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RAP SITE DESIGN FOR STABILIZATION OF
THE INACTIVE URANIUM MILL TAILINGS S
BOX:RU 16 DOC:09/01/1991

SURF000514

# Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site At Grand Junction, Colorado

**Appendix A to Attachment 3**
**Volume IV**

## Final

**September 1991**

**Appendix B of the**
**Cooperative Agreement**
**No. DE-FC04-81AL16257**

Uranium Mill Tailings Remedial Action Project

um/GRS 9.A.1
(Final)

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JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-03-90-13-01-00c DISCIPLINE Civil/Hydro NO. OF SHEETS 21

**PROJECT:**

UMTRA

**SITE:**

GRAND JUNCTION, COLORADO – Cheney Disposal Site

**FEATURE:**

Summary of Average Gravimetric Water Contents @ the Bedrock Contact for All Boreholes at the Cheney Disposal Site

**SOURCES OF DATA:**

GRJ-03-90-13-01-00a "Gravimetric Water Contents, Neutron Moisture Meter Logs and Gamma-Gamma Logs for All Boreholes"

**SOURCES OF FORMULAE & REFERENCES:**

1) Chatfield, C. (1978), Statistics for Technology: A Course in Applied Statistics, 2nd ed., A Halsted Press Book, John Wiley & Sons, New York.

2) NH Analytical Software, "STATISTIX: An Interactive Statistical Analysis Program for Microcomputers", PC DOS Vers. 2.0 Roseville, MN, 1987.

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
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JE JACOBS ENGINEERING

DATE 4/18/1990 SUBJECT GWC's @ the Bedrock Contact for All Boreholes @ the Cheney Disp. Site SHEET NO. 1

BY D Dery CHKD. J Millard JOB NO.

## I. Purpose

The purpose of this calculation set is to determine the mean gravimetric water contents (gwc's) of the upper three feet of the weathered and unweathered mancos shale layers directly beneath the alluvial contact at the Cheney disposal site, using the gwc measurement data from Calculation Set No. 6RJ-03-90-13-01-00 ("GWC's, Neutron Moisture Meter Logs and Gamma-Gamma Logs for All Boreholes"). Methods found in Statistics for Technology by C. Chatfield (1978) for comparing sample means will be used to determine if there is a significant difference between the mean gwc's of the wet weathered and the dry weathered mancos shale.

## II. Methods of Analysis

Two methods of comparison shall be used (taken from C. Chatfield, 1978): the two sample "t"-test for comparing two sample means; and the "F"-test using the One-way Analysis of Variance (AOV). The second method tests the hypothesis that there is no difference between a number of groups. In this case, the total variation of the gwc measurements is partitioned into two components, one measuring the variability between the group means (mean gwc's of the wet weathered and dry weathered shale units) and the other measuring the variation within each group. These two components are compared by means of the F-test (the significance test used for comparing different estimates of variation.

The hypothesis to be tested (using each method) shall be the two-tailed null hypothesis which is written as:

$$H_0 : \mu_1 = \mu_2$$

where $\mu_1$ = population 1 true mean of $\mu_2$ = true mean population of 2

FORM 91-005-1 (4/81)

JE JACOBS ENGINEERING

DATE 4/18 SUBJECT SHEET NO. 2

BY Oley CHKD. J Millard JOB NO.

A statistical analysis computer program called STATISTIX[2] shall be used to compute most values in this calculation set. All other values such as Student's t-distribution and F-distribution shall be obtained from standard tables found in a Statistics text book[1] See Appendix

FORM 91-005-1 (4/81)

## III. Data and Assumptions

A. Data

(See Tables 1 – 4 in APPENDIX)

Table 4 was input for running "Two Sample T-Tests" and "One-Way AOV" STATISTIX computer programs referenced in section II.

B. Assumptions

1. Both populations (gwc's of dryweathered and wetweathered units) are normally distributed
2. Both populations have the same variance $\sigma^2$
3. The two samples (sample sets) are independent.

## IV. Calculations and Analysis

A. Two sample "t"-test (Comparing two sample means)

Null Hypothesis to test –

$$H_0: \mu_1 = \mu_2 \quad \text{(two-tailed test)}$$

where $\mu_1$ = population mean of wetweathered shale gwc's
$\mu_2$ = population mean of dryweathered shale gwc's

Alternative Hypothesis –

$$H_A: \mu_1 \neq \mu_2$$

For $\sigma$ (standard deviation of the population) unknown, $\sigma$ is replaced with the sample standard deviation, s to obtain the test statistic (Chatfield, 1978).

$$t_0 = \frac{\bar{X}_1 - \bar{X}_2}{s\sqrt{1/n_1 + 1/n_2}}$$

where $t_0$ = test statistic
$\bar{X}_1$ = sample mean gwc's for wetweathered shale
$\bar{X}_2$ = " " " " dryweathered "
$n_1$ = number of samples (value) for wetweath. shale

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DATE 4/18 SUBJECT SHEET NO. 4

BY Valery CHKD. J Millard JOB NO.

$n_2$ = number of sample (values) for drywreath. shale

$$S = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}}$$

where $S_1^2$ = sample variance for wetwreath. shale
$S_2^2$ = sample variance for drywreath. shale

Two Sample T-test Output

TWO SAMPLE T TESTS FOR WETW VS DRYW

| VARIABLE | MEAN | SAMPLE SIZE | S.D. | S.E. |
|---|---|---|---|---|
| WETW | 1.052E-01 | 53 | 2.620E-02 | 3.599E-03 |
| DRYW | 9.498E-02 | 121 | 8.067E-02 | 7.334E-03 |

| | $T_0$ | DF | P |
|---|---|---|---|
| EQUAL VARIANCES | 0.90 | 172 | 0.3689 |
| UNEQUAL VARIANCES | 1.25 | 162.9 | 0.2098 |

| | F | NUM DF | DEN DF | P |
|---|---|---|---|---|
| TESTS FOR EQUALITY OF VARIANCES | 9.48 | 120 | 52 | 0.0000 |

CASES INCLUDED 174 MISSING CASES 68

S.D. = Standard deviation of Sa

$T_0$ = test statistic

DF = degrees of freedom

From Table below (taken from Chatfield, 1978)

$t_{0.005,172} = 2.576$ (99% critical values)
$t_{0.025,172} = 1.96$ (95% critical value)

The 95 per cent and 99 per cent critical values for the test statistic $z$ can be found from normal tables and are given in Table 11. (See Table 5 in Appendix also)

Table 11

| | Two-tailed | One-tailed |
|---|---|---|
| 95% | 1·96 | 1·64 |
| 99% | 2·58 | 2·33 |

(Chatfield, 1978)

$t_0 < t$

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DATE 4/18 SUBJECT SHEET NO 5

BY Dery CHKD. J Millard JOB NO.

Since test statistic t values for equal and unequal variances are less than the 95 and 99 % critical values, we accept the null hypothesis that there is no significant difference between the sample mean gvc's of the wetweathered vs. dry weathered mancos shale units.

B. One-Way AOV (comparing different components of variation)

One-Way AOV Output

ONE WAY AOV

| VARIABLE | MEAN | SAMPLE SIZE | GROUP VARIANCE |
|---|---|---|---|
| WETW | 1.052E-01 | 53 = $N_1$ | 6.865E-04 |
| DRYW | 9.498E-02 | 121 = $N_2$ | 6.507E-03 |
| TOTAL | 9.810E-02 | 174 = $N_T$ | |

| SOURCE | DF | SS | MS | $F_o$ | P |
|---|---|---|---|---|---|
| BETWEEN (a) | 1 (c) | 3.853E-03 (e) | 3.853E-03 (g) | 0.81 (i) | 0.3689 |
| WITHIN (b) | 172 (d) | 8.166E-01 (f) | 4.748E-03 (h) | | |
| TOTAL | 173 | 8.204E-01 | | | |

Here DF = degrees of freedom
SS = sum of squares
MS = mean square
$F_o$ = ratio of mean squares

Group Variance - same as variance, or $s^2$

(a) Variation between groups
(b) Variation within groups
(c) Number of groups minus 1; $(c-1)$
(d) $N_T - 2$
(e) $n \sum_{i=1}^{c} (\bar{x}_i - \bar{x})^2$
(f) $\sum_{i=1}^{c} \sum_{j=1}^{n} (x_{ij} - \bar{x}_i)^2$

(g) $S_B^2 = n \sum_{i=1}^{c} \frac{(\bar{x}_i - \bar{x})^2}{c-1}$

(h) $s^2 = \sum_{i=1}^{c} \sum_{j=1}^{n} \frac{(x_{ij} - \bar{x}_i)^2}{c(n-1)}$

(i) $\frac{S_B^2}{s^2}$

[Chatfield, 1978]

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DATE 4/18/90 SUBJECT SHEET NO. 6

BY 4/18 CHKD. JMillard JOB NO.

From Tables 6 & 7 in Appendix (taken from Chatfield, 1978)

The 95% and 99% critical values for F are:

$F_{0.01,1,172} = 6.63$

$F_{0.05,1,172} = 3.84$

$F_o < F$

Since the ratio of mean squares (0.81) is less than the 95 and 99% critical values for F, we accept the null hypothesis that there is no significant variability between the group gwc's.

V. Results and Conclusions

A. Summary of Descriptive Statistics for all Shale Units

DESCRIPTIVE STATISTICS

| VARIABLE | MEAN | S.D. | N | MEDIAN | MINIMUM | MAXIMUM |
|---|---|---|---|---|---|---|
| WETW | 1.052E-01 | 2.620E-02 | 53 | 1.050E-01 | 5.600E-02 | 1.710E-01 |
| DRYW | 9.498E-02 | 8.067E-02 | 121 | 8.600E-02 | 1.300E-02 | 8.700E-01 |
| DR-U | 7.816E-02 | 2.150E-02 | 37 | 8.200E-02 | 3.000E-02 | 1.230E-01 |

Output from Descriptive Statistics/ STATISTIX Computer Program

B. Comparison of the mean gwc's of the wet weathered and dry-weathered shale units (using the standard t and F-tests) shows that there is no significant difference between them.

FORM 91-005-1 (4/81)

# Appendix

# Table 2, cont

(DRY WEATHERED)

| DEPTH INTERVAL (FEET) | 912 | 913 | 914 | 916 | 918 | 923 | 926 | 928 | 929 | 930 | 933 | 934 | 936 | 937 | 938 | 940 | 941 | 945 | 946 | 953 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.5 | | | | | | | | | | | | | | | | | | | | |
| 8.5 | | | | | | | | | | | | | | | | | | | | |
| 9.5 | | | | | | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | | | | | | |
| 11.5 | | | | | | | | | | | | | | | | | 0.044 | | | |
| 12.5 | | | | | | | | | | | | | | | | | 0.072 | | | |
| 13.5 | | | | | | | | | | | | | | | | | 0.086 | | | |
| 14.5 | | | | | | | | | | | | | | | | | | | | |
| 15.5 | | | | | | | | | | | | | | | 0.096 | | | | | |
| 16.5 | | | | | | | | | | | | | | | 0.097 | | | | | |
| 17.5 | | | | | | | | | | | | | | | 0.097 | | | | | |
| 18.5 | | | | | | 0.076 | | | | | | | | | | | | | | |
| 19.5 | | | | | | | | | | | | | | | | | | | | |
| 20.5 | | | | | | | | | | | | 0.090 | | | | 0.081 | | | | |
| 21.5 | | | | | | | | | | | | 0.094 | | | | 0.080 | | | | |
| 22.5 | | | | | | | | | | 0.113 | | 0.084 | | | | 0.061 | | | | |
| 23.5 | | | | | | | | | | 0.122 | | | | | | | | | | |
| 24.5 | | | | | | | 0.076 | | | 0.123 | 0.069 | | | | | | | | | 0 |
| 25.5 | | | | | | | 0.094 | | 0.075 | | 0.083 | | | | | | | | | 0 |
| 26.5 | | | | | | | 0.085 | | 0.082 | | 0.075 | | | | | | | | | 0 |
| 27.5 | | | | | | | | | 0.087 | | | | | | | | | | | |
| 28.5 | | | | | | | | | | | | | | | | | | 0.040 | | |
| 29.5 | | | | | | | | | | | | | 0.067 | | | | | 0.064 | | |
| 30.5 | | | | | | | | | | | | | | 0.117 | | | | 0.074 | | |
| 31.5 | | | | | | | | | | | | | | 0.116 | | | | | | |
| 32.5 | | | | | | | | | | | | | | 0.112 | | | | | | |
| 33.5 | | | | | | | | | | | | | | | | | | | | |
| 34.5 | 0.084 | | | | | | | 0.043 | | | | | | | | | | | | |
| 35.5 | 0.089 | 0.064 | | | 0.059 | | | 0.056 | | | | | | | | | | | | |
| 36.5 | 0.088 | 0.051 | 0.085 | | 0.036 | | | 0.100 | | | | | | | | | | 0.122 | | |
| 37.5 | | 0.041 | 0.086 | 0.037 | 0.040 | | | | | | | | | | | | | 0.105 | | 0.067 |
| 38.5 | | | 0.050 | 0.066 | | | | | | | | | | | | | | 0.108 | | 0.042 |
| 39.5 | | | | 0.057 | | | | | | | | | | | | | | | | |
| 40.5 | | | | | | | | | | | | | | | | | | | | |
| 41.5 | | | | | | | | | | | | | | | | | | | | |
| 42.5 | | | | | | | | | | | | | | | | | | | | |
| 43.5 | | | | | | | | | | | | | | | | | | | | |
| 44.5 | | | | | | | | | | | | | | | | | | | | |
| 45.5 | | | | | | | | | | | | | | | | | | | | |
| 46.5 | | | | | | | | | | | | | | | | | | | | |
| 47.4 | | | | | | | | | | | | | | | | | | | | |
| 48.4 | | | | | | | | | | | | | | | | | | | | |
| 49.5 | | | | | | | | | | | | | | | | | | | | |

# Table 3

CHENEY DISPOSAL SITE - GROUP: AVERAGE GRAVIMETRIC WATER CONTENT IN DRY HOLES IN UNWEATHERED MANCOS SHALE

| DEPTH INTERVAL (FEET) | 819 | 824 | 826 | 902 | 906 | 915 | 917 | 919 | 920 | 921 | 922 | 944 | 947 | 950 | 955 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.5 | | | | | | | | | | | | | | | |
| 8.5 | | | | | | | | | | | | | | | |
| 9.5 | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | |
| 11.5 | | | | | | | | | | | | | | | |
| 12.5 | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | |
| 14.5 | | | | | | | | | | | | | | | |
| 15.5 | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | |
| 17.5 | | | | | | | | | | | | | | | |
| 18.5 | | | | | | | | | | | | | | | |
| 19.5 | | | | | | | | | | | | | | | |
| 20.5 | | | | | | | | | | | | | | | |
| 21.5 | | | | | | | | | | | | | | | |
| 22.5 | | | | | | | | | | | | | | | |
| 23.5 | | | | | | | | | | | | | | | |
| 24.5 | | | | | | | | | | | | | | | |
| 25.5 | | | | | | | | | | | | | | | |
| 26.5 | | | | | | | | | | | | | | | |
| 27.5 | | | | | | | | | | | | | | | |
| 28.5 | | | | | | | | | | | | | | | |
| 29.5 | | | | | | | | | | | | | | | |
| 30.5 | | | | | | | | | | | | | 0.088 | | |
| 31.5 | | | | | | | | | | | | | 0.090 | | |
| 32.5 | | | | | | | | | | | | | 0.094 | | |
| 33.5 | | | | | | | | | | | | | | | |
| 34.5 | | | | | | | | | | | | | | | |
| 35.5 | | | | | | | | | | | 0.086 | | | | |
| 36.5 | | | | 0.079 | | | | | | | | | | | |
| 37.5 | | | | 0.069 | | | | | 0.085 | | | | | | |
| 38.5 | 0.103 | | | 0.073 | | | | | 0.082 | | | | | | |
| 39.5 | 0.103 | | 0.084 | | 0.091 | 0.044 | | | 0.081 | | | | | | 0.081 |
| 40.5 | 0.090 | | 0.114 | | 0.093 | 0.068 | 0.080 | | | | | 0.079 | | 0.080 | 0.081 |
| 41.5 | | | 0.082 | | 0.085 | | | | | 0.091 | | | | 0.081 | 0.095 |
| 42.5 | | | | | | | | | | 0.074 | | | | 0.044 | |
| 43.5 | | | | | | | | | | | | | | | |
| 44.5 | | | | | | | | | | | | | | | |
| 45.5 | | | | | | | | 0.099 | | | | | | | |
| 46.5 | | 0.087 | | | | | | 0.090 | | | | | | | |
| 47.5 | | 0.064 | | | | | | 0.082 | | | | | | | |
| 48.5 | | 0.056 | | | | | | | | | | | | | |
| 49.5 | | | | | | | | | | | | | | | |
| 50.5 | | | | | | | | | | | | | | | |

lable 4 Input to STATISTIX Programs

VIEW DATA

| CASE | WETW | DRYW | DRYU |
|---|---|---|---|
| 1 | 0.0740 | 0.0720 | 0.1220 |
| 2 | 0.1010 | 0.0810 | 0.1030 |
| 3 | 0.1260 | 0.0870 | 0.0900 |
| 4 | 0.0830 | 0.1180 | 0.0570 |
| 5 | 0.1010 | 0.1040 | 0.0640 |
| 6 | 0.0890 | 0.0910 | 0.0560 |
| 7 | 0.1710 | 0.1090 | 0.0840 |
| 8 | 0.0960 | 0.1170 | 0.1140 |
| 9 | 0.0990 | 0.1180 | 0.0820 |
| 10 | 0.1360 | 0.1160 | 0.0790 |
| 11 | 0.1250 | 0.1120 | 0.0690 |
| 12 | 0.1040 | 0.1140 | 0.0730 |
| 13 | 0.0730 | 0.0960 | 0.0910 |
| 14 | 0.0690 | 0.0930 | 0.0930 |
| 15 | 0.0810 | 0.0860 | 0.0850 |
| 16 | 0.1410 | 0.1380 | 0.0440 |
| 17 | 0.1180 | 0.1130 | 0.0680 |
| 18 | 0.1260 | 0.1130 | 0.0720 |
| 19 | 0.0860 | 0.0340 | 0.0990 |
| 20 | 0.0830 | 0.0440 | 0.0900 |
| 21 | 0.0890 | 0.1100 | 0.0820 |
| 22 | 0.1440 | 0.1230 | 0.0850 |
| 23 | 0.0780 | 0.1380 | 0.0820 |
| 24 | 0.0650 | 0.1010 | 0.0810 |
| 25 | 0.1300 | 0.1090 | 0.0910 |
| 26 | 0.1150 | 0.1090 | 0.0740 |
| 27 | 0.1080 | 0.1040 | 0.0860 |
| 28 | 0.1190 | 0.0840 | 0.0790 |
| 29 | 0.1300 | 0.1020 | 0.0880 |
| 30 | 0.1720 | 0.1130 | 0.0920 |
| 31 | 0.0990 | 0.0810 | 0.0940 |
| 32 | 0.1300 | 0.1060 | 0.0300 |
| 33 | 0.0590 | 0.1050 | 0.0310 |
| 34 | 0.1020 | 0.1120 | 0.0440 |
| 35 | 0.1000 | 0.1010 | 0.0810 |
| 36 | 0.1060 | 0.1020 | 0.0810 |
| 37 | 0.0600 | 0.1260 | 0.0950 |
| 38 | 0.1400 | 0.1230 | M |
| 39 | 0.0810 | 0.1160 | M |
| 40 | 0.1100 | 0.0610 | M |
| 41 | 0.1270 | 0.0450 | M |
| 42 | 0.1210 | 0.0430 | M |
| 43 | 0.1070 | 0.0680 | M |
| 44 | 0.1070 | 0.0660 | M |
| 45 | 0.1330 | 0.0610 | M |
| 46 | 0.1200 | 0.0710 | M |
| 47 | 0.1560 | 0.1020 | M |
| 48 | 0.0560 | 0.0610 | M |
| 49 | 0.0840 | 0.2750 | M |
| 50 | 0.0640 | 0.0800 | M |
| 51 | 0.1150 | 0.0610 | M |
| 52 | 0.1020 | 0.0880 | M |
| 53 | 0.1050 | 0.0130 | M |
| 54 | M | 0.0720 | M |
| 55 | M | 0.1800 | M |
| 56 | M | 0.7100 | M |
| 57 | M | 0.8700 | M |

| | | | |
|---|---|---|---|
| 60 | M | 0.1[illegible] | M |
| 61 | M | 0.0790 | M |
| 62 | M | 0.0880 | M |
| 63 | M | 0.0580 | M |
| 64 | M | 0.0840 | M |
| 65 | M | 0.0890 | M |
| 66 | M | 0.0880 | M |
| 67 | M | 0.0640 | M |
| 68 | M | 0.0510 | M |
| 69 | M | 0.0410 | M |
| 70 | M | 0.0850 | M |
| 71 | M | 0.0860 | M |
| 72 | M | 0.0500 | M |
| 73 | M | 0.0370 | M |
| 74 | M | 0.0660 | M |
| 75 | M | 0.0570 | M |
| 76 | M | 0.0590 | M |
| 77 | M | 0.0360 | M |
| 78 | M | 0.0400 | M |
| 79 | M | 0.0760 | M |
| 80 | M | 0.0760 | M |
| 81 | M | 0.0940 | M |
| 82 | M | 0.0850 | M |
| 83 | M | 0.0430 | M |
| 84 | M | 0.0560 | M |
| 85 | M | 0.1000 | M |
| 86 | M | 0.0750 | M |
| 87 | M | 0.0820 | M |
| 88 | M | 0.0870 | M |
| 89 | M | 0.1130 | M |
| 90 | M | 0.1220 | M |
| 91 | M | 0.1230 | M |
| 92 | M | 0.0690 | M |
| 93 | M | 0.0830 | M |
| 94 | M | 0.0750 | M |
| 95 | M | 0.0900 | M |
| 96 | M | 0.0940 | M |
| 97 | M | 0.0840 | M |
| 98 | M | 0.0670 | M |
| 99 | M | 0.1170 | M |
| 100 | M | 0.1160 | M |
| 101 | M | 0.1120 | M |
| 102 | M | 0.0960 | M |
| 103 | M | 0.0970 | M |
| 104 | M | 0.0970 | M |
| 105 | M | 0.0810 | M |
| 106 | M | 0.0800 | M |
| 107 | M | 0.0610 | M |
| 108 | M | 0.0440 | M |
| 109 | M | 0.0720 | M |
| 110 | M | 0.0860 | M |
| 111 | M | 0.1220 | M |
| 112 | M | 0.1050 | M |
| 113 | M | 0.1080 | M |
| 114 | M | 0.0400 | M |
| 115 | M | 0.0640 | M |
| 116 | M | 0.0740 | M |
| 117 | M | 0.0510 | M |
| 118 | M | 0.0740 | M |
| 119 | M | 0.0820 | M |
| 120 | M | 0.0670 | M |
| 121 | M | 0.0420 | M |

JE JACOBS ENGINEERING

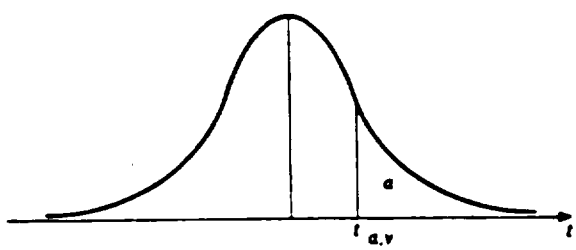
DATE _____ SUBJECT _____ SHEET NO 14

BY _____ CHKD. _____ JOB NO. _____

Table 5

**Table 2 Percentage points of Student's t-distribution**

| $\alpha$ | ·10 | ·05 | ·025 | ·01 | ·005 | ·001 |
|---|---|---|---|---|---|---|
| $\nu$ | | | | | | |
| 1 | 3·078 | 6·314 | 12·706 | 31·821 | 63·657 | 318·310 |
| 2 | 1·886 | 2·920 | 4·303 | 6·965 | 9·925 | 22·327 |
| 3 | 1·638 | 2·353 | 3·182 | 4·541 | 5·841 | 10·215 |
| 4 | 1·533 | 2·132 | 2·776 | 3·747 | 4·604 | 7·173 |
| 5 | 1·476 | 2·015 | 2·571 | 3·365 | 4·032 | 5·893 |
| 6 | 1·440 | 1·943 | 2·447 | 3·143 | 3·707 | 5·208 |
| 7 | 1·415 | 1·895 | 2·365 | 2·998 | 3·499 | 4·785 |
| 8 | 1·397 | 1·860 | 2·306 | 2·896 | 3·355 | 4·501 |
| 9 | 1·383 | 1·833 | 2·262 | 2·821 | 3·250 | 4·297 |
| 10 | 1·372 | 1·812 | 2·228 | 2·764 | 3·169 | 4·144 |
| 11 | 1·363 | 1·796 | 2·201 | 2·718 | 3·106 | 4·025 |
| 12 | 1·356 | 1·782 | 2·179 | 2·681 | 3·055 | 3·930 |
| 13 | 1·350 | 1·771 | 2·160 | 2·650 | 3·012 | 3·852 |
| 14 | 1·345 | 1·761 | 2·145 | 2·624 | 2·977 | 3·787 |
| 15 | 1·341 | 1·753 | 2·131 | 2·602 | 2·947 | 3·733 |
| 16 | 1·337 | 1·746 | 2·120 | 2·583 | 2·921 | 3·686 |
| 17 | 1·333 | 1·740 | 2·110 | 2·567 | 2·898 | 3·646 |
| 18 | 1·330 | 1·734 | 2·101 | 2·552 | 2·878 | 3·610 |
| 19 | 1·328 | 1·729 | 2·093 | 2·539 | 2·861 | 3·579 |
| 20 | 1·325 | 1·725 | 2·086 | 2·528 | 2·845 | 3·552 |
| 21 | 1·323 | 1·721 | 2·080 | 2·518 | 2·831 | 3·527 |
| 22 | 1·321 | 1·717 | 2·074 | 2·508 | 2·819 | 3·505 |
| 23 | 1·319 | 1·714 | 2·069 | 2·500 | 2·807 | 3·485 |
| 24 | 1·318 | 1·711 | 2·064 | 2·492 | 2·797 | 3·467 |
| 25 | 1·316 | 1·708 | 2·060 | 2·485 | 2·787 | 3·450 |
| 26 | 1·315 | 1·706 | 2·056 | 2·479 | 2·779 | 3·435 |
| 27 | 1·314 | 1·703 | 2·052 | 2·473 | 2·771 | 3·421 |
| 28 | 1·313 | 1·701 | 2·048 | 2·467 | 2·763 | 3·408 |
| 29 | 1·311 | 1·699 | 2·045 | 2·462 | 2·756 | 3·396 |
| 30 | 1·310 | 1·697 | 2·042 | 2·457 | 2·750 | 3·385 |
| 40 | 1·303 | 1·684 | 2·021 | 2·423 | 2·704 | 3·307 |
| 60 | 1·296 | 1·671 | 2·000 | 2·390 | 2·660 | 3·232 |
| 120 | 1·289 | 1·658 | 1·980 | 2·358 | 2·617 | 3·160 |
| $\infty$ | 1·282 | 1·645 | 1·960 | 2·326 | 2·576 | 3·090 |






Taken from Chatfield, 1978.

FORM 91-005-1 (4/81)

DATE _____ SUBJECT SHEET NO 15

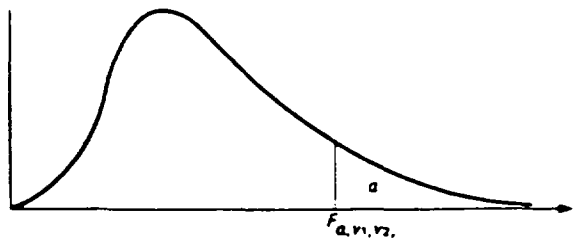
BY _____ CHKD. _____ JOB NO _____

Table 6

**Table 4 Upper percentage points of the *F*-distribution**

(a) $\alpha = 0{\cdot}01$

| $\nu_2$ \ $\nu_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4052·2 | 4999·5 | 5403·4 | 5624·6 | 5763·6 | 5859·0 | 5928·4 | 5981·1 | 6022·5 | 6055·8 | 6106·3 | 6157·3 | 6209·7 | 6234·6 | 6260·6 |
| 2 | 98·50 | 99·00 | 99·17 | 99·25 | 99·30 | 99·33 | 99·36 | 99·37 | 99·39 | 99·40 | 99·42 | 99·43 | 99·45 | 99·46 | 99·47 |
| 3 | 34·12 | 30·82 | 29·46 | 28·71 | 28·24 | 27·91 | 27·67 | 27·49 | 27·35 | 27·23 | 27·05 | 26·87 | 26·69 | 26·60 | 26·50 |
| 4 | 21·20 | 18·00 | 16·69 | 15·98 | 15·52 | 15·21 | 14·98 | 14·80 | 14·66 | 14·55 | 14·37 | 14·20 | 14·02 | 13·93 | 13·84 |
| 5 | 16·26 | 13·27 | 12·06 | 11·39 | 10·97 | 10·67 | 10·46 | 10·29 | 10·16 | 10·05 | 9·89 | 9·72 | 9·55 | 9·47 | 9·38 |
| 6 | 13·75 | 10·92 | 9·78 | 9·15 | 8·75 | 8·47 | 8·26 | 8·10 | 7·98 | 7·87 | 7·72 | 7·56 | 7·40 | 7·31 | 7·23 |
| 7 | 12·25 | 9·55 | 8·45 | 7·85 | 7·46 | 7·19 | 6·99 | 6·84 | 6·72 | 6·62 | 6·47 | 6·31 | 6·16 | 6·07 | 5·99 |
| 8 | 11·26 | 8·65 | 7·59 | 7·01 | 6·63 | 6·37 | 6·18 | 6·03 | 5·91 | 5·81 | 5·67 | 5·52 | 5·36 | 5·28 | 5·20 |
| 9 | 10·56 | 8·02 | 6·99 | 6·42 | 6·06 | 5·80 | 5·61 | 5·47 | 5·35 | 5·26 | 5·11 | 4·96 | 4·81 | 4·73 | 4·65 |
| 10 | 10·04 | 7·56 | 6·55 | 5·99 | 5·64 | 5·39 | 5·20 | 5·06 | 4·94 | 4·85 | 4·71 | 4·56 | 4·41 | 4·33 | 4·25 |
| 11 | 9·65 | 7·21 | 6·22 | 5·67 | 5·32 | 5·07 | 4·89 | 4·74 | 4·63 | 4·54 | 4·40 | 4·25 | 4·10 | 4·02 | 3·94 |
| 12 | 9·33 | 6·93 | 5·95 | 5·41 | 5·06 | 4·82 | 4·64 | 4·50 | 4·39 | 4·30 | 4·16 | 4·01 | 3·86 | 3·78 | 3·70 |
| 13 | 9·07 | 6·70 | 5·74 | 5·21 | 4·86 | 4·62 | 4·44 | 4·30 | 4·19 | 4·10 | 3·96 | 3·82 | 3·66 | 3·58 | 3·51 |
| 14 | 8·86 | 6·51 | 5·56 | 5·04 | 4·69 | 4·46 | 4·28 | 4·14 | 4·03 | 3·94 | 3·80 | 3·66 | 3·51 | 3·43 | 3·35 |
| 15 | 8·68 | 6·36 | 5·42 | 4·89 | 4·56 | 4·32 | 4·14 | 4·00 | 3·89 | 3·80 | 3·67 | 3·52 | 3·37 | 3·29 | 3·21 |
| 16 | 8·53 | 6·23 | 5·29 | 4·77 | 4·44 | 4·20 | 4·03 | 3·89 | 3·78 | 3·69 | 3·55 | 3·41 | 3·26 | 3·18 | 3·10 |
| 17 | 8·40 | 6·11 | 5·18 | 4·67 | 4·34 | 4·10 | 3·93 | 3·79 | 3·68 | 3·59 | 3·46 | 3·31 | 3·16 | 3·08 | 3·00 |
| 18 | 8·29 | 6·01 | 5·09 | 4·58 | 4·25 | 4·01 | 3·84 | 3·71 | 3·60 | 3·51 | 3·37 | 3·23 | 3·08 | 3·00 | 2·92 |
| 19 | 8·18 | 5·93 | 5·01 | 4·50 | 4·17 | 3·94 | 3·77 | 3·63 | 3·52 | 3·43 | 3·30 | 3·15 | 3·00 | 2·92 | 2·84 |
| 20 | 8·10 | 5·85 | 4·94 | 4·43 | 4·10 | 3·87 | 3·70 | 3·56 | 3·46 | 3·37 | 3·23 | 3·09 | 2·94 | 2·86 | 2·78 |
| 21 | 8·02 | 5·78 | 4·87 | 4·37 | 4·04 | 3·81 | 3·64 | 3·51 | 3·40 | 3·31 | 3·17 | 3·03 | 2·88 | 2·80 | 2·72 |
| 22 | 7·95 | 5·72 | 4·82 | 4·31 | 3·99 | 3·76 | 3·59 | 3·45 | 3·35 | 3·26 | 3·12 | 2·98 | 2·83 | 2·75 | 2·67 |
| 23 | 7·88 | 5·66 | 4·76 | 4·26 | 3·94 | 3·71 | 3·54 | 3·41 | 3·30 | 3·21 | 3·07 | 2·93 | 2·78 | 2·70 | 2·62 |
| 24 | 7·82 | 5·61 | 4·72 | 4·22 | 3·90 | 3·67 | 3·50 | 3·36 | 3·26 | 3·17 | 3·03 | 2·89 | 2·74 | 2·66 | 2·58 |
| 25 | 7·77 | 5·57 | 4·68 | 4·18 | 3·85 | 3·63 | 3·46 | 3·32 | 3·22 | 3·13 | 2·99 | 2·85 | 2·70 | 2·62 | 2·54 |
| 26 | 7·72 | 5·53 | 4·64 | 4·14 | 3·82 | 3·59 | 3·42 | 3·29 | 3·18 | 3·09 | 2·96 | 2·81 | 2·66 | 2·58 | 2·50 |
| 27 | 7·68 | 5·49 | 4·60 | 4·11 | 3·78 | 3·56 | 3·39 | 3·26 | 3·15 | 3·06 | 2·93 | 2·78 | 2·63 | 2·55 | 2·47 |
| 28 | 7·64 | 5·45 | 4·57 | 4·07 | 3·75 | 3·53 | 3·36 | 3·23 | 3·12 | 3·03 | 2·90 | 2·75 | 2·60 | 2·52 | 2·44 |
| 29 | 7·60 | 5·42 | 4·54 | 4·04 | 3·73 | 3·50 | 3·33 | 3·20 | 3·09 | 3·00 | 2·87 | 2·73 | 2·57 | 2·49 | 2·41 |
| 30 | 7·56 | 5·39 | 4·51 | 4·02 | 3·70 | 3·47 | 3·30 | 3·17 | 3·07 | 2·98 | 2·84 | 2·70 | 2·55 | 2·47 | 2·39 |
| 40 | 7·31 | 5·18 | 4·31 | 3·83 | 3·51 | 3·29 | 3·12 | 2·99 | 2·89 | 2·80 | 2·66 | 2·52 | 2·37 | 2·29 | 2·20 |
| 60 | 7·08 | 4·98 | 4·13 | 3·65 | 3·34 | 3·12 | 2·95 | 2·82 | 2·72 | 2·63 | 2·50 | 2·35 | 2·20 | 2·12 | 2·03 |
| 120 | 6·85 | 4·79 | 3·95 | 3·48 | 3·17 | 2·96 | 2·79 | 2·66 | 2·56 | 2·47 | 2·34 | 2·19 | 2·03 | 1·95 | 1·86 |
| ∞ | 6·63 | 4·61 | 3·78 | 3·32 | 3·02 | 2·80 | 2·64 | 2·51 | 2·41 | 2·32 | 2·18 | 2·04 | 1·88 | 1·79 | 1·70 |






FORM 91-005-1 (4/81)

SUMMARY OF BOREHOLES AT GRJ-03
1989

| HOLE NUMBER | HOLE TYPE | LOCATION EAST COORDINATE | LOCATION NORTH COORDINATE | GS ELEVATION (FT-MSL) | INTERVAL CORED | BOREHOLE DIAM. (IN) | HOLE DEPTH (FT) | DEPTH TO MANCOS (FT) | BEDROCK ELEVATION (FT) |
|---|---|---|---|---|---|---|---|---|---|
| 906 | BH | 93778.4 | 11423.2 | 5238.9 | | 6 | 55 | 41 | 5197.9 |
| 908 | BH | 93779.3 | 10830.4 | 5232.4 | | 6 | 44 | 41 | 5191.4 |
| 909 | BH | 94006.8 | 11607.8 | 5245.4 | | 6 | 45 | 40.5 | 5204.9 |
| 910 | BH | 93869.4 | 11339.1 | 5239.9 | | 6 | 46 | 42 | 5197.9 |
| 911 | BH | 93751.1 | 11536.2 | 5238.4 | | 6 | 45 | 41 | 5197.4 |
| 912 | BH | 93659.0 | 11762.6 | 5239.7 | | 6 | 38 | 34.5 | 5205.2 |
| 913 | BH | 93611.0 | 11853.0 | 5241.5 | | 6 | 40 | 36 | 5205.5 |
| 914 | BH | 93685.1 | 11713.7 | 5239.2 | | 6 | 40 | 37 | 5202.2 |
| 916 | BH | 93735.3 | 11396.9 | 5237.6 | | 6 | 40 | 38 | 5199.6 |
| 917 | BH | 93658.6 | 10883.8 | 5230.2 | | 6 | 42 | 42 | 5188.2 |
| 918 | BH | 93765.0 | 11480.4 | 5237.7 | | 6 | 40 | 36 | 5201.7 |
| 919 | BH | 93828.5 | 11382.1 | 5239.4 | | 6 | 55 | 46 | 5193.4 |
| 920 | BH | 93533.6 | 10856.7 | 5227.6 | | 6 | 48 | 38.5 | 5189.1 |
| 921 | BH | 93741.3 | 10857.5 | 5232.1 | | 6 | 45 | 43.5 | 5188.6 |
| 922 | BH | 93646.9 | 10343.1 | 5224.3 | 37-47 | 6 | 37 | 36 | 5188.3 |
| 923 | BH | 93712.8 | 10215.8 | 5221.9 | | 6 | 20 | 18.5 | 5203.4 |
| 924 | BH | 93641.3 | 10727.3 | 5230.0 | | 6 | 46 | 45.5 | 5184.5 |
| 925 | BH | 93933.9 | 10825.4 | 5235.0 | | 6 | 40 | 25 | 5210.0 |
| 926 | BH | 94071.9 | 10831.2 | 5237.5 | | 6 | 27 | 24 | 5213.5 |
| 928 | BH | 93479.8 | 11110.6 | 5228.9 | | 6 | 38 | 35 | 5193.9 |
| 929 | BH | 93592.4 | 11941.1 | 5242.4 | | 6 | 29 | 25 | 5217.4 |
| 930 | BH | 93545.9 | 12041.5 | 5242.6 | | 6 | 25 | 22 | 5220.6 |
| 932 | BH | 93915.2 | 11303.2 | 5240.5 | | 6 | 48 | 45 | 5195.5 |
| 933 | BH | 92841.9 | 12670.5 | 5235.3 | | 6 | 30 | 24.5 | 5210.9 |
| 934 | BH | 92557.4 | 12625.1 | 5227.2 | | 6 | 25 | 20 | 5207.2 |
| 940 | BH | 92200.5 | 12595.1 | 5221.7 | | 6 | 23 | 20 | 5201.7 |
| 941 | BH | 92205.7 | 12729.1 | 5224.0 | | 6 | 15 | 11.5 | 5212.5 |
| 942 | BH | 93272.7 | 10189.6 | 5217.9 | | 6 | 34 | 32 | 5185.9 |
| 947 | BH | 92271.2 | 12250.7 | 5220.9 | | 6 | 35 | 31.5 | 5189.4 |
| 948 | BH | 92298.8 | 12438.1 | 5224.3 | | 6 | 33 | 32 | 5192.3 |
| 949 | BH | 93825.4 | 10796.1 | 5233.1 | | 6 | 30 | 26.5 | 5206.6 |
| 950 | BH | 93885.7 | 10763.9 | 5234.0 | | 6 | 27 | 26 | 5208.0 |
| 953 | BH | 93847.3 | 10876.5 | 5234.0 | | 6 | 40 | 38 | 5196.0 |
| 968 | BH | 94015.1 | 10748.1 | 5236.0 | | 6 | 35 | 29 | 5206.0 |

