.79	12.20	1.98
196	NaCl	9	36	0-15	0.405	6.59	11.6	8.67	3.482	0.392	27.89	14.85	2.19
87	NaCl	10	23	0-15	0.327	6.68	11.0	5.35	2.342	0.351	28.71	12.90	2.06
88	NaCl	10	23	0-15	0.302	5.84	8.8	3.97	1.360	0.276	17.20	8.92	1.89
89	NaCl	10	23	0-15	0.266	4.19	8.2	5.62	2.022	0.371	28.59	16.07	2.30
90	NaCl	10	23	0-15	0.320	5.22	9.1	5.27	1.733	0.355	24.44	13.37	2.24
91	NaCl	10	23	0-15	0.275	5.10	8.2	4.03	1.392	0.297	17.86	9.58	1.83
129	NaCl	10	28	0-15	0.340	6.45	10.4	5.18	2.156	0.328	21.74	10.77	2.03
130	NaCl	10	28	0-15	0.300	6.15	10.1	5.33	2.026	0.327	21.09	10.70	1.97
131	NaCl	10	28	0-15	0.328	6.15	9.7	4.59	1.804	0.335	19.42	9.93	1.90
132	NaCl	10	28	0-15	0.317	6.30	10.2	4.47	1.865	0.317	21.49	10.23	1.92
133	NaCl	10	28	0-15	0.327	6.40	10.4	4.37	2.000	0.371	23.35	12.15	2.09
199	NaCl	10	38	0-15	0.263	5.92	9.1	9.05	2.123	0.317	15.13	10.52	1.87
200	NaCl	10	38	0-15	0.323	6.77	10.4	8.10	1.905	0.348	13.35	11.97	2.16
201	NaCl	10	38	0-15	0.411	7.02	10.4	5.90	1.451	0.385	10.29	12.75	2.26
202	NaCl	10	38	0-15	0.348	7.21	11.8	6.57	2.941	0.380	15.15	14.47	2.14
203	NaCl	10	38	0-15	0.185	3.96	5.7	4.91	0.954	0.239	8.08	7.14	1.21

(Concluded). Total Elemental Analysis Data for the Soils and Soil/Waste Mixtures in the ESSO Fields Plots in 1992.

Field Samp. No:	Waste	Rate	Plot	Depth (cm)	Cu	Zn	Mo	V	Cr	Ba	Sr	Li	Zr	Co
					ug/g									
64	NaCl	9	19	0-15	7.12	41.3	<1.5	32.8	41.3	337	79.7	14.24	112.5	5.70
65	NaCl	9	19	0-15	5.83	27.7	<1.5	29.2	42.3	312	71.4	11.66	109.3	4.37
66	NaCl	9	19	0-15	6.52	28.7	<1.5	33.9	44.3	318	76.9	14.34	106.9	5.22
67	NaCl	9	19	0-15	6.06	31.8	<1.5	31.8	45.5	327	80.3	13.64	115.2	6.06
68	NaCl	9	19	0-15	6.66	31.6	<1.5	31.6	45.0	333	81.6	13.32	116.6	5.00
157	NaCl	9	31	0-15	6.65	25.3	<1.5	47.9	51.9	359	91.8	19.95	127.7	7.98
158	NaCl	9	31	0-15	2.74	17.8	2.74	30.1	43.8	330	76.6	13.69	123.2	6.84
159	NaCl	9	31	0-15	4.55	19.7	1.52	37.9	50.1	348	85.0	15.18	132.0	7.59
160	NaCl	9	31	0-15	5.49	26.1	<1.5	43.9	52.2	338	87.8	17.84	137.2	8.23
161	NaCl	9	31	0-15	6.17	24.7	<1.5	40.7	53.1	321	82.7	17.27	117.2	7.40
196	NaCl	9	36	0-15	7.32	29.3	2.44	52.5	51.3	340	91.5	20.75	129.4	8.54
87	NaCl	10	23	0-15	6.10	30.5	<1.5	40.2	57.3	401	102.4	17.07	122.0	6.10
88	NaCl	10	23	0-15	6.44	27.1	<1.5	32.2	42.5	314	72.2	12.89	125.0	5.16
89	NaCl	10	23	0-15	132.31	105.3	2.57	56.5	47.5	383	149.0	33.40	106.6	8.99
90	NaCl	10	23	0-15	71.09	69.6	<1.5	47.4	50.4	376	121.4	25.18	118.5	7.41
91	NaCl	10	23	0-15	32.75	41.2	<1.5	35.2	42.5	314	83.7	16.98	106.7	6.06
129	NaCl	10	28	0-15	3.57	28.5	<1.5	38.0	44.0	348	85.6	16.64	123.6	7.13
130	NaCl	10	28	0-15	3.01	37.7	1.51	36.2	45.2	334	85.9	16.57	119.0	7.53
131	NaCl	10	28	0-15	2.77	23.6	<1.5	33.2	42.9	330	81.7	15.24	110.8	6.93
132	NaCl	10	28	0-15	2.72	27.2	<1.5	34.0	44.9	347	87.1	14.98	113.0	6.81
133	NaCl	10	28	0-15	5.06	31.6	<1.5	41.8	57.0	342	88.6	17.72	126.6	7.59
199	NaCl	10	38	0-15	17.34	45.8	<1.5	39.6	39.6	254	57.0	17.34	113.9	7.43
200	NaCl	10	38	0-15	14.16	50.2	2.57	47.6	52.8	266	55.4	19.31	136.5	9.01
201	NaCl	10	38	0-15	11.47	49.7	2.55	51.0	56.1	268	53.5	19.11	142.7	8.92
202	NaCl	10	38	0-15	15.08	52.8	3.77	52.8	57.8	319	67.9	20.11	124.4	7.54
203	NaCl	10	38	0-15	6.06	19.7	3.03	27.3	30.3	210	34.8	10.60	77.2	6.06