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-03-90-13-03-01 DISCIPLINE HYDRO NO. OF SHEETS 115

**PROJECT:**
UMTRA

**SITE:**
Cheney – Grand Junction, Colorado

**FEATURE:**
Borehole Water Level Measurements @ Cheney Disposal Site

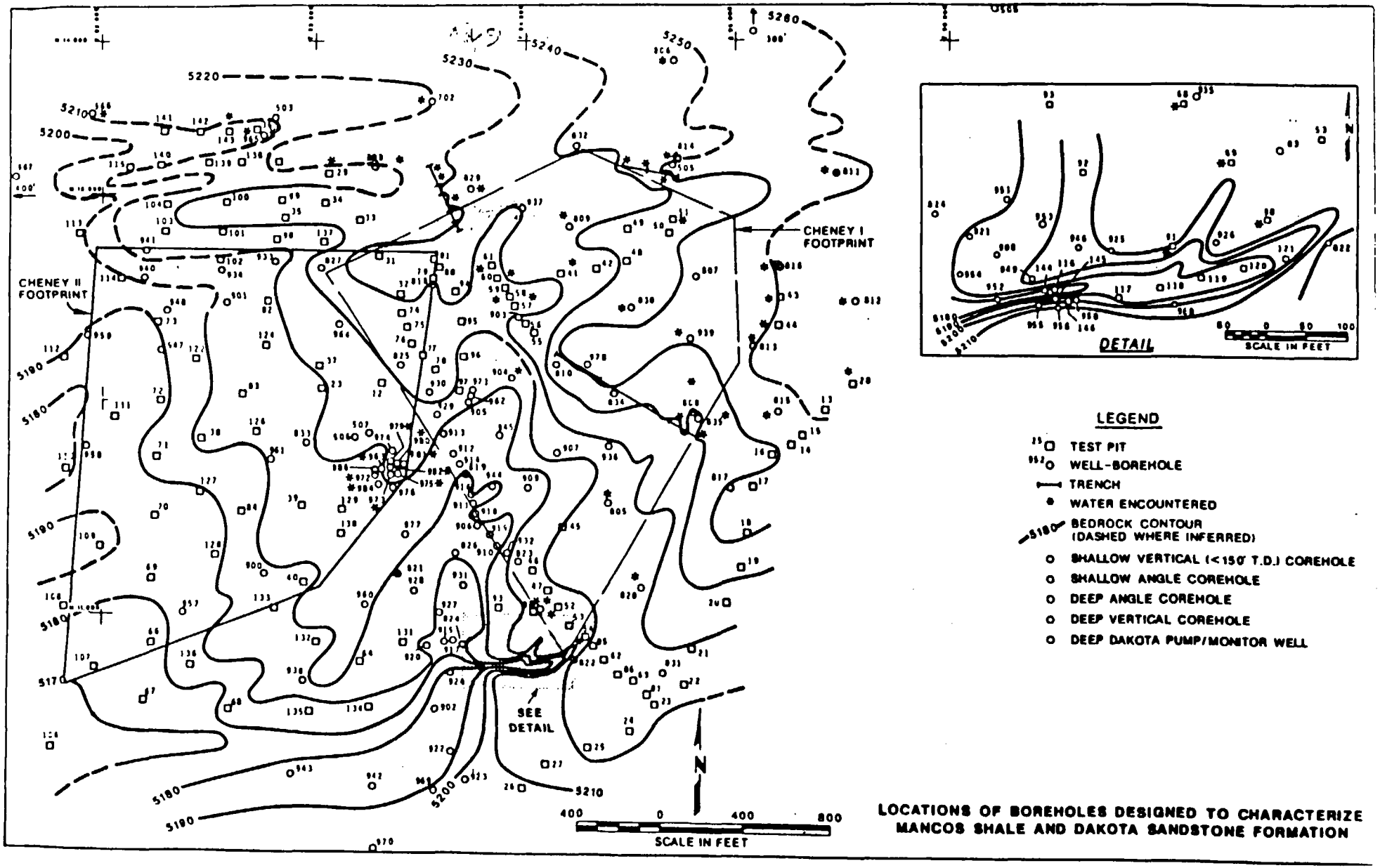
**SOURCES OF DATA:**
MK-Ferguson Field Data
TEG Field Data

**SOURCES OF FORMULAE & REFERENCES:**

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | V. Dean | 3/29/90 | [illegible] | [illegible]/90 | T. Coons | 7/16/90 |

8/85




LOCATIONS OF BOREHOLES DESIGNED TO CHARACTERIZE MANCOS SHALE AND DAKOTA SANDSTONE FORMATION

FIGURE 1

# Table 1 WATER LEVEL DATA

| DATE | 507 | 508 | 509 | 701 | 702 | 805S | 805D | 806S | 806D | 807S | 807D | 808 | 809 | 810 | 811S | 811D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | | | | | | | | 25.50 | 58.40 |
| 03/06/89 : | | | | | | | | | | | | | | | 25.50 | 57.70 |
| 03/07/89 : | | | | | | | | 29.20 | DRY | | | | | | 25.40 | 56.70 |
| 03/08/89 : | | | | | | | | 29.40 | DRY | | | | | | 25.50 | 56.35 |
| 03/13/89 : | | | | | | | | - | - | | | | | | 25.40 | 56.00 |
| 03/14/89 : | | | | | | | | 29.35 | DRY | | | | | | 25.45 | 56.20 |
| 03/15/89: | | | | | | | | 29.35 | DRY | DRY | DRY | | | | 25.45 | 56.10 |
| 03/16/89 : | | | | | | | | 29.35 | DRY | DRY | DRY | | | | 25.45 | 56.10 |
| 03/18/89 : | | | | | | | | 29.35 | DRY | DRY | DRY | | | | 25.50 | 56.00 |
| 03/20/89 : | | | | | | | | - | - | DRY | DRY | | 29.15 | | 25.50 | 55.90 |
| 03/21/89 : | | | | | | | | - | - | DRY | DRY | 17.80 | DRY | DRY | - | - |
| 03/22/89 : | | | | | | | | - | - | - | - | - | - | - | - | - |
| 03/24/89 : | | | | | | 28.14 | DRY | 27.67 | DRY | DRY | DRY | 17.57 | - | DRY | - | - |
| 03/30/89 : | | | | | | - | - | 29.25 | DRY | DRY | - | - | - | - | 25.37 | - |
| 03/31/89 : | | | | | | 24.84 | DRY | 27.67 | DRY | DRY | DRY | 17.53 | 28.88 | DRY | 25.43 | 56.08 |
| 04/01/89 : | | | | | | 24.84 | DRY | 29.15 | 76.62 | DRY | DRY | 17.38 | 28.80 | DRY | 25.26 | 56.00 |
| 04/04/89 : | | | | | | - | - | - | - | - | - | - | - | - | - | - |
| 04/05/89 : | DRY | 31.87 | 50.75 | - | - | 25.49 | DRY | 29.27 | 76.65 | DRY | DRY | 17.51 | 28.75 | DRY | 25.45 | 55.78 |
| 04/12/89 : | DRY | 31.77 | 48.83 | 27.60 | 25.40 | 24.15 | DRY | 29.13 | 76.62 | DRY | DRY | 17.36 | 28.72 | DRY | 25.25 | 56.10 |
| 04/15/89 : | - | 31.75 | 47.93 | 27.63 | 25.31 | 32.26[a] | 39.97[b] | 29.07 | DRY[a] | DRY | DRY | 17.33 | 28.70 | DRY | 25.20 | 56.00 |
| 04/18/89 : | DRY | 31.70 | 46.80 | 27.55 | 25.27 | 31.81 | 39.73[b] | 29.03 | 76.45 | DRY | 42.94[b] | 17.25 | 28.56 | DRY | 25.13 | 55.50 |
| 04/26/89 : | DRY | 31.76 | 44.65 | 27.65 | 25.25 | 30.57 | 38.66[b] | 30.70 | 76.50 | DRY | 43.57[b] | 17.24 | 28.50 | DRY | 25.22 | 55.38 |
| 04/28/89 : | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 04/29/89 : | DRY | 31.83 | 43.85 | 27.70 | 25.30 | 30.31 | 38.36[b] | 31.04 | 76.50 | DRY | 43.62[b] | 17.28 | 28.50 | DRY | 25.25 | 55.30 |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to re[illegible]e this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 507 | 508 | 509 | 701 | 702 | 805S | 805D | 806S | 806D | 807S | 807D | 808 | 809 | 810 | 811S | 811D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03/89 | DRY | 31.75 | 42.85 | 27.75 | 25.25 | 29.94 | 38.19[b] | 28.97 | 76.45[b] | DRY | 43.67[b] | 17.24 | 28.50 | DRY | 25.22 | 55.16 |
| 05/09/89 | DRY | 31.79 | 41.32 | 27.82 | 25.32 | 27.39 | 37.86[b] | 29.02 | 76.39[b] | DRY | 43.72[b] | 17.27 | 28.46 | DRY | 25.29 | 55.06 |
| 05/10/89 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 05/19/89 | - | - | - | - | - | 28.72 | 51.63[b] | - | 76.45[b] | - | - | - | 28.50 | - | - | - |
| 05/25/89 | DRY | 32.03 | 40.44 | 28.06 | 25.39 | 29.94 | 34.16[b] | 29.14 | 27.15[b] | DRY | 43.01[b] | 17.45 | 28.45 | DRY | 25.47 | 54.56 |
| 06/02/89 | - | 32.07 | 40.47 | 28.28 | 25.43 | - | - | 29.20 | 28.41[b] | - | - | - | 28.57 | - | 25.54 | 54.38 |
| 06/03/89 | DRY | 32.16 | 40.49 | 28.25 | 25.38 | 30.28 | 33.47[b] | 29.21 | 28.48[b] | DRY | 43.40 | 17.51 | 28.58 | DRY | 25.53 | 54.36 |
| 06/05/89 | - | 32.15 | 40.49 | 28.35 | 25.50 | 30.06 | 33.75[b] | 29.30 | 28.78[b] | - | 43.50[b] | 17.56 | 28.60 | - | 25.63 | 54.13 |
| 06/06/89 | - | 32.06 | 40.41 | 28.31 | 27.48 | 29.91 | 33.41[b] | 29.20 | 28.91[b] | - | 43.50[b] | 17.59 | 28.66 | - | 25.58 | 53.76 |
| 06/07/89 | - | 32.19 | 40.51 | 28.43 | 25.50 | 30.09 | 33.24[b] | 29.25 | 29.10[b] | - | 43.56[b] | 17.79 | 28.70 | - | 25.63 | 53.57 |
| 06/08/89 | - | 32.20 | 40.49 | 28.44 | 25.50 | 29.82 | 33.52[b] | 29.28 | 29.20[b] | - | 43.58[b] | 17.96 | 28.69 | - | 25.65 | 53.38 |
| 06/09/89 | - | 32.25 | 40.52 | 28.43 | 25.50 | 30.13 | 32.83[b] | 29.31 | 29.32[b] | - | 43.57[b] | 18.14 | 28.72 | - | 25.68 | 53.15 |
| 06/10/89 | - | 32.25 | 40.45 | 28.40 | 25.50 | 30.65 | 32.47[b] | 29.31 | 29.20[b] | - | 43.59[b] | 18.27 | 28.76 | - | 25.70 | 52.92 |
| 06/12/89 | - | 32.29 | 40.49 | 28.47 | 25.57 | 31.12 | 32.87[b] | 29.34 | 29.69[b] | - | 43.65[b] | 18.50 | 28.82 | - | 25.70 | 52.52 |
| 06/13/89 | - | 32.29 | 40.47 | 28.48 | 25.59 | 31.22 | 33.16[b] | 29.37 | 29.81[b] | - | 43.66[b] | 18.59 | 28.87 | - | 25.77 | 52.32 |
| 06/14/89 | - | 32.24 | 40.45 | 28.49 | 25.57 | 31.07 | 33.56[b] | 29.37 | 29.95[b] | - | 43.68[b] | 18.64 | 28.88 | - | 25.75 | 52.11 |
| 06/16/89 | - | - | - | - | - | 30.20 | 34.13[b] | 29.28 | 30.21[b] | - | 43.69[b] | 18.71 | 28.93 | - | 25.83 | 51.49 |
| 06/19/89 | - | 32.32 | 40.41 | 28.56 | 25.59 | 29.42 | 33.94[b] | 29.34 | 30.53[b] | - | 43.76[b] | 18.78 | 29.05 | - | 25.76 | 51.07 |
| 06/20/89 | - | 32.34 | 40.45 | 28.56 | 25.55 | 30.30 | 33.11[b] | 29.37 | 30.65[b] | - | 43.78[b] | 18.78 | 29.07 | - | 25.77 | 50.90 |
| 06/21/89 | - | 32.38 | 40.42 | 28.56 | 25.63 | 30.78 | 33.52[b] | 29.46 | 30.74[b] | - | 43.80[b] | 18.84 | 29.10 | - | 25.85 | 50.78 |
| 06/22/89 | - | 32.32 | 40.42 | 28.59 | 25.58 | 30.73 | 33.99[b] | 29.37 | 30.88[b] | - | 43.81[b] | 18.86 | 29.15 | - | 25.81 | 50.53 |
| 06/26/89 | - | 32.36 | 40.38 | 28.59 | 25.60 | 31.23 | 35.48[b] | 29.40 | 31.30[b] | - | 43.88[b] | 18.88 | 29.47 | - | 25.85 | 49.86 |
| 06/28/89 | - | 32.39 | 40.42 | 28.63 | 25.61 | 31.36 | 36.21[b] | 29.43 | 31.52[b] | - | 43.92[b] | 18.90 | 29.95 | - | 25.88 | 49.35 |
| 06/30/89 | - | 32.42 | 40.45 | 28.69 | 25.63 | 32.16 | 36.43[b] | 29.44 | 31.72[b] | - | 43.93[b] | 18.91 | 30.45 | - | 25.90 | 49.00 |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE : | 507 | 508 | 509 | 701 | 702 | 805S | 805D | 806S | 806D | 807S | 807D | 808 | 809 | 810 | 811S | 811D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 : | - | 32.47 | 40.42 | 28.72 | 25.70 | 32.49 | 38.68 | 29.49 | 32.23[b] | - | 44.01[b] | 18.97 | DRY | - | 25.96 | 47.90 |
| 07/15/89 : | - | - | - | - | - | 32.64 | 40.96 | - | - | - | - | 19.21 | - | - | - | - |
| 07/19/89 : | - | 32.67 | 89.47 | 28.91 | 25.85 | 32.76 | 41.92 | 29.75 | 33.60[b] | - | 44.32[b] | 19.14 | DRY | - | 26.71 | 55.98 |
| 07/22/89 : | - | 32.71 | 86.99 | 28.93 | 25.95 | DRY | 42.14 | 27.04 | 61.24[b] | - | 44.27[b] | 19.10 | DRY | - | 26.23 | 55.63 |
| 07/31/89 : | - | - | - | - | - | - | - | - | - | - | 44.42[b] | 19.24 | DRY | - | - | - |
| 08/04/89 : | - | 32.88 | 85.05 | 29.00 | 25.88 | DRY | 41.98 | 29.75 | 61.10[b] | - | 44.45[b] | 19.24 | DRY | - | 26.31 | 55.23 |
| 08/14/89 : | - | 33.00 | 87.15 | 29.19 | 26.02 | DRY | 57.83 | 30.25 | 66.33[b] | - | 44.75[b] | 19.41 | DRY | - | 26.64 | 55.23 |
| 08/17/89 : | - | 33.01 | 87.14 | 29.17 | 26.01 | DRY | 57.83 | 30.22 | 66.34[b] | - | 44.75[b] | 19.34 | DRY | - | 26.60 | 55.21 |
| 08/19/89 : | - | 33.15 | 86.68 | 29.08 | 26.04 | DRY | 57.82 | 30.20 | 66.33[b] | - | 44.75[b] | 19.34 | DRY | - | 26.58 | 55.21 |
| 08/21/89 : | - | 33.17 | 86.22 | 29.13 | 26.08 | DRY | 57.31 | 30.33 | 66.37[b] | - | 44.29[b] | 17.41[f] | DRY | - | 26.60 | 55.11 |
| 08/24/89 : | - | 33.00 | 86.18 | 29.17 | 26.00 | DRY | 57.31 | 30.29 | 66.08[b] | - | 44.33[b] | 19.43 | DRY | - | 26.56 | 55.13 |
| 08/29/89 : | - | 33.00 | 87.15 | 29.19 | 26.00 | DRY | 57.83 | 30.25 | 66.33[b] | - | 44.76[b] | 19.39 | DRY | - | 26.64 | 55.21 |
| 09/05/89 : | - | 33.00 | 83.05 | 29.29 | 26.25 | DRY | 57.89 | 30.22 | 66.49[b] | - | 44.79[b] | 19.34 | DRY | - | 26.73 | 55.30 |
| 09/11/89 : | - | 33.17 | 82.80 | 29.33 | 26.19 | DRY | 57.89 | 30.20 | 66.45[b] | - | 44.72[b] | 19.30 | DRY | - | 30.68 | 55.23 |
| 09/18/89 : | - | 33.00 | 80.18 | 29.25 | 26.00 | DRY | 59.92 | 30.25 | 66.45[b] | - | 44.91[b] | 19.34 | DRY | - | 26.75 | 55.30 |
| 09/20/89 : | - | 33.37 | - | 29.33 | - | DRY | - | 30.54 | 66.03[b] | - | - | - | - | - | 26.77 | 52.88 |
| 09/21/89 : | - | 33.33 | - | 29.40 | - | DRY | - | - | - | - | - | - | - | - | 27.11 | 52.96 |
| 09/22/89 : | - | 33.41 | - | 29.37 | - | - | DRY | - | 30.55[b] | 66.03 | - | - | - | - | 27.01 | 53.75 |
| 09/25/89 : | - | 33.42 | 79.98 | 29.33 | 25.96 | DRY | 59.02 | 30.45 | 65.87[b] | - | 45.04[b] | 19.34 | DRY | - | 26.85 | 54.17 |
| 10/02/89 : | - | 33.46 | 77.80 | 29.33 | 26.75 | DRY | 59.00 | 29.79 | 66.47[b] | - | 44.87[b] | 19.34 | DRY | - | 27.18 | 52.96 |
| 10/09/89 : | - | 33.42 | 77.97 | 29.33 | 26.50 | DRY | 59.03 | 29.79 | 66.37[b] | - | 44.87[b] | 19.43 | DRY | - | 26.85 | 52.96 |
| 10/17/89 : | - | 34.58 | 85.97 | 29.50 | 26.17 | DRY | 56.48[g] | 30.20 | 66.47[b] | - | 45.08[b] | 19.43 | DRY | - | 26.70 | 55.30 |
| 10/27/89 : | - | 34.60 | 85.80 | 29.33 | 26.50 | DRY | 56.50[g] | 30.29 | 66.45[b] | - | 45.20[b] | 19.51 | DRY | - | 26.85 | 55.30 |
| 10/30/89 : | - | 33.80 | 74.44 | 29.43 | 26.42 | DRY | 58.23[g] | 30.52 | 66.81[b] | - | 45.52[b] | 19.64 | DRY | - | 27.28 | 47.33 |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is ect.
g) Increas ater level suggests groundwater is beginning to rech this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE : | 507 | 508 | 509 | 701 | 702 | 805S | 805D | 806S | 806D | 807S | 807D | 808 | 809 | 810 | 811S | 811D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/06/89 : | - | 33.71 | 74.14 | 29.03 | 26.40 | DRY | 58.23[g] | 30.48[b] | 66.78 | - | 45.54[b] | 19.62 | DRY | - | 27.26 | 47.33 |
| 11/13/89 : | - | 34.13 | 74.87 | 29.00 | 26.51 | DRY | 57.70[g] | 31.39[b] | 66.86 | - | 45.50[b] | 20.51 | DRY | - | 27.47 | 47.37 |
| 11/21/89 : | - | 34.10 | 70.01 | 29.23 | 26.57 | DRY | 56.36[g] | 30.78[b] | 65.91 | - | 45.61[b] | 19.67 | DRY | - | 27.52 | 56.59 |
| 12/14/89 : | - | 33.62 | 63.97 | 29.32 | 26.29 | DRY | 56.37[g] | 30.62[b] | 65.56 | - | 44.92[b] | 19.45 | DRY | - | 26.87 | 56.25 |
| 12/29/89 : | - | 34.31 | 69.81 | 29.15 | 27.46 | DRY | 56.53[g] | 30.67[b] | 65.73 | - | 45.63[b] | 19.52 | DRY | - | 27.21 | 56.49 |
| 01/17/90 : | - | 34.37 | 70.60 | 29.41 | 28.12 | DRY | 54.59[g] | 30.67[b] | 65.95 | - | 45.89[b] | 19.62 | DRY | - | 27.73 | 56.69 |
| 02/01/90 : | - | 35.30 | - | 31.27 | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/02/90 : | - | 31.24 | - | 31.24 | - | - | - | - | - | - | - | - | - | - | - | - |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 812S | 812D | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821S | 821D | 822 | 823S | 823D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | | | | | | | | |
| 03/06/89 : | | | | | | | | | | | | | | | |
| 03/07/89 : | | | | | | | | | | | | | | | |
| 03/08/89 : | | | | | | | | | | | | | | | |
| 03/13/89 : | 26.80 | DRY | | | | | | | | | | | | | |
| 03/14/89 : | 24.85 | 61.10 | | | | | | | | | | | | | |
| 03/15/89 : | 23.70 | 59.50 | | | | | | | | | | | | | |
| 03/16/89 : | 23.10 | 58.30 | DRY | | | | | | | | | | | | |
| 03/18/89 : | 22.50 | 55.55 | DRY | 31.00 | 19.80 | DRY | | | | | | | | | |
| 03/20/89 : | 22.00 | - | DRY | - | 19.70 | DRY | | | | | | | | | |
| 03/21/89 : | 19.90 | 57.35 | DRY | - | 19.60 | - | | | | | | | | | |
| 03/22/89 : | - | - | - | - | - | - | | | | | | | | | |
| 03/24/89 : | 19.70 | 57.09 | 14.99[c] | - | 19.75 | 19.46 | | | | | | | | | |
| 03/30/89 : | 19.82 | - | DRY | - | 19.68 | 16.64 | | | | | | | | | |
| 03/31/89 : | 19.87 | 56.88 | 14.45[c] | 30.61 | 19.73 | DRY | DRY | DRY | DRY | | | | | | |
| 04/01/89 : | 19.71 | 56.77 | DRY | 30.63 | 19.69 | 19.70[d] | DRY | DRY | DRY | 21.76 | | | | | |
| 04/04/89 : | - | - | - | - | - | - | - | - | - | - | | | | | |
| 04/05/89 : | 25.02[d] | 56.62 | 14.99[c] | 30.75 | 19.74 | 20.09[d] | 15.54[b] | DRY | DRY | 21.76 | | | | | |
| 04/12/89 : | 19.66 | 61.27[a] | 14.87 | 30.61 | 19.69 | 16.19 | 18.14[b] | DRY | DRY | 21.66 | | | DRY | | |
| 04/15/89 : | 19.65 | 62.20 | 14.63 | 30.60 | 19.69 | 15.52 | 18.56[b] | 23.31[b] | DRY | 21.65 | | | 28.44[b] | DRY | DRY |
| 04/18/89 : | 19.62 | 61.77 | 14.28 | 30.50 | 19.59 | 14.99 | 18.70[b] | 24.11[b] | DRY | 18.56[f] | | | 29.29[b] | DRY | - |
| 04/26/89 : | 19.67 | 61.65 | 13.84 | 30.50 | 19.64 | 14.52 | 19.22[b] | 24.78[b] | DRY | 21.51 | | | 30.82[b] | DRY | DRY |
| 04/28/89 : | - | - | - | - | - | - | - | - | - | - | DRY | DRY | - | - | 48.13[b] |
| 04/29/89 : | 19.80 | 61.62 | 13.74 | 30.50 | 19.79 | 14.52 | 19.37[b] | 24.91[b] | DRY | 21.51 | DRY | DRY | 31.18[b] | DRY | 48.50[b] |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rec this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 812S | 812D | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821S | 821D | 822 | 823S | 823D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03/89 | 19.78 | 61.49 | 13.60 | 30.50 | 19.66 | 14.48 | 19.49[b] | DRY | DRY | 21.48 | 30.02[b] | 33.04 | 31.55[b] | DRY | 48.54[b] |
| 05/09/89 | 19.93 | 61.40 | 13.51 | 30.50 | 19.75 | 14.56 | 19.60[b] | DRY | DRY | 21.43 | 30.51[b] | 34.97 | 32.02[b] | DRY | 48.87[b] |
| 05/10/89 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 05/19/89 | - | 61.19 | 13.52 | - | 19.85 | - | - | - | - | - | - | 34.11 | 32.48[b] | - | - |
| 05/25/89 | 20.27 | 18.27[b,c] | 15.10[d] | 30.87 | 19.95 | - | 17.83[b] | DRY | DRY | 21.34 | DRY | 35.02 | 28.56[b] | DRY | 48.43[b] |
| 06/02/89 | - | - | - | 31.13 | - | - | - | - | - | - | - | - | - | - | - |
| 06/03/89 | 20.45 | 19.94[b] | 14.54 | 31.12 | 20.11 | 15.25 | 18.63[b] | DRY | DRY | 21.39 | DRY | 37.38 | 29.88[b] | DRY | 48.44[b] |
| 06/05/89 | 20.57 | 20.05 | 14.46 | 31.29 | 20.17 | 15.17 | - | - | - | 21.43 | - | 37.85[b] | 30.11[b] | - | 48.55[b] |
| 06/06/89 | 20.69 | 19.97 | 14.32 | 31.28 | 20.15 | 15.07 | - | - | - | 21.38 | - | 38.10[b] | 30.23[b] | - | 48.46[b] |
| 06/07/89 | 20.60 | 20.16 | 14.39 | 31.38 | 20.25 | 15.14 | - | - | - | 21.39 | - | 38.39[b] | 30.30[b] | - | 48.50[b] |
| 06/08/89 | 20.62 | 20.19 | 14.36 | 31.39 | 20.23 | 15.10 | - | - | - | 21.40 | - | 38.56[b] | 30.42[b] | - | 48.54[b] |
| 06/09/89 | 20.63 | 20.19 | 14.31 | 31.38 | 20.27 | 15.10 | - | - | - | 21.40 | - | 38.74[b] | 30.56[b] | - | 48.54[b] |
| 06/10/89 | 20.64 | 20.23 | 14.29 | 31.38 | 20.23 | 15.10 | - | - | - | 21.42 | - | 38.97[b] | 30.66[b] | - | 48.56[b] |
| 06/12/89 | 20.70 | 20.28 | 14.17 | 31.41 | 20.27 | 15.08 | - | - | - | 21.44 | - | 39.38[b] | 30.87[b] | - | 48.58[b] |
| 06/13/89 | 20.73 | 20.31 | 14.18 | 31.44 | 20.29 | 15.10 | - | - | - | 21.44 | - | 39.57[b] | 30.95[b] | - | 48.54[b] |
| 06/14/89 | 20.75 | 20.35 | 14.19 | 31.48 | 20.31 | 15.11 | - | - | - | 21.44 | - | 39.76[b] | 31.03[b] | - | 48.53[b] |
| 06/16/89 | - | - | 14.15 | - | 20.29 | 15.09 | - | - | - | 21.42 | - | 40.18[b] | - | - | - |
| 06/19/89 | 20.82 | 20.47 | 14.09 | 31.48 | 20.31 | 15.12 | - | - | - | 21.47 | - | 40.70[b] | 31.40[b] | - | 48.52[b] |
| 06/20/89 | 20.84 | 20.50 | 14.08 | 31.49 | 20.31 | 15.14 | - | - | - | 21.51 | - | 40.90[b] | 31.47[b] | - | 48.52[b] |
| 06/21/89 | 20.91 | 20.54 | 14.10 | 31.50 | 20.32 | 15.15 | - | - | - | 21.55 | - | 41.09[b] | 31.58[b] | - | 48.54[b] |
| 06/22/89 | 20.87 | 20.56 | 14.09 | 31.50 | 20.33 | 15.14 | - | - | - | 21.54 | - | 41.28[b] | 31.64[b] | - | 48.50[b] |
| 06/26/89 | 20.97 | 20.67 | 14.06 | 31.52 | 20.34 | 15.17 | - | - | - | 21.63 | - | 41.98[b] | 31.90[b] | - | 48.50[b] |
| 06/28/89 | 21.02 | 20.70 | 14.06 | 31.53 | 20.32 | 15.20 | - | - | - | 21.68 | - | 42.30[b] | 32.02[b] | - | 48.83[b] |
| 06/30/89 | 21.04 | 20.74 | 14.07 | 31.57 | 20.34 | 15.22 | - | - | - | 21.73 | - | 42.58[b] | 32.12[b] | - | 48.82[b] |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 812S | 812D | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821S | 821D | 822 | 823S | 823D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 | 21.15 | 20.87 | 14.13 | - | 20.36 | 15.29 | - | - | - | 21.94 | - | 43.35[b] | 32.42[b] | DRY | 47.35[b] |
| 07/15/89 | - | - | 13.54 | - | 20.04 | - | - | - | - | - | - | 44.95[b] | 33.02[c] | DRY | 40.20[i] |
| 07/19/89 | 21.44 | 21.23 | DRY | 31.71 | 22.30[c] | 20.90[f] | - | - | - | 22.30 | - | 45.42[b] | 33.12[c] | DRY | - |
| 07/22/89 | 21.42 | 21.24 | DRY | - | 22.09[c] | 18.88[f] | - | - | - | 22.41 | - | 45.73[b] | DRY | DRY | - |
| 07/31/89 | 21.64 | 21.51 | 15.89[f] | - | 21.71[c] | 16.14 | - | - | - | 22.66 | - | - | 33.92[c] | DRY | - |
| 08/04/89 | 21.75 | 21.53 | DRY | - | 21.59[c] | 15.90 | - | - | - | 22.70 | - | 47.33 | DRY | DRY | - |
| 08/14/89 | 21.79 | 22.02 | DRY | 31.85 | 22.99[c] | 17.83 | - | - | - | 22.93 | - | DRY | 34.19[c] | DRY | 46.54[i] |
| 08/17/89 | 21.78 | 22.01 | DRY | 31.85 | 22.93[c] | 17.83 | - | - | - | 22.93 | - | DRY | 34.17[c] | DRY | 46.45[i] |
| 08/19/89 | 21.77 | 22.01 | DRY | 31.85 | 22.99[c] | 17.81 | - | - | - | 22.84 | - | DRY | DRY | DRY | 45.73[i] |
| 08/21/89 | 21.85 | 22.01 | DRY | 31.91 | 23.03[c] | 17.19 | - | - | - | 22.92 | - | DRY | DRY | DRY | 46.62[i] |
| 08/24/89 | 21.85 | 21.85 | DRY | 32.50 | 23.09[c] | 17.23 | - | - | - | 22.89 | - | DRY | DRY | DRY | 46.62[i] |
| 08/29/89 | 21.77 | 22.01 | DRY | 31.85 | 22.97[c] | 17.83 | - | - | - | 22.91 | - | DRY | 34.19[c] | DRY | 46.52[i] |
| 09/05/89 | 21.79 | 22.01 | DRY | 31.92 | 22.94[c] | 17.44 | - | - | - | 23.51 | - | DRY | DRY | DRY | 46.56[i] |
| 09/11/89 | 21.77 | 21.97 | DRY | 31.94 | 23.01[c] | 17.42 | - | - | - | 23.51 | - | DRY | DRY | DRY | 46.54[i] |
| 09/18/89 | 21.87 | 21.93 | DRY | 32.00 | 23.26[c] | 17.44 | - | - | - | 22.93 | - | DRY | DRY | DRY | 46.58[i] |
| 09/20/89 | - | - | - | - | - | 15.75 | - | - | - | 23.43 | - | - | - | - | - |
| 09/21/89 | - | - | - | - | - | 15.67 | - | - | - | 23.43 | - | - | DRY | - | - |
| 09/22/89 | - | - | - | - | | 15.79 | | - | - | 23.51 | - | - | DRY | - | - |
| 09/25/89 | 21.94 | 21.97[b] | 18.33[f] | 31.50 | 23.13[c] | 15.35 | - | - | - | 23.43 | - | DRY | DRY | DRY | 46.60[i] |
| 10/02/89 | 21.69 | 21.97[b] | 18.00[f] | 31.42 | 23.22[c] | 18.02 | - | - | - | 23.93 | - | DRY | DRY | DRY | 46.62[i] |
| 10/09/89 | 21.69 | 21.59[b] | 18.08[f] | 31.83 | 23.17[c] | 18.02 | - | - | - | 23.51 | - | DRY | DRY | DRY | 46.62[i] |
| 10/17/89 | 21.77 | 22.05[b] | 16.81[f] | 31.83 | 22.92[c] | 17.92 | - | - | - | 23.64 | - | DRY | DRY | - | DRY |
| 10/27/89 | 21.85 | 22.10[b] | 16.79[f] | 32.00 | 22.84[c] | 18.11 | - | - | - | 23.51 | - | DRY | DRY | - | DRY |
| 10/30/89 | 22.01 | 22.36[b] | 17.64[f] | 32.37 | 23.31[c] | 16.17 | - | - | - | 25.13 | - | DRY | DRY | - | DRY |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data i[illegible]pect.
g) Increa[illegible] water level suggests groundwater is beginning to rec[illegible]e this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No [illegible]surement taken.

# Table 1 WATER LEVEL DATA

| DATE | 812S | 812D | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821S | 821D | 822 | 823S | 823D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/06/89 | 21.95 | 22.39[b] | 17.55[f] | 32.32 | 23.29[c] | 16.21 | - | - | - | 23.61 | - | DRY | DRY | - | DRY |
| 11/13/89 | 21.93 | 22.43[b] | 17.61[f] | 32.30 | 23.31[c] | 16.19 | - | - | - | 23.65 | - | DRY | DRY | - | DRY |
| 11/21/89 | 22.26 | 22.54[b] | 15.70[f] | 32.03 | 23.13[c] | 16.08 | - | - | - | 27.67[c] | - | DRY | DRY | - | DRY |
| 12/14/89 | 22.17 | 22.39[b] | 15.38[f] | 31.81 | 22.60[c] | 15.53 | - | - | - | 28.01[c] | - | DRY | DRY | - | DRY |
| 12/29/89 | 22.32 | 22.39[b] | 14.60[f] | 31.90 | 22.91[c] | 15.20 | - | - | - | 27.73[c] | - | DRY | DRY | - | DRY |
| 01/17/90 | 22.22 | 22.83[b] | 15.55[f] | 32.36 | 23.50[c] | 15.25 | - | - | - | 28.23[c] | - | DRY | DRY | - | DRY |
| 02/01/90 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/02/90 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 824 | 825S | 825D | 826 | 827 | 828 | 829S | 829D | 830 | 831 | 832 | 833S | 833D | 834S | 834D | 835 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | | | | | | | | | |
| 03/06/89 : | | | | | | | | | | | | | | | | |
| 03/07/89 : | | | | | | | | | | | | | | | | |
| 03/08/89 : | | | | | | | | | | | | | | | | |
| 03/13/89 : | | | | | | | | | | | | | | | | |
| 03/14/89 : | | | | | | | | | | | | | | | | |
| 03/15/89 : | | | | | | | | | | | | | | | | |
| 03/16/89 : | | | | | | | | | | | | | | | | |
| 03/18/89 : | | | | | | | | | | | | | | | | |
| 03/20/89 : | | | | | | | | | | | | | | | | |
| 03/21/89 : | | | | | | | | | | | | | | | | |
| 03/22/89 : | | | | | | | | | | | | | | | | |
| 03/24/89 : | | | | | | | | | | | | | | | | |
| 03/30/89 : | | | | | | | | | | | | | | | | |
| 03/31/89 : | | | | | | | | | | DRY | | | | | | |
| 04/01/89 : | | | | | | | | | DRY | DRY | | | | | | |
| 04/04/89 : | | | | | | | | | - | - | | | | | | |
| 04/05/89 : | | | | | | | | | DRY | 22.90 | | | | | | |
| 04/12/89 : | | | | | | | | | 25.97 | 23.95 | | | | | | |
| 04/15/89 : | | DRY | DRY | | | | | | 24.49 | 24.14 | | | | | | |
| 04/18/89 : | | DRY | DRY | DRY | | 21.17 | 27.48 | 27.61[e] | 22.95 | 24.19 | DRY | | | | | |
| 04/26/89 : | DRY | DRY | 51.02[b] | - | DRY | 21.07 | 27.45 | 31.85[e] | 20.03 | 24.55 | DRY | | | | | |
| 04/28/89 : | - | - | - | - | - | - | 27.51 | 28.21[e] | - | - | - | | | | | |
| 04/29/89 : | DRY | DRY | 51.42[b] | - | DRY | 21.12 | 27.48 | 28.90[e] | 19.29 | 24.65 | DRY | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rech this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).

\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 824 | 825S | 825D | 826 | 827 | 828 | 829S | 829D | 830 | 831 | 832 | 833S | 833D | 834S | 834D | 835 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03/89 | DRY | DRY | 51.54[b] | DRY | DRY | 21.04 | 27.43 | 27.43[e] | 18.52 | 24.70 | DRY | DRY | DRY | 26.15[b] | DRY | - |
| 05/09/89 | DRY | DRY | 51.59[b] | DRY | DRY | 21.05 | 27.44 | 27.51[e] | 18.17 | 24.88 | DRY | DRY | DRY | 27.37[b] | DRY | 17.62 |
| 05/10/89 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 05/19/89 | - | DRY | 48.98[b] | - | DRY | 21.05 | - | - | 18.05 | - | DRY | DRY | DRY | 19.96[b] | DRY | - |
| 05/25/89 | 46.58[b] | DRY | 49.42[b] | 44.71[b] | 14.17[b] | 21.12 | 27.47 | 30.62[e] | 21.86 | 23.60 | 25.97[b] | 34.60[b] | 35.51[b] | 21.93[b] | DRY | 17.75[j] |
| 06/02/89 | - | - | - | - | - | 21.13 | 27.43 | 30.64[e] | - | - | 26.89[b] | - | - | - | - | - |
| 06/03/89 | 46.68[b] | DRY | 50.24[b] | 44.67[b] | 15.21[b] | 21.12 | 27.43 | 30.52[e] | 19.26 | 24.05 | 26.91[b] | 34.61[b] | 37.64[b] | - | - | 17.83 |
| 06/05/89 | 46.78[b] | - | 50.40[b] | - | - | 21.19 | 27.58 | 31.27[e] | 18.98 | - | - | 34.65[b] | 38.05[b] | - | - | 17.87 |
| 06/06/89 | 46.71[b] | - | 50.32[b] | - | - | 21.15 | 27.51 | 31.43[e] | 20.90 | - | - | 34.68[b] | 38.30[b] | - | - | 17.91 |
| 06/07/89 | 46.80[b] | - | 50.35[b] | - | - | 21.19 | 27.51 | 31.76[e] | 18.76 | - | - | 34.71[b] | 38.55[b] | - | - | 17.99 |
| 06/08/89 | 46.81[b] | - | 50.40[b] | - | - | 21.16 | 27.56 | 31.87[e] | 18.70 | - | - | 34.72[b] | 38.70[b] | - | - | 18.35 |
| 06/09/89 | 46.71[b] | - | 50.42[b] | - | - | 21.19 | 27.56 | 31.90[e] | 18.60 | - | - | 34.69[b] | 38.85[b] | - | - | 18.49 |
| 06/10/89 | 46.78[b] | - | 50.44[b] | - | - | 21.18 | 27.57 | 31.57[e] | 18.52 | - | - | 34.74[b] | 39.07[b] | - | - | 18.67 |
| 06/12/89 | 46.80[b] | - | 50.57[b] | - | - | 21.21 | 27.63 | 31.71[e] | 18.43 | - | - | 34.72[b] | 39.45[b] | - | - | 20.92 |
| 06/13/89 | 46.87[b] | - | 50.61[b] | - | - | 21.22 | 27.68 | 31.91[e] | 18.42 | - | - | 34.75[b] | 39.64[b] | - | - | 18.95 |
| 06/14/89 | 46.85[b] | - | 50.59[b] | - | - | 21.21 | 27.68 | 32.05[e] | 18.38 | - | - | 34.75[b] | 39.83[b] | - | - | 19.00 |
| 06/16/89 | 46.88[b] | - | 50.52[b] | - | - | - | - | - | 18.37 | - | - | 34.72[b] | 40.22[b] | - | - | 19.05 |
| 06/19/89 | 46.88[b] | - | 50.69[b] | - | - | 21.19 | 27.87 | 32.45[e] | 18.35 | - | - | 34.74[b] | 40.71[b] | - | - | 19.08 |
| 06/20/89 | 46.91[b] | - | 50.67[b] | - | - | 21.19 | 27.86 | 32.45[e] | 18.32 | - | - | 34.75[b] | 40.87[b] | - | - | 19.13 |
| 06/21/89 | 46.88[b] | - | 50.66[b] | - | - | 21.24 | 27.96 | 32.54[e] | 18.34 | - | - | 34.75[b] | 41.07[b] | - | - | 19.19 |
| 06/22/89 | 46.95[b] | - | 50.63[b] | - | - | 21.23 | 27.91 | 32.59[e] | 18.34 | - | - | 34.77[b] | 41.30[b] | - | - | 19.18 |
| 06/26/89 | 46.93[b] | - | 50.69[b] | - | - | 21.22 | 28.01 | 32.67[e] | 18.35 | - | - | 34.76[b] | 41.89[b] | - | - | 19.21 |
| 06/28/89 | 47.01[b] | - | 50.79[b] | - | - | 21.24 | 28.04 | 32.77[e] | 18.38 | - | - | - | 41.31[b] | - | - | 19.23 |
| 06/30/89 | 47.03[b] | - | 46.54[b] | - | - | 21.24 | 28.08 | 32.83[e] | 18.37 | - | - | 34.69[i] | 41.59[b] | - | - | 19.24 |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 824 | 825S | 825D | 826 | 827 | 828 | 829S | 829D | 830 | 831 | 832 | 833S | 833D | 834S | 834D | 835 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 | 47.02[b] | - | 49.14[b] | - | - | 21.29 | 28.19 | 32.96[e] | 18.42 | - | - | 34.62[i] | 42.41[i] | - | - | 19.30 |
| 07/15/89 | 48.20[b] | - | - | - | - | - | - | 18.57[e] | - | - | - | - | - | - | 19.22 | - |
| 07/19/89 | 47.43[b] | - | - | - | - | 21.63 | 28.35 | 42.59[e] | 18.52 | - | - | - | - | - | - | 19.39 |
| 07/22/89 | 47.43[b] | - | - | - | - | 21.44 | 28.51 | 37.53[e] | 18.51 | - | - | - | - | - | - | 19.44 |
| 07/31/89 | - | - | - | - | - | - | - | - | 18.39 | - | - | - | - | - | - | 19.54 |
| 08/04/89 | 47.62[b] | - | - | - | - | 21.37 | 28.58 | 34.53[e] | 18.34 | - | - | - | - | - | - | 19.54 |
| 08/14/89 | 46.87[b] | - | 50.93[b] | - | - | 21.57 | 29.06 | 37.24[e] | 22.13 | - | - | 34.99[i] | 40.07[i] | - | - | 19.62 |
| 08/17/89 | 46.85[b] | - | 50.85[b] | - | - | 21.54 | 29.03 | 37.22[e] | 22.13 | - | - | 34.86[i] | 40.05[i] | - | - | 19.62 |
| 08/19/89 | 46.86[b] | - | 50.94[b] | - | - | 21.54 | 29.06 | 37.20[e] | 21.28 | - | - | 34.99[i] | 40.05[i] | - | - | 19.62 |
| 08/21/89 | 46.93[b] | - | 51.02[b] | - | - | 21.62 | 29.10 | 37.26[e] | 19.49 | - | - | 35.57[i] | 40.12[i] | - | - | 20.12 |
| 08/24/89 | 47.10[b] | - | 51.02[b] | - | - | 21.66 | 29.10 | 37.28[e] | 18.57 | - | - | 35.57[i] | 40.14[i] | - | - | 20.12 |
| 08/29/89 | 46.87[b] | - | 50.94[b] | - | - | 21.58 | 29.06 | 37.24[e] | 22.11 | - | - | 34.99[i] | 40.05[i] | - | - | 19.62 |
| 09/05/89 | 46.85[b] | - | 51.02[b] | - | - | 21.62 | 29.08 | 37.37[e] | 22.09 | - | - | 34.99[i] | 40.05[i] | - | - | 19.72 |
| 09/11/89 | 46.60[b] | - | 50.98[b] | - | - | 21.54 | 29.06 | 37.37[e] | 22.07 | - | - | 34.99[i] | 20.05[f] | - | - | 19.87 |
| 09/18/89 | 46.93[b] | - | 50.85[b] | - | - | 21.54 | 29.81 | 37.53[e] | 24.07 | - | - | 34.99[i] | 40.22[i] | - | - | 20.12 |
| 09/20/89 | - | - | - | - | - | - | - | - | 18.40 | - | - | - | - | - | - | - |
| 09/21/89 | - | - | - | - | - | 21.79 | - | - | 18.40 | - | - | - | - | - | - | - |
| 09/22/89 | - | - | - | - | - | 21.80 | - | - | 18.57 | - | - | - | - | - | - | - |
| 09/25/89 | 47.02[b] | - | 51.02[b] | - | - | 21.79 | 29.76 | 37.45[f] | 20.58 | - | - | 30.32[i] | 40.22 | - | - | 20.62 |
| 10/02/89 | 46.85[b] | - | 51.35[b] | - | - | 21.37 | 29.12 | 37.45[f] | 22.17 | - | - | 35.49[i] | 39.72 | - | - | 19.79 |
| 10/09/89 | 47.35[b] | - | 51.02[b] | - | - | 21.37 | 29.10 | 37.37[f] | 22.15 | - | - | 34.99[i] | 39.89 | - | - | 19.62 |
| 10/17/89 | DRY | - | 51.02[b] | - | - | 21.54 | 29.10 | 37.33[f] | 22.15 | - | - | 34.99[i] | 40.14 | - | - | 19.79 |
| 10/27/89 | DRY | - | 51.19[b] | - | - | 21.58 | 29.26 | 37.37[f] | 22.20 | - | - | 35.22[i] | 40.05 | - | - | 19.62 |
| 10/30/89 | DRY | - | 51.68[b] | - | - | 22.24 | 38.14[f] | 37.62[f] | 22.40 | - | - | 34.82[i] | 48.40 | - | - | 19.83 |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data i[illegible]pect.
g) Increa[illegible]water level suggests groundwater is beginning to rec[illegible]e this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 824 | 825S | 825D | 826 | 827 | 828 | 829S | 829D | 830 | 831 | 832 | 833S | 833D | 834S | 834D | 835 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/06/89 | DRY | - | 51.65[b] | - | - | 22.25 | 38.12[f] | 37.61[f] | 22.37 | - | - | 34.82[i] | 48.36 | - | - | 19.82 |
| 11/13/89 | DRY | - | 51.68[b] | - | - | 22.29 | 38.09[f] | 37.64[f] | 22.46 | - | - | 34.88[i] | 48.34 | - | - | 19.94 |
| 11/21/89 | DRY | - | 51.41[b] | - | - | 22.35 | 30.07 | 34.67[f] | 19.48 | - | - | 34.85[i] | 50.18 | - | - | 19.77 |
| 12/14/89 | DRY | - | 51.37[b] | - | - | 21.71 | 29.55 | 33.95[f] | 18.06 | - | - | 34.84[i] | 50.59 | - | - | 19.74 |
| 12/29/89 | DRY | - | 51.51[b] | - | - | 22.47 | 29.96 | 34.66[f] | 19.56 | - | - | 34.82[i] | 50.24 | - | - | 19.71 |
| 01/17/90 | DRY | - | 51.73[b] | - | - | 22.56 | 30.29 | 34.82[f] | 19.76 | - | - | 35.52[i] | 50.41 | - | - | 19.94 |
| 02/01/90 | - | - | - | - | - | 23.35 | - | - | - | - | - | - | - | - | - | - |
| 03/02/90 | - | - | - | - | - | 23.36 | - | - | - | - | - | - | - | - | - | - |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 936 | 937 | 938 | 939 | 903 | 904 | 906 | 908 | 910 | 911 | 912 | 913 | 914 | 915 | 916 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | | | | | | | | |
| 03/06/89 : | | | | | | | | | | | | | | | |
| 03/07/89 : | | | | | | | | | | | | | | | |
| 03/08/89 : | | | | | | | | | | | | | | | |
| 03/13/89 : | | | | | | | | | | | | | | | |
| 03/14/89 : | | | | | | | | | | | | | | | |
| 03/15/89 : | | | | | | | | | | | | | | | |
| 03/16/89 : | | | | | | | | | | | | | | | |
| 03/18/89 : | | | | | | | | | | | | | | | |
| 03/20/89 : | | | | | | | | | | | | | | | |
| 03/21/89 : | | | | | | | | | | | | | | | |
| 03/22/89 : | | | | | | | | | | | | | | | |
| 03/24/89 : | | | | | | | | | | | | | | | |
| 03/30/89 : | | | | | | | | | | | | | | | |
| 03/31/89 : | | | | | | | | | | | | | | | |
| 04/01/89 : | | | | | | | | | | | | | | | |
| 04/04/89 : | | | | | | | | | | | | | | | |
| 04/05/89 : | | | | | | | | | | | | | | | |
| 04/12/89 : | | | | | | | | | | | | | | | |
| 04/15/89 : | | | | | | | | | | | | | | | |
| 04/18/89 : | | | | | | | | | | | | | | | |
| 04/26/89 : | | | | | | | | | | | | | | | |
| 04/28/89 : | | | | | | | | | | | | | | | |
| 04/29/89 : | | | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to reach this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 936 | 937 | 938 | 939 | 903 | 904 | 906 | 908 | 910 | 911 | 912 | 913 | 914 | 915 | 916 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03/89 | 28.13 | - | DRY | - | | | | | | | | | | | |
| 05/09/89 | 29.13 | DRY | DRY | - | | | | | | | | | | | |
| 05/10/89 | 27.54 | - | - | 13.95 | | | | | | | | | | | |
| 05/19/89 | - | DRY | DRY | 13.97 | | | | | | | | | | | |
| 05/25/89 | 26.08 | DRY | 17.13[b] | 14.12 | | | | | | | | | | | |
| 06/02/89 | - | DRY | - | - | | | | | | | | | | | |
| 06/03/89 | 25.96 | - | 18.71[b] | 14.20 | | | | | | | | | | | |
| 06/05/89 | 26.05 | - | 19.00[b] | 14.28 | | | | | | | | | | | |
| 06/06/89 | 25.94 | - | 19.15[b] | 14.20 | | | | | | | | | | | |
| 06/07/89 | 26.26 | - | 19.30[b] | 14.32 | | | | | | | | | | | |
| 06/08/89 | 26.00 | - | 19.36[b] | 14.31 | | | | | | | | | | | |
| 06/09/89 | 25.95 | - | 19.47[b] | 14.30 | | | | | | | | | | | |
| 06/10/89 | 26.00 | - | 19.57[b] | 14.33 | | | | | | | | | | | |
| 06/12/89 | 26.01 | - | 19.81[b] | 14.37 | | | | | | | | | | | |
| 06/13/89 | 26.01 | - | 19.89[b] | 14.38 | | | | | | | | | | | |
| 06/14/89 | 25.98 | - | 19.97[b] | 14.38 | | | | | | | | | | | |
| 06/16/89 | 25.89 | - | 20.21[b] | 14.34 | | | | | | | | | | | |
| 06/19/89 | 25.89 | - | 20.42[b] | 14.42 | | | | | | | | | | | |
| 06/20/89 | 25.86 | - | 20.52[b] | 14.42 | | | | | | | | | | | |
| 06/21/89 | 25.99 | - | 20.59[b] | 14.45 | | | | | | | | | | | |
| 06/22/89 | 25.91 | - | 20.69[b] | 14.47 | | | | | | | | | | | |
| 06/26/89 | 25.80 | - | 21.05[b] | 14.47 | | | | | | | | | | | |
| 06/28/89 | 25.87 | - | - | 14.50 | | | | | | | | | | | |
| 06/30/89 | 25.78 | - | DRY | 14.52 | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 936 | 937 | 938 | 939 | 903 | 904 | 906 | 908 | 910 | 911 | 912 | 913 | 914 | 915 | 916 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 | 25.79 | - | - | 14.61 | | | | | | | | | | | |
| 07/15/89 | 25.76 | - | - | 14.75 | | | | | | | | | | | |
| 07/19/89 | 26.02 | - | - | 14.81 | | | | | | | | | | | |
| 07/22/89 | 25.73 | - | - | 14.85 | | | | | | | | | | | |
| 07/31/89 | - | - | - | 14.90 | | | | | | | | | | | |
| 08/04/89 | DRY[f] | - | - | 14.83 | | | | | | | | | | | |
| 08/14/89 | 25.68 | - | - | 14.96 | | 35.41 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 08/17/89 | 25.67 | - | - | 14.95 | | 35.29 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 08/19/89 | 25.63 | - | - | 14.95 | | 35.42 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 08/21/89 | 25.54 | - | DRY | 15.03 | | 35.58 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 08/24/89 | 25.46 | - | DRY | 14.95 | | 35.50 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 08/29/89 | 25.67 | - | DRY | 14.95 | | 35.42 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 09/05/89 | DRY[f] | - | DRY | 14.96 | | 36.00 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 09/11/89 | 25.71 | - | DRY | 14.95 | | 36.00 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 09/18/89 | 25.63 | - | DRY | 15.03 | | 35.56 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 09/20/89 | - | - | - | - | | - | - | - | - | - | - | - | - | - | - |
| 09/21/89 | - | - | - | - | | - | - | - | - | - | - | - | - | DRY | - |
| 09/22/89 | - | - | - | - | | - | - | - | - | - | - | - | - | DRY | - |
| 09/25/89 | 25.63 | - | DRY | 15.12 | | 36.50 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 10/02/89 | 25.54 | - | DRY | 15.16 | | 36.00 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 10/09/89 | 26.21 | - | DRY | 15.12 | | 35.92 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 10/17/89 | 25.71 | - | DRY | 14.95 | | 36.11 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 10/27/89 | 25.46 | - | DRY | 15.14 | | 35.50 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 10/30/89 | 26.00 | - | DRY | 15.34 | | 36.20 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is [illegible]ct.
g) Increas[illegible]ater level suggests groundwater is beginning to rech[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No [illegible]rement taken.

# Table 1 WATER LEVEL DATA

| DATE | 936 | 937 | 938 | 939 | 903 | 904 | 906 | 908 | 910 | 911 | 912 | 913 | 914 | 915 | 916 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/06/89 | 25.98 | - | DRY | 15.32 | | 36.23 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 11/13/89 | 25.98 | - | DRY | 15.34 | | 36.29 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 11/21/89 | 25.47 | - | DRY | 14.96 | 32.54[i] | 37.86 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 12/14/89 | 25.08 | - | DRY | 14.73 | 32.51[i] | 36.43 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 12/29/89 | 25.69 | - | DRY | 15.21 | 32.59[i] | 34.38 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 01/17/90 | 25.83 | - | DRY | 15.47 | 32.74[i] | 34.39 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 02/01/90 | - | - | - | - | 35.34 | - | - | - | - | - | - | - | - | - | - |
| 03/02/90 | - | - | - | - | 35.33 | - | - | - | - | - | - | - | - | - | - |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 917 | 918 | 919 | 920 | 921 | 925 | 932 | 831 | 926 | 946 | 950 | 949 | 956 | 955 | 954 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | | | | | | | | |
| 03/06/89 : | | | | | | | | | | | | | | | |
| 03/07/89 : | | | | | | | | | | | | | | | |
| 03/08/89 : | | | | | | | | | | | | | | | |
| 03/13/89 : | | | | | | | | | | | | | | | |
| 03/14/89 : | | | | | | | | | | | | | | | |
| 03/15/89 : | | | | | | | | | | | | | | | |
| 03/16/89 : | | | | | | | | | | | | | | | |
| 03/18/89 : | | | | | | | | | | | | | | | |
| 03/20/89 : | | | | | | | | | | | | | | | |
| 03/21/89 : | | | | | | | | | | | | | | | |
| 03/22/89 : | | | | | | | | | | | | | | | |
| 03/24/89 : | | | | | | | | | | | | | | | |
| 03/30/89 : | | | | | | | | | | | | | | | |
| 03/31/89 : | | | | | | | | | | | | | | | |
| 04/01/89 : | | | | | | | | | | | | | | | |
| 04/04/89 : | | | | | | | | | | | | | | | |
| 04/05/89 : | | | | | | | | | | | | | | | |
| 04/12/89 : | | | | | | | | | | | | | | | |
| 04/15/89 : | | | | | | | | | | | | | | | |
| 04/18/89 : | | | | | | | | | | | | | | | |
| 04/26/89 : | | | | | | | | | | | | | | | |
| 04/28/89 : | | | | | | | | | | | | | | | |
| 04/29/89 : | | | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
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e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rech this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
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k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 917 | 918 | 919 | 920 | 921 | 925 | 932 | 831 | 926 | 946 | 950 | 949 | 956 | 955 | 954 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03/89 : | | | | | | | | | | | | | | | |
| 05/09/89 : | | | | | | | | | | | | | | | |
| 05/10/89 : | | | | | | | | | | | | | | | |
| 05/19/89 : | | | | | | | | | | | | | | | |
| 05/25/89 : | | | | | | | | | | | | | | | |
| 06/02/89 : | | | | | | | | | | | | | | | |
| 06/03/89 : | | | | | | | | | | | | | | | |
| 06/05/89 : | | | | | | | | | | | | | | | |
| 06/06/89 : | | | | | | | | | | | | | | | |
| 06/07/89 : | | | | | | | | | | | | | | | |
| 06/08/89 : | | | | | | | | | | | | | | | |
| 06/09/89 : | | | | | | | | | | | | | | | |
| 06/10/89 : | | | | | | | | | | | | | | | |
| 06/12/89 : | | | | | | | | | | | | | | | |
| 06/13/89 : | | | | | | | | | | | | | | | |
| 06/14/89 : | | | | | | | | | | | | | | | |
| 06/16/89 : | | | | | | | | | | | | | | | |
| 06/19/89 : | | | | | | | | | | | | | | | |
| 06/20/89 : | | | | | | | | | | | | | | | |
| 06/21/89 : | | | | | | | | | | | | | | | |
| 06/22/89 : | | | | | | | | | | | | | | | |
| 06/26/89 : | | | | | | | | | | | | | | | |
| 06/28/89 : | | | | | | | | | | | | | | | |
| 06/30/89 : | | | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
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c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 917 | 918 | 919 | 920 | 921 | 925 | 932 | 831 | 926 | 946 | 950 | 949 | 56 | 955 | 954 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 : | | | | | | | | | | | | | | | |
| 07/15/89 : | | | | | | | | | | | | | | | |
| 07/19/89 : | | | | | | | | | | | | | | | |
| 07/22/89 : | | | | | | | | | | | | | | | |
| 07/31/89 : | | | | | | | | | | | | | | | |
| 08/04/89 : | | | | | | | | | | | | | | | |
| 08/14/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 08/17/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 08/19/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 08/21/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 08/24/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 08/29/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 09/05/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 09/11/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 09/18/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 09/20/89 : | - | - | - | - | - | - | - | | | | | | | | |
| 09/21/89 : | - | - | - | DRY | - | - | - | | | | | | | | |
| 09/22/89 : | - | - | - | DRY | - | - | - | | | | | | | | |
| 09/25/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 10/02/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 10/09/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | | | | | | | | |
| 10/17/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 10/27/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 10/30/89 : | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data i pect.
g) Increa water level suggests groundwater is beginning to rech ge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No surement taken.

# Table 1 WATER LEVEL DATA

| DATE | 917 | 918 | 919 | 920 | 921 | 925 | 932 | 831 | 926 | 946 | 950 | 949 | 956 | 955 | 954 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/06/89 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 11/13/89 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 11/21/89 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 12/14/89 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 12/29/89 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 01/17/90 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY |
| 02/01/90 | - | - | - | - | - | - | DRY | - | - | - | - | - | - | - | - |
| 03/02/90 | - | - | - | - | - | - | DRY | - | - | - | - | - | - | - | - |

FOOTNOTES:

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f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | : 927 | X | UNMRKD | 951 | 922 | 923 | 943 | 826 | 944 | 909 | 965 | 966 | 972 | 974 | 981 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | | | | | | | | |
| 03/06/89 : | | | | | | | | | | | | | | | |
| 03/07/89 : | | | | | | | | | | | | | | | |
| 03/08/89 : | | | | | | | | | | | | | | | |
| 03/13/89 : | | | | | | | | | | | | | | | |
| 03/14/89 : | | | | | | | | | | | | | | | |
| 03/15/89 : | | | | | | | | | | | | | | | |
| 03/16/89 : | | | | | | | | | | | | | | | |
| 03/18/89 : | | | | | | | | | | | | | | | |
| 03/20/89 : | | | | | | | | | | | | | | | |
| 03/21/89 : | | | | | | | | | | | | | | | |
| 03/22/89 : | | | | | | | | | | | | | | | |
| 03/24/89 : | | | | | | | | | | | | | | | |
| 03/30/89 : | | | | | | | | | | | | | | | |
| 03/31/89 : | | | | | | | | | | | | | | | |
| 04/01/89 : | | | | | | | | | | | | | | | |
| 04/04/89 : | | | | | | | | | | | | | | | |
| 04/05/89 : | | | | | | | | | | | | | | | |
| 04/12/89 : | | | | | | | | | | | | | | | |
| 04/15/89 : | | | | | | | | | | | | | | | |
| 04/18/89 : | | | | | | | | | | | | | | | |
| 04/26/89 : | | | | | | | | | | | | | | | |
| 04/28/89 : | | | | | | | | | | | | | | | |
| 04/29/89 : | | | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
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f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rec' this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 927 | X | UNMRKD | 951 | 922 | 923 | 943 | 826 | 944 | 909 | 965 | 966 | 972 | 974 | 981 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03/89 : | | | | | | | | | | | | | | | |
| 05/09/89 : | | | | | | | | | | | | | | | |
| 05/10/89 : | | | | | | | | | | | | | | | |
| 05/19/89 : | | | | | | | | | | | | | | | |
| 05/25/89 : | | | | | | | | | | | | | | | |
| 06/02/89 : | | | | | | | | | | | | | | | |
| 06/03/89 : | | | | | | | | | | | | | | | |
| 06/05/89 : | | | | | | | | | | | | | | | |
| 06/06/89 : | | | | | | | | | | | | | | | |
| 06/07/89 : | | | | | | | | | | | | | | | |
| 06/08/89 : | | | | | | | | | | | | | | | |
| 06/09/89 : | | | | | | | | | | | | | | | |
| 06/10/89 : | | | | | | | | | | | | | | | |
| 06/12/89 : | | | | | | | | | | | | | | | |
| 06/13/89 : | | | | | | | | | | | | | | | |
| 06/14/89 : | | | | | | | | | | | | | | | |
| 06/16/89 : | | | | | | | | | | | | | | | |
| 06/19/89 : | | | | | | | | | | | | | | | |
| 06/20/89 : | | | | | | | | | | | | | | | |
| 06/21/89 : | | | | | | | | | | | | | | | |
| 06/22/89 : | | | | | | | | | | | | | | | |
| 06/26/89 : | | | | | | | | | | | | | | | |
| 06/28/89 : | | | | | | | | | | | | | | | |
| 06/30/89 : | | | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 927 | X | UNMRKD | 951 | 922 | 923 | 943 | 826 | 944 | 909 | 965 | 966 | 972 | 974 | 981 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 : | | | | | | | | | | | | | | | |
| 07/15/89 : | | | | | | | | | | | | | | | |
| 07/19/89 : | | | | | | | | | | | | | | | |
| 07/22/89 : | | | | | | | | | | | | | | | |
| 07/31/89 : | | | | | | | | | | | | | | | |
| 08/04/89 : | | | | | | | | | | | | | | | |
| 08/14/89 : | | | | | | | | | | | | | | | |
| 08/17/89 : | | | | | | | | | | | | | | | |
| 08/19/89 : | | | | | | | | | | | | | | | |
| 08/21/89 : | | | | | | | | | | | | | | | |
| 08/24/89 : | | | | | | | | | | | | | | | |
| 08/29/89 : | | | | | | | | | | | | | | | |
| 09/05/89 : | | | | | | | | | | | | | | | |
| 09/11/89 : | | | | | | | | | | | | | | | |
| 09/18/89 : | | | | | | | | | | | | | | | |
| 09/20/89 : | | | | | | | | | | | | | | | |
| 09/21/89 : | | | | | | | | | | | | | | | |
| 09/22/89 : | | | | | | | | | | | | | | | |
| 09/25/89 : | | | | | | | | | | | | | | | |
| 10/02/89 : | | | | | | | | | | | | | | | |
| 10/09/89 : | | | | | | | | | | | | | | | |
| 10/17/89 : | 44.67[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 24.13 | - | | | |
| 10/27/89 : | 44.75[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 24.14 | - | | | |
| 10/30/89 : | 44.83[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 23.95 | 26.82 | 88.97 | 137.50 | 78.47 |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data [illegible]pect.
g) Incre[illegible] water level suggests groundwater is beginning to rec[illegible]e this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No [illegible]surement taken.

# Table 1 WATER LEVEL DATA

| DATE | 927 | X | UNMRKD | 951 | 922 | 923 | 943 | 826 | 944 | 909 | 965 | 966 | 972 | 974 | 981 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/06/89 | 44.80[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 23.92 | 26.84 | 88.99 | 137.40 | 78.46 |
| 11/13/89 | 44.87[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 23.94 | 26.87 | 88.93 | 137.31 | 78.42 |
| 11/21/89 | 44.92[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 23.96 | 26.89 | 88.87 | 137.34 | 78.49 |
| 12/14/89 | 44.95[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 23.86 | 26.69 | 71.46 | 114.57 | 78.92 |
| 12/29/89 | 45.12[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 23.74 | 26.58 | 64.96 | 117.30 | 74.60 |
| 01/17/90 | 45.21[i] | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 23.76 | 26.71 | 64.99 | 117.37 | 76.85[k] |
| 02/01/90 | - | - | - | - | - | - | - | - | DRY | - | - | 26.41 | - | - | - |
| 03/02/90 | - | - | - | - | - | - | - | - | DRY | - | - | 26.39 | - | - | - |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 975 | 980 | 973 | 976 | 970 | 969 | 979 | 982 | 963 | 967 | 905 | TP41 | TP51 | TP43 | TP44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | | | | | | | | |
| 03/06/89 : | | | | | | | | | | | | | | | |
| 03/07/89 : | | | | | | | | | | | | | | | |
| 03/08/89 : | | | | | | | | | | | | | | | |
| 03/13/89 : | | | | | | | | | | | | | | | |
| 03/14/89 : | | | | | | | | | | | | | | | |
| 03/15/89 : | | | | | | | | | | | | | | | |
| 03/16/89 : | | | | | | | | | | | | | | | |
| 03/18/89 : | | | | | | | | | | | | | | | |
| 03/20/89 : | | | | | | | | | | | | | | | |
| 03/21/89 : | | | | | | | | | | | | | | | |
| 03/22/89 : | | | | | | | | | | | | | | | |
| 03/24/89 : | | | | | | | | | | | | | | | |
| 03/30/89 : | | | | | | | | | | | | | | | |
| 03/31/89 : | | | | | | | | | | | | | | | |
| 04/04/89 : | | | | | | | | | | | | | | | |
| 04/05/89 : | | | | | | | | | | | | | | | |
| 04/12/89 : | | | | | | | | | | | | | | | |
| 04/15/89 : | | | | | | | | | | | | | | | |
| 04/18/89 : | | | | | | | | | | | | | | | |
| 04/26/89 : | | | | | | | | | | | | | | | |
| 04/28/89 : | | | | | | | | | | | | | | | |
| 04/29/89 : | | | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to re[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 975 | 980 | 973 | 976 | 983 | 970 | 969 | 979 | 982 | 963 | 967 | 905 | TP41 | TP51 | TP43 | TP44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03/89 : | | | | | | | | | | | | | | | | |
| 05/09/89 : | | | | | | | | | | | | | | | | |
| 05/10/89 : | | | | | | | | | | | | | | | | |
| 05/19/89 : | | | | | | | | | | | | | | | | |
| 05/25/89 : | | | | | | | | | | | | | | | | |
| 06/02/89 : | | | | | | | | | | | | | | | | |
| 06/03/89 : | | | | | | | | | | | | | | | | |
| 06/05/89 : | | | | | | | | | | | | | | | | |
| 06/06/89 : | | | | | | | | | | | | | | | | |
| 06/07/89 : | | | | | | | | | | | | | | | | |
| 06/08/89 : | | | | | | | | | | | | | | | | |
| 06/09/89 : | | | | | | | | | | | | | | | | |
| 06/10/89 : | | | | | | | | | | | | | | | | |
| 06/12/89 : | | | | | | | | | | | | | | | | |
| 06/13/89 : | | | | | | | | | | | | | | | | |
| 06/14/89 : | | | | | | | | | | | | | | | | |
| 06/16/89 : | | | | | | | | | | | | | | | | |
| 06/19/89 : | | | | | | | | | | | | | | | | |
| 06/20/89 : | | | | | | | | | | | | | | | | |
| 06/21/89 : | | | | | | | | | | | | | | | | |
| 06/22/89 : | | | | | | | | | | | | | | | | |
| 06/26/89 : | | | | | | | | | | | | | | | | |
| 06/28/89 : | | | | | | | | | | | | | | | | |
| 06/30/89 : | | | | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | 975 | 980 | 973 | 976 | 983 | 970 | 969 | 979 | 982 | 963 | 967 | 905 | TP41 | TP51 | TP43 | TP44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 : | | | | | | | | | | | | | | | | |
| 07/15/89 : | | | | | | | | | | | | | | | | |
| 07/19/89 : | | | | | | | | | | | | | | | | |
| 07/22/89 : | | | | | | | | | | | | | | | | |
| 07/31/89 : | | | | | | | | | | | | | | | | |
| 08/04/89 : | | | | | | | | | | | | | | | | |
| 08/14/89 : | | | | | | | | | | | | | 31.00 | 28.23 | 19.79 | 18.10 |
| 08/17/89 : | | | | | | | | | | | | | 31.02 | 28.41 | 19.79 | 18.08 |
| 08/19/89 : | | | | | | | | | | | | | 31.00 | 28.21 | 19.79 | 18.08 |
| 08/21/89 : | | | | | | | | | | | | | 31.00 | 28.17 | 20.35 | DRY[f] |
| 08/24/89 : | | | | | | | | | | | | | 31.00 | 28.00 | 20.37 | DRY[f] |
| 08/29/89 : | | | | | | | | | | | | | 31.00 | 28.23 | 19.79 | 18.08 |
| 09/05/89 : | | | | | | | | | | | | | 31.17 | 28.23 | 20.25 | 21.19 |
| 09/11/89 : | | | | | | | | | | | | | 31.13 | 28.17 | 20.29 | 21.19 |
| 09/18/89 : | | | | | | | | | | | | | 31.00 | 28.21 | 20.21 | 21.10 |
| 09/20/89 : | | | | | | | | | | | | | | | | |
| 09/21/89 : | | | | | | | | | | | | | | | | |
| 09/22/89 : | | | | | | | | | | | | | 47.98[f] | 28.17 | 20.21 | 23.33 |
| 09/25/89 : | | | | | | | | | | | | | | | | |
| 10/02/89 : | | | | | | | | | | | | | 32.17 | 28.58 | 20.46 | 21.33 |
| 10/09/89 : | | | | | | | | | | | | | 32.00 | 28.50 | 20.37 | 21.42 |
| 10/17/89 : | | | | | | | | | | | | | 31.17 | 28.27 | 21.12 | 21.50 |
| 10/27/89 : | | | | | | | | | | | | | - | - | - | 21.41 |
| 10/30/89 : | 80.40 | 79.45 | DRY | DRY | DRY | | | | | | | | 31.23 | 28.34 | 20.46 | 21.23 |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water le[illegible] affected by water from upper screen.
f) Data is [illegible]t.
g) Increasi[illegible] ater level suggests groundwater is beginning [illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No [illegible]ement taken.

# Table 1 WATER LEVEL DATA

| DATE | 975 | 980 | 973 | 976 | 983 | 970 | 969 | 979 | 982 | 963 | 967 | 905 | TP41 | TP51 | TP43 | TP44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/06/89 | 80.43 | 79.40 | DRY | DRY | DRY | DRY | DRY | - | - | - | - | - | 31.31 | 28.20 | 19.95 | 19.65 |
| 11/13/89 | 80.72 | 79.61 | DRY | DRY | DRY | DRY | DRY | 82.37 | 82.34 | - | - | - | 31.36 | 28.24 | 19.92 | 19.67 |
| 11/21/89 | 80.85 | 77.74 | DRY | DRY | DRY | DRY | DRY | 82.36 | 82.31 | 83.52 | 26.70 | 45.96[d] | 31.37 | 28.25 | 19.89 | 19.69 |
| 12/14/89 | 75.65 | 76.60 | DRY | DRY | DRY | DRY | DRY | 74.90 | 74.99 | 83.56 | 26.74 | 45.98[d] | 31.39 | 28.21 | 20.51 | 24.99 |
| 12/29/89 | 73.31 | 73.93 | DRY | DRY | DRY | DRY | DRY | 72.33 | 72.42 | 83.67 | 25.92 | 46.13[d] | 28.28[f] | 22.08[f] | DRY | DRY |
| 01/17/90 | 77.78[k] | 77.34[k] | DRY | DRY | DRY | DRY | DRY | 82.77[k] | 75.30[c] | 83.51 | 26.02 | 46.13[d] | 31.37 | 28.61 | 22.00 | DRY |
| 02/01/90 | - | - | - | - | - | - | - | - | - | - | 26.17 | - | - | - | - | - |
| 03/02/90 | - | - | - | - | - | - | - | - | - | - | 26.15 | - | - | - | - | - |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | TP47 | TP52 | TP53 | TP54 | TP36 | TP29 | TP28 | TP62 | TP57 | TP58 | TP60 | TP116 | TP143 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | | | | | | |
| 03/06/89 : | | | | | | | | | | | | | |
| 03/07/89 : | | | | | | | | | | | | | |
| 03/08/89 : | | | | | | | | | | | | | |
| 03/13/89 : | | | | | | | | | | | | | |
| 03/14/89 : | | | | | | | | | | | | | |
| 03/15/89 : | | | | | | | | | | | | | |
| 03/16/89 : | | | | | | | | | | | | | |
| 03/18/89 : | | | | | | | | | | | | | |
| 03/20/89 : | | | | | | | | | | | | | |
| 03/21/89 : | | | | | | | | | | | | | |
| 03/22/89 : | | | | | | | | | | | | | |
| 03/24/89 : | | | | | | | | | | | | | |
| 03/30/89 : | | | | | | | | | | | | | |
| 03/31/89 : | | | | | | | | | | | | | |
| 04/01/89 : | | | | | | | | | | | | | |
| 04/04/89 : | | | | | | | | | | | | | |
| 04/05/89 : | | | | | | | | | | | | | |
| 04/12/89 : | | | | | | | | | | | | | |
| 04/15/89 : | | | | | | | | | | | | | |
| 04/18/89 : | | | | | | | | | | | | | |
| 04/26/89 : | | | | | | | | | | | | | |
| 04/28/89 : | | | | | | | | | | | | | |
| 04/29/89 : | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rec[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | TP47 | TP52 | TP53 | TP54 | TP36 | TP29 | TP28 | TP62 | TP57 | TP58 | TP60 | TP116 | TP143 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/03/89 : | | | | | | | | | | | | | |
| 05/09/89 : | | | | | | | | | | | | | |
| 05/10/89 : | | | | | | | | | | | | | |
| 05/19/89 : | | | | | | | | | | | | | |
| 05/25/89 : | | | | | | | | | | | | | |
| 06/02/89 : | | | | | | | | | | | | | |
| 06/03/89 : | | | | | | | | | | | | | |
| 06/05/89 : | | | | | | | | | | | | | |
| 06/06/89 : | | | | | | | | | | | | | |
| 06/07/89 : | | | | | | | | | | | | | |
| 06/08/89 : | | | | | | | | | | | | | |
| 06/09/89 : | | | | | | | | | | | | | |
| 06/10/89 : | | | | | | | | | | | | | |
| 06/12/89 : | | | | | | | | | | | | | |
| 06/13/89 : | | | | | | | | | | | | | |
| 06/14/89 : | | | | | | | | | | | | | |
| 06/16/89 : | | | | | | | | | | | | | |
| 06/19/89 : | | | | | | | | | | | | | |
| 06/20/89 : | | | | | | | | | | | | | |
| 06/21/89 : | | | | | | | | | | | | | |
| 06/22/89 : | | | | | | | | | | | | | |
| 06/26/89 : | | | | | | | | | | | | | |
| 06/28/89 : | | | | | | | | | | | | | |
| 06/30/89 : | | | | | | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | TP47 | TP52 | TP53 | TP54 | TP36 | TP29 | TP28 | TP62 | TP57 | TP58 | TP60 | TP116 | TP143 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/05/89 : | | | | | | | | | | | | | |
| 07/15/89 : | | | | | | | | | | | | | |
| 07/19/89 : | | | | | | | | | | | | | |
| 07/22/89 : | | | | | | | | | | | | | |
| 07/31/89 : | | | | | | | | | | | | | |
| 08/04/89 : | | | | | | | | | | | | | |
| 08/14/89 : | 23.38 | DRY | 27.33 | 28.61 | 22.73 | 21.04 | DRY | 24.48 | | | | | |
| 08/17/89 : | 23.35 | DRY | 27.25 | 28.55 | 22.73 | 20.96 | DRY | 24.44 | | | | | |
| 08/19/89 : | 23.21 | DRY | 27.25 | 28.57 | 22.71 | 21.04 | DRY | 24.42 | | | | | |
| 08/21/89 : | 23.42 | DRY | 27.50 | 28.72 | 22.71 | 21.21 | DRY | - | | | | | |
| 08/24/89 : | 23.50 | DRY | 27.25 | 28.72 | 22.75 | 21.79 | DRY | - | DRY | 29.00 | 27.08 | | |
| 08/29/89 : | 23.38 | DRY | 27.31 | 28.61 | 22.71 | 21.02 | DRY | 24.46 | DRY | 30.00 | 27.17 | | |
| 09/05/89 : | 23.50 | DRY | 27.51 | 28.65 | DRY | 21.17 | DRY | - | DRY | 29.00 | 27.50 | | |
| 09/11/89 : | 23.42 | DRY | DRY | DRY | DRY | 21.19 | DRY | - | DRY | DRY | 27.50 | | |
| 09/18/89 : | 23.42 | DRY | DRY | DRY | DRY | 21.21 | DRY | - | DRY | 29.00 | 27.13 | 28.50 | 18.00 |
| 09/20/89 : | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 09/21/89 : | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 09/22/89 : | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 09/25/89 : | 23.42 | DRY | DRY | DRY | DRY | 21.17 | DRY | - | - | DRY | 27.21 | 28.50 | [illegible] |
| 10/02/89 : | 23.75 | DRY | DRY | DRY | DRY | 21.62 | DRY | - | DRY | DRY | 27.00 | DRY[f] | DRY |
| 10/09/89 : | 23.50 | DRY | DRY | DRY | DRY | 21.54 | DRY | - | DRY | DRY | 27.17 | DRY[f] | DRY |
| 10/17/89 : | 24.50 | 24.50[c] | 29.42[c] | 29.58 | 22.75 | 21.19 | DRY | - | 22.92[f] | DRY | DRY[f] | 33.08[f] | DRY |
| 10/27/89 : | 24.25 | 24.49[c] | 29.44[c] | 29.40 | 22.90 | 21.21 | DRY | - | 23.00[f] | DRY | DRY[f] | 33.17 | DRY |
| 10/30/89 : | 23.56 | DRY | DRY | DRY | 21.25 | 21.34 | DRY | - | DRY | DRY | 27.23 | 28.62 | DRY |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is [illegible]ect.
g) Increas[illegible] water level suggests groundwater is beginning to rech[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No [illegible]urement taken.

# Table 1 WATER LEVEL DATA

| DATE | TP47 | TP52 | TP53 | TP54 | TP36 | TP29 | TP28 | TP62 | TP57 | TP58 | TP60 | TP116 | TP143 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/06/89 | 24.92 | 24.42[c] | 28.53[c] | 29.66 | 22.70 | 21.59 | DRY | - | DRY | 29.15[c] | DRY | 28.63 | DRY |
| 11/13/89 | 24.94 | 24.43[c] | 28.54[c] | 29.88 | 22.71 | 21.69 | DRY | - | DRY | 29.16 | DRY | 28.66 | DRY |
| 11/21/89 | 24.96 | 24.43[c] | 28.55[c] | 29.69 | 22.71 | 21.69 | DRY | - | DRY | 29.17 | DRY | 28.67 | DRY |
| 12/14/89 | 23.60 | 28.64[f] | 32.80[f] | 22.17 | 24.17 | DRY | DRY | - | DRY | DRY | DRY | 28.69 | DRY |
| 12/29/89 | DRY | DRY | DRY | 21.09 | DRY | DRY | DRY | - | DRY | 28.64 | DRY | 29.39 | DRY |
| 01/17/90 | DRY | DRY | DRY | 21.91 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 29.67 | DRY |
| 02/01/90 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 03/02/90 | - | - | - | - | - | - | - | - | - | - | - | - | - |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | TP56 | TP88 | TP89 | TP92 | UNK | 971 | 977 | 978 |
|---|---|---|---|---|---|---|---|---|
| 03/05/89 : | | | | | | | | |
| 03/06/89 : | | | | | | | | |
| 03/07/89 : | | | | | | | | |
| 03/08/89 : | | | | | | | | |
| 03/13/89 : | | | | | | | | |
| 03/14/89 : | | | | | | | | |
| 03/15/89 : | | | | | | | | |
| 03/16/89 : | | | | | | | | |
| 03/18/89 : | | | | | | | | |
| 03/20/89 : | | | | | | | | |
| 03/21/89 : | | | | | | | | |
| 03/22/89 : | | | | | | | | |
| 03/24/89 : | | | | | | | | |
| 03/30/89 : | | | | | | | | |
| 03/31/89 : | | | | | | | | |
| 04/01/89 : | | | | | | | | |
| 04/04/89 : | | | | | | | | |
| 04/05/89 : | | | | | | | | |
| 04/12/89 : | | | | | | | | |
| 04/15/89 : | | | | | | | | |
| 04/18/89 : | | | | | | | | |
| 04/26/89 : | | | | | | | | |
| 04/28/89 : | | | | | | | | |
| 04/29/89 : | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rec' this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | TP56 | TP88 | TP89 | TP92 | UNK | 971 | 977 | 978 |
|---|---|---|---|---|---|---|---|---|
| 05/03/89 : | | | | | | | | |
| 05/09/89 : | | | | | | | | |
| 05/10/89 : | | | | | | | | |
| 05/19/89 : | | | | | | | | |
| 05/25/89 : | | | | | | | | |
| 06/02/89 : | | | | | | | | |
| 06/03/89 : | | | | | | | | |
| 06/05/89 : | | | | | | | | |
| 06/06/89 : | | | | | | | | |
| 06/07/89 : | | | | | | | | |
| 06/08/89 : | | | | | | | | |
| 06/09/89 : | | | | | | | | |
| 06/10/89 : | | | | | | | | |
| 06/12/89 : | | | | | | | | |
| 06/13/89 : | | | | | | | | |
| 06/14/89 : | | | | | | | | |
| 06/16/89 : | | | | | | | | |
| 06/19/89 : | | | | | | | | |
| 06/20/89 : | | | | | | | | |
| 06/21/89 : | | | | | | | | |
| 06/22/89 : | | | | | | | | |
| 06/26/89 : | | | | | | | | |
| 06/28/89 : | | | | | | | | |
| 06/30/89 : | | | | | | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

# Table 1 WATER LEVEL DATA

| DATE | TP56 | TP88 | TP89 | TP92 | UNK | 971 | 977 | 978 |
|---|---|---|---|---|---|---|---|---|
| 07/05/89 : | | | | | | | | |
| 07/15/89 : | | | | | | | | |
| 07/19/89 : | | | | | | | | |
| 07/22/89 : | | | | | | | | |
| 07/31/89 : | | | | | | | | |
| 08/04/89 : | | | | | | | | |
| 08/14/89 : | | | | | | | | |
| 08/17/89 : | | | | | | | | |
| 08/19/89 : | | | | | | | | |
| 08/21/89 : | | | | | | | | |
| 08/24/89 : | | | | | | | | |
| 08/29/89 : | | | | | | | | |
| 09/05/89 : | | | | | | | | |
| 09/11/89 : | | | | | | | | |
| 09/18/89 : | | | | | | | | |
| 09/20/89 : | | | | | | | | |
| 09/21/89 : | | | | | | | | |
| 09/29/89 : | | | | | | | | |
| 09/25/89 : | | | | | | | | |
| 10/02/89 : | | | | | | | | |
| 10/09/89 : | | | | | | | | |
| 10/17/89 : | | | 27.50 | 28.92 | | | | |
| 10/27/89 : | | | 27.54 | 28.92 | | | | |
| 10/30/89 : | | 22.96 | 27.65 | 29.28 | 30.92 | | | |

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is [illegible]ct.
g) Increas[illegible]ter level suggests groundwater is beginning to rech[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No m[illegible]rement taken.

# Table 1 WATER LEVEL DATA

| DATE | TP56 | TP88 | TP89 | TP92 | UNK | 971 | 977 | 978 |
|---|---|---|---|---|---|---|---|---|
| 1/06/89 | 23.01 | 30.89 | 29.31 | 30.91 | - | | | |
| 1/13/89 | 23.11 | 30.90 | 29.36 | 30.91 | - | | | |
| 1/21/89 | 23.11 | 30.90 | 29.38 | 30.92 | - | | | |
| 2/14/89 | 23.13 | DRY | 29.40 | DRY | - | | | |
| 2/29/89 | - | - | - | - | - | | | |
| 1/17/90 | - | - | - | - | - | | | |
| 2/01/90 | - | - | - | - | - | | | |
| 3/02/89 | - | - | - | - | - | | | |
| 2/07/90 | - | - | - | - | - | | 363.60 | 455.30 |
| 2/08/90 | - | - | - | - | - | | 365.10 | 447.40 |
| 2/09/90 | - | - | - | - | - | | 363.70 | 441.20 |
| 2/20/90 | - | - | - | - | - | 327.35 | - | 417.90 |
| 2/21/90 | - | - | - | - | - | 327.40 | - | 417.30 |
| 2/22/90 | - | - | - | - | - | - | - | 417.42 |
| 2/27/90 | - | - | - | - | - | 326.90 | - | 417.30 |

FOOTNOTES:

Water level recovering from rising head test.
Dry hole - water in hole added during falling head test.
Water in sump; well is actually dry.
Bailed water down.
Water levels affected by water from upper screen.
Data is suspect.
Increasing water level suggests groundwater is beginning to recharge this well screen.

h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

JACOBS ENGINEERING

B5
7 of 8

DATE _____ SUBJECT

SHEET NO. _____

BY _____ CHKD. _____

JOB NO. _____

# Appendix

(Field Data & Notes)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project _____ Contract No. _____ Sheet _____
Feature Water levels from land surface Designed _____ File No. _____
Item _____ Checked _____ Date _____

| Date | 507 | 608 | 609 | 701 | 702 |
|---|---|---|---|---|---|
| 5 March | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 13 | | | | | |
| 14 | | | | | |
| 15 | | | | | |
| 16 | | | | | |
| 18 | | | | | |
| 20 | | | | | |
| 21 | | | | | |
| 22 | | | | | |
| 24 | | | | | |
| 30 | | | | | |
| 31 | | | | | |
| 1 April | | | | | |
| 4 | | | | | |
| 5 | Dry | 31.87 | 50.75 | — | — |
| 12 | Dry | 31.77 | 48.83 | 27.6 | 25.4 |
| 15 | Dry | 31.75 | 47.93 | 27.63 | 25.31 |
| 18 | Dry | 31.70 | 46.80 | 27.55 | 25.27 |
| 26 | Dry | 31.76 | 44.65 | 27.65 | 25.25 |
| 28 | | — | — | — | — |
| 29 | Dry | 31.83 | 43.85 | 27.70 | 25.30 |
| 3 May | Dry | 31.75 | 42.85 | 27.75 | 25.25 |
| 9 | Dry | 31.79 | 41.32 | 27.82 | 25.32 |
| 10 | — | — | — | — | — |
| 12-19 | — | — | — | — | — |

TOC = Top of casing
LSA = Land Surface

(2)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project ____ Contract No. ____ Sheet ____
Nature ____ Designed ____ File No. ____
Date ____ Checked ____ Date ____

| | 805S | 805D | 806S | 806D | 807S | 807D | 808 | 809 | 810 | 811S | 811D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 March | | | | | | | | | | 25.5 | 58.4 |
| 6 | | | | | | | | | | 25.5 | 54.7 |
| 7 | | | 29.2 | Dry | | | | | | 25.4 | 56.7 |
| 8 | | | 29.4 | Dry | | | | | | 25.5 | 56.35 |
| 13 | | | — | — | | | | | | 25.4 | 56.0 |
| 14 | | | 29.35 | Dry | | | | | | 25.45 | 56.2 |
| 15 | | | 29.35 | Dry | Dry | Dry | | | | 25.45 | 56.1 |
| 16 | | | 29.35 | Dry | Dry | Dry | | | | 25.45 | 56.1 |
| 18 | | | 29.35 | Dry | Dry | Dry | | | | 25.5 | 56.0 |
| 20 | | | — | — | Dry | Dry | | 29.15 | | 25.5 | 55.9 |
| 21 | | | — | — | Dry | Dry | 17.8 | Dry | Dry | — | — |
| 22 | | | | | | | | | | | |
| 24 (5) | 28.14 | Dry | 27.67 | Dry | Dry | Dry | 17.57 | — | Dry | | |
| 30 | — | — | 29.25 | Dry | Dry | — | — | — | — | 25.32 | — |
| 31 | 24.84 | Dry | 27.67 | Dry | Dry | Dry | 17.53 | 28.88 | Dry | 25.43 | 56.02 |
| 1 April | 24.[illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 56.0 |
| 4 | | | | | | | | | | | |
| 5 | 25.49 | Dry | 29.27 | 76.65 | Dry | Dry | 17.57 | 28.75 | Dry | 25.45 | 56.42 |
| 12 | 24.15 | Dry (**) | 29.13 | 76.62 | Dry | Dry | 17.36 | 28.72 | Dry | 25.25 | 56.1 |
| 15 | 32.26 (*) | 39.97 | 29.07 | Dry (*) | Dry | Dry | 17.33 | 28.70 | Dry | 25.20 | 56.0 |
| 18 | 31.81 | 39.73 | 29.03 | 76.45 | Dry | 42.94 (**) | 17.25 | 28.56 | Dry | 25.13 | 55.50 |
| 26 | 30.57 | 38.66 | [illegible] | 76.50 | Dry | 43.57 | 17.24 | 28.50 | Dry | 25.22 | 55.39 |
| 28 | — | — | — | — | — | — | — | — | — | — | — |
| 29 | 30.31 | 38.36 | 31.04 | 76.50 | Dry | 43.62 | 17.22 | 28.50 | Dry | 25.25 | 55.30 |
| 3 May | 29.94 | 38.19 | 28.97 | 76.45 | Dry | 43.67 | 17.24 | 28.50 | Dry | 25.22 | 55.16 |
| 9 | 27.39 | 37.86 | 29.02 | 76.39 | Dry | 43.72 | 17.27 | 28.46 | Dry | 25.29 | 55.06 |
| 10 | — | — | — | — | — | — | — | — | — | — | — |
| 12-19 | 28.72 | 57.63 | | 76.45 | | | | 28.50 | | | |

(3)

**MORRISON-KNUDSEN ENGINEERS, INC.**
A MORRISON KNUDSEN COMPANY

Project: Water levels from land surface
Feature:
Item: 12-19

Contract No. ____ Sheet ____
Designed ____ File No. ____
Checked ____ Date ____ Date ____

| | 812S | 812D | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821S | 821D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 March | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 13 | 26.8 | Dn | | | | | | | | | | |
| 14 | 24.85 | 61.1 | | | | | | | | | | |
| 15 | 23.7 | 59.5 | | | | | | | | | | |
| 16 | 23.1 | 58.3 | Dn | | | | | | | | | |
| 18 | 22.5 | 55.55 | Dn | 31.0 | 19.8 | Dn | | | | | | |
| 20 | 22.0 | — | Dn | — | 19.7 | Dn | | | | | | |
| 21 | 19.9 | 57.35 | Dn | — | 19.6 | — | | | | | | |
| 22 | | | | | | | | | | | | |
| 24 | 19.7 | 57.09 | 14.99 (2) | — | 19.75 | 19.46 | | | | | | |
| 30 | 19.82 | — | Dn | — | 19.68 | 16.64 | | | | | | |
| 31 | 19.37 | 56.82 | 14.95 | 30.61 | 19.73 | 24.57 (2) | Dn | Dn | Dn | | | |
| 1 April | [illegible] | 56.75 | Dn | 30.63 | 19.69 | 19.[illegible] | Dn | Dn | Dn | | | |
| 4 | | | | | | | | | | | | |
| 5 | 25.02 | 56.62 | 14.99 (2) | 30.75 | 19.74 | 20.09 | 15.54 | Dn | Dn | 21.76 | | |
| 12 | 19.66 | 61.27 (*) | 14.87 | 30.61 | 19.69 | 16.19 | 18.14 (2) | Dn | Dn | 21.66 | | |
| 15 | 19.65 | 62.20 | 14.63 | 30.60 | 19.69 | 15.52 | 18.56 (2) | 23.21 (2) | Dn | 21.65 | | |
| 18 | 19.62 | 61.77 | 14.28 | 30.50 | 19.59 | 14.99 | 18.7 (2) | 24.11 (2) | Dn | 18.56 | | |
| 26 | 19.67 | 61.65 | 13.84 | 30.50 | 19.64 | 14.52 | 19.22 (2) | 24.78 (2) | Dn | 21.51 | | |
| 28 | — | — | — | — | — | — | — | — | — | — | Dn | [illegible] |
| 29 | 19.80 | 61.62 | 13.74 | 30.50 | 19.79 | 14.52 | 19.37 (2) | 24.91 (2) | Dn | 21.57 | Dn | Dn |
| 3 May | 19.78 | 61.49 | 13.60 | 30.50 | 19.66 | 14.48 | 19.49 (2) | Dn | Dn | 21.48 | 30.02 (**) | 33.[illegible] |
| 9 | 19.93 | 61.40 | 13.51 | 30.50 | 19.75 | 14.56 | 19.60 (2) | Dn | Dn | 21.43 | 30.51 | 34.[illegible] |
| 10 | — | — | — | — | — | — | — | — | — | — | — | — |
| 12-19 | | 61.19 | 13.52 | | 19.85 | | | | | | | 34.11 |

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project Water levels from land surface

Contract No. ____ Sheet ____
Designed ____ File No. ____
Checked ____ Date ____ Date ____

| | 822 | 823S | 823D | 824 | 825S | 825D | 826 | | 827 | 828 | 829S | 829 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 March | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | |
| 1 April | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 12 | Dry | | | | | | | | | | | |
| 15 | 28.44 | Dry | Dry | | Dry | Dry | | | | 21.17 | 27.48 | [illegible] |
| 18 | 29.29 | Dry | Dry | | Dry | Dry | | | | 21.07 | 27.45 | [illegible] |
| 26 | 30.82 | Dry | Dry | Dry | Dry | 51.02 | | | Dry | — | 27.51 | [illegible] |
| 28 | — | — | 48.13 | — | — | | | | — | | | |
| 29 | 31.18 | Dry | 48.50 | Dry | Dry | 57.42 | | | Dry | 21.12 | 27.48 | [illegible] |
| 3 May | 31.55 | Dry | 48.54 | Dry | Dry | 57.54 | Dry | | Dry | 21.04 | 27.43 | [illegible] |
| 9 | 32.02 | Dry | 48.87 | Dry | Dry | 57.59 | Dry | | Dry | 21.05 | 27.44 | [illegible] |
| 10 | — | — | — | — | — | — | — | | — | — | — | — |
| 12-19 | 32.48 | | | | | 48.98 | | | Dry | 21.05 | | |

(5)

**MORRISON-KNUDSEN ENGINEERS, INC.**
A MORRISON KNUDSEN COMPANY

Project: Water levels from land surface
Feature:
Item:

Contract No. ____ Sheet ____
Designed ____ File No. ____
Checked ____ Date ____ Date ____

| | 830 | 831 | 832 | 833S | 833D | 834S | 834D | 835 | 936 | 937 | 938 | 939 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 March | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 31 | | Dry | | | | | | | | | | |
| 1 April | Dry | Dry | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | Dry | 22.9 (2) | | | | | | | | | | |
| 12 | 25.97 | 23.95 (2) | | | | | | | | | | |
| 15 | 24.49 | 24.14 (2) | | | | | | | | | | |
| 18 | 22.95 | 24.19 (2) | Dry | | | | | | | | | |
| 26 | 20.03 | 24.55 (2) | Dry | | | | | | | | | |
| 28 | — | — | — | | | | | | | | | |
| 29 | 19.29 | 24.65 (2) | Dry | | | | | | | | | |
| 3 May | 18.52 | 24.70 (2) | Dry | Dry | Dry | 26.15 | Dry | | 28.13 | | Dry | |
| 9 | 18.17 | 24.88 (2) | Dry | Dry | Dry | 27.37 | Dry | 17.62 | 29.13 (2) | Dry | Dry | |
| 10 | — | — | — | — | — | — | — | — | 27.54 | — | — | 13.9 |
| 12-19 | 18.05 | | Dry | Dry | Dry | 19.96 | Dry | | | | Dry | 13.9 |

For Dale ⑥
Hammerman

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____
DESCRIPTION _____
SHEET NO. _____
MADE BY _____ CHECKED BY _____ DATE _____

| | 507 | 508 | 509 | 701 | 702 |
|---|---|---|---|---|---|
| 25 May | Dry | 32.03 | 40.44 | 28.06 | 25.39 |
| 2 June | Dry | 32.07 | 40.47 | 28.28 | 25.43 |
| 3 | Dry | 32.16 | 40.49 | 28.25 | 25.38 |
| 5 | Dry | 32.15 | 40.49 | 28.35 | 25.50 |
| 7 | Dry | [illegible] | [illegible] | 28.31 | 25.48 |
| 8 | Dry | 32.19 | 40.57 | 28.43 | 25.50 |
| 9 | Dry | 32.20 | 40.49 | 28.44 | 25.50 |
| 10 | Dry | 32.25 | 40.52 | 28.43 | 25.50 |
| 12 | Dry | 32.25 | 40.45 | 28.40 | 25.50 |
| 13 | Dry | 32.29 | 40.49 | 28.47 | 25.57 |
| 17 | Dry | 32.29 | 40.47 | 28.48 | 25.59 |
| 17 | Dry | 32.24 | 40.45 | 28.49 | 25.57 |
| 6/17 | Dry | — | — | — | — |
| 19 | Dry | 32.32 | 40.41 | 28.56 | 25.59 |
| 20 | Dry | 32.34 | 40.45 | 28.56 | 25.55 |
| 21 | Dry | 32.38 | 40.42 | 28.56 | 25.63 |
| 22 | Dry | 32.32 | 40.42 | 28.59 | 25.58 |
| 26 | Dry | 32.30 | 40.38 | 28.55 | 25.60 |
| 28 | Dry | 32.39 | 40.42 | 28.63 | 25.61 |
| 30 | Dry | 32.42 | 40.45 | 28.65 | 25.63 |
| | | -0.39 | -0.01 | -0.63 | -0.24 |

May 25 - June 30

Summary - ~~water~~ water levels in wells ~~away~~ not adjacent to ~~from~~ trenches upgradient ~~has~~ have decreased .36 feet. Wells adjacent to trenches ~~have~~ upgradient and downgradient Dale note the changes in [illegible] & [illegible] have decreased 1.4 feet (includes 814, ~~808~~, 809, 835. 11N.2055 located around 100' downgradient from Trench 3 has decreased 22 ft. this rise in water must be due to all 605s has appeared to dry up.

the water we put in 8235 + 8255.

They both took a whole 400+ gal

tank of water Sasan.

(7)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

| | 805S | 805D | 806S | E D | 807S | 807D | 808 | 809 | 810 | E | 811D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 May | 29.94 (*) | 34.16 (*) | 29.14 (4) | 27.15 (**) | Dry | 43.01 (**) | 17.45 (4) | 28.45 (*) | Dry (*) | 25.[illegible] (4) | 54.56 (*) |
| 2 June | — | — | 29.20 | 28.41 | — | — | — | 28.57 | — | 25.54 | 54.38 |
| 3 | 30.28 | 33.47 | 29.21 | 28.48 | Dry | 43.40 | 17.51 | 28.58 | Dry | 25.53 | 54.36 |
| 5 | 30.06 | 33.75 | 29.30 | 28.78 | — | 43.50 | 17.56 | 28.60 | — | 25.63 | [illegible] |
| 6 | 29.91 | 33.41 | [illegible] | 28.91 | — | [illegible] | [illegible] | 28.65 | — | | |
| 7 | 30.09 | 33.24 | 29.25 | 29.10 | — | 43.56 | 17.79 | 28.70 | — | 25.63 | 53.57 |
| 8 | 29.82 | 33.52 | 29.28 | 29.20 | — | 43.58 | 17.96 | 28.69 | — | 25.65 | [illegible] |
| 9 | 30.13 | 32.83 | 29.31 | 29.32 | — | 43.57 | 18.14 | 28.72 | — | 25.68 | [illegible] |
| 10 | 30.65 | 32.47 | 29.31 | 29.20 | — | 43.59 | 18.27 | 28.76 | — | 25.70 | 52.92 |
| 12 | 31.12 | 32.87 | 29.34 | 29.69 | — | 43.65 | 18.50 | 28.82 | — | 25.70 | 52.52 |
| 13 | 31.22 | 33.16 | 29.37 | 29.81 | — | 43.66 | 18.59 | 28.87 | — | 25.77 | 52.32 |
| 14 | 31.07 | 33.56 | 29.37 | 29.95 | — | [illegible] | [illegible] | 28.88 | — | 25.75 | [illegible] |
| 16/17 | 30.20 | 34.13 | 29.28 | 30.21 | — | 43.69 | 18.71 | 28.93 | — | 25.83 | 51.[illegible] |
| 19 | 29.42 | 33.94 | 29.34 | 30.53 | — | 43.76 | 18.78 | 29.05 | — | 25.76 | 51.04 |
| 20 | 30.30 | 33.11 | 29.37 | 30.65 | — | 43.78 | 18.78 | 29.07 | — | 25.77 | 50.[illegible] |
| 21 | 30.78 | 33.52 | 29.46 | 30.74 | — | 43.80 | 18.84 | 29.10 | — | 25.85 | 50.[illegible] |
| 22 | 30.55 | 33.99 | 29.37 | 30.88 | — | 43.81 | 18.86 | 29.15 | — | 25.81 | 50.[illegible] |
| 26 | 31.23 | 35.48 | 29.40 | 31.30 | — | 43.88 | 18.88 | 29.[illegible] | — | [illegible] | [illegible] |
| 28 | 31.36 | 36.21 | 29.43 | 31.52 | — | 43.92 | 18.90 | 29.95 | — | 25.88 | [illegible] |
| 30 | [illegible] | 36.43 | 29.44 | 31.72 | — | 43.[illegible] | 18.91 | 30.15 | — | [illegible] | [illegible] |
| | -2.22 | | -0.30 | | | | -1.46 | -2.00 | | -0.43 | [illegible] |

(8)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

| | 812S | 812D | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 |
|---|---|---|---|---|---|---|---|---|---|---|
| 25 May | 20.27* | 18.27** | 15.10*(2) | 30.87(4) | 19.95* | 16.93* | 17.83** | Dn | Dn | 21.34* |
| 2 June | — | — | — | 31.13 | — | — | — | — | — | — |
| 3 | 20.45 | 19.94 | 14.54 | 31.12 | 20.11 | 15.25 | 18.63(2) | Dn | Dn | 21.39 |
| 5 | 20.57 | 20.05 | 14.46 | 31.29 | 20.17 | 15.17 | — | — | — | 21.43 |
| 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 15.07 | — | — | — | [illegible] |
| 7 | 20.60 | 20.16 | 14.39 | 31.38 | 20.25 | 15.14 | — | — | — | 21.39 |
| 8 | 20.62 | 20.19 | 14.36 | 31.39 | 20.23 | 15.10 | — | — | — | [illegible] |
| 9 | 20.63 | 20.19 | 14.31 | 31.38 | 20.27 | 15.10 | — | — | — | [illegible] |
| 10 | 20.64 | 20.23 | 14.29 | 31.38 | 20.23 | 15.10 | — | — | — | [illegible] |
| 12 | 20.70 | 20.28 | 14.17 | 31.41 | 20.27 | 15.08 | — | — | — | 21.44 |
| 13 | 20.73 | 20.31 | 14.18 | 31.44 | 20.29 | 15.10 | — | — | — | 21.44 |
| 14 | [illegible] | 20.35 | 14.19 | [illegible] | [illegible] | [illegible] | — | — | — | [illegible] |
| 16/17 | — | — | 14.15 | — | 20.29 | 15.09 | — | — | — | 21.42 |
| 19 | 20.82 | 20.47 | 14.09 | 31.48 | 20.31 | 15.12 | — | — | — | 21.47 |
| 20 | 20.84 | 20.50 | 14.08 | 31.49 | 20.31 | 15.14 | — | — | — | 21.51 |
| 21 | 20.91 | 20.54 | 14.10 | 31.50 | 20.32 | 15.15 | — | — | — | 21.55 |
| 22 | 20.87 | 20.56 | 14.09 | 31.50 | 20.33 | 15.14 | — | — | — | [illegible] |
| 26 | 20.97 | 20.67 | 14.06 | 31.52 | 20.34 | 15.17 | — | — | — | [illegible] |
| 28 | 21.02 | 20.70 | 14.06 | 31.53 | 20.32 | 15.20 | — | — | — | [illegible] |
| 30 | 21.04 | 20.74 | 14.07 | 31.57 | 20.34 | 15.22 | — | — | — | [illegible] |
| | -0.77 | | +1.03 | -0.70 | -0.39 | +0.03 | | | | -0.39 |

(9)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

| | 821S | 821D | 822 | E | S | 823D | 824 | 825S | 825D | 826 | C | 828 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 May | Dry | 35.02 | 28.56 | Dry | | 48.43 | 46.58 | Dry | 49.42 | 44.71 | 14.[illegible] | 21.12 |
| 2 June | – | – | – | – | | – | – | – | – | – | – | 21.12 |
| 3 | Dry | 37.38 | 29.88 | Dry | | 48.44 | 46.68 | Dry | 50.24 | 44.67 | 15.21 | 21.12 |
| 5 | – | 37.85 | 30.11 | – | | 48.55 | 46.78 | – | 50.40 | – | – | 21.13 |
| 6 | – | 38.10 | 30.22 | – | | [illegible] | [illegible] | – | [illegible] | | | 15 |
| 7 | – | 38.39 | 30.38 | – | | 48.50 | 46.80 | – | 50.35 | – | – | [illegible] |
| 8 | – | 38.56 | 30.42 | – | | 48.54 | 46.81 | – | 50.40 | – | – | [illegible] |
| 9 | – | 38.74 | 30.56 | – | | 48.54 | 46.71 | – | 50.42 | – | – | 21 [illegible] |
| 10 | – | 38.97 | 30.66 | – | | [illegible] | [illegible] | | [illegible] | | | |
| 12 | – | 39.38 | 30.87 | – | | 48.58 | 46.80 | – | 50.57 | – | – | 21.21 |
| 13 | – | 39.57 | 30.95 | – | | 48.54 | 46.87 | – | 50.61 | – | – | [illegible] |
| 14 | – | 39.76 | 31.03 | – | | [illegible] | [illegible] | – | [illegible] | – | – | |
| 16/17 | – | 40.18 | – | – | | – | 46.88 | – | 50.52 | – | – | – |
| 19 | – | 40.70 | 31.40 | – | | 48.52 | 46.88 | – | 50.69 | – | – | 21.19 |
| 20 | – | 40.90 | 31.47 | – | | 48.52 | 46.91 | – | 50.67 | – | – | 21.1[illegible] |
| 21 | – | 41.09 | 31.58 | – | | 48.54 | 46.88 | – | 50.66 | – | – | [illegible] |
| 22 | – | 41.22 | 31.64 | – | | 48.50 | 46.95 | – | 50.63 | – | – | [illegible] |
| 26 | – | 41.98 | 31.90 | – | | 48.50 | 46.93 | – | 50.69 | – | – | [illegible] |
| 28 | – | 42.30 | 32.02 | – | | | 47.01 | – | 50.79 | – | – | [illegible] |
| 30 | – | 42.58 | 32.12 | – | | 48.82 | 47.03 | – | [illegible] | – | – | [illegible] |
| | | | | | | +1.68 | | | +4.25 | | | -0.12 |

(10)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

| | 829S | 829D | 830 | 831 | 832 | 833S | 833D | 834S | 834D | 835 | 936 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 May | 27.47+ | 30.62+ | 21.86+ | 23.60 (2) | 25.97 | 34.60 | 35.57 | 21.93+ | 0.00 | 17.75 | 26.0 |
| 2 June | 27.43 | 30.64 | — | — | 26.89 (2) | — | — | — | — | — | — |
| 3 | 27.43 | 30.52 | 19.26 | 24.05 | 26.91 (2) | 34.61 | 37.64 | Destroyed | | 17.83 | 25.9 |
| 5 | 27.58 | 31.27 | 18.98 | — | — | 34.65 | 38.05 | | | 17.87 | 26.0 |
| 6 | [illegible] | [illegible] | [illegible]90 | — | — | 34.68 | 38.30 | | | [illegible] | |
| 7 | 27.57 | 31.76 | 18.76 | — | — | 34.71 | 38.55 | | | 17.99 | 26.2 |
| 8 | 27.56 | 31.87 | [illegible] | — | — | 34.72 | 38.70 | | | [illegible] | [illegible] |
| 9 | 27.56 | 31.90 | 18.60 | — | — | 34.69 | 38.85 | | | 18.49 | [illegible] |
| 10 | [illegible] | [illegible] | [illegible] | — | — | [illegible] | [illegible] | | | [illegible] | |
| 12 | 27.63 | 31.91 | 18.43 | — | — | 34.72 | 39.45 | | | 20.92 | [illegible] |
| 13 | 27.68 | 31.91 | 18.42 | — | — | 34.75 | 39.64 | | | 18.95 | 26.[illegible] |
| 14 | [illegible] | 32.05 | 18.38 | — | — | 34.75 | [illegible] | | | 19.0 | 25.9 |
| 16/17 | — | — | 18.37 | — | — | 34.72 | 40.22 | | | 19.05 | [illegible] |
| 19 | 27.87 | 32.45 | 18.35 | — | — | 34.74 | 40.71 | | | 19.08 | 25 |
| 20 | 27.86 | 32.45 | 18.32 | — | — | 34.75 | 40.87 | | | 19.13 | [illegible] |
| 21 | 27.96 | 32.54 | 18.34 | — | — | 34.75 | 41.07 | | | 19.19 | [illegible] |
| 22 | 27.91 | 32.59 | 18.34 | — | — | 34.77 | 41.30 | | | 19.18 | [illegible] |
| 26 | 28.51 | 32.67 | 18.35 | — | — | 34.76 | 41.89 | | | [illegible] | [illegible] |
| 28 | 28.04 | 32.77 | 18.38 | — | — | 5 | 41.31 | | | [illegible] | [illegible] |
| 30 | 28.02 | 32.83 | 18.3[illegible] | — | — | 34.69 | 41.59 | | | 19.24 | [illegible] |
| | −0.61 | | +.349 | | | | | | | 1.49 | 10. |

(11)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

| | 937 | 938 | 939 |
|---|---|---|---|
| 25 May | Dn | 17.13** | 14.12* |
| 2 June | Dn | — | — |
| 3 | Dn | 18.71 | 14.20 |
| 5 | — | 19.00 | 14.28 |
| 6 | — | 19.15 | 14.30 |
| 7 | — | 19.30 | 14.32 |
| 8 | — | 19.36 | 14.31 |
| 9 | — | 19.47 | 14.30 |
| 10 | — | 19.57 | 14.33 |
| 12 | — | 19.81 | 14.37 |
| 13 | — | 19.89 | 14.38 |
| 14 | — | 19.97 | 14.38 |
| 16/17 | — | 20.21 | 14.34 |
| 19 | — | 20.42 | 14.42 |
| 20 | — | 20.52 | 14.42 |
| 21 | — | 20.59 | 14.45 |
| 22 | — | 20.69 | 14.47 |
| 26 | — | 21.05 | 14.47 |
| 28 | — | (5) | 14.50 |
| 30 | — | 0.00 | 14.52 |
| | | | -0.40 |

(12)

JACOBS ENGINEERING

DATE ____ BY ____ CHKD. ____ SUBJECT ____ SHEET NO ____ JOB NO ____

| DATE | 507 | 508 | 509 | 701 | 702 | | 906 | 911 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JULY 5 | – | 32.47 | 40.42 | 28.72 | 25.70 | | | | | | |
| ~~15/16~~ 18 | | 32.67 | 89.47 | 38.88 | 25.85 | | | | | | |
| 22 | | 32.71 | 86.99 | 28.93 | 25.95 | | | | | | |
| 31 | | | | | | | DRY | DRY | | | |
| Aug 3/4 | | 32.88 | 85.05 | 29.0 | 25.88 | | | | | | |

(13)

JE JACOBS ENGINEERING

DATE ____ SUBJECT ____ SHEET NO ____

BY ____ CHKD. ____ JOB NO ____

| DATE | 805 S | 805 D | 806 S | 806 D | 807 S | 807 D | 808 | 809 | 810 | 811 S | 811 D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JULY 5 | 32.49 | 38.68 | 29.49 | 32.23 | – | 44.01 | 18.97 | DRY | – | 25.96 | 47.90 |
| 15/16/18 | 32.64 | 40.96 | 29.75 | 33.60 | | | 19.21 | | | – | 55.98 |
| 22 | DRY | 42.14 | 27.04 | 61.24 | – | 44.27 | 19.10 | DRY | | 26.23 | 55.63 |
| 31 | | | | | | 44.42 | 19.24 | DRY | | | |
| AUG 3/4 | 32.88 (DRY?) | 41.98 | 29.75 | 61.10 | | 44.45 | 19.24 | DRY | | 26.31 | 55.23 |

CONSTANT HEAD PERMEABILITY TESTING

(14)

JE JACOBS ENGINEERING

DATE ____ BY ____ CHKD. ____ SUBJECT ____ SHEET NO ____ JOB NO ____

| DATE | 812 S | 812 D | 813 | 815 | 816 | 820 | 821 S | 821 D | 822 | 823 S | 823 D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JULY 5 | 21.15 | 20.87 | 14.13 | 20.36 | 15.29 | 21.94 | – | 43.35 | 32.42 | DRY | 47.35 |
| 15/16/18 | 26.34 | – | | 20.04 | | | | 44.95 | 33.02 | | |
| 22 | 21.42 | 21.24 | DRY | 22.09 | 18.88 | 22.41 | – | 45.73 | DRY | | |
| 31 | 21.64 | 21.51 | 15.89 | 21.71 | 16.14 | 22.66 | | | 33.92 | | |
| AUG 3/4 | 21.75 | 21.53 | DRY | 21.59 | 15.90 | 22.70 | | 47.33 | DRY | | |

CONSTANT HEAD TEST

(15)

JE JACOBS ENGINEERING

DATE ____ BY ____ CHKD ____ SUBJECT ____ SHEET NO ____ JOB NO ____

| DATE | 824 | 825D | 828 | 829S | 829D | 830 | 833S | 833D | 835 | 936 | 939 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JULY 5 | 47.02 | 49.14 | 21.29 | 28.19 | 32.96 | 18.42 | 34.62 | 42.41 | 19.30 | 25.79 | 14.61 |
| 15/16/18 | 48.20 | | 21.36 | | | 18.57 | | | 19.22 | 25.76 | 14.75 |
| 22 | 47.43 | | 21.44 | 28.51 | 37.53 | 18.51 | | | 19.44 | 25.73 | 14.85 |
| 31 | | CONSTANT HEAD TEST | | | | 18.39 | | | 19.54 | | 14.90 |
| AUG 3/4 | 47.62 | | 21.37 | 28.58 | 34.53 | 18.34 | CONSTANT HEAD TEST | CONSTANT HEAD TEST | 19.54 | DRY | 14.83 |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(16)

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____

Footnotes _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

* Recovery from rising head test
** Recovery from falling head test
(1) Height of pvc casing from surveyors from 24 March, except for 507, 508, 509, 701, 702
(2) Water in sump
(3) Bailed out
(4) Blown dry
(5) Constant head test

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(17)

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____

SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE 7/15 to

| | TOC | LSD |
|---|---|---|
| 508 | -1.5 | |
| 609 | -1.2 | |
| 701 | -2.0 | |
| 702 | -1.5 | |
| 805S | -1.06 | 33.7 @ 1:53, 7/15 ✓ |
| 805D | -1.11 | 42.4 @ 1:50, 7/15 ✓ |
| 806S | -1.63 | |
| 806D | -2.05 | |
| 807D | -1.63 | |
| 808 | -1.19 | 20.7 @ 11:35, 7/16 ✓ |
| 809 | -1.10 | |
| 811S | -1.15 | |
| 811D | -1.62 | |
| 812S | -0.98 | |
| 812D | -1.53 | |
| 813 | -1.16 | 15.0 @ 11:23, 7/16 ✓ |
| 814 | -1.50 | |
| 815 | -1.11 | 21.45 @ 11:17, 7/16 ✓ |
| 816 ✓319 ~~deg~~ dry, 21', full depth | -1.58 | |
| 820 | -1.19 | unable to get accurate depth ~26' |
| 821D | -1.65 | 46.6 @ 10:07, 7/16 ✓ |
| 822 | -1.58 | 34.6 @ 10:55, 7/16 ✓ |
| 823D | -1.[illegible] | 41.58 @ 10:40 7/16 - possible [illegible] |
| 824 | -1.10 | 49.6 @ 10:15, 7/16 ✓ |
| 825D | -1.12 | constant head test |
| 828 | -1.63 | |
| 829S | -1.07 | |
| 829D | 1.[illegible] | |
| ✓830 | -1.13 | 20.0' @ 11:40, 7/16 ✓ |
| 833S | -1.18 | ↑ |
| 833D | -1.78 | CONSTANT ~~HEAD~~ TEST |
| 835 | -1.38 | ↓ 20.6 @ 11:31, 7/16 ✓ |
| ✓936 | -1.51 | 27.3 - 7/15 @ 1:45 ✓ |
| 938 | -1.19 | constant head test |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE FTR

WO NO

DESCRIPTION

SHEET NO

MADE BY O. Holmquist

CHECKED BY

DATE 7/18 & 19/89

| | | TOC | | | W.L. |
|---|---|---|---|---|---|
| 508 | 7/19 | 30' + 50" | - | 1.5 | 32.67 ✓ |
| * 509 | 7/19 | 90 + 8" | - | 1.2 | 89.47 ✓ |
| 701 | 7/19 | 30 + 10 7/8" | - | 2.0 | 28.91 ✓ |
| 702 | 7/19 | 30 - 2' 7 3/4" | - | 1.5 | ~~31.15~~ 25.85 |
| 805S | 7/20 | 33.82 | - | 1.06 | 32.76 DRY? |
| 805D | 7/20 | 43.36 | - | [illegible] | 41.92 |
| 806S | 7/19 | 31' 4 1/2" | - | [illegible] | 29.75 |
| 806D | 7/19 | 35' 7 3/4" | - | 2.05 | 33.60 |
| 807D | 7/20 | 50 - 4.05' | - | [illegible] | 44.32 |
| 808 | 7/20 | 20.63 | - | [illegible] | 19.14 |
| 809 | 7/20 | DRY | - | [illegible] | DRY |
| 115 | 7/19 ~~30 - 32 1/8"~~ | 30 - 32 1/8" | - | [illegible] | 26.17 |
| 11D | 7/19 | 60 - 2' 4 3/4" | - | [illegible] | 55.98 |
| 812S | 7/20 | 22.42 | - | 0.98 | 21.44 |
| 812D | 7/20 | 22.76 | - | [illegible] | 21.23 |
| 813 | 7/20 | DRY | - | [illegible] | DRY |
| 814 | 7/20 | 33.21 | - | 1.50 | 31.71 |
| 815 | 7/20 | 23.71 | - | 1.41 | 22.30 |
| * 816 | 7/20 | 22.48 | - | 1.58 | 20.90 |
| 820 | 7/20 | 30 - 6.21 | - | 1.19 | 22.30 |
| 821D | 7/20 | 50 - 2.93 | - | 1.65 | 45.42 |
| 822 | 7/20 | 34.7 | - | [illegible] | 33.12 |
| 823D | 7/20 | ——— | - | [illegible] | CONSTANT HEAD TEST |
| 824 | 7/20 | 50 - 1.17 | - | 1.10 | 47.43 |
| 825D | 7/20 | ——— | - | 1.18 | CONSTANT HEAD TEST |
| 828 | 7/19 | 22' 11 7/8" | - | [illegible] | 21.63 |
| 829S | 7/20 | 30 - 0.58 | - | 0.71 | 28.35 |
| * 829D | 7/20 | 44.14 | - | [illegible] | 42.59 |
| 830 | 7/20 | 19.95 | - | 1.13 | 18.52 |
| 835 | 7/20 | ——— | - | 1.18 | CONSTANT HEAD TEST |
| 83D | 7/20 | ——— | - | 1.78 | " " " |
| 835 | 7/20 | 20.77 | - | 1.38 | 19.39 |
| 936 | 7/20 | 30 - 2.44 | - | 1.41 | 26.02 |
| 938 | 7/20 | ——— | - | [illegible] | CONSTANT HEAD TEST |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W O NO _____

DESCRIPTION _____

SHEET NO. _____

MADE BY O. Hangvist CHECKED BY _____ DATE 7/22/89

| | TOC | | L.A.D |
|---|---|---|---|
| 508 | 30+50.5" | 1.5 | 32.71 |
| 509 | 40-21.75" | 1.2 | 86.99 |
| 701 | 30+11 1/8" | 2.0 | 28.93 |
| 702 | 30-3[illegible] | 1.5 | 25.92 |
| 805S | DRY | 1.06 D | DRY |
| 805D | 40-4[illegible] | 1.1 | 42.14 |
| 806S | [illegible]-19 1/2" | 1.3 | 27.04 |
| *806D | 60+34.5 | 2.05 | 61.24 |
| 807D | 50-4[illegible] | 1.3 | 44.27 |
| 808 | 20+[illegible] | 1.9 | 19.10 |
| 809 | DRY | 1.[illegible] | DRY |
| 811S | 30-31.5" | 1.1 | 26.23 |
| 811D | 60-33" | [illegible] | 55.63 Sand - |
| 812S | 20+28.75 | 0.98 | 21.42 |
| 812D | 20+33.75 | 1.3 | 21.24 |
| 813 | DRY | 1.6 | DRY |
| 814 | 30+39" | 1.50 | 31.75 |
| 815 | 20+42" | 1.41 | 27.69 |
| *816 | 20+5 1/2" | 1.58 | 18.88 |
| 820 | 20+46.75" | 1.19 | 27.41 |
| 821D | 50-31.5" | 1.65 | 45.73 |
| 822 | DRY | 1.8 | DRY [illegible] |
| 823D | | 1.[illegible] | CONSTANT HEAD TEST |
| 824 | 50-14" | 1.10 | 47.43 |
| 825D | | 1.18 | CONSTANT HEAD TEST |
| 828 | 20+3.75 | 1.[illegible] | 21.44 |
| 829S | 30-5" | [illegible].1 | 28.51 |
| *829D | 40-11" | [illegible] | 37.53 |
| 830 | 20-8.75" | 1.13 | 18.51 |
| 833S | | 1.18 | CONSTANT HEAD TEST |
| 833D | | 1.18 | CONSTANT HEAD TEST |
| 835 | 20+9 7/8" | 1.28 | 19.44 |
| 836 | 30-32.75 | 1.[illegible]1 | 25.73 |
| 838 | [illegible] | [illegible] | CONSTANT HEAD TEST |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE: Well Testing
DESCRIPTION: testing water wells
WO NO:
SHEET NO:
MADE BY: [illegible] CHECKED BY: [illegible] DATE: 8-14-89

| | TOC | | | |
|---|---|---|---|---|
| 503 | 1.5 | | 34'6" | 34.5 |
| 509 | 1.2 | | 88'4¼" | 88.35 |
| 701 | 2.0 | | 31'2¼" | 31.19 |
| 702 | 1.5 | | 27'6¼" | 27.52 |
| 805S | 1.06 | | 34'6½" | 34.54 |
| 805D | 1.41 | | 59'3¼" | 59.27 |
| 806S | 2.03 | | 31'10½" | 31.88 |
| 806D | 2.05 | | 68'4⅝" | 68.38 |
| 807D | 1.56 | | 46'4⅝" | 46.38 |
| 808 | 1.49 | .63 | 20'10¾" | 20.90 |
| 809 | 1.40 | | Dry | |
| 811S | 1.12 | | 27'9½" | 27.77 |
| 811D | 1.52 | | 56'10¼" | 56.85 |
| 812S | 0.98 | | 22'9¼" | 22.77 |
| 812D | 2.0 | | 23'6⅝" | 23.55 |
| 813 | 1.46 | | ~~[illegible]~~ 18'7" | 18.58 |
| 814 | 1.50 | | 33'4¼" | 33.35 |
| 815 | 1.41 | | 24'4¾" | 24.40 |
| 816 | 1.58 | | 19'9¾" | 19.81 |
| 820 | 1.49 | | 24'5" | 24.42 |
| 821D | 1.65 | | Dry | |
| 822 | 1.38 | | 35'9¼" | 35.77 |
| 823D | 1.[illegible] | | ~~Dry~~ 47'11" | 47.92 |
| 824 | 1.[illegible] | | 48'3¼" | 48.27 |
| 825D | 1.[illegible] | | ~~Dry~~ 52'5" | 52.41 |
| 828 | 1.[illegible] | | 23'2½" | 23.20 |
| 829S | 1.[illegible] | | 30'1⅝" | 30.13 |
| 829D | | | 38'9½" | 38.79 |
| 830 8-14-89 | 1.[illegible] | | 23'6¾" | 23.56 |
| 833S | 1.15 | | 36'2" | 36.17 |
| 833D | 1.78 | | 41'10¼" | 41.85 |
| 835 | 1.[illegible] | | 21' | 21.00 |
| 936 | 1.[illegible] | | 27'2⅝" | 27.22 |
| 932 | | | | Dry |
| 939 | | | 16'[illegible]½" | 16.51 |

# CHENEY TEST PIT PIEZOMETERS

DATE: 8-14-89 NAME: Ivan D. Miracle

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS | |
|---|---|---|---|---|---|
| | 8-14-89 | | – | | |
| TP 41 | | | – | 38' | 31.00 |
| TP 51 | | | – | 28' 2 3/4" | 28.23 |
| TP 43 | | | [illegible] | 22' | 22.00 |
| TP 44 | | | -3.0 | 21' 1 1/4" | 21.10 |
| TP 47 – | | | -3.0 | 24' 4 1/2" | 26.38 |
| TP 52 – | | | 2.17 | Dry | |
| TP 53 – | | | -2.25 | 29' 7" | 29.58 |
| TP 54 – | | | -3.10 | 31' 8 1/2" | 31.– |
| TP 36 | | | -2.58 | 25' 3 3/4" | 25.31 |
| TP 29 | | | -2.46 | 23' 6" | 23.5 |
| TP 28 | | | DRY | DRY | |
| TP 62 | | | ~~24~~ | 24' 5 3/4" | 24.48 |
| | | | | | |
| | | | | | |
| | | | | | |
| ~~[illegible]~~ | | | | ~~3[illegible]~~' | |

CHENEY MW WATER LEVELS

(22)

DATE: 8-14-89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 8-14-89 | (time PM) | - | |
| 904 | " " " | 40' | -1.5' | 36'11" 36.91 |
| 913 | " " " | 40' | - | Dry |
| 912 | " " " | 40' | - | Dry |
| 914 | " " " | 40' | - | Dry |
| 916 | " " " | 40' | - | Dry |
| 911 | " " " | 45' | - | Dry |
| 918 | " " " | 40' | - | Dry |
| 906 | " " " | 40' | - | Dry |
| 9 | " " " | 50' | - | Dry |
| 7C | " " " | 40' | - | Dry |
| 925 | " " " | | - | Dry |
| 908 | " " " | | - | Dry |
| 921 | " " " | | - | Dry |
| 832 | " " " | | - | 36'1" ~~Dry~~ |
| 915 | " " " | | - | Dry |
| 917 | " " " | | - | Dry |
| 926 | " " " | | - | Dry |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | | |
| | | | | |
| | | | - | |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(23)

JOB TITLE testing wells

WO NO

DESCRIPTION Testing Water Level

SHEET NO.

MADE BY [illegible] CHECKED BY [illegible]

DATE 8-16-89 8-17-89

| | TOC | L.S.D | |
|---|---|---|---|
| 508 - 8-16-89 | - 1.5 | 34' 6 5/8" | 34.51 |
| 509 - 8-17-89 | - 1.2 | 88 4 5/8" | 88.34 |
| 701 - 8-17-89 | - 2.0 | 31' 2" | 31.17 |
| 702 - 8-17-89 | - 1.5 | 27' 6 1/8" | 27.51 |
| 805S - 8-17-89 | - 1.06 | 34' 6 1/2" | 34.54 |
| 805D - 8-17-89 | - 1.11 | 59' 3 1/4" | 59.27 |
| 806S - 8-17-89 | - 1.03 | 31' 10 1/4" | 31.85 |
| 806D - 8-17-89 | - 2.05 | 68' 4 5/8" | 68.39 |
| 807D - 8-17-89 | 1.03 | 46' 4 1/2" | 46.38 |
| 808 - 8-17-89 | 1.19 | 20' 10" | 20.83 |
| 809 - 8-17-89 | - 1.13 | DRY | |
| 811S - 8-16-89 | - 1.1[illegible] | 27' 9" | 27.75 |
| 811D - 8-17-89 | - [illegible] | 56' 10" | 51' [illegible] |
| 812S - 8-17-89 | 0.98 | 22' 9 1/8" | 2[illegible].16 |
| 812D - 8-17-89 | - 1.[illegible] | 23' 6 1/2" | 23.54 |
| 813 | 1.1[illegible] | 18' | 18.00 |
| 814 | - 1.50 | 33' 4 1/4" | 33.35 |
| 815 | 1.41 | 24' 4 1/8" | 24.34 |
| 816 | - 1.38 | 19' 9 3/4" | 19.81 |
| 820 | - 1.19 | 24' 5" | 24.42 |
| 821D | - 1.65 | DRY | |
| 822 | - 1.58 | 35' 9" | 35.75 |
| 823D | 1.[illegible] | 47' 10" - (D-1) | 47.83 |
| 824 | 1.10 | 48' 3" | 48.25 |
| 825D | - 1.12 | 52' 4" (D-1) | 52.33 |
| 828 | - 1.[illegible] | 23' 2" | 23.17 |
| 829S | 1.07 | 30' 1 1/2" | 30.10 |
| 829D | 1.[illegible] | 38' 9 1/4" | 38.77 |
| 830 | - 1.13 | 23' 6 3/4" | 23.56 |
| 833S | - 1.18 | 36' 1" | 36.14 |
| 833D | - 1.78 | 41' 10" | [illegible] |
| 835 | 1.[illegible] | 21' 0" | 0 |
| 936 | 1.[illegible] | 27' 2 1/2" | 27.21 |
| 938 | - 1.[illegible] | | |
| 939 | [illegible] | 16' 6" | 16.50 |

# CHENEY TEST PIT PIEZOMETERS

DATE 8-18-89 NAME Ivan D. Miracle

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS | |
|---|---|---|---|---|---|
| | | | - | | |
| TP 41 | 8-18-89 | | - | 31 1/4" | 31.02 |
| TP 51 | 8-18-89 | | - | 28 7 3/4" | 28.15 |
| TP 43 | " " " | | -2.21 | 22' | 22.00 |
| TP 44 | " " " | | -3.0 | 21' 1" | 21.08 |
| TP 47 | " " " | | -3.0 | 26' 4 1/4" | 26.35 |
| TP 52 | " " " | | -2.17 | Dry | Dry |
| TP 53 | " " " | | -2.25 | 29' 6" | 29.50 |
| 54 | " " " | | -3.10 | 31' 8 1/4" | 31.65 |
| P 36 | " " " | | -2.58 | 25' 3 3/4" | 25.31 |
| TP 29 | " " " | | -2.16 | 23' 5" | 23.42 |
| TP 28 | " " " | | DRY | DRY | |
| TP 62 | " " " | | | 24' 5 1/2" | 24.44 |

CHENEY MW W/ 12 LEVELS

(25)

DATE: 8-19-89

MADE BY: Ivan D. Minacle

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 8-19-89 | | -1.5' | 36'9½" 36.79 |
| 913 | " " " | | - | Dry |
| 912 | " " " | | - | Dry |
| 914 | " " " | | - | Dry |
| 916 | " " " | | - | Dry |
| 911 | " " " | | - | Dry |
| 918 | " " " | | - | Dry |
| 906 | " " " | | - | Dry |
| 919 | " " " | | - | Dry |
| 910 | " " " | | - | Dry |
| 922 | " " " | | - | Dry |
| 932 | " " " | | - | Dry |
| 921 | " " " | | - | Dry |
| 930 | " " " | | - | Dry |
| 915 | " " " | | - | Dry |
| 917 | " " " | | - | Dry |
| 920 | " " " | | - | Dry |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | | |
| | | | - | |
| | | | - | |
| | | | | |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE Well Testing W.O. NO.

DESCRIPTION Water well Depth test

MADE BY [illegible] CHECKED BY [illegible] SHEET NO. DATE 8-19-89

| | TOC | D |
|---|---|---|
| 508 | 15 | 34' 7¾" |
| 509 | 12 | 88' 10½" |
| 701 | 20 | 31' 1" |
| 702 | 15 | 27' 6½" |
| 805S | 106 | 34' 6" |
| 805D | 111 | 59' 3¾" |
| 806S | [illegible] | 3[illegible] 10" |
| 806D | 205 | 68' 4½" |
| 807D | [illegible] | 46' 4½" |
| 808 | [illegible] | 20' 10" |
| 809 | [illegible] | DRY |
| 811S | [illegible] | 27' 8¾" |
| 11D | [illegible] | 56' 10" |
| 812S | 098 | 22' 9" |
| 812D | [illegible] | 23' 6½" |
| 813 | [illegible] | 18' |
| 814 | 150 | 33' 4¼" |
| 815 | [illegible] | 24' 4¾" |
| 816 | 158 | 19' 9½" |
| 820 | 119 | 24' 4" |
| 821D | 165 | Dry |
| 822 | [illegible] | DRY |
| 823D | [illegible] | 47' 11' (Dry) |
| 824 | [illegible] | 48' 3¾" |
| 825D | [illegible] | 52' 5" (Dry) |
| 828 | [illegible] | 23' 2" |
| 829S | 07 | 30' 1½" |
| 829D | [illegible] | 38' 9" |
| 830 | [illegible] | 22' 8½" |
| 833S | 119 | 36' 2" |
| 833D | 178 | 41' 10" |
| 835 | [illegible] | 21' |
| 936 | [illegible] | 27' 2" |
| 938 | [illegible] | |
| 939 | [illegible] | 16' 1" |

(27)

DATE: [redacted]

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | DEPTH TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 8-19-89 | | - 1.5' | 36'11" 36.1 |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 914 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 910 | " " " | | - | DRY |
| 125 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 932 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |

# CHENEY TEST PIT PIEZOMETERS

TR: [redacted] NAME: Ivan D. Miracle

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| TP 41 | | | - | 31' |
| TP 51 | | | - | 28' 2½" |
| TP 43 | | | [illegible] | 22' |
| TP 44 | | | [illegible] | 21' 1" |
| TP 47 | | | [illegible] | 26' 4½" |
| TP 52 | | | 2.17 | DRY |
| TP 53 | | | 2.25 | 29' 6" |
| 54 | | | 3.10 | 31' 8 |
| 36 | | | 2.58 | 25' 3½" |
| TP 29 | | | 2.46 | 3" 6" |
| TP 28 | | | DRY | DRY |
| TP 62 | | | | 24' 5" |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(29)

JOB TITLE testing water wells WO NO

DESCRIPTION Check depth of water

SHEET NO

MADE BY [illegible] CHECKED BY [illegible] DATE 8-21-89

| | TOC | | T.D |
|---|---|---|---|
| 508 | - 1.5 | | 34' 8" |
| 509 | - 1.2 | | 87' 5" |
| 701 | - 2.0 | | 31' 2½" |
| 702 | - 1.5 | | 27' 7" |
| 805S | - 1.06 | | 34' 8" |
| 805D | - 1.11 | | 58' 9" |
| 806S | - 1.6 | | 31' 11½" |
| 806D | - 2.05 | | 68' 5" |
| 807D | 1.53 | | 45' 11" |
| 808 | 1.19 | | 18' 10¾" |
| 809 | - 1.7 | | DRY |
| 811S | - 1.1 | | 27' 9" |
| 811D | - 1.5 | | 56' 8¾" |
| 812S | 0.98 | | 22' 10" |
| 812D | - 1.5 | | 23' 6½" |
| 813 | - 1.5 | | 17' 10¾" |
| 814 | - 1.50 | | 33' 4⅞" |
| 815 | - 1.41 | | 24' 5⅞" |
| 816 | - 1.58 | | 19' 2" |
| 820 | - 1.19 | | 24' 4⅞" |
| 821D | - 1.65 | | DRY |
| 822 | - 1.58 | | DRY |
| 823D | 1.[illegible] | | 48' (Dry) |
| 824 | 1.10 | | 48' 4" (Dry) |
| 825D | 1.18 | | 52' 6" (Dry) |
| 828 | 1.[illegible] | | 23' 3" |
| 829S | [illegible] | | 30' 2" |
| 829D | [illegible] | | 38' 9¾" |
| 830 | - 1.13 | | 20' 01" |
| 833S | - 1.18 | | 36' 9" |
| 833D | - 1.18 | | 41' 10¾" |
| 835 | - 1.38 | | 21' 6" |
| 936 | 1.51 | | 27' 1" |
| 938 | - 1.3 | | DRY |
| 939 | [illegible] | | 16' 7" |

CHENEY MW & FR LEVELS

(30)

DATE: 8-21-89

MADE BY [illegible]

| WELL Number | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 8-21-89 | | - 1.5' | 37'/ "37.08 |
| 906 | " " " | | - | DRY |
| 910 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 913 | " " " | | - | DRY |
| 914 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| [illegible] | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 921 (Deep) | " " " | | - | DRY |
| 922 (Deep) | " " " | | - | DRY |
| 923 (Deep) | " " " | | - | DRY |
| 943 (Deep) | " " " | | - | DRY |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | | |
| | | | - | |
| | | | | |

# CHENEY TEST PIT PIEZOMETERS

DATE: 8-21-89 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | ~~8-21-89~~ 8-22-89 | | - | |
| TP 41 | " " " | | - | 31' 31.00 |
| TP 51 | " " " | | - | 28'2" 28.17 |
| TP 43 | " " " | | -2.21 | 22'6 3/4" 22.56 |
| TP 44 | " " " | | -.30 | DRY |
| TP 47 | " " " | | -.30 | 26'5" (DRY) |
| TP 52 | " " " | | -2.17 | DRY |
| TP 53 | " " " | | -2.25 | 29'9" (DRY) |
| TP 54 | " " " | .33' | -3.10 | 31'9 7/8" (DRY) |
| TP 36 | " " " | | -2.58 | 25'3 1/2" 25.24 |
| TP 29 | " " " | | -2.46 | 23'8" 23.67 |
| TP 28 | " " " | | DRY | DRY |
| ~~[illegible]~~ | ~~" " "~~ | | | ~~[illegible]~~ |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(32)

JOB TITLE Well testing W.O. NO

DESCRIPTION testing for water Depth in wells

SHEET NO.

MADE BY [illegible] CHECKED BY [illegible] DATE 8-24-89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 34' 6" | 34.50 |
| 509 | -1.2 | 87' 4½" | 87.38 |
| 701 | -2.0 | 31' 2" | 31.17 |
| 702 | -1.5 | 27' 6" | 27.50 |
| 805S | -1.06 | 34' 8" | 34.67 |
| 805D | -1.41 | 58' 8" | 51.75 |
| 806S | -1.63 | 31' 11" | 31.92 |
| 806D | -2.05 | 68' 1½" | 68.13 |
| 807D | -1.63 | 45' 10½" | 45.96 |
| 808 | -1.19 | 20' 11" | 20.92 |
| 809 | -1.40 | DRY | |
| 811S | -1.16 | 27' 8½" | 27.71 |
| 811D | -1.62 | 56' 8" | 56.75 |
| 812S | -0.98 | 22' 10" | 22.83 |
| 812D | -1.53 | 23' 4½" | 23.38 |
| 813 | -1.46 | 17' 11" | [illegible] |
| 814 | -1.50 | 34' | 34.00 |
| 815 | -1.41 | 24' 6" | 24.50 |
| 816 | -1.58 | 19' 2½" | 19.21 |
| 820 | -1.19 | 24' 4½" | 24.38 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | 48' (DRY) | |
| 824 | -1.10 | 48' 6 (DRY) | |
| 825D | -1.48 | 52' 6" (DRY) | |
| 828 | -1.63 | 23' 3½" | 23.29 |
| 829S | -1.07 | 30' 2" | 30.17 |
| 829D | -1.55 | 38' 10" | 38.83 |
| 830 | -1.43 | 20' | 20.00 |
| 833S | -1.18 | 36' 9" | (DRY) |
| 833D | -1.78 | 41' 11" | 41.92 |
| 935 | -1.38 | 21' 6" | 21.50 |
| 936 | -1.51 | 27' | 27.00 |
| 938 | -1.19 | DRY | |
| 939 | [illegible] | 16' 6" | 16.50 |

# CHENEY TEST PIT PIEZOMETERS

DATE: 8-24-89 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| TP 41 | | | - | 31' 31.00 |
| TP 51 | | | - | 28' 28.00 |
| TP 43 | | | -2.21 | 22'7" 22.58 |
| TP 44 | | | -3.0 | DRY |
| TP 47 | | | -3.0 | 26'6 (DRY) |
| TP 52 | | | -2.17 | DRY |
| TP 53 | | | -2.25 | 29'9" (DRY) |
| TP 54 | | | -3.10 | 31'9½" (DRY) |
| TP 36 | | | -2.58 | 25'4" [illegible] |
| TP 29 | | | -2.46 | 24'3" 24.[illegible] |
| TP 28 | | | DRY | DRY |
| TP 57 | | | | DRY |
| TP 58 | | | | 29' (DRY) |
| TP 60 | | | | 27'1" 27.08 |

CHENEY MW WATER LEVELS

(34)

DATE: 8-24-89

MADE BY: Ivan M.

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | | | - 1.5' | 37' 37.00 |
| 906 | | | - | DRY |
| 910 | | | - | DRY |
| 911 | | | - | DRY |
| 912 | | | - | DRY |
| 913 | | | - | DRY |
| 914 | | | - | DRY |
| 915 | | | - | DRY |
| 916 | | | - | DRY |
| 917 | | | - | DRY |
| 918 | | | - | DRY |
| 919 | | | - | DRY |
| 920 | | | - | DRY |
| 921 | | | - | DRY |
| 926 | | | - | DRY |
| 932 | | | - | DRY |
| 933 | | | - | DRY |
| 943 | | | - | DRY |
| 933 | | | - | DRY |
| 948 | | | - | DRY |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE testing water wells WO NO

DESCRIPTION test depth of water in test wells

SHEET NO 7

MADE BY Shon CHECKED BY Shon '77 DATE 8-29-89

| | TOC | L.S.D. | |
|---|---|---|---|
| 508 | -1.5 | 34'6" | 34.50 |
| 509 | -1.2 | 88'4¼" | 88.35 |
| 701 | -2.0 | 31'2¼" | 31.19 |
| 702 | -1.5 | 27'6" | 27.50 |
| 805S | -1.06 | 34'6½" | 34.54 |
| 805D | -1.19 | 59'3¼" | 59.27 |
| 806S | -1.03 | 31'10½" | 31.88 |
| 806D | -2.05 | 68'4½" | 68.38 |
| 807D | -1.63 | 46'4¾" | 46.39 |
| 808 | -1.19 | 20'10½" | 20.88 |
| 809 | -1.4[illegible] | DRY | |
| 811S | -1.1[illegible] | 27'9½" | 27.79 |
| 811D | -1.[illegible] | 56'10" | 56.42 |
| 812S | 0.98 | 22'9" | 22.[illegible] |
| 812D | -1.5[illegible] | 23'6½" | 23.54 |
| 813 | -1.16 | 18'1" | 18.08 |
| 814 | -1.50 | 33'4¼" | 33.35 |
| 815 | -1.41 | 24'4½" | 24.38 |
| 816 | -1.58 | 19'9¾" | 19.81 |
| 820 | -1.19 | 24'4¾" | 24.40 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | 35'9¼" | (DRY) |
| 823D | -1.[illegible] | 47'10¾" | 47.90 |
| 824 | 1.10 | 48'3¼" | 48.27 |
| 825D | -1.12 | 52'5" | 52.42 |
| 828 | -1.6[illegible] | 23'2½" | 23.21 |
| 829S | [illegible] | 30'1½" | 30.13 |
| 829D | [illegible] | 38'9½" | 38.79 |
| 830 | -1.13 | 23'6½" | [illegible] |
| 833S | -1.18 | 36'2" | 36.17 |
| 833D | -1.78 | 41'10" | 41.[illegible] |
| 835 | [illegible] | 21'[illegible] | [illegible] |
| 936 | [illegible] | 27'2½" | 27.21 |
| 938 | [illegible] | DRY | |
| 939 | [illegible] | 16'6" | 16.50 |

CHENEY TEST PIT PIEZOMETERS

DATE 8-29-89 NAME Ivan D. Minnick

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS | |
|---|---|---|---|---|---|
| | 8-29-89 | | - | | |
| TP 41 | " " " | | - | 31' | 31.00 |
| TP 51 | " " " | | - | 28' 2 3/4" | 28.23 |
| TP 43 | " " " | | -2.2' | 22' | 22.00 |
| TP 44 | " " " | | -3.0 | 21' 1" | 21.08 |
| TP 47 | " " " | | -3.0 | 26' 4 1/2" | 26.38 |
| TP 52 | " " " | | 2.17 | DRY | |
| TP 53 | " " " | | -2.25 | 29' 6 3/4" | 29.56 |
| 54 | " " " | | -3.10 | 31' 8 1/2" | 31.71 |
| P 36 | " " " | | -2.58 | 25' 3 1/2" | 25.29 |
| TP 29 | " " " | | -2.46 | 23' 5 3/4" | 23.48 |
| TP 28 | " " " | | DRY | DRY | |
| Tp 62 | " " " | | | 24' 5 1/2" | 24.46 |
| TP 57 | " " " | | | DRY | |
| TP 58 | " " " | | | 30' (Dry) | |
| TP 60 | " " " | | | 27' 2" | 27.17 |

CHENEY [illegible] WATER LF.

DATE: 8-29-89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPT BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 8-29-89 | | - 1.5' | 36'11" 36.92 |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 914 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 10 | " " " | | - | DRY |
| 925 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 832 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| | | | - | |
| | | | - | |
| | | | - | |
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| | | | - | |
| | | | - | |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE Well tester W.O. NO.

DESCRIPTION Testing Depth of water level

SHEET NO. 9-5-89

MADE BY [illegible] CHECKED BY [illegible] DATE ~~[illegible]~~-89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 34'6" | 34.50 |
| 509 | -1.2 | 84"3' | 84.25 |
| 701 | -2.0 | 31' 3¼' | 31.29 |
| 702 | -1.5 | 27'9" | 27.75 |
| 805S | -1.06 | 34'7¼" | 34.60 |
| 805D | -1.11 | 59' 4' | 59.33 |
| 806S | -1.63 | 31' 10¼" | 31.85 |
| 806D | -2.05 | 68' 6½" | 68.54 |
| 807D | -1.63 | 46' 5" | 46.42 |
| 808 | -1.19 | 20' 10" | 20.83 |
| 809 | -1.40 | DRY | |
| 11S | -1.15 | 27' 10½" | 27.88 |
| 11D | -1.62 | 56' 11" | 56.92 |
| 812S | -0.98 | 22' 9¼" | 22.77 |
| 812D | -1.53 | 23' 6½" | 23.54 |
| 813 | -1.16 | 18' 3" | 18.25 |
| 814 | -1.50 | 33' 5" | 33.42 |
| 815 | -1.41 | 24' 4¼" | 24.35 |
| 816 | -1.58 | 19' 5" | 19.42 |
| 820 | -1.19 | 25' 0" | 25.00 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | 47' 11¼" | 47.94 |
| 824 | -1.10 | 48' 3" | 48.25 |
| 825D | -1.18 | 52' 6" | 52.50 |
| 828 | -1.63 | 23' 3" | [illegible] |
| 829S | -1.07 | 30' 1¾" | 30.15 |
| 829D | -1.55 | 38' 11" | [illegible] |
| 830 | -1.13 | 23' 6¼" | 23.52 |
| 33S | -1.18 | 36' 2" | 36.17 |
| 33D | -1.78 | 41' 10" | 41.83 |
| 835 | -1.38 | 21' 1¼" | 21.10 |
| 936 | -1.54 | 27' 3⅞" | 27.26 |
| 932 | -1.13 | DRY | |

# CHENEY TEST PIT PIEZOMETERS

DATE: 9-5-89 NAME: Dan Minacle

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 9-5-89 | | - | |
| TP 41 | " " " | | - | 31'2" 31.17 |
| TP 51 | " " " | | - | 28'2 3/4" 28.2[illegible] |
| TP 43 | " " " | | -2.21 | 22'5 1/2" 22.46 |
| TP 44 | " " " | | -3.0 | 24'2 1/4" 24.19 |
| TP 47 | " " " | | -3.0 | 26'6" 26.50 |
| TP 52 | " " " | | -2.17 | DRY |
| TP 53 | " " " | | -2.25 | 29'9 1/8" 29.72 (DRY) |
| TP 54 | " " " | | -3.10 | 30'9" 31.75 (DRY) |
| TP 36 | " " " | | -2.58 | ~~25'4 1/4"~~ (DR[illegible]) |
| TP 29 | " " " | | -2.46 | 23'7 1/2" 23.70[illegible] |
| TP 28 | " " " | | DRY | DRY |
| TP 57 | " " " | | | DRY. |
| TP 58 | " " " | | | 29' (DRY) |
| TP 60 | " " " | | | 27'6" 27.50 |

# CHENEY MW WATER LEVELS



DATE: 9-5-89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 9-5-89 | | - | |
| 904 | " " " | | - 1.5' | 37'6" 37.50 |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 914 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| [illegible] | " " " | | - | DRY |
| 925 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 832 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| | | | - | |
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| | | | - | |
| | | | - | |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE: testing wells
W.O. NO.:
DESCRIPTION: Depth of water
SHEET NO.:
MADE BY: [illegible]
CHECKED BY:
DATE: 9-11-89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 34'8" | 34.67 |
| 509 | -1.2 | 84'0" | 84.00 |
| 701 | -2.0 | 31'4" | 31.33 |
| 702 | -1.5 | 27'8 1/4 | 27.69 |
| 805S | -1.06 | 34'8" | 34.67 |
| 805D | -1.11 | 59'4" | 59.33 |
| 806S | -1.63 | 31'10" | 31.83 |
| 806D | -2.05 | 68'6" | 68.5 |
| 807D | -1.63 | 46'4 1/4 | 46.35 |
| 808 | -1.49 | 20'9 1/2" | 20.79 |
| 809 | -1.40 | DRY | |
| 811S | -1.15 | 27'10" | 31.83 |
| 811D | -1.62 | 56'10 1/4 | 56.85 |
| 812S | -0.98 | 22'9" | 22.[illegible] |
| 812D | -1.53 | 23'6" | 23.5 |
| 813 | -1.16 | 18'3" | 18.25 |
| 814 | -1.50 | 33'5 1/4 | 33.44 |
| 815 | -1.41 | 24'5" | 24.42 |
| 816 | -1.58 | 19'4 3/4 | 19.42 |
| 820 | -1.49 | 25' | 25.00 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.39 | 47'11" | 47.92 |
| 824 | -1.10 | 48' | 48.00 |
| 825D | -1.48 | 52'5 1/2" | 52.46 |
| 828 | -1.63 | 23'2" | 23.17 |
| 829S | -1.07 | 30'1 1/2" | 30.125 |
| 829D | -1.55 | 38'11" | 38.92 |
| 830 | -1.43 | 23'6" | 23.50 |
| 833S | -1.18 | 36'2" | 36.17 |
| 833D | -1.78 | 21'10" | 21.8[illegible] |
| 835 | -1.38 | 21'3" | 21.[illegible] |
| 936 | -1.54 | 27'3" | 27.25 |
| 938 | -1.43 | DRY | |
| 939 | -1.[illegible] | 16'6" | 12.50 |

# CHENEY MW WATER LEVELS



DATE: 9/11/89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | ~~12~~ 9/12/89 | | -1.5' | 37'6" 37.5 |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 914 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 0 | " " " | | - | DRY |
| 925 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 832 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| | | | - | |
| | | | - | |
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# CHENEY TEST PIT PIEZOMETERS

DATE: 9/11/89 ~~12~~ NAME: _____

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 9/12/89 | | - | |
| TP 41 | " " " | | - | 31' 1½" 31.125 |
| TP 51 | " " " | | - | 28' 2" 28.17 |
| TP 43 | " " " | | -2.21 | 22' 6" 22.5 |
| TP 44 | " " " | | -3.0 | 24-24½" 24.19 |
| TP 47 | " " " | | -3.0 | 26' 5" 26.42 |
| TP 52 | " " " | | -2.17 | DRY |
| TP 53 | " " " | | -2.25 | DRY |
| TP 54 | " " " | | -3.10 | DRY |
| TP 36 | " " " | | -2.58 | DRY |
| TP 29 | " " " | | -2.46 | 23' 3¾" 23.65 |
| TP 28 | " " " | | DRY | DRY |
| TP 57 | " " " | | | DRY |
| TP 58 | " " " | | | DRY |
| TP 60 | " " " | | | 27' 6" 27.5 |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE testing depth of water in wells W.O. NO.

DESCRIPTION Testing water level in wells & Test pits.

SHEET NO. 1 of 3

MADE BY Ivan M CHECKED BY I. D. M. DATE 9/18/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 34' 6" | 34.5 |
| 509 | -1.2 | 81' 4½" | 81.38 |
| 701 | -2.0 | 31' 3" | 31.25 |
| 702 | -1.5 | 27' 6" | 27.5 |
| 805S | -1.06 | 34' 5" | 34.42 |
| 805D | -1.19 | 59' .04" | 59.92 |
| 806S | -1.63 | 31' 10½" | 31.88 |
| 806D | -2.05 | 68' 6" | 68.5 |
| 807D | -1.63 | 46' 6½" | 46.54 |
| 808 | -1.49 | 20' 10" | 20.83 |
| 809 | -1.40 | DRY | |
| 115 | -1.15 | 27' 10¾" | 27.90 |
| 11D | -1.62 | 56' 11" | 56.92 |
| 812S | -0.98 | 22' 10¼" | 22.85 |
| 812D | -1.53 | 23' 5½" | 23.46 |
| 813 | -1.16 | 18' 4" | 18.33 |
| 814 | -1.50 | 33' 6" | 33.5 |
| 815 | -1.41 | 24' 8" | 24.67 |
| 816 | -1.58 | 19' 5" | 19.42 |
| 820 | -1.49 | 24' 5" | 24.42 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | 47' 11½" | 47.96 |
| 824 | -1.10 | 48' 4" | 48.33 |
| 825D | -1.48 | 52' 4" | 52.33 |
| 828 | -1.63 | 23' 2" | 23.17 |
| 829S | -1.07 | 30' 10½" | 30.86 |
| 829D | -1.55 | 39' .01" | 39.08 |
| 830 | -1.43 | 23' 6" | 23.5 |
| 833S | -1.18 | 36' 2" | 36.17 |
| 33D | -1.78 | 42' | 42 |
| 835 | -1.38 | 21' 6" | 21.5 |
| 836 | -1.54 | 24' 2" | 24.17 |
| 838 | -1.43 | DRY | |

CHENEY MW WATER LEVELS

(45)

DATE: 9/18/89

MADE BY: [illegible]

P.2 of 3

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 9/18/89 | | -1.5' | 31 3/4 E 37.0 |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 910 | " " " | | - | DRY |
| 925 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 932 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| | | | - | |
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# CHENEY TEST PIT PIEZOMETERS

TIME: 9/18/89 NAMES: By Ivan A.3.83

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 9/18/89 | | - | |
| TP 41 | " " " | | - | 31' 31 |
| TP 51 | " " " | | - | 28' 2½" 28.21 |
| TP 43 | " " " | | -2.21 | 22' 5" 22.42 |
| TP 44 | " " " | | -3.0 | 24' 1¼" 24.10 |
| TP 47 | " " " | | -3.0 | 26' 5" 26.42 |
| TP 52 | " " " | | -2.17 | DRY |
| TP 53 | " " " | | -2.25 | DRY |
| TP 54 | " " " | | -3.10 | DRY |
| 36' | " " " | | -2.58 | DRY |
| TP 29 | " " " | | -2.46 | 23' 8" 23.67 |
| TP 28 | " " " | | DRY | DRY |
| TP 58 | " " " | | | 29 DRY 29 |
| TP 57 | " " " | | | DRY |
| TP 60 | " " " | | | 27' 1½" 27.13 |
| TP 116 | | 30' | | 28' 6" 28.5 |
| TP 143 | | | | 18' 18 |

(Gather more) (47)

9/2/89 # well 828 water depth 21.79
23' 5"

after Night Rain 9/20/89

9-20-89 = well # 830 - water Depth 19' 10" 18.4
9-20-89 = " # 816 - " " 17' 4" 15.75
9-20-89 = " # 811S - " " 27' 11" 26.77
9/20/89 = " # 811D - " " 54' 6" 52.88
9/20/89 = " # 508 - " " 34' 10½" 3.
9/20/89 = " # 701 - " " 31' 4" 29.33
9/20/89 - " # 806D - " " 68' 1" 66.03
9/20/89 - " # 806S - " " 32' 2" 30.54
9/20/89 - " # 820 - " " 24' 11" 23.43
9/21/89 - " # 822 - " " Dry
9/21/89 - " # 920 - " " Dry.
9/21/89 - " # 508 - " " 34' 10" 33.33
9/21/89 - " # 701 - " " 31' 4½" 29.40
9/21/89 - " # 830 - " " 19' 10" 18.4
9/21/89 - " # 816 - " " 17' 3" 15.67
9/21/89 - " # 811D - " " ~~54' 6½"~~ 54' 7 52.46
9/21/89 - " # 811S - " " ~~27' 11"~~ 27' 11" 26.
9/21/89 - " # 820 - " " 24' 11" 13
~~9/21/89 - " # 701 - " " 31' 5"~~
~~9/21/89 - " # 820 - " " 24' 11"~~

| | | | | | | | test by [illegible] |
|---|---|---|---|---|---|---|---|
| 1/22/89 | # well | # | 830 | ✓ | water | Depth | 20' 18.5" |
| 9/22/89 | # | " | # 816 | ✓ | " | " | 17' 4½" 15.7" |
| 9/22/89 | = | " | # 811S | ✓ | " | " | 28' 02" 27.0 |
| 9/22/89 | = | " | # 811D | ✓ | " | " | 56' 04½" 53' |
| 9/22/89 | = | " | # 508 | ✓ | | | 34' 11" 33.41 |
| 9/22/89 | = | " | # 701 | ✓ | " | " | 31' 9½" 29.3 |
| 9/22/89 | | " | # 806S | ✓ | " | " | 32' 2¾" 30.5 |
| 9/22/89 | | " | # 806D | ✓ | " | " | 68' 1" 66.03 |
| 9/22/89 | | " | # 820 | ✓ | " | " | 25' 23.51 |
| 9/22/89 | | " | # 915 | ✓ | " | " | Dry |
| 9/22/89 | | " | # 828 | ✓ | " | " | 23' 5¼" |
| [illegible]/89 | | " | # 822 | ✓ | " | " | Dry |
| [illegible]/89 | | " | # 920 | ✓ | " | " | DRY |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE: testing wells
W.O. NO.:
DESCRIPTION: test wells for Depth
SHEET NO.:
MADE BY: [illegible]
CHECKED BY: [illegible]
DATE: 9-25-89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 34' 11" | 34.92 |
| 509 | -1.2 | 81' 5½" | 81.18 |
| 701 | -2.0 | 31' 4" | 31.33 |
| 702 | -1.5 | 27' 5½" | 27.46 |
| 805S | -1.06 | 34' 5¼ | 34.44 |
| 805D | -1.11 | 59' 02" | 59.02 |
| 806S | -1.63 | 32' 1 | 32.08 |
| 806D | -2.05 | 67' 11" | 67.92 |
| 807D | -1.63 | 46' 8" | 46.67 |
| 808 | -1.19 | 20' 10" | 20.83 |
| 809 | -1.40 | DRY | |
| 811S | -1.15 | 28' | |
| 811D | -1.6[illegible] | 55' 9½" | 55.[illegible] |
| 812S | -0.98 | 22' 11" | 22.9[illegible] |
| 812D | -1.53 | 23' 6" | 23.5 |
| 813 | -1.16 | 18' 4" | 18.33 |
| 814 | -1.50 | 33' 6½" | 33.[illegible] |
| 815 | -1.41 | 24' 9½" | 24.54 |
| 816 | -1.58 | 17' 4" | 17.33 |
| 820 | -1.19 | 24' 11" | 24.92 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | 47' 11¾" | 47.98 |
| 824 | -1.10 | 48' 5" | 48.42 |
| 825D | -1.18 | 52' 6" | 52.5 |
| 828 | -1.63 | 23' 5" | 23.42 |
| 829S | -1.07 | 30' 10" | 30.83 |
| 829D | -1.55 | 39' | |
| 830 | -1.13 | 22' 01" | 22.01 |
| 833S | -1.18 | 31' 6" | 31.5 |
| 833D | -1.78 | 42' | |
| 835 | -1.38 | 22' | |
| 936 | -1.54 | 27' 2" | 27.17 |
| 938 | -1.13 | DRY | |
| [illegible] | [illegible] | [illegible] | 1.62 |

CHENEY MW WATER LEVELS

(50)

DATE: 9-25-89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | 38' |
| 904 | 9/25/89 | | -1.5' | DRY |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 914 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 0 | " " " | | - | DRY |
| 925 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 932 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |

# CHENEY TEST PIT PIEZOMETERS

DATE: 9/25/89 NAMES: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 9/25/89 | | – | |
| TP 41 | " " " | | – | 30' 11 3/4" 47.98 |
| TP 51 | " " " | | – | 28' 2" 28.17 |
| TP 43 | " " " | | -2.21 | 22' 5" 22.42 |
| TP 44 | " " " | | -3.0 | 26' 4" 26.33 |
| TP 47 | " " " | | -3.0 | 26' 5" 26.42 |
| TP 52 | " " " | | -2.17 | ~~DRY~~ DRY |
| TP 53 | " " " | | -2.25 | DRY |
| TP 54 | " " " | | -3.10 | DRY |
| TP 36 | " " " | | -2.58 | DRY |
| TP 29 | " " " | | -2.46 | 23' 7 1/2" 23.63 |
| TP 28 | " " " | | DRY | DRY |
| TP 58 | " " " | | | DRY |
| TP 57 | " " " | | | DRY |
| TP 60 | " " " | | | 27' 2 1/2" 27.21 |
| TP 116 | " " " | | | 28' 6" 28.5 |
| TP 193 | " " " | | | 18' 1" 18.08 |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION testing water depth in wells

SHEET NO. _____

MADE BY [illegible] CHECKED BY [illegible] DATE 10/2/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 37' 11" | 34.92 |
| 509 | -1.2 | 79' 2" | 79.17 |
| 701 | -2.0 | 31' 4" | 31.33 |
| 702 | -1.5 | 28' | |
| 805S | -1.06 | 34' 11" | 34.03 |
| 805D | -1.11 | 59' 07" | 59.03 |
| 806S | -1.63 | 31' 5" | 31.42 |
| 806D | -2.05 | 68' 4" | 68.42 |
| 807D | -1.63 | 46' 6" | 46.5 |
| 808 | -1.19 | 20' 11" | 20.92 |
| 809 | -1.40 | DRY | |
| 11S | -1.15 | 28' | 28 |
| 11D | -1.6[illegible] | 54' 3" | 54.25 |
| 812S | -0.98 | 22' 8" | 22.67 |
| 812D | -1.53 | 23' 6" | 23.16 |
| 813 | -1.16 | 18' 1" | 18.08 |
| 814 | -1.50 | 33' 4" | 33.33 |
| 815 | -1.41 | 29' 7" | 29.58 |
| 816 | -1.58 | 20' | |
| 820 | -1.19 | 25' | |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | 48' | |
| 824 | -1.10 | 48' 4" | 48.45 |
| 825D | -1.18 | 52' 6" | 52.5 |
| 828 | -1.63 | 23' | |
| 829S | -1.07 | 30' 2" | |
| 829D | -1.55 | 38' 11" | 38.92 |
| 830 | -1.43 | 23' 7" | 23.58 |
| 33S | -1.18 | 36' 2" | 36.17 |
| 33D | -1.78 | 41' 8" | 41.67 |
| 835 | -1.38 | 21' | |
| 936 | -1.51 | 27' 4" | 27.35 |
| 938 | -1.13 | DRY | |

CHENEY MW WATER LEVELS



DATE: 10/2/89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 10/2/89 | | - 1.5' | 27.5" 37.42 |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 914 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 910 | " " " | | - | DRY |
| 925 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 932 | " " " | | - | DRY |
| 9 5 | " " " | | - | DRY |
| 9.7 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |

# CHENEY TEST PIT PIEZOMETERS

DATE: 10/2/89 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS | |
|---|---|---|---|---|---|
| | 10/2/89 | | - | | |
| TP 41 | " " | | - | 32' | |
| TP 51 | " " | | - | 28'6" | 28.5 |
| TP 43 | " " | | [illegible] | 22'7" | 22.58 |
| TP 44 | " " | | -3.0 | 29'5" | 24.42 |
| TP 47 | " " | | -3.0 | 26'6" | 26.5 |
| TP 52 | " " | | -2.17 | DRY | |
| TP 53 | " " | | -2.25 | DRY | |
| TP 4 | " " | | -3.10 | DRY | |
| 36 | " " | | -2.58 | DRY | |
| TP 29 | " " | | -2.46 | 23' | |
| TP 28 | " " | | DRY | DRY | |
| TP 57 | " " | | | DRY | |
| 58 | " " | | | DRY | |
| 60 | " " | | | 27'2" | 27.17 |
| D 116 | " " | | | DRY | |
| TP 143 | " " | | | DRY | |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O NO. _____

DESCRIPTION _____

SHEET NO. _____

MADE BY J.M. CHECKED BY J.M. DATE 10/9/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 39' 11½" | 34.96 |
| 509 | -1.2 | 79' | |
| 701 | -2.0 | 31' 9" | 31.33 |
| 702 | -1.5 | 28' 3" | 28.25 |
| 805S | -1.06 | 39' 9¼" | 34.97 |
| 805D | -1.19 | 59' | |
| 806S | -1.63 | 31' 5" | 31.42 |
| 806D | -2.05 | 68' 6¼" | 68.52 |
| 807D | -1.63 | 96' 6" | 46.51 |
| 808 | -1.19 | 20' 10" | 20.83 |
| 809 | -1.40 | DRY | |
| 811S | -1.15 | 28' 8" | 28.33 |
| 811D | -1.62 | 59' 7" | |
| 812S | -0.98 | 22' 8" | 22.67 |
| 812D | -1.53 | 23' 6" | 23.5 |
| 813 | -1.16 | 18' | |
| 814 | -1.50 | 32' 11" | 32.92 |
| 815 | -1.41 | 29' 7½" | 24.63 |
| 816 | -1.58 | 20' | |
| 820 | -1.49 | 25' 5" | 25.42 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | 48' | |
| 824 | -1.10 | 48' 3" | 48.25 |
| 825D | -1.48 | 52' 10" | 20.83 |
| 828 | -1.63 | 23' | |
| 829S | -1.07 | 30' 9½" | 30.19 |
| 829D | -1.55 | 39' | |
| 830 | -1.43 | 23' 7¼" | 23.6 |
| 833S | -1.18 | 36' 8" | 36.6 |
| 833D | -1.78 | 41' 6" | |
| 835 | -1.38 | 21' 2" | 21.17 |
| 936 | -1.54 | 27' 1" | 27.08 |
| 938 | -1.43 | DRY | |
| | | 11' 8½" | |

# CHENEY TEST PIT PIEZOMETERS

TI 10/2/89 NAME: IVAN

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| TP 41 | | | - | 32' 2" 32.17 |
| TP 51 | | | - | 28' 7" 28.58 |
| TP 43 | | | [illegible] | 22' 8" 22.67 |
| TP 44 | | | -3.0 | 24' 9" [illegible] |
| TP 47 | | | -3.0 | 26' 9" 26.25 |
| TP 52 | | | -2.17 | DRY |
| TP 53 | | | -2.25 | DRY |
| TP 4 | | | -3.10 | DRY |
| 56 | | | -2.58 | DRY |
| TP 29 | | | -2.46 | 24' 1" 24.08 |
| TP 28 | | | DRY | DRY |
| TP 57 | | | | DRY |
| TP 58 | | | | DRY |
| TP 60 | | | | 27' |
| TP 116 | | | | DRY |
| TP 143 | | | | DRY |

# CHENEY MW WATER LEVELS

(57)

DATE: 10/9/89

MAOR BY: J.M.

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 10/9/89 | | -1.5' | 37' 6' 37.5 |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 910 | " " " | | - | DRY |
| 925 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 932 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |
| | | | - | |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE test Drain water in wells W.O.

DESCRIPTION

SHEET NO.

MADE BY ch CHECKED BY ch DATE 10/17/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 36' 1" | 34.58 |
| 509 | -1.2 | 87' 2" | 85.97 |
| 701 | -2.0 | 31' 6" | 29.5 |
| 702 | -1.5 | 27' 8" | 26.17 |
| 805S | -1.06 | DRY | |
| 805D | -1.11 | | 56.42 |
| 806S | -1.63 | 31' 10" | 30.25 |
| 806D | -2.05 | 68' 6 1/4" | 66.47 |
| 807D | -1.63 | 46' 8 1/2" | 45.08 |
| 808 | -1.19 | 20' 11" | 19.93 |
| 809 | -1.40 | DRY | |
| 115 | -1.15 | 27' 10 1/4" | 26.70 |
| 11D | -1.62 | 56' 11" | 55.3 |
| 812S | -0.98 | 22' 9" | 21.7 |
| 812D | -1.53 | 23' 7" | 22.55 |
| 813 | -1.16 | 18' 3 1/4" | 16.81 |
| 814 | -1.50 | 33' 4" | 31.23 |
| 815 | -1.41 | 24' 4" | 22.92 |
| 816 | -1.58 | 19' 6" | 17.92 |
| 820 | -1.49 | [illegible] | 23.64 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.57 | DRY | |
| 824 | -1.10 | DRY | |
| 825D | -1.18 | 52' 6" | 51.02 |
| 828 | -1.63 | 22' 2" | 21.54 |
| 829S | -1.07 | 30' 2" | 29.10 |
| 829D | -1.55 | 38' 10 1/2" | 33.33 |
| 830 | -1.13 | 23' 7" | 22.15 |
| 33S | -1.18 | 36' 2" | 34.99 |
| 33D | -1.78 | 91' 11" | 49.14 |
| 835 | -1.38 | 21' 2" | 19.99 |
| 9[illegible]6 | [illegible] | 27' 3" | 25.51 |
| 9[illegible]2 | [illegible] | DRY | |

# CHENEY TEST PIT PIEZOMETERS

DATE: 10/17/89 NAME: _____

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS | |
|---|---|---|---|---|---|
| | 10/17/89 | | - | | |
| TP 41 | | | - | 31' 2" | 31.17 |
| TP 51 | | | - | 28' 3¼ | 28.27 |
| TP 43 | | | - | 23' 4 | 21.12 |
| TP 44 | | | - | 24' 6" | 21.5 |
| TP 47 | | | -3.0 | [illegible] | 24.5 |
| TP 52 | | | -2.17 | [illegible] | 24.5 |
| TP 53 | | | -2.25 | [illegible] | 29.42 |
| TP 54 | | | -3.10 | 32' [illegible] | 29.48 |
| 36 | | | -2.58 | 25' 4 8 | [illegible] |
| TP 29 | | | -2.46 | 23' 7¾" | 21.19 |
| TP 28 | | | DRY | DRY | |
| TP 57 | | | | 22' 11" | 22.92 |
| TP 58 | | | | DRY | |
| TP 60 | | | | DRY | |
| TP 116 | | | | 33' [illegible] | 33.08 |
| TP 143 | | | | DRY | |
| TP 89 | | | | 27' 6 | 27.5 |
| TP 79 | | | | 28' [illegible] | 28.92 |

# CHENEY MW WATER LEVELS

(60)

DATE: 10/17/89

MADE BY: [illegible]/YM

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 1017 | | - | |
| 904 ✓ | " " " | | -1.5' | [illegible] 35.42 |
| 913 ✓ | " " " | | - | [illegible] |
| 912 ✓ | " " " | | - | [illegible] |
| 914 ✓ | " " " | | - | [illegible] |
| 916 ✓ | " " " | | - | [illegible] |
| 911 ✓ | " " " | | - | [illegible] |
| 918 ✓ | " " " | | - | [illegible] |
| 906 ✓ | " " " | | - | [illegible] |
| 919 ✓ | " " " | | - | [illegible] |
| [illegible] ✓ | " " " | | - | [illegible] |
| 925 | " " " | | - | [illegible] |
| 908 ✓ | " " " | | - | [illegible] |
| 921 ✓ | " " " | | - | [illegible] |
| 932 ✓ | " " " | | - | [illegible] |
| 915 ✓ | " " " | | - | [illegible] |
| 917 ✓ | " " " | | - | [illegible] |
| 920 ✓ | " " " | | - | [illegible] |
| [illegible] | " " " | | - | [illegible] |
| [illegible] | " " " | | - | [illegible] |
| [illegible] | " " " | | - | [illegible] |
| [illegible] | " " " | | - | [illegible] |
| [illegible] | " " " | | - | [illegible] |
| [illegible] | " " " | | - | [illegible] |
| [illegible] | " " " | | - | [illegible] |
| [illegible] | " " " | | - | [illegible] |

10/17/79

#751
#922
#925
#943
#826
#944
#909
#965
#966 not Completed at date

24.13

(62)

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE: tester for DATA
W.O. NO.:
DESCRIPTION: test water depth in wells
SHEET NO.:
MADE BY: J.M.
CHECKED BY: [illegible]
DATE: 10/27/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 36' 2" | 34.6 |
| 509 | -1.2 | 87' | 85.8 |
| 701 | -2.0 | 31' 4" | 29.33 |
| 702 | -1.5 | 28' | 26.5 |
| 805S | -1.06 | DRY | |
| 805D | -1.41 | 57' 11 1/4" | 56.5 |
| 806S | -1.63 | 31' 11" | 30.29 |
| 806D | -2.05 | 68' 6" | 66.45 |
| 807D | -1.63 | 46' 10" | 45.20 |
| 808 | -1.49 | 21' | 19.51 |
| 809 | -1.40 | DRY | |
| 11S | -1.15 | 28' | 26.85 |
| 11D | -1.62 | 56' 11" | 55.2 |
| 812S | -0.98 | 22' 10" | 21.85 |
| 812D | -1.53 | 23' 7 1/2" | 22.1 |
| 813 | -1.46 | 18' 3" | 16.79 |
| 814 | -1.50 | 33' 6" | 32 |
| 815 | -1.41 | 24' 3" | 22.84 |
| 816 | -1.58 | 19' 8 1/4" | 18.11 |
| 820 | -1.49 | 25' | 23.51 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | DRY | |
| 824 | -1.40 | DRY | |
| 825D | -1.48 | 52' 8" | 51.19 |
| 828 | -1.63 | 23' 2 1/2" | 21.58 |
| 829S | -1.07 | 30' 4" | 29.26 |
| 829D | -1.55 | 38' 11" | 37.27 |
| 830 | -1.43 | 23' 7 1/2" | 22.20 |
| 833S | -1.18 | 36' 3" | 35.22 |
| 833D | -1.78 | 41' 10" | 40.05 |
| 835 | -1.38 | 21' | 19.62 |
| 936 | -1.54 | 27' | 25.46 |
| 938 | -1.43 | DRY | |

# CHENEY MW WATER LEVELS

(63)

DATE: 10/27/87

MADE BY: d/m.

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | DEPTH TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 10/27/89 | | - 1.5' | 37' >5.5 |
| 913 | " " " | | - | DRY |
| 912 | " " " | | - | DRY |
| 914 | " " " | | - | DRY |
| 916 | " " " | | - | DRY |
| 911 | " " " | | - | DRY |
| 918 | " " " | | - | DRY |
| 906 | " " " | | - | DRY |
| 919 | " " " | | - | DRY |
| 910 | " " " | | | DRY |
| 925 | " " " | | - | DRY |
| 908 | " " " | | - | DRY |
| 921 | " " " | | - | DRY |
| 932 | " " " | | - | DRY |
| 915 | " " " | | - | DRY |
| 917 | " " " | | - | DRY |
| 920 | " " " | | - | DRY |
| 831 | " " " | | - | DRY |
| 926 | " " " | | - | DRY |
| 946 | " " " | | - | DRY |
| 950 | " " " | | - | DRY |
| 949 | " " " | | - | DRY |
| 956 | " " " | | - | DRY |
| 955 | " " " | | - | DRY |
| 954 | " " " | | - | DRY |
| 927 | | | | 22' 0" 4475 |

(4)

# CHENEY TEST PIT PIEZOMETERS

TIME: 10/27/89 NAME: JM

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS | |
|---|---|---|---|---|---|
| | 10/27/89 | | - | | |
| TP 41 | | | - | 3" | |
| TP 51 | | | - | 2' 4½" | |
| TP 43 | | | | 2' 6¼ | |
| TP 44 | | | -3.0 | 24' 5" | 21.41 |
| TP 47 | | | -3.0 | 27' 3" | 24.25 |
| TP 52 | | | -2.17 | 26' 8" | 24.49 |
| TP 53 | | | -2.25 | 31' 8¼" | 29.44 |
| -4 | | | -3.10 | 32' 6" | 29.4 |
| 36 | | | -2.58 | 25.48 | 22.9 |
| TP 29 | | | -2.46 | 23' 8" | 21.21 |
| TP 28 | | | DRY | DRY. | |
| TP 57 | | | | 23' | 23 |
| TP 58 | | | | DRY | |
| TP 60 | | | | DRY | |
| TP 116 | | | | 33' 2" | 33.17 |
| TP 143 | | | | DRY | |
| TP 88 | | | | 27' 6½" | 27.54 |
| TP 89 | | | | 28' 11" | 28.92 |

| | | |
|---|---|---|
| ist by LM. | 10/27/89 | Depth |
| Jell X | | DRY |
| Jell not Numbered | | DRY |
| # 951 | | DRY |
| # 922 | | DRY |
| # 923 | | DRY |
| # 943 | | DRY |
| # 826 | | DRY |
| # 944 | | DRY |
| # 909 | | DRY |
| # 965 | | 24.14 |
| ~~# 966~~ | ~~Not Complete~~ | |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE Test Data Water Depth W.O. NO.

DESCRIPTION

SHEET NO.

MADE BY [illegible] CHECKED BY [illegible] DATE 10/20/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 35.30 | 33.8 |
| 509 | -1.2 | 75.67 | 74.41 |
| 701 | -2.0 | 31.45 | 29.43 |
| 702 | -1.5 | 27.92 | 26.42 |
| 805S | -1.06 | 34.73 | 33.67 |
| 805D | -1.11 | 59.67 | 58.23 |
| 806S | -1.63 | 32.18 | 30.52 |
| 806D | -2.05 | [illegible] | 66.81 |
| 807D | -1.63 | 47.15 | 45.52 |
| 808 | -1.49 | 21.15 | 19.64 |
| 809 | -1.40 | DRY | |
| 11S | -1.15 | [illegible] | 27.28 |
| 811D | -1.62 | [illegible] | 42.33 |
| 812S | -0.98 | [illegible] | 22.01 |
| 812D | -1.53 | [illegible] | 22.36 |
| 813 | -1.46 | [illegible] | 17.64 |
| 814 | -1.50 | [illegible] | 32.37 |
| 815 | -1.41 | [illegible] | 23.31 |
| 816 | -1.58 | [illegible] | 16.17 |
| 820 | -1.49 | 25.13 | 23.64 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | DRY | |
| 824 | -1.10 | | |
| 825D | -1.48 | 53.16 | 51.68 |
| 828 | -1.63 | 23.87 | 22.24 |
| 829S | -1.07 | 39.6 | 38.44 |
| 829D | -1.55 | 39.17 | 37.62 |
| 830 | -1.43 | 23.83 | 22.4 |
| 33S | -1.18 | [illegible] | 34.82 |
| 833D | -1.78 | [illegible] | 48.4 |
| 835 | -1.38 | [illegible] | 19.83 |
| 936 | -1.51 | [illegible] | 26. |
| 938 | -1.13 | [illegible] | |

CHENEY MW WATER LEVELS

(67)

DATE: 10/30/89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 10/30/89 | | -1.5' | 37.70 362 |
| 913 | " | | - | DRY |
| 912 | " | | - | DRY |
| 914 | " | | - | DRY |
| 916 | " | | - | DRY |
| 911 | " | | - | DRY |
| 918 | " | | - | DRY |
| 906 | " | | - | DRY |
| 919 | " | | - | DRY |
| 910 | " | | - | DRY |
| 925 | " | | - | DRY |
| 908 | " | | - | DRY |
| 921 | " | | - | DRY |
| 932 | " | | - | DRY |
| 915 | " | | - | DRY |
| 917 | " | | - | DRY |
| 920 | " | | - | DRY |
| 927 | " | | - | 44.83 |
| 831 | " | | - | DRY |
| 926 | " | | - | DRY |
| 946 | " | | - | DRY |
| 950 | " | | - | DRY |
| 949 | " | | - | DRY |
| 956 | " | | - | DRY |
| 955 | " | | - | DRY |
| 954 | " | | | DRY |

10/8/79

951
922

74
74
101
975
980
972
976
983

5
131

DRY

# CHENEY TEST PIT PIEZOMETERS

DATE: 10/30/89 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS | |
|---|---|---|---|---|---|
| | | | - | | |
| TP 41 | | | - | 31.23 | |
| TP 51 | | | - | 28.34 | |
| TP 43 | | | [illegible] | 22.67 | 20.46 |
| TP 44 | | | -3.0 | 24.23 | 21.23 |
| TP 47 | | | -3.0 | 26.56 | 23.56 |
| TP 52 | | | -2.17 | DRY | |
| TP 53 | | | -2.25 | DRY | |
| TP 54 | | | -3.10 | DRY | |
| 36 | | | -2.58 | 23.83 | 21.25 |
| TP 29 | | | -2.46 | 23.80 ~~DRY~~ | 21.34 |
| TP 28 | | | DRY | ~~23.~~ DRY | |
| TP 57 | | | | DRY | |
| TP 58 | | | | DRY | |
| TP 60 | | | | 27.23 | |
| TP 116 | | | | 28.62 | |
| TP 143 | | | | DRY | |
| TP 56 | | | | 22.96 (DRY) | |
| TP 88 | | | | 27.65 (DRY) | |
| TP 89 | | | | 29.28 | |
| TP 92 | | | | 30.91 (DRY) | |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____

SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE 11/6/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 35.21 | 33.71 |
| 509 | -1.2 | 75.34 | 74.14 |
| 701 | -2.0 | 31.03 | 29.03 |
| 702 | -1.5 | 27.90 | 26.4 |
| 805S | -1.06 | 34.76 | 33.7 |
| 805D | -1.19 | 59.67 | 58.23 |
| 806S | -1.63 | 32.11 | 30.48 |
| 806D | -2.05 | 68.83 | 66.78 |
| 807D | -1.63 | 47.17 | 45.54 |
| 808 | -1.19 | 21.11 | 19.62 |
| 809 | -1.40 | DRY | |
| 1S | -1.16 | 28.41 | 27.26 |
| 811D | -1.62 | 48.95 | 47.33 |
| 812S | -0.98 | 22.93 | 21.95 |
| 812D | -1.53 | 23.92 | 22.39 |
| 813 | -1.16 | 19.01 | 17.55 |
| 814 | -1.50 | 33.82 | 32.32 |
| 815 | -1.41 | 24.70 | 23.29 |
| 816 | -1.58 | 17.79 | 16.21 |
| 820 | -1.49 | 25.10 | 23.61 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.58 | DRY | |
| 824 | -1.40 | DRY | |
| 825D | -1.48 | 53.13 | 51.65 |
| 828 | -1.63 | 23.89 | 22.25 |
| 829S | -1.07 | 39.19 | 37.12 |
| 829D | -1.55 | 39.16 | 37.61 |
| 830 | -1.43 | 23.80 | 22.37 |
| 833S | -1.18 | 36.0 | 34.82 |
| 833D | -1.78 | 50.14 | 48.36 |
| 835 | -1.38 | 21.20 | 19.82 |
| 836 | -1.54 | 27.52 | 25.98 |
| 838 | -1.43 | DRY | |

# CHENEY MW WATER LEVELS

(71)

DATE: 11/6/89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | 11/6/89 | | -1.5' | 37.73 36.23 |
| 913 | " | | - | DRY |
| 912 | " | | - | DRY |
| 914 | " | | - | DRY |
| 916 | " | | - | DRY |
| 911 | " | | - | DRY |
| 918 | " | | - | DRY |
| 906 | " | | - | DRY |
| 919 | " | | - | DRY |
| 910 | " | | - | DRY |
| 925 | " | | - | DRY |
| 908 | " | | - | DRY |
| 921 | " | | - | DRY |
| 932 | " | | - | DRY |
| 915 | " | | - | DRY |
| 917 | " | | - | DRY |
| 920 | " | | - | DRY |
| 927 | " | | - | 44.80 |
| 831 | " | | - | DRY |
| 926 | " | | - | DRY |
| 946 | " | | - | DRY |
| 950 | " | | - | DRY |
| 949 | " | | - | DRY |
| 956 | " | | - | DRY |
| 955 | " | | - | DRY |
| [illegible] | [illegible] | | | [illegible] |

| Well No. | | Depth |
|---|---|---|
| DATE 11/6/89 | Test by [illegible] | |
| not Numbered | | DRY |
| Marked x | | DRY |
| ± 951 | | DRY |
| 922 | | DRY |
| 923 | | DRY |
| 943 | | DRY |
| 826 | | DRY |
| ± 944 | | DRY |
| ± 909 | | DRY |
| ± 965 | | 23.92 |
| ± 966 | | 26.84 |
| 972 | | 88.99 |
| ± 974 | | 137.4 |
| ± 981 | | 78.46 |
| 975 | | 80.43 |
| ± 980 | | 79.40 |
| ± 973 | 56' | DRY |
| 976 | 130' | DRY |
| # 983 | | DRY |
| # 970 | 30'6" Depth | DRY |
| # 969 | | DRY |

# CHENEY TEST PIT PIEZOMETERS

DATE: 11/6/89 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS | |
|---|---|---|---|---|---|
| | 11/6/89 | | - | | |
| TP 41 | " | | - | [illegible] | |
| TP 51 | " | | - | [illegible] | |
| TP 43 | " | | [illegible] | [illegible] | 19.95 |
| TP 44 | " | | -[illegible] | [illegible] | 19.65 |
| TP 47 | " | | -[illegible]0 | [illegible] | 24.92 |
| TP 52 | " | | -2.17 | [illegible] | 24.42 |
| TP 53 | " | | -2.25 | [illegible] | 28.53 |
| TP 54 | " | | -3.10 | [illegible] | 28.66 |
| 36 | " | | -2.58 | [illegible] | 22.7 |
| TP 29 | " | | -2.46 | [illegible] | 21.59 |
| TP 28 | " | | DRY | DRY | |
| TP 57 | " | | | [illegible] | |
| TP 58 | " | | | [illegible] | |
| TP 60 | " | | | [illegible] | |
| TP 116 | " | | | [illegible] | |
| TP 143 | " | | | [illegible] | |
| TP 89 | " | | | [illegible] | |
| TP 88 | " | | [illegible] | 30.27 | |
| TP 92 | " | | [illegible] | 30.71 | |
| TP 56 | " | | | 23.01 | |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE Testing Depth Data W.O. NO.

DESCRIPTION

SHEET NO.

MADE BY CHECKED BY DATE 11/13/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 35.63 | 34.13 |
| 509 | -1.2 | 76.07 | 74.87 |
| 701 | -2.0 | 31.0 | 29 |
| 702 | -1.5 | 28.01 | 26.51 |
| 805S | -1.06 | 34.78 | 33.72 |
| 805D | -1.44 | 59.74 | 57.7 |
| 806S | -1.63 | 33.02 | 31.39 |
| 806D | -2.05 | 68.91 | 66.86 |
| 807D | -1.63 | 47.13 | 45.5 |
| 808 | -1.49 | 22.0 | 20.51 |
| 809 | -1.40 | DRY | |
| 11S | -1.15 | 28.62 | 27.47 |
| 811D | -1.62 | 48.99 | 47.37 |
| 812S | -0.98 | 22.91 | 21.93 |
| 812D | -1.53 | 23.96 | 22.43 |
| 813 | -1.46 | 19.07 | 17.61 |
| 814 | -1.50 | 33.80 | 32.3 |
| 815 | -1.41 | 24.72 | 23.31 |
| 816 | -1.58 | 17.77 | 16.19 |
| 820 | -1.49 | 25.14 | 23.65 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.38 | DRY | |
| 824 | -1.40 | DRY | |
| 825D | -1.48 | 53.16 | 51.68 |
| 828 | -1.63 | 23.92 | 22.29 |
| 829S | -1.07 | 39.16 | 38.09 |
| 829D | -1.55 | 39.19 | 37.64 |
| 830 | -1.43 | 23.89 | 22.46 |
| 33S | -1.18 | 36.06 | 34.88 |
| 33D | -1.78 | 50.12 | 48.34 |
| 835 | -1.38 | 21.32 | 19.94 |
| 936 | -1.54 | 27.52 | 25.98 |
| 938 | -1.43 | DRY | |

# CHENEY MW WATER LEVELS



DATE: 11/13/89

MEAS BY: L.M.

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| 904 | | | -1.5' | 37.79 36.29 |
| 913 | | | - | DRY |
| 912 | | | - | DRY |
| 914 | | | - | DRY |
| 916 | | | - | DRY |
| 911 | | | - | DRY |
| 918 | | | - | DRY |
| 906 | | | - | DRY |
| 919 | | | - | DRY |
| 910 | | | - | DRY |
| 925 | | | - | DRY |
| 908 | | | - | DRY |
| 921 | | | - | DRY |
| 932 | | | - | DRY |
| 915 | | | - | DRY |
| 917 | | | - | DRY |
| 920 | | | - | DRY |
| 927 | | | - | 44.87 |
| 831 | | | - | DRY |
| 926 | | | - | DRY |
| 946 | | | - | DRY |
| 950 | | | - | DRY |
| 949 | | | - | DRY |
| 956 | | | - | DRY |
| 955 | | | - | DRY |
| 954 | | | | DRY |

DATE 11/13/89 Test by L.M.

| Well No. | | Depth |
|---|---|---|
| Numbered | | DRY |
| Marked x | | DRY |
| 951 | | DRY |
| 922 | | DRY |
| 923 | | DRY |
| 943 | | DRY |
| 826 | | DRY |
| 944 | | DRY |
| 909 | | DRY |
| 965 | | 23.94 |
| 966 | | 26.87 |
| 72 | | 88.93 |
| 974 | | 137.31 |
| 981 | | 78.42 |
| 975 | | 80.72 |
| 980 | | 79.61 |
| 973 | | DRY |
| 976 | | DRY |
| 983 | | DRY |
| 970 | | DRY |
| 969 | | DRY |
| 979 | | 82.37 |
| 982 | (4" PVC) | 82.37 |

# CHENEY TEST PIT PIEZOMETERS

DATE: 11/13/89 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| TP 41 | | | - | 31.36 |
| TP 51 | | | - | 28.24 |
| TP 43 | | | [illegible] | 22.13 |
| TP 44 | | | [illegible] | 22.67 19.67 |
| TP 47 | | | -3.0 | 27.94 (DRY) |
| TP 52 | | | -2.17 | 26.60 (DRY) |
| TP 53 | | | -2.25 | 30.79 (DRY) |
| TP 54 | | | -3.10 | 32.78 (DRY) |
| 36 | | | -2.58 | 25.29 (DRY) |
| TP 29 | | | -2.46 | 24.15 |
| TP 28 | | | DRY | DRY |
| TP 57 | | | | DRY |
| TP 58 | | | | 29.16 (DRY) |
| TP 60 | | | | DRY |
| TP 116 | | | | 28.66 |
| TP 143 | | | | DRY |
| TP 89 | | | | 29.36 |
| TP 88 | | | | 30.90 (DRY) |
| TP 92 | | | | 30.91 (DRY) |
| TP 56 | | | | 23.11 |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE: Well Depth, Ex.
W.O. NO.:
DESCRIPTION: DATA Water Levi.
SHEET NO.:
MADE BY: [illegible]
CHECKED BY: [illegible]
DATE: 11/21/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | [illegible] | 34.10 |
| 509 | -1.2 | 71.21 | 70.01 |
| 701 | -2.0 | [illegible] | 29.23 |
| 702 | -1.5 | [illegible] | 26.57 |
| 805S | -1.06 | [illegible] | |
| 805D | -1.11 | 57.[illegible] | 56.36 |
| 806S | -1.63 | [illegible] | 30.78 |
| 806D | -2.05 | [illegible] | 65.91 |
| 807D | -1.63 | [illegible] | 45.61 |
| 808 | -1.19 | | 19.67 |
| 809 | -1.40 | | |
| 11S | -1.15 | | 27.52 |
| 11D | -1.62 | 58.[illegible] | 56.59 |
| 812S | -0.98 | [illegible] | 22.26 |
| 812D | -1.53 | [illegible] | 22.5- |
| 813 | -1.16 | | 15.7 |
| 814 | -1.50 | [illegible] | 32.03 |
| 815 | -1.41 | [illegible] | 23.13 |
| 816 | -1.58 | | 16.08 |
| 820 | -1.19 | | 27.67 |
| 821D | -1.65 | | |
| 822 | -1.58 | | |
| 823D | -1.38 | | |
| 824 | -1.10 | | |
| 825D | -1.48 | [illegible] | 51.41 |
| 828 | -1.63 | [illegible] | 22.35 |
| 829S | -1.07 | [illegible] | 32.07 |
| 829D | -1.55 | [illegible] | 30.67 |
| 830 | -1.43 | [illegible] | 19.48 |
| 833S | -1.18 | | 34.85 |
| 33D | -1.78 | | 50.18 |
| 835 | -1.38 | | 19.77 |
| 936 | -1.54 | [illegible] | 25.65 |
| 938 | -1.43 | | |

# CHENEY MW WATER LEVELS



DATE: _____

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED 11/27/89 | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| 903 | | | - | 32.54 |
| 904 | | | -1.5' | 37.86 37.36 |
| 913 | | | - | DRY |
| 912 | | | - | DRY |
| 914 | | | - | DRY |
| 916 | | | - | DRY |
| 911 | | | - | DRY |
| 918 | | | - | DRY |
| 906 | | | - | DRY |
| 919 | | | - | DRY |
| 910 | | | - | DRY |
| 925 | | | - | DRY |
| 908 | | | - | DRY |
| 921 | | | - | DRY |
| 932 | | | - | DRY |
| 915 | | | - | DRY |
| 917 | | | - | DRY |
| 920 | | | - | DRY |
| 927 | | | - | 44.92 |
| 831 | | | - | DRY |
| 926 | | | - | DRY |
| 946 | | | - | DRY |
| 950 | | | - | DRY |
| 949 | | | - | DRY |
| 956 | | | - | DRY |
| 955 | | | - | DRY |
| 954 | | | | DRY |

Well No. DATE 11/20/89 Test by [illegible] Depth

Numbered

Marked x

951

922

923

943

826

944

909

965

966

72

974

981

975

980

973

976

983

970

969

979

982

963 Angle Hole (pre 2" 5.65 from ground)

967

905 (49' Depth)

# CHENEY TEST PIT PIEZOMETERS

DATE: 11/20/89 NAME: by [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| TP 91 | | | - | [illegible] |
| TP 51 | | | - | [illegible] |
| TP 43 | | | [illegible] | [illegible] 19.87 |
| TP 44 | | | -3.0 | [illegible] 19.69 |
| TP 47 | | | -3.0 | 24.96 |
| TP 52 | | | -2.17 | 24.4 |
| TP 53 | | | -2.25 | [illegible] 21.5 |
| TP 54 | | | -3.10 | [illegible] |
| TP 36 | | | -2.58 | [illegible] 22.7 |
| TP 29 | | | -2.46 | [illegible] 21.69 |
| TP 28 | | | DRY | |
| TP 57 | | | — | |
| TP 58 | | | | [illegible] |
| TP 60 | | | | |
| TP 116 | | | | |
| TP 143 | | | | [illegible] |
| TP 89 | | | | [illegible] |
| TP 88 | | | | [illegible] |
| TP 92 | | | | [illegible] |
| TP 56 | | | | [illegible] |

Well No. DATE 12/13/89 Test by [illegible] Depth

Numbered

Marked x

951

922

923

943

826

944

909

965

966

72

974

981

975

980

973

976

983

970

969

979

982

963 Angle hole (PVC 2" = 5.65 from ground)

967

905 (49' Depth)

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE Well tester W.O. NO.

DESCRIPTION test wells DATA Depth

SHEET NO.

MADE BY CHECKED BY DATE 12/14/89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | [illegible] | 33.6 |
| 509 | -1.2 | [illegible] | 63.97 |
| 701 | -2.0 | [illegible] | 29.32 |
| 702 | -1.5 | 27.7[illegible] | 26.29 |
| 805S | -1.06 | D[illegible] | |
| 805D | -1.11 | 57.[illegible] | 56.37 |
| 806S | -1.63 | 32.[illegible] | 30.62 |
| 806D | -2.05 | [illegible] | 65.57 |
| 807D | -1.63 | [illegible] | 41.[illegible] |
| 808 | -1.49 | [illegible] | 19.45 |
| 809 | -1.40 | | |
| 811S | -1.15 | | 26.42 |
| 811D | -1.6[illegible] | | 5[illegible] |
| 812S | -0.98 | [illegible] | 22.17 |
| 812D | -1.53 | 2[illegible] | 22.39 |
| 813 | -1.16 | [illegible] | 15.38 |
| 814 | -1.50 | [illegible] | 31.81 |
| 815 | -1.41 | [illegible] | 22.6 |
| 816 | -1.58 | [illegible] | 15.53 |
| 820 | -1.49 | [illegible] | 28.01 |
| 821D | -1.65 | | |
| 822 | -1.58 | | |
| 823D | -1.[illegible]8 | | |
| 824 | -1.40 | | |
| 825D | -1.18 | | 51.37 |
| 828 | -1.63 | 23.3[illegible] | 21.71 |
| 829S | -1.07 | [illegible] | 29.55 |
| 829D | -1.55 | 35.50 | 33.95 |
| 830 | -1.43 | [illegible] | 18.06 |
| 833S | -1.18 | [illegible] | 37.[illegible] |
| 833D | -1.78 | [illegible] | 50 |
| 835 | -1.38 | [illegible] | 19.74 |
| 936 | -1.51 | [illegible] | 25.08 |
| 938 | -1.43 | [illegible] | |

# CHENEY MW WATER LEVELS

(89)

DATE: 12/14-89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | DEPTH TOC | DEPTH BLS |
|---|---|---|---|---|
| 903 | / | | - | = |
| 904 | | | - 1.5' | 36.[illegible] |
| 913 | | | - | |
| 912 | | | - | |
| 914 | | | - | |
| 916 | | | - | |
| 911 | | | - | |
| 918 | | | - | |
| 906 | | | - | |
| 919 | | | - | |
| | | | - | |
| 925 | | | - | |
| 908 | | | - | |
| 921 | | | - | |
| 932 | | | - | |
| 915 | | | - | |
| 917 | | | - | |
| 920 | | | - | |
| 927 | | | - | 14.[illegible] |
| 831 | | | - | |
| 926 | | | - | |
| 996 | | | - | |
| [illegible]0 | | | - | |
| [illegible] | | | - | |
| 956 | | | - | |
| 955 | | | - | |
| 954 | | | - | |

# CHENEY TEST PIT PIEZOMETERS

DATE: 12/14/89 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | | | - | |
| TP 41 | | | - | |
| TP 51 | | | - | |
| TP 43 | | | - | 30.51 |
| TP 44 | | | -3.0 | 24 |
| TP 47 | | | -3.0 | 23.6 |
| TP 52 | | | -2.17 | 28.64 |
| TP 53 | | | -2.25 | 30.55 |
| TP 54 | | | -3.10 | 22.17 |
| 36 | | | -2.58 | |
| TP 29 | | | -2.46 | |
| TP 28 | | | DRY | |
| TP 57 | | | | |
| TP 58 | | | | |
| TP 60 | | | | |
| TP 116 | | | | |
| TP 143 | | | | |
| TP 89 | | | | |
| TP 88 | | | | |
| TP 92 | | | | |
| TP 56 | | | | |

**MK-FERGUSON COMPANY**
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION test water test wells

SHEET NO. _____

MADE BY [illegible] CHECKED BY [illegible] DATE 12-28-89

| | TOC | LSD | |
|---|---|---|---|
| 508 | -1.5 | 35.81 | 34.31 |
| 509 | -1.2 | 71.01 | [illegible] |
| 701 | -2.0 | 31.15 | 29.15 |
| 702 | -1.5 | 28.96 | 27.46 |
| 805S | -1.06 | DRY | |
| 805D | -1.44 | 57.97 | 56.53 |
| 806S | -1.63 | 32.30 | 30.67 |
| 806D | -2.05 | 67.78 | 65.73 |
| 807D | -1.63 | 47.26 | 45.63 |
| 808 | -1.49 | 21.01 | 19.52 |
| 809 | -1.40 | DRY | |
| 11S | -1.15 | 28.36 | [illegible] |
| 11D | -1.6[illegible] | 58.11 | 56.[illegible] |
| 812S | -0.98 | 23.30 | 22.32 |
| 812D | -1.53 | 23.92 | 22.39 |
| 813 | -1.46 | 16.06 | [illegible] |
| 814 | -1.50 | 32.40 | 31.90 |
| 815 | -1.41 | 29.32 | 27.91 |
| 816 | -1.58 | 16.78 | 15.20 |
| 820 | -1.49 | 29.22 | 27.73 |
| 821D | -1.65 | DRY | |
| 822 | -1.58 | DRY | |
| 823D | -1.39 | DRY | |
| 824 | -1.10 | DRY | |
| 825D | -1.48 | 52.99 | 51.51 |
| 828 | -1.63 | 24.10 | 22.47 |
| 829S | -1.07 | 31.03 | 29.96 |
| 829D | -1.55 | 36.21 | 34.66 |
| 830 | -1.43 | 20.94 | 19.51 |
| 833S | -1.18 | 36.0 | 34.82 |
| 833D | -1.78 | 52.02 | 50.24 |
| 835 | -1.38 | 21.09 | 19.71 |
| 936 | -1.54 | 27.22 | [illegible] |
| 938 | -1.43 | DRY | |

# CHENEY MW WATER LEVELS



DATE: 12-28-89

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| 903 | 12-28-89 | | - | 32.59 |
| 904 | " | | -1.5' | 35.88 |
| 913 | " | | - | DRY |
| 912 | " | | | DRY |
| 914 | " | | - | DRY |
| 916 | " | | | DRY |
| 911 | " | | - | DRY |
| 918 | " | | - | DRY |
| 906 | " | | | DRY |
| 919 | " | | | DRY |
| 910 | " | | - | DRY |
| 925 | " | | - | DRY |
| 908 | " | | - | DRY |
| 921 | " | | - | DRY |
| 932 | " | | - | DRY |
| 915 | " | | - | DRY |
| 917 | " | | - | DRY |
| 920 | " | | - | DRY |
| 927 | " | | - | 45.12 |
| 831 | " | | - | DRY |
| 926 | " | | - | DRY |
| 946 | " | | - | DRY |
| 950 | " | | - | DRY |
| 949 | " | | - | DRY |
| 956 | " | | - | DRY |
| 955 | " | | - | DRY |

DATE 12-29-89 Test by [illegible]

| NO. | Depth |
|---|---|
| Numbered | DRY |
| Marked x | DRY |
| 951 | DRY |
| 922 | DRY |
| 923 | DRY |
| 943 | DRY |
| 826 | DRY |
| 944 | DRY |
| 909 | DRY |
| 965 | 23.74 |
| 966 | 26.58 |
| 72 | 64.96 |
| 974 | 117.30 |
| 981 | 74.60 |
| 975 | 73.31 |
| 980 | 73.93 |
| 973 | DRY |
| 976 | DRY |
| 983 | DRY |
| 970 | DRY |
| 969 | DRY |
| 979 | 72.33 |
| 982 | 72.42 |
| 963 | 73.67 |
| 967 | 25.92 |
| 905 | 46.13 |

Angle hole 2" PVC is 5.6[illegible]

CHENEY TEST PIT PIEZOMETERS

DATE: 12-29-89 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 12-29-89 | | – | |
| TP 91 | " | | – | 28.28 |
| TP 51 | " | | – | 22.08 |
| TP 93 | " | | – | DRY |
| TP 94 | " | | – [illegible] | DRY |
| TP 97 | " | | – 3.0 | DRY |
| TP 52 | " | | – 2.17 | DRY |
| TP 53 | " | | – 2.25 | DRY |
| TP 54 | " | | – 3.10 | 24.19 |
| TP 36 | " | | – 2.58 | DRY |
| TP 29 | " | | – 2.46 | DRY |
| TP 28 | " | | DRY | DRY |
| TP 57 | " | | | DRY |
| TP 58 | " | | | 28.64 |
| TP 60 | " | | | DRY |
| TP 116 | " | | | 29.39 |
| TP 143 | " | | | DRY |
| | | | | DRY |

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE DATa on Wells Recovery W.O. NO.

DESCRIPTION Check water levi on well's

SHEET NO.

MADE BY [illegible] CHECKED BY [illegible] DATE Jan 17-90

| | TOC | LSD |
|---|---|---|
| 508 | -1.5 | 35.87 |
| 509 | -1.2 | 71.80 |
| 701 | -2.0 | 31.41 |
| 702 | -1.5 | 29.62 |
| 805S | -1.06 | DRY |
| 805D | -1.14 | 56.03 |
| 806S | -1.63 | 32.30 |
| 806D | -2.05 | 68.0 |
| 807D | -1.63 | 47.52 |
| 808 | -1.19 | 21.11 |
| 809 | -1.40 | DRY |
| 811S | -1.15 | 28.88 |
| 811D | -1.62 | 58.31 |
| 125 | -0.98 | 23.20 |
| 812D | -1.53 | 29.36 |
| 813 | -1.16 | 17.01 |
| 814 | -1.50 | 33.86 |
| 815 | -1.41 | 29.91 |
| 816 | -1.58 | 16.83 |
| 820 | -1.19 | 29.72 |
| 821D | -1.65 | DRY |
| 822 | -1.58 | DRY |
| 823D | -1.38 | DRY |
| 824 | -1.10 | DRY |
| 825D | -1.48 | 53.21 |
| 828 | -1.63 | 29.19 |
| 829S | -1.07 | 31.36 |
| 829D | -1.55 | 36.37 |
| 830 | -1.43 | 21.19 |
| 833S | -1.18 | 36.70 |
| 833D | -1.78 | 52.19 |
| 35 | -1.38 | 21.32 |
| 936 | -1.54 | 27.37 |
| 938 | -1.43 | DRY |
| 939 | -1.56 | 17.02 |

DATE: 01-17-90

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| 903 | 01-17-90 | | - | 32.79 |
| 904 | " | | -1.5' | 35.87 |
| 913 | " | | - | DRY |
| 912 ✓ | " to be abandoned | | - | DRY |
| 919 ✓ | " " " " | | - | DRY |
| 916 ✓ | " " " " | | - | DRY |
| 911 ✓ | " " " " | | - | DRY |
| 918 ✓ | " " " " | | - | DRY |
| 906 ✓ | " " " " | | - | DRY |
| 919 | " | | - | DRY |
| 910 ✓ | to be abandoned | | - | DRY |
| ~~925 ✓~~ | ~~abandoned well~~ | | | ~~DRY~~ |
| 908 ✓ | " " | | - | DRY |
| 921 ✓ | " " | | - | DRY |
| 932 ✓ | to be abandoned | | - | DRY |
| 915 | " | | - | DRY |
| ~~917 ✓~~ | ~~abandoned well~~ | | - | ~~DRY~~ |
| ~~920 ✓~~ | ~~abandoned well~~ | | | ~~DRY~~ |
| 927 | | | - | 45.21 |
| 831 | | | - | DRY |
| 926 ✓ | to be abandoned | | - | DRY |
| 946 | | | - | DRY |
| ~~950 ✓~~ | ~~abandoned well~~ | | | ~~DRY~~ |
| ~~949 ✓~~ | ~~abandoned well~~ | | - | ~~DRY~~ |
| 956 | | | - | DRY |
| 955 | | | | DRY |
| 954 | | | | DRY |

| Well No. | DATE. 01-17-90 Test by Tom | Depth |
|---|---|---|
| Numbered | | DRY |
| Marked x | | DRY |
| 951 | | DRY |
| 922 ✓ | to be Abandoned | DRY |
| 923 ✓ | to be Abandoned | DRY |
| 943 | | DRY |
| 826 | | DRY |
| 944 | | DRY |
| 909 ✓ | to be Abandoned | DRY |
| 965 | | 23.76 |
| 966 | | 26.71 |
| 972 | | 64.99 |
| 74 | | 117.37 |
| 981 | | 76.85 |
| 975 | | 77.78 |
| 980 | | 77.39 |
| 973 | | DRY |
| 976 | | DRY |
| 983 | | DRY |
| 970 | | DRY |
| 969 | | DRY |
| 979 | | 82.77 |
| 982 | | 75.30 |
| 963 | Angle Hole | 83.51 |
| 967 | | 26.02 |
| 905 | 49' Depth | 96.13 |

CHENEY TEST PIT PIEZOMETERS

DATE: 01-18-90 NAME: [illegible]

| TEST PIT NO. | DATE | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| | 01-18-90 | | - | 31.37 |
| TP 41 | " | | - | 28.61 |
| TP 51 | " | | - | 22.01 |
| TP 43 | " | | | DRY |
| TP 44 | " | | -3.0 | DRY |
| TP 47 | " | | -3.0 | DRY |
| TP 52 | " | | -2.17 | DRY |
| TP 53 | " | | -2.25 | DRY |
| TP 54 | " | | -3.10 | 28.01 (DRY) |
| TP 36 | " | | -2.58 | DRY |
| TP 29 | " | | -2.46 | DRY |
| TP 28 | " | | DRY | DRY |
| TP 57 | " | | | DRY |
| TP 58 | " | | | DRY |
| TP 60 | " | | | DRY |
| TP 116 | " | | | 29.67 (DRY) |
| TP 143 | " | | | DRY |
| | | | | ? |

DATE: 02-01-90

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| # 967 | 2-1-90 | | | 26.17 |
| # 966 | " | | | 26.41 |
| # 828 | " | | | 23.35 |
| # 508 | " | | | 35.30 |
| # 701 | " | | | 31.27 |
| # 904 | " | | | 35.34 |
| # 914 | " | | | DRY |
| # 931 | " | | | 49.09 |

? Water added during constant head / falling head tests

DW 3/1/90 Record As Dry

DATE: 02-02-10

MADE BY: [illegible]

| WELL NUMBER | DATE SAMPLED | DEPTH BTOC | TOC | DEPTH BLS |
|---|---|---|---|---|
| 967 | | | | 26.15 |
| 966 | | | | 26.39 |
| 828 | | | | 23.36 |
| 701 | | | | 31.24 |
| 508 | | | | 35.33 |
| 904 | | | | 35.31 |
| 944 | | | | Test DRY |
| 931 | | | | 49.07 |

Should read dry. Water added during constant head / falling head tests.

DA 3/16/90

JE JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

2-25

# Insitu Hydraulic Conductivity Testing
4/11/89 - 4/21/89

well Data to (b) w/ information on other

Initially Dry (as of 5/4/)

## Task I Conducting Falling Head Tests in Competent Moncos Zones in 808D and 807D

1. Sound to make sure wells are still dry
2. Fill wells (PVC pipe) to the ground surface with water using the water truck
3. Continue adding water and maintain water level (near the ground surface) in PVC pipe for at least 0.5 hours. Record rate (gal./min) at which you add water to maintain constant level.
4. Stop addition of water and measure falling head vs. time. Keep recording data until water level has fallen to the level of the sand pack (note that this may take several days - adjust data collection interval accordingly, eg. one measurement/24 hrs). after initial rapid falling head.

## Task II. Repeat Rising Head Tests in Wet Competent Moncos Zones in MW 810D and 806D

1. Sound well to obtain static
2. Bail down to level of screen bottom (sump top).
3. Record rising head vs. time. Continue collecting data until water level has recovered (risen) at least ½ of the initial drawdown depth. For example if the initial static is at 57' and you bail the water level down to the bottom of the screen at 63', continue to collect data until the water level has risen to at least 60'.

## Task III. Conduct Both Rising Head and Falling Head Tests in wet MW 811D

1. Rising Head Test in MW 811D
   a) After drilling has been completed for the day, ask Mark to move the compressor truck to 811D and blow the hole dry with air. Blow dry in several stages - that is blow dry and then let water flow back into the hole for 1 minute - then repeat blowing and waiting several times.

FORM 91-005-1 (4/81)

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

III b) After blowing dry the final time, quickly run sounder cable down inside of the plastic blow pipe and record rising head data. Do not wait until Mark takes blow pipe out of the hole to start recording data. Be sure and subtract height of blow pipe "stick-up" above the PVC casing from the sounder depth readings to obtain depth from TOC. Again keep collecting data until water has risen at least 0.5 of the initial draw down depth. Help Mark remove blow pipe when you are finished.

2. Falling Head Test Test in wet MW811D
   a). Conduct tests as described in Task I above for holes 805D and 807D.

Task IV. Conduct Falling Head Test in Initially Dry Weathered Mancos screen interval in MW ~~820~~
1. Conduct test following steps described in Task I.

Task V. Conduct Constant Head Tests in Initially Dry Weathered Mancos zones in MW's 818, 819, and 830.
1. Sound wells to make sure wells are still dry.
2. Add water to well until the water level is approximately 1 ft below the weathered Mancos overlying GP or GC contact. Do not raise water level above this contact. Water levels you need to obtain are given below:

| gals to reach WL | MW No | GP or GC/Shale Contact Ground Surface | TOC | Water Level Below TOC |
|---|---|---|---|---|
| 2.2 | 818 | 20 | 21.5 | 22.5 |
| 2.7 | 819 | 39 | 40.5 | 41.5 |
| 2.7 | 830 | 22 | 23.5 | 24.5 |

3. Maintain this water level for at least 0.5 hours. R rate of addition of water (gallons/min) required to maintain water level.

FORM 01-605-1 (4/81)

(1) 818 location

(2) Response on 818D
806D from Susan

(3) Phase one survey to take place this week.

(4) Resistivity Survey to be done ? MK?

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-03-90-14-09 DISCIPLINE HYDRO NO. OF SHEETS 6

PROJECT: Grand Junction UMTRA Project

SITE: Cheney Site

FEATURE: Demonstration of Class III (Based on Yield) for the Fractured Mancos.

SOURCES OF DATA:

1) Pumping Test data for well GRJ 982 (10/31/89)
2) Calc # GRJ-11-89-14-03 (Pumping Test Analysis)
3) Calc # GRJ-03-90-14-15

SOURCES OF FORMULAE & REFERENCES:

N/A

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | GRJ-03-90-14-09 | TGoering | 3/12/90 | L Cone | 3/12/90 | B Ballaban | 4/20/90 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Tim Goering
3/12/90

Lane
3/12/90

# DEMONSTRATION OF LOW YIELD OF THE FRACTURED MANCOS SHALE, CHENEY SITE, GRAND JUNCTION, COLORADO

**PURPOSE:** To demonstrate that the fractured Mancos shale at the Cheney site (Grand Junction, Colorado) cannot sustain a yield of 150 gallons per day (gpd) to a well.

**PROCEDURE:** Because of the complex hydrologic characteristics of fractured bedrock, quantitative numerical modeling does not accurately simulate flow in the fractured Mancos shale at the Cheney disposal site. Therefore, to assess whether the fractured Mancos could yield 150 gpd to a well, superposition of pumping test data and daily pumping of monitor well GRJ 982 was conducted to estimate long-term drawdown in the well.

Monitor well GRJ 982 is screened within the fractured Mancos formation at the Cheney site. Analyses of data from two pumping tests conducted on monitor wells GRJ 979 and 982 (Calculation # GRJ 11-89-14-03) indicate that the average transmissivity of the fractured Mancos shale in the vicinity of these wells is 1 $ft^2$ per day and the storativity is 1 X 10-5.

Actual drawdown and recovery data from these pumping tests were used to predict drawdown over a 10 day period. Two pumping scenarios were simulated using superposition of the pumping and recovery data from the tests. The first scenario consisted of pumping 52.5 gallons from the well each day over a 3.5 hour period, and then allowing the well to recover until the following day. The second scenario consisted of pumping 87.5 gallons over a 11.7 hour period each day, and then allowing the well to recover until the following day. These pumping schedules were simulated for a period of ten days, and the principle of superposition was used to graphically predict the total drawdown at the end of the 10-day period.

Actual field testing of monitor well GRJ 982 was also conducted to provide additional evidence of the low yield of the fractured Mancos shale. The monitor well was pumped twice daily over a 15 day period, with an average withdrawal rate of 45 gpd. The drawdown after each pumping event and the cumulative drawdown was observed, and is tabulated in Table 1. A pumping rate greater than 45 gpd could not be sustained because drawdown became excessive and the pump would not function properly.

**ASSUMPTIONS:**

1) The rate of recharge in the Mancos shale is independent of the total drawdown in the well. Therefore, the recovery curve is consistent each day, regardless of the water level.

3/12/90
Tim Goering
Jmc 3/12/90

| Date | Pump. Test | Time Begin | Time End | Water Level Begin | Water Level End | Volume of Water Pumped (gals) | Rising Head (1) K(d) |
|---|---|---|---|---|---|---|---|
| 1/9/90 | morning | 0919 | 0955 | 79.24 | 94.35 | 39 | $1.3 \times 10^{-5}$ |
| | afternoon | 1301 | 1349 | 84.06 | 95.31 | 21 | |
| 1/10/90 | morning | 0810 | 0856 | 81.23 | 95.99 | 28.5 | $5.0 \times 10^{-6}$ |
| | afternoon | 1303 | 1343 | 89.61 | 95.74 | 20.5 | |
| 1/11/90 | morning | 0815 | 0951 | 85.12 | 95.47 | 23 | $5.8 \times 10^{-6}$ |
| | afternoon | 1514 | 1621 | 87.32 | 95.63 | 25 | |
| 1/12/90 | morning | 0810 | 0914 | 83.59 | 95.99 | 26 | $1.0 \times 10^{-5}$ |
| | afternoon | 510 | 1615 | 83.21 | 95.42 | 20.5 | |
| 1/13/90 | morning | 0812 | 0855 | 84.97 | 95.52 | 20 | $7.9 \times 10^{-6}$ |
| | afternoon | 1511 | 1631 | 85.93 | 95.41 | 21.5 | |
| 1/14/90 | morning | 0901 | 1005 | 86.17 | 95.86 | 23 | $9.1 \times 10^{-6}$ |
| | afternoon | 1550 | 1631 | 84.98 | 95.21 | 22 | |
| 1/15/90 | morning | 0745 | 0850 | 82.51 | 96.17 | 25 | $7.9 \times 10^{-6}$ |
| | afternoon | 1505 | 1611 | 85.96 | 95.13 | 21 | |
| 1/16/90 | morning | 0746 | 0849 | 83.46 | 95.30 | 22 | $7.1 \times 10^{-6}$ |
| | afternoon | 1510 | 1624 | 85.97 | 96.38 | 23 | |
| 1/17/90 | morning | 0745 | 0856 | 83.26 | 96.16 | 22.5 | $9.4 \times 10^{-6}$ |
| | afternoon | 1431 | 1534 | 85.31 | 95.89 | 24 | |
| 1/18/90 | morning | 0737 | 0847 | 86.13 | 95.63 | 21.5 | $7.9 \times 10^{-6}$ |
| | afternoon | 1440 | 1538 | 85.97 | 95.81 | 22 | |
| 1/19/90 | morning | 0800 | 0907 | 84.70 | 96.57 | 22 | $7.4 \times 10^{-6}$ |
| | afternoon | 1501 | 1611 | 85.03 | 95.24 | 21 | |
| 1/20/90 | morning | 0945 | 1049 | 83.34 | 94.86 | 22 | $1.1 \times 10^{-5}$ |
| | afternoon | 1510 | 1556 | 85.01 | 95.72 | 23 | |
| 1/21/90 | morning | 0807 | 0911 | 87.20 | 95.23 | 24.5 | $7.8 \times 10^{-6}$ |
| | afternoon | 1504 | 1610 | 85.67 | 94.90 | 22 | |
| 1/22/90 | morning | 0742 | 0849 | 83.06 | 95.67 | 22 | $8.8 \times 10^{-6}$ |
| | afternoon | 1507 | 1600 | 84.13 | 95.03 | 23 | |
| 1/23/90 | morning | 0831 | 0940 | 81.96 | 96.22 | 21.5 | $3.0 \times 10^{-5}$ |
| | afternoon | 1445 | 1551 | 85.66 | 95.13 | 23 | |

NOTE: (1) Reference Calc. No. GRJ-08-89-14-03

Jmc

Table I. Summary of actual drawdown data from pumping period. GRJ 932 over a 15 day

JACOBS ENGINEERING

DATE ____ BY ____ CHKD. ____ SUBJECT ____ SHEET NO. ____ JOB NO. ____

COBS ENGINEERING

DATE ____ BY ____ CHKD. ____ SUBJECT ____ SHEET NO. ____ JOB NO. ____

3/12/90

2) No boundary conditions occur other than those detected during the one-day pumping tests conducted on monitor well GRJ 982 during October 31, 1989. Hence, the hydrologic characteristics of the fractured Mancos remain relatively constant while the formation is being dewatered.

3) To predict the effects of pumping the well at 150 gpd, the daily decline in water levels is assumed to be a linear function of the pumping rate. (see Figure 3)

**DATA SOURCES**

1) Pumping Test Analyses on GRJ Monitor Wells 979 and 982 (Calculation # GRJ-11-89-14-03).

**CALCULATIONS AND RESULTS:**

The drawdown data from the pumping tests conducted on monitor well GRJ 982 (Calc. # GRJ-11-89-14-03) was graphically superimposed over a 10-day time period to predict the total drawdown over 10 days. Figure 1 shows the predicted drawdown when 52.5 gallons is pumped from the well for 3.5 hours each day. Total drawdown after 10 days is 10.3 feet, with an average decline in water level of 1.03 feet per day.

Figure 2 shows the predicted drawdown when 87.5 gallons is pumped from the well over a 11.7 hour period each day. Total drawdown over the 10-day period at this higher pumping rate is 24.1 feet, with an average decline in water level of 2.41 feet per day.

Although a 150 gpd pumping rate could not be simulated using this graphical superposition technique, the cumulative drawdown at the lower pumping rates (52.5 gpd and 87.5 gpd) is significant. The maximum available drawdown for monitor well GRJ 982 is approximately 30 feet (Calc # GRJ 11-89-14-03). Hence, GRJ 982 cannot support these pumping rates for even one month of time.

If cumulative drawdown is assumed to be a linear function of the average daily pumping rate, then the drawdown can be predicted for a pumping rate of 150 gpd. Figure 3 is a graph of average daily decline in pre-pumping water level as a function of the daily pumping rate. The graph indicates that if the well were to be pumped at 150 gpd, water levels would decline an average of 4.8 ft/day. Even if the total depth of the well was 700 feet (thus utilizing the effects of well borehole storage), the well would be pumped dry in less than 150 days. (through the active thickness of the Km)

Table 1 presents actual drawdown data when GRJ 982 is pumped twice daily for 15 days, with an average daily withdrawal of 45 gpd. The cumulative drawdown by the 15th day was 6.7 feet. This is consistent with the graphical simulations described above, except total drawdown is less because the average pumping rate was lower.

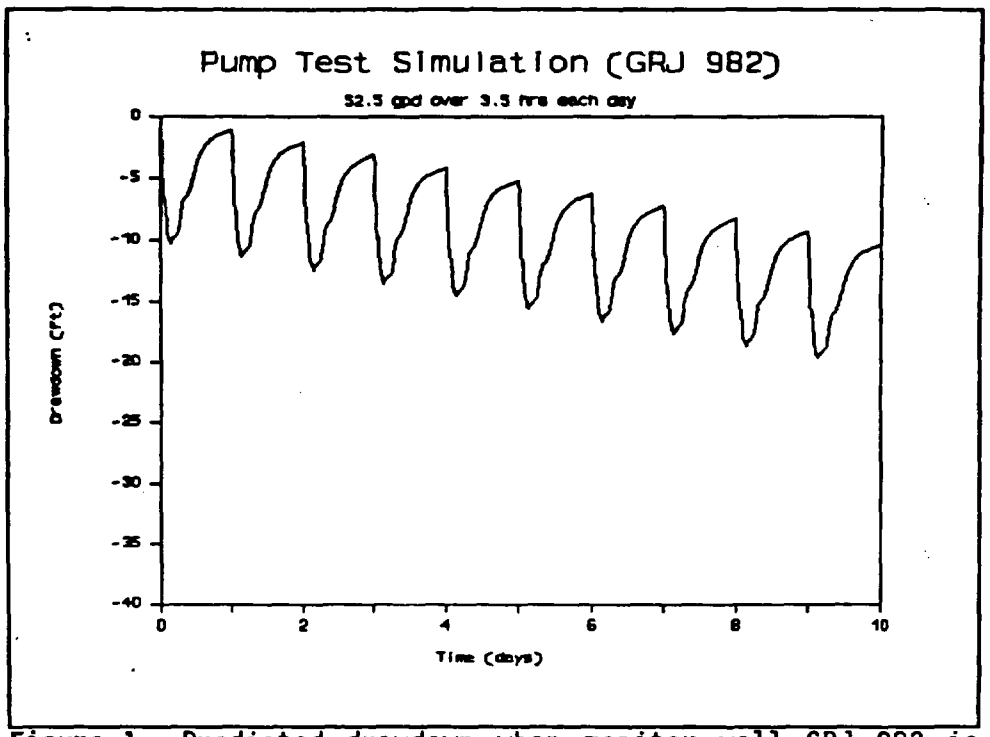


Figure 1 Predicted drawdown when monitor well GRJ 982 is pumped 52.5 gpd for 10 days.

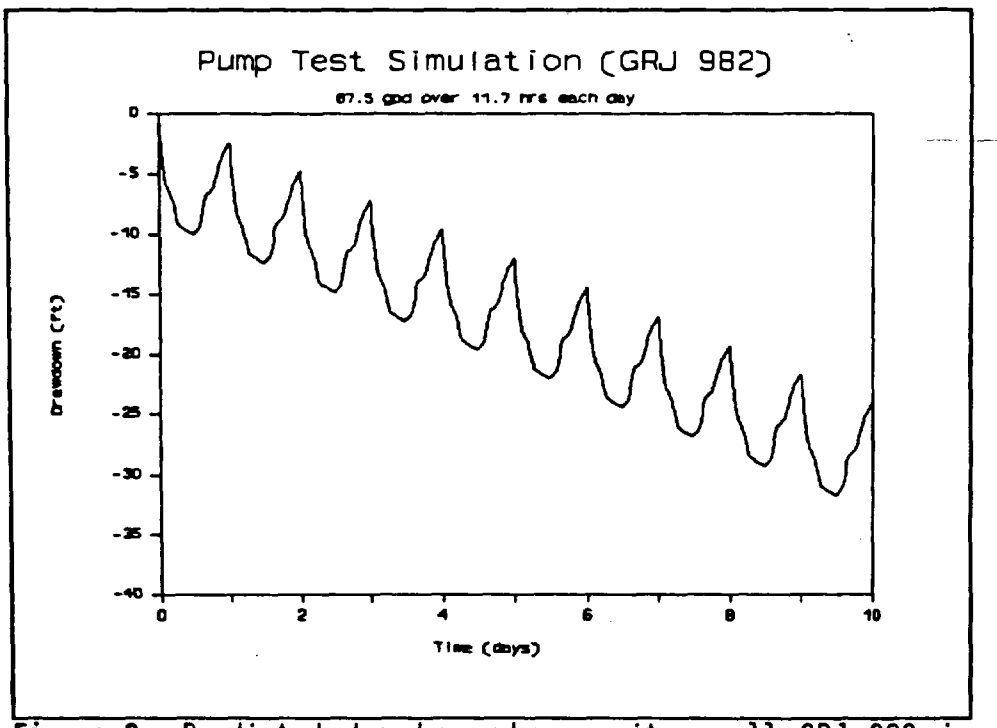


Figure 2 Predicted drawdown when monitor well GRJ 982 is pumped 87.5 gpd for 10 days.

Tim Goeling 3/12/90 5

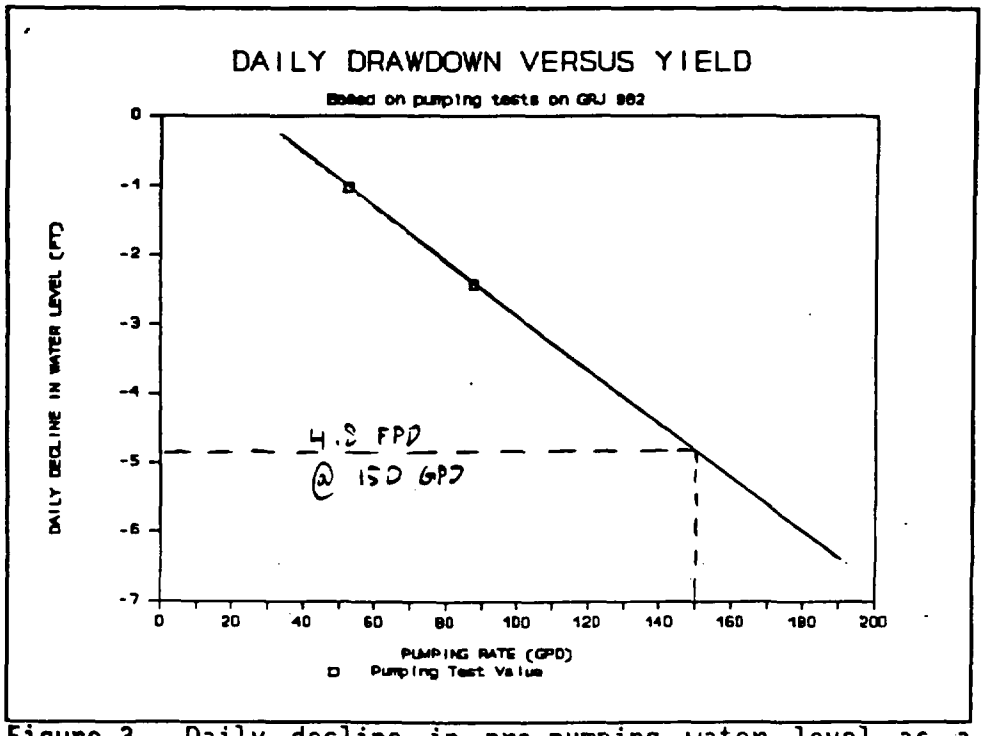


Figure 3 Daily decline in pre-pumping water level as a function of the pumping rate.

**CONCLUSIONS AND RECOMMENDATIONS:**

Both the graphical simulations and the field pumping exercise indicate that the fractured Mancos formation has a very low yield, and cannot sustain a yield of 150 gpd. Recovery in monitor well GRJ 982 is insufficient for maintaining a constant pumping rate of 150 gpd, and drawdown will be excessive at this rate of pumping. If the daily decline in water level is assumed to be a linear function of the pumping rate, then water levels would decline at a rate of 4.8 ft/day at a pumping rate of 150 gpd. Even if the well were completed throughout the entire 700' thickness of the Mancos shale to utilize borehole storage effects, the well would be pumped dry within 150 days. Therefore, because the fractured Mancos cannot sustain a yield of 150 gpd to a well, it can be classified as Class III (or Limited Use) groundwater.

Additional evidence of the low yield of the formation is available from radiological dating of groundwater from the fractured Mancos and from the overlying alluvium. Radiocarbon dating of groundwater from the fractured Mancos indicates that the groundwater is roughly 30,000 years old (Calculation #GRJ-03-90-14-15). This reflects extremely limited recharge from perched water in the overlying alluvium. Tritium analyses of water from

Tim
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the alluvium (Calc. #GRJ-03-90-14-15) indicates that alluvial groundwater is young (less than 30 years). If substantial recharge were occurring into the fractured Mancos, then the water in the Mancos would be relatively recent. This is additional proof of the low yield potential of the fractured Mancos and the Limited Use (Class III) characteristics of the groundwater in the fractured Mancos.

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-03-90-14-15 DISCIPLINE Hydrology NO. OF SHEETS 6 plus Appendix

PROJECT: UMTRA / DOE

SITE: GRJ-03

FEATURE: Radio Isotope Dating of GRJ-03 Groundwater Including Sample Collection and Processing Procedures, Laboratory Data, and Some Factors Affecting Lab Data Interpretation.

SOURCES OF DATA:

Teledyne Isotope Labs, Ridgewood NJ

Geochron Lab Division Krueger Enterprises, Cambridge MA

(1) Davis et al 1985 An Introduction To Groundwater Tracers Cooperative Agreement CR-810003-01, Robert S Kerr Environmental Research Lab, USEPA, Ada OK 74820

SOURCES OF FORMULAE & REFERENCES:

(1) Gleason, JD; Friedman, I; and Hanshaw, BB. 1969. Extraction of dissolved carbonate species from natural water for carbon isotope analysis: U.S. Geological Prof Paper 650-D, p D248-D250.

(2) Yang, IC, Radiochemist with the U.S. Geological Survey, Denver CO. (Telephone Communication 11/21/89)

(3) Water Sampling for Tritium Analysis UMTRA A16 Operations Manual Section 16.2.2. 8/18/88 3p.

PRELIMINARY CALC. ☒ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | Dale Hainsworth | 3/6/90 | [illegible] | 3/13/90 | Bruce Holbrook | 5/7/90 |
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8/86

JACOBS ENGINEERING

DATE 3/6/90 SUBJECT SHEET NO. 1 of 6

BY DH CHKD. JOB NO.

## 1.0 Purpose:

1.1 To document the methods used to collect samples for $H^3$ and $C^{14}$ age dating of groundwater at GRJ-03

1.2 To describe possible sources of error (in addition to lab error) that affect the interpretation of laboratory analytical results

## 2.0 Methods and Procedures for Sample Collection

2.1 Tritium: The UMTRA SOP entitled "Water Sampling for Tritium Analysis" (Reference 3) was used for the two sampling episodes for tritium.

2.1.1. UMTRA water samples followed this SOP during the first tritium water sampling episode conducted between 11/14/89 and 11/18/89. at GRJ-03

2.1.1.1. Before collecting tritium samples at least 3 casing volumes were purged from the well by pumping and field parameters of pH, EC, Alkalinity and Temperature were measured on the groundwater samples. Tritium samples were collected after the field parameters stabilized

2.1.1.2. The following wells were sampled: GRJ-03-011, -811 -904, -981 -982, -965, -967, -808.

2.1.2 The same SOP was followed during the second episode of tritium sampling conducted on 2/2/90

2.1.2.1. At least 5 casing volumes were purged from each well by bailing before collecting tritium samples. Field water quality parameters were not measured during this second episode of sampling

2.1.2.1. The following wells were sampled on 2/2/90: GRJ-03-011, -805, and -904.

2.2 Carbon 14 The procedure described by Gleason et al. (Reference 1) for the direct precipitation of dissolved carbon species was used during $C^{14}$ sample collection/preparation 1/31/90 & 2/2/90 (Episode 2). This procedure was modified slightly as per instructions from I.C. Yang

FORM 91-006-1 (4/81)

2.2 cont. (Reference 2). The procedures which were followed are outlined below.

2.2.1 Samples were collected in 15 gallon polyethylene carboys from the following wells: GJT-03-011, 811, 835, 904, 966, 977, 981; and 982. Sampled were pumped from 977 and 982, and were bailed from all other wells. Extreme care was taken when bailing and pumping to minimize any sploshing which would facilitate the dissolution of present-day atmospheric $CO_2$ into the water sample. Care was also taken to completely fill the carboys so that no head space existed above the samples, again to minimize the introduction of atmospheric $CO_2$ into the groundwater samples. Prior to the collection of water samples 20 mL of freshly prepared NaOH (see methods described below) to each carboy to help preserve dissolved carbon species.

2.2.2 Samples were transported (the same day they were collected) to a subcontractor's laboratory in Grand Junction (Lincoln Devore) where dissolved species in the ground water were precipitated and collected by the following methods.

2.2.2.1 Preparation of Sodium Hydroxide Reagent

Sodium Hydroxide (NaOH) was required to raise the pH of the groundwater to approximately 10.4 to convert all bicarbonate species to carbonate. The equation is:

$$HCO_3^- + OH^- \longrightarrow CO_3^{-2} + HOH$$

Approximately 6.25 M NaOH was prepared by dissolving 150 g of reagent grade NaOH into 600 mL of demineralized water. The solution was allowed to stand overnight to permit carbonate precipitates to settle. The clear supernatant was stored in an air tight glass container before use.

2.2.2.2 Preparation of Strontium Chloride Solution ($SrCl_2$)

$SrCl_2$ was required to precipitate dissolved carbonate species as $SrCO_3$. Approximately 1.67 M $SrCl_2$ solution was prepared by adding 450 g of $SrCl_2 \cdot 6H_2O$ to 1 liter of demineralized water. The solution was allowed to stand overnight, so that any impurities in solid $SrCl_2 \cdot 6H_2O$ could settle before using the clear supernatant.

2.2.2.3 Groundwater Sample Size - The radiocarbon dating lab (Geochron Labs) requires 2 g of pure carbon. The groundwater sample size required to yield 2g carbon can be calculated from alkalinity data as follows.

(eg) Alkalinity of MW 011 = 286 mg/l $CaCO_3$

$$\text{mg C per liter} = \left(\frac{12\text{ mg C}}{100\text{ mg } CaCO_3}\right) \times \left(\frac{286\text{ mg } CaCO_3}{\text{liter}}\right) = \frac{34.3\text{ mg C}}{\text{liter}}$$

$$\text{liters of groundwater} = \left(\frac{2\text{ gm C}}{1}\right) \times \left(\frac{1\text{ liter}}{.0343}\right) = 58.3 \text{ liters}$$

2.2.2.3 Amount of $SrCl_2$ required to precipitate all dissolved C

Assume all carbon species to be in form $CO_3^-$. Amount of $SrCl_2$ should be in excess to precipitate both $SrCO_3$ and $SrSO_4$. Moles of $CO_3^{-2}$ determined from alkalinity field titrations and moles of $SO_4^{-2}$ determined water quality lab analysis for $SO_4^{-2}$.

(eg) Concentration of $SO_4^{-2}$ in MW-011 $= \left(\frac{2.270\text{ g } SO_4^{-2}}{\text{liter}}\right)\left(\frac{1\text{ Mole } SO_4}{96\text{ gm } SO_4}\right) = \frac{2.81 \times 10^{-3}\text{ moles}}{\text{liter}}$

Concentration of $CO_3^{-2}$ in MW-011 $= \left(\frac{0.286\text{ g } CaCO_3}{\text{liter}}\right)\left(\frac{1\text{ Mole } CaCO_3}{100\text{ g } CaCO_3}\right) = \frac{2.86 \times 10^{-3}\text{ moles}}{\text{liter}}$

Moles of $SO_4^{-2}$ in 58.3 liters $= \left(\frac{58.3\text{ liters}}{1}\right)\left(\frac{2.81 \times 10^{-3}\text{ moles}}{\text{liter}}\right) = 1.63 \times 10^{-1}$

Moles of $CO_3^{-2}$ in 58.3 liters $= \left(\frac{58.3\text{ liters}}{1}\right)\left(\frac{2.86\text{ moles}}{\text{liter}}\right) = 1.67 \times 10^{-1}$ moles

Moles of $SO_4^{-2}$ + $CO_3^{-2}$ = $3.3 \times 10^{-1}$ moles

Moles (Minimum) of $SrCl_2$ solution req'd to completely precipitate $SO_4^{-2}$ + $CO_3^{-2}$ = $3.3 \times 10^{-1}$ moles

Minimum volume of $SrCl_2$ solution for MW-011 =

$$\left(\frac{.33\text{ moles}}{1}\right)\left(\frac{1\text{ liter } SrCl_2}{1.69\text{ moles } SrCl_2}\right) = .195 \text{ liters } SrCl_2 \text{ solution}$$

22.2.4. Precipitation (Collection Procedure)

- Allow suspended sediment in groundwater sample to settle and siphon (decant) off clear supernatant ground water sample into an empty 5 gallon carboy. Leave small head space for the addition of $SrCl_2$ and NaOH solutions.
- Add excess (2x) 1.69 M $SrCl_2$ solution (see 2.2.23) to the groundwater sample that is free of sediment.
- Slowly add 6.25 M NaOH solution until pH 10.4 is exceeded. The amount of NaOH (moles) to be added can be estimated from the alkalinity (assume all $CO_3^{-2}$ exists as $HCO_3^-$ at field pH; ∴ moles of NaOH required ≅ moles of $CaCO_3$)
- If possible, heat to 40° while stirring for several hours. If this is not possible go on to the next step. The reaction is nearly complete without heating or stirring.
- Allow the precipitate to settle, decant, and discard the high pH supernatant, and collect the precipitate in glass bottles. Half gallon Mason canning jars will serve as glass bottles.
- Label glass bottles, pack carefully in plastic cooler, label cooler as containing fragile contents, and ship to Lab for analysis ASAP.
- Top off carboys with clear supernatant groundwater sample to eliminate head space.

JACOBS ENGINEERING

DATE 3/6/90 SUBJECT SHEET NO. 596

BY DA CHKD. JOB NO.

3.0 Laboratory Data

3.1 Episode 1

As mentioned in Section 2.1-22, radio isotope sample collection and testing was conducted in two episodes. The first episode involved tritium (no carbon 14) sample collection and analysis of shallow alluvial and Mancos Shale groundwater. Analyses were conducted by Teledyne Isotopes, Ridgewood, N.J. Laboratory raw data as well as a summary table of data is presented in Appendix 1

3.2. Episode 2 involved both tritium and carbon-14 sampling and analysis. All laboratory testing was conducted by Geochron Labs, Cambridge MA. Tritium sampling and analysis were conducted on only 3 shallow alluvial groundwater monitor wells to verify the results of Episode 1 testing. Tritium testing was repeated on MW-011 and -904. An attempt was made to repeat analyses on MW-808, however this well was damaged by construction equipment. MW-835 located less than 10 ft away from MW-808 and screened over the same screened interval was substituted as a replacement well.

Episode 2 also involved carbon 14 analyses on all groundwater zones found at GRJ-03 including alluvial, shallow Mancos Shale, and Dakota Sandstone groundwater. Triplicate samples were collected from both shallow Mancos Shale (MW-982) and Dakota (MW-977) groundwater zones to attempt to bound the range of error which results from field sampling procedures (see Section 4.2).

Laboratory raw data from Episode 2 plus a summary data table (including Episode 1 data) is presented in Appendix 1.

FORM 91-005-1 (4/81)

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DATE 3/6/90 SUBJECT SHEET NO. 6 of 6

BY DH CHKD. JOB NO.

4.0 Assumptions / Sources of Error which Affect The Interpretation of Laboratory Results.

4.1 Tritium (See Reference 4)

- In general groundwater in the Northern Hemisphere which has more than 5 Tritium Units (1TU = 3.24 pCi / liter) is less than 30 years old. Groundwater recharged prior to thermonuclear bomb testing (mid 1950's) will typically have less than 2.5 TU's.

4.2 Carbon 14 (See Reference 4)

Carbon 14 is in general useful for dating groundwater between 500 and 40,000 years old. The following are some sources of error:

- The age of young groundwater (eg 500 years) can be affected (made to appear older) by the dissolution of carbonate species from minerals as groundwater passes over these mineral surfaces.
- The age of old groundwater (eg 40,000 years) can be affected (made to appear younger) by contamination with present-day atmospheric carbon dioxide. Even though every effort should be made to minimize this error by minimizing the exposure to the atmosphere, it is extremely difficult to eliminate this error entirely.

FORM 91-005-1 (4/81)

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DATE 3/6/90 SUBJECT SHEET NO.

BY DA CHKD. JOB NO.

# Appendix 1

Includes Summary Data To 66

Tritium Lab Data From Teledyne Isotopes Lab (Episode 2)

Tritium + Carbon-14 Lab Data From Geochron Lab (Episode 2)

* Appendix is incomplete as of 3/6/90
Laboratory $C^{14}$ analyses to be completed
are MW-835, -904, -966, -981.

FORM 91-005-1 (4/81)

Table Radio Isotope Dating of Groundwater at Cheney (GRT-63)

| Borehole No. | Sample No. | Formation | Carbon-14* Age (years) | Tritium Data: Tritium Units** | Tritium Age (yrs)** | Tritium Units** | Tritium Age (yrs)** |
|---|---|---|---|---|---|---|---|
| 011 | | Arkansan | 13,345 ± 75 | 2.1 ± 0.8 | ? | 3.8 ± 2.0 | ? |
| 808 | | | | 10.8 ± 0.1 | < 30 | | |
| 835 | | | 405 ± 100 | | | 14.0 ± 2.1 | < 30 |
| 904 | | | 2175 ± 75 | 2.3 ± 0.8 | ? | 4.3 ± 2.0 | ? |
| 965 | | | | < 1.6 | > 30 | | |
| 966 | | | 1400 ± 75 | | | | |
| 967 | | | | < 1.9 | > 30 | | |
| 811 | 811 | Shallow Mancos | 26,900 ± 2100 | < 0.9 | > 30 | | |
| 981 | 981 | | 19,565 ± 320 | < 0.9 | > 30 | | |
| 982 | 982-2 | | 30,200 ± 1050 | < 0.9 | > 30 | | |
| 982 | 991 | | 28,580 ± 870 | | | | |
| 982 | 993 | | 30,470 ± 1150 | | | | |
| 977 | 977 | Dakota | 39,450 +4000/-2700 | | | | |
| 977 | 987 | | 34,170 +1690/-1690 | | | | |
| 977 | 997 | | > 42,000 | | | | |

* Geochron Lab Division of Krueger Enterprises Inc (Episode 2)

** Teledyne Isotopes (Episode 1)

JACOBS ENGINEERING

DATE 3/6/90 BY DH CHKD. SUBJECT

SHEET NO. 1 of JOB NO.

FORM B1-005-1 (4/81)

Episo

TELEDYNE ISOTOPES

REPORT OF ANALYSIS

RUN DATE 01/25/90

| WORK ORDER NUMBER | CUSTOMER P.O. NUMBER | DATE RECEIVED | DELIVERY DATE | PAGE |
|---|---|---|---|---|
| 3-0127 | | 11/30/89 | 01/02/90 | 1 |

A ARCHULETA
JACOBS ENGINEERING GROUP INC
5301 CENTRAL AVENUE SUITE 1700
ALBUQUERQUE NM 87108

W A T E R

| TELEDYNE SAMPLE NUMBER | CUSTOMER'S IDENTIFICATION | STA NUM | COLLECTION-DATE START DATE | START TIME | STOP DATE | STOP TIME | NUCLIDE | ACTIVITY (PCI/LITER) | T.U # ~~NUCL-UNIT-%~~ ~~U/M~~ | MID-COUNT TIME DATE | MID-COUNT TIME TIME | VOLUME - UNITS ASH-WGHT-% * | LAB. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 85850 | 01F-011 GRJ 03 | | 11/16 | | | | H-3 | 6.9 +-2.7 E 00 | 2.1 ± 0.8 | 01/10 | | | 5 |
| 85851 | 01F-811 GRJ 03 | | 11/16 | | | | H-3 | L.T. 3. E 00 | < 0.9 | 01/12 | | | 5 |
| 85852 | 01F-904 GRJ 03 | | 11/18 | | | | H-3 | 7.4 +-2.5 E 00 | 2.3 ± 0.8 | 01/19 | | | 5 |
| 85853 | 01F-981 GRJ 03 | | 11/18 | | | | H-3 | L.T. 3. E 00 | < 0.9 | 01/13 | | | 5 |
| 85854 | 01F-982 GRJ 03 | | 11/18 | | | | H-3 | L.T. 3. E 00 | < 0.9 | 01/20 | | | 5 |
| 85855 | 01F-967 GRJ 03 | | 11/16 | | | | H-3 | L.T. 6. E 00 | < 1.9 | 01/20 | | | 5 |
| 85856 | 01F-965 GRJ 03 | | 11/14 | | | | H-3 | L.T. 5. E 00 | < 1.6 | 01/24 | | | 5 |
| 85857 | 01F-808 GRJ 03 | | 11/17 | | | | H-3 | 3.5 +-0.3 E 01 | 10.8 ± 0.1 | 01/23 | | | 5 |

LAST PAGE OF REPORT

B Campbell
APPROVED BY B. CAMPBELL 01/25/90

SEND 1 COPIES TO JA040S A ARCHULETA

2 - GAS LAB. 3 - RADIO CHEMISTRY LAB. 4 - GE(LI) GAMMA SPEC LAB. 5 - TRITIUM GAS/L.S. LAB. 6 - ALPHA SPEC LAB.

* 1 Tritium Unit = 1 TU = 3.224 pci/L

3/6/90
DA

Episode 2

3 of

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

Dale Hammerwiester
Jacobs Engineering
5301 Central Ave NE, Suite 1700
Albuquerque, NM 87108

Date Received: 2/5/90
Date Reported: 2/20/90
Reference: Letter

REPORT OF TRITIUM ANALYSES

| Our Lab. No. | Your Sample No. | Tritium Units |
|---|---|---|
| T-4246 | 011 | 3.8 +/- 2.0 |
| T-4247 | 835 | 14.0 +/- 2.1 |
| T-4248 | 904 | 4.3 +/- 2.0 |

DA

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GEOCHRON LABORATORIES DIVISION
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RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15615 **PRIORITY BASIS** Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/22/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 011.
Sr salt precipitate.

AGE = 1345 +/- 75 C-14 years BP (C-13 corrected).
(84.6 +/- 0.8)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 6.6 ‰

Notes: This date is based upon the Libby half life (5570 years) for $^{14}C$. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

DIS

Episode 2

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RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15616 **PRIORITY BASIS** — Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 — Date Reported: 02/26/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 811.
Sr salt precipitate.

AGE = 26,900 +/- 2100 C-14 years BP (C-13 corrected).
( 3.5 +/- 0.9)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 3.3 ‰

Notes: This date is based upon the Libby half life (5570 years) for $^{14}C$. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

DA

Episode 2

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GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15617 **PRIORITY BASIS** Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/22/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 982-2.
Sr salt precipitate.

AGE = 30,200 +/- 1050 C-14 years BP (C-13 corrected).
( 2.3 +/- 0.3)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = -10.0 ‰

Notes: This date is based upon the Libby half life (5570 years) for $^{14}C$ The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.
The age is referenced to the year A.D. 1950.

Episode L

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24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15618 **PRIORITY BASIS** Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/22/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 991.
Sr salt precipitate.

AGE = 28,580 +/- 870 C-14 years BP (C-13 corrected).
( 2.9 +/- 0.3)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 9.3 ‰

Notes: This date is based upon the Libby half life (5570 years) for $^{14}C$. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15619 PRIORITY BASIS — Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 — Date Reported: 02/26/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 993.
Sr salt precipitate.

AGE = 30,470 +/- 1150 C-14 years BP (C-13 corrected).
( 2.3 +/- 0.3)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = -10.2 ‰

Notes: This date is based upon the Libby half life (5570 years) for $^{14}C$. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

7/17/90
DA

Epsode 2

7 8

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RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15561 **PRIORITY BASIS** Date Received: 02/05/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/10/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 977.
Sr salt precipitate.

AGE = 39,450 +4000/-2700 C-14 years BP (C-13 corrected).
( 0.74 +/- 0.29) % of the modern (1950) C-14 activity.

Description: Sample of sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: Calculated age is significant at 2 sigma (95%).

$\delta^{13}C_{PDB}$ = + 4.5 ‰

Notes: This date is based upon the Libby half life (5570 years) for $^{14}C$. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

76/70
DA

Epizode C

10 7

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RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15562 **PRIORITY BASIS** Date Received: 02/05/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/10/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 987.
Sr salt precipitate.

AGE = 34,170 +/- 1690 C-14 years BP (C-13 corrected).
( 1.42 +/- 0.29) % of the modern (1950) C-14 activity.

Description: Sample of sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: Calculated age is significant at 2 sigma (95%).

$\delta^{13}C_{PDB}$ = + 3.5 ‰

Notes: This date is based upon the Libby half life (5570 years) for $^{14}C$. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

DA  Fpende 2  11 8

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION  REPORT OF ANALYTICAL WORK

Our Sample No. GX-15563  **PRIORITY BASIS**  Date Received: 02/05/90

Your Reference: PO# 34-6705-P-90-00234  Date Reported: 02/10/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 997.
Sr salt precipitate.

AGE = Greater than 42,000 C-14 years BP (C-13 corrected).
( <0.54 )% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: No C-14 activity was detected. The age limit reported is 2 sigma (95% certainty).

$\delta^{13}C_{PDB}$ = + 3.1 ‰

Notes: This date is based upon the Libby half life (5570 years) for $^{14}C$. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-07-9014-07 DISCIPLINE Hydro NO. OF SHEETS 9

PROJECT:

DOE UMTRA

SITE:

Grand Junction, Cheney Disposal Site

FEATURE:

Groundwater flow velocities for alluvial paleochannels

SOURCES OF DATA:

Calc Set GRJ-03-90-13-03-00 "Borehole water level measurements at the Cheney disposal site"

Calc Set GRJ-07-89-14-03/09 "Aquifer pumping test analysis of monitor wells GRJ-03-835, GRJ-03-808

SOURCES OF FORMULAE & REFERENCES:

Freeze and Cherry, 1979

TAD (Technical Approach Document) 1989

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | B Gallaher | 07-01-90 | K Lambert | 8/13/90 | K Bostick | 8/14/90 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

JEG-AL-ENG-51 (6/87)

JE JACOBS ENGINEERING

(b)

DATE 1 July 1990 SUBJECT

BY BS CHKD. KAL 8/13/90

SHEET NO. 2

JOB NO.

D. Calculations and Analyses

Groundwater flow velocities will be calculated for two separate groundwater flow systems (see attached figure) as delineated by drilling and trenching:

a. Well 811 to well 828
b. Well 815 to 820.

K Hydraulic Conductivity

Hydraulic conductivities used in these calcs. will be those determined from aquifer pumping tests in wells 808 and 835, described in detail w/in Calc Set -07-89-14-03/09. Average K was determined to be = $2.1 \times 10^{-3}$ cm/sec. It is assumed that this average is representative of all paleochannels elsewhere on the site.

i Hydraulic Gradient

| | Well | date | BTOC Depth to $H_2O$ | TOC Elevation | GW Elevation |
|---|---|---|---|---|---|
| a. | 811 | (6/2/89) or | 25.54 | 5292.7 | 5267.16 |
| | 828 | " | 21.13 | 5247.5 | 5226.37 |

Distance between wells ≅ 2200 ft.

$$i = \frac{5267.2 - 5226.4 \text{ ft.}}{2200 \text{ ft.}} = \frac{40.8}{2200} = 0.019$$

| | Well | Date | Below TOC DTW | Elevation TOC | GW Elevation |
|---|---|---|---|---|---|
| b. | 815 | 6/3/89 | 20.11 | 5274.4 | 5254.29 |
| | 820 | " | 21.39 | 5251.2 | 5229.81 |

Distance between wells ≅ 1,050 ft.

$$i = \frac{5254.3 - 5229.8}{1,050} = \frac{24.5}{1,050} = 0.023$$

$n_e$ Assumed to be 0.25

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE 1 July 1990 SUBJECT Paleochannel Flow Velocities SHEET NO. 1
BY BJ CHKD. KAL 8/13/90 GRJ-07-90-14-07 JOB NO.

## A. Purpose of Calculation

To determine the average linear velocity of groundwater in the alluvial paleochannels, Cheney disposal site, Grand Junction, Colorado.

## B. Method of Analysis

Average groundwater velocities were calculated using a modified version of the Darcy equation, as specified in the TAD (1989):

$$\bar{V} = \frac{Ki}{n_e}$$

where $\bar{V}$ = average linear g.w. velocity
$K$ = hydraulic conductivity
$i$ = lateral hydraulic gradient
$n_e$ = effective porosity

## C. Material Properties

The alluvial paleochannels are comprised of a highly variable admixture of clays, silts, gravels, cobbles, and boulders. These have filled thin channels that eroded into the top of the underlying Mancos Shale. Typically, the zone of saturation in the paleochannels is limited to less than 10 feet in thickness and 20 feet in width. Water filled paleochannels form thin, discrete groundwater flow systems that may be isolated from ~~and~~ adjacent flow systems by hundreds of feet (see attached figure 2).

FORM 91-005-1 (4/81)

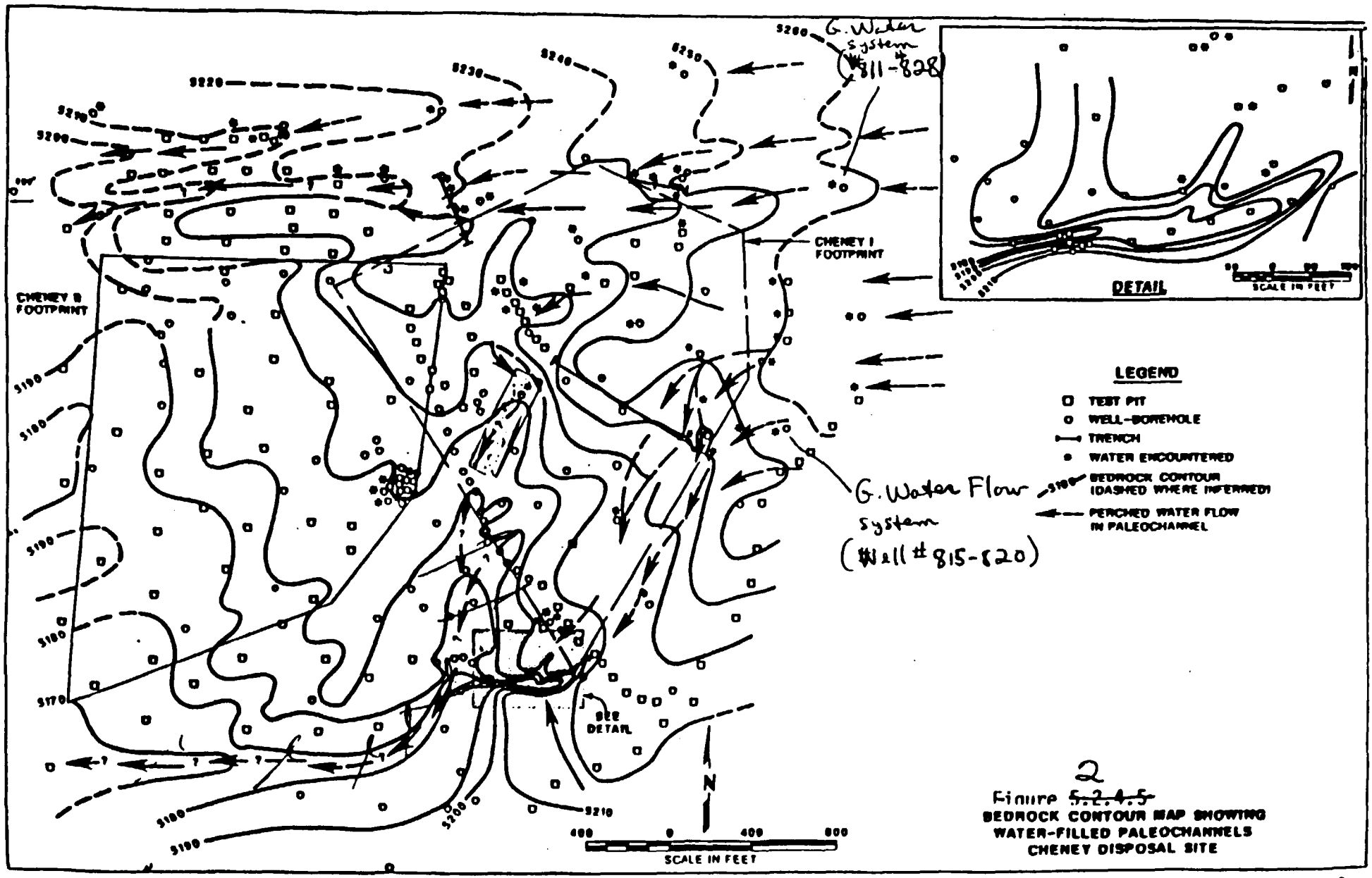


Figure ~~5.2.4.5~~ 2
BEDROCK CONTOUR MAP SHOWING WATER-FILLED PALEOCHANNELS CHENEY DISPOSAL SITE

~~EDDIE BOND IS PRODUCING A PUBLISHABLE FIGURE~~

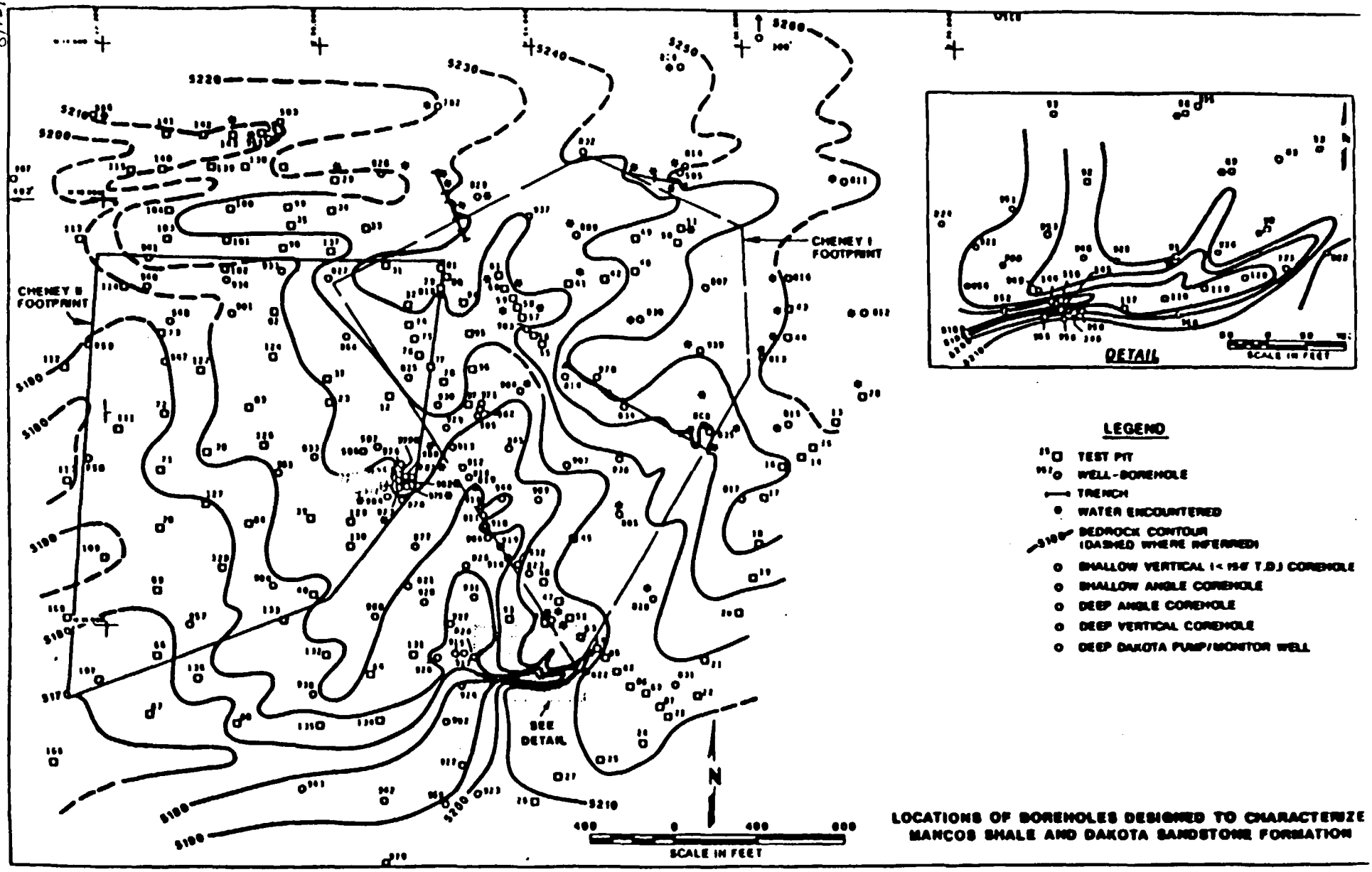


Figure 1. Location of trenches, test pits, and boreholes in relation to Cheney I and Cheney II footprints

A ROBINSON ENVISER COMPANY

JOB TITLE Depth to water level measurements W.O. NO

DESCRIPTION A. below top of casing SHEET NO.

MADE BY DATE

CHECKED BY

From Calc Set
~~GRS-07-89-11-07~~
GRS-03-90-13-03-00

| | 805S | 805D | 806S | 806D | 3075 | 807D | 808 | 809 | 810 | 811S | 811D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 Mar | 29.94 | 34.16 | 29.14(A) | 27.15 | P | 43.01 | 17.45(A) | 28.45 | Dry | 25.47 | 56 |
| 2 June | — | — | 29.20 | 28.41 | — | — | — | 28.57 | — | 25.59 | 1.38 |
| 3 | 30.28 | 33.47 | 29.21 | 28.48 | Dry | 43.40 | 17.57 | 28.58 | Dry | 25.53 | 54.36 |
| 5 | 30.06 | 33.75 | 29.30 | 28.78 | — | 43.50 | 17.56 | 28.60 | — | 25.63 | [illegible] |
| 6 | 29.91 | 33.41 | [illegible] | 28.91 | — | [illegible] | [illegible] | 28.66 | — | [illegible] | [illegible] |
| 7 | 30.09 | 33.24 | 29.25 | 29.10 | — | 43.56 | 17.79 | 28.70 | — | 25.63 | 53.57 |
| 8 | 29.82 | 33.52 | 29.28 | 29.20 | — | 43.58 | 17.96 | 28.69 | — | 25.65 | 53.38 |
| 9 | 30.13 | 32.83 | 29.31 | 29.32 | — | 43.57 | 18.14 | 28.72 | — | 25.68 | 53.15 |
| 10 | 30.65 | 32.47 | 29.31 | 29.20 | — | 43.59 | 18.27 | 28.76 | — | 25.70 | 52.92 |
| 12 | 31.12 | 32.87 | 29.34 | 29.69 | — | 43.65 | 18.50 | 28.82 | — | 25.70 | 52.52 |
| 13 | 31.22 | 33.16 | 29.37 | 29.81 | — | 43.66 | 18.59 | 28.87 | — | 25.77 | 52.32 |
| 14 | 31.07 | 33.56 | 29.37 | 29.95 | — | 43.68 | 18.64 | 28.88 | — | 25.75 | [illegible] |
| 16/17 | 30.20 | 34.13 | 29.28 | 30.21 | — | 43.69 | 18.71 | 28.93 | — | 25.83 | 51.49 |
| 19 | 29.42 | 33.94 | 29.34 | 30.53 | — | 43.76 | 18.78 | 29.05 | — | 25.76 | 51.07 |
| 20 | 30.30 | 33.11 | 29.37 | 30.65 | — | 43.78 | 18.78 | 29.07 | — | 25.77 | 50.90 |
| 21 | 30.78 | 33.52 | 29.46 | 30.74 | — | 43.80 | 18.84 | 29.10 | — | 25.85 | 50.78 |
| 22 | 30.73 | 33.99 | 29.37 | 30.88 | — | 43.81 | 18.86 | 29.15 | — | 25.81 | 50.53 |
| 26 | 31.23 | 35.48 | 29.40 | 31.30 | — | 43.88 | 18.88 | 29.47 | — | 25.85 | [illegible] |
| 28 | 31.36 | 36.21 | 29.43 | 31.52 | — | 43.92 | 18.90 | 29.95 | — | 25.88 | 49.35 |
| 30 | 32.10 | 36.43 | 29.44 | 31.72 | — | 43.93 | 18.91 | 30.45 | — | 25.90 | [illegible] |
| | -2.22 | | -0.30 | | | | -1.46 | -2.00 | | -0.43 | +5.56 |

2

2

a. Well 811 to well 828

$$\bar{v} = \frac{ki}{n_e}$$

$$= \frac{(2.1 \times 10^{-3}\ cm/sec)(2834.65\ \frac{ft/d}{cm/sec})(0.019)}{0.25}$$

$$= 0.45\ ft/day$$

b. Well 815 to Well 820

$$\bar{v} = \frac{ki}{n_e}$$

$$= \frac{(2.1 \times 10^{-3}\ cm/sec)(2834.65\ \frac{ft/d}{cm/sec})(0.023)}{0.25}$$

$$= 0.55\ ft/day$$

Conclusions

The calculated average linear groundwater velocities for the alluvial paleochannels ~~6~~ are calculated ~~to~~ be approximately 200 feet per year. Given the inherent uncertainties in the hydraulic conductivity and effective porosity parameters, this velocity may be in error ~~by~~ a factor of 2 ~~to~~ or 3.

JOB TITLE _____ WO NO _____

DESCRIPTION _____ SHEET NO _____

MADE BY _____ CHECKED BY _____ DATE _____

| | 812S | 812D | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 |
|---|---|---|---|---|---|---|---|---|---|---|
| 25 May | 20.27* | 18.27** | 15.10*(2) | 30.87(4) | 19.95* | ~~16.93~~* | 17.83** | Dry | Dry | 21.34* |
| 2 June | – | – | – | 31.13 | – | – | – | – | – | – |
| 3 | 20.45 | 19.94 | 14.54 | 31.12 | 20.11 | 15.25 | 18.63(2) | Dry | Dry | 21.39 |
| 5 | 20.57 | 20.05 | 14.46 | 31.29 | 20.17 | 15.17 | – | – | – | 21.43 |
| 6 | 20.59 | 20.07 | 14.38 | 31.28 | 20.15 | 15.07 | – | – | – | 21.38 |
| 7 | 20.60 | 20.16 | 14.39 | 31.38 | 20.25 | 15.14 | – | – | – | 21.39 |
| 8 | 20.62 | 20.19 | 14.36 | 31.39 | 20.23 | 15.10 | – | – | – | 21.40 |
| 9 | 20.63 | 20.19 | 14.31 | 31.38 | 20.27 | 15.10 | – | – | – | 21.40 |
| 10 | 20.64 | 20.23 | 14.29 | 31.38 | 20.23 | 15.10 | – | – | – | 21.42 |
| 12 | 20.70 | 20.28 | 14.17 | 31.41 | 20.27 | 15.08 | – | – | – | 21.44 |
| 13 | 20.73 | 20.31 | 14.18 | 31.44 | 20.29 | 15.10 | – | – | – | 21.44 |
| 14 | 20.75 | 20.35 | 14.19 | 31.48 | 20.31 | 15.11 | – | – | – | 21.44 |
| 16/17 | – | – | 14.15 | – | 20.29 | 15.09 | – | – | – | 21.42 |
| 19 | 20.82 | 20.47 | 14.09 | 31.48 | 20.31 | 15.12 | – | – | – | 21.47 |
| 20 | 20.84 | 20.50 | 14.08 | 31.49 | 20.31 | 15.14 | – | – | – | 21.51 |
| 21 | 20.91 | 20.54 | 14.10 | 31.50 | 20.32 | 15.15 | – | – | – | 21.55 |
| 22 | 20.87 | 20.56 | 14.09 | 31.50 | 20.33 | 15.14 | – | – | – | 21.54 |
| 26 | 20.97 | 20.67 | 14.06 | 31.52 | 20.34 | 15.17 | – | – | – | 21.63 |
| 28 | 21.02 | 20.70 | 14.06 | 31.53 | 20.32 | 15.20 | – | – | – | 21.68 |
| 30 | 21.04 | 20.74 | 14.07 | 31.57 | 20.34 | 15.22 | – | – | – | 21.73 |
| | -0.77 | | +1.03 | -0.70 | -0.39 | +0.03 | | | | -0.39 |

MK-FERGUSON COMPANY
A SOMMER SNYDER COMPANY

JOB TITLE _____ W.O. NO. _____
DESCRIPTION _____ SHEET NO. _____
MADE BY _____ CHECKED BY _____ DATE _____

| | 821S | 821D | 822 | 823 | 823D | 824 | 825S | 825D | 826 | 827 | 828 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 May | Dn | 35.02 | 28.56 | Dn | 48.43 | 46.58 | Dn | 49.42 | 44.71 | 14.1 | 21.12 |
| 2 June | — | — | — | — | — | — | — | — | — | — | 21.13 |
| 3 | Dn | 37.38 | 29.88 | Dn | 48.44 | 46.68 | Dn | 50.24 | 44.67 | 15.21 | 21.12 |
| 5 | — | 37.85 | 30.11 | — | 48.55 | 46.78 | — | 50.40 | — | — | 21.15 |
| [illegible] | — | 38.10 | 30.23 | — | [illegible] | 46.71 | — | 50.32 | — | — | 15 |
| 7 | — | 38.39 | 30.38 | — | 48.50 | 46.80 | — | 50.35 | — | — | 21.19 |
| 8 | — | 38.56 | 30.42 | — | 48.54 | 46.81 | — | 50.40 | — | — | 21.16 |
| 9 | — | 38.74 | 30.56 | — | 48.54 | 46.71 | — | 50.42 | — | — | 21.19 |
| 10 | — | 38.97 | 30.66 | — | [illegible] | [illegible] | — | [illegible] | — | — | [illegible] |
| 12 | — | 39.38 | 30.87 | — | 48.58 | 46.80 | — | 50.57 | — | — | 21.21 |
| 13 | — | 39.57 | 30.95 | — | 48.54 | 46.87 | — | 50.61 | — | — | 21.22 |
| 14 | — | 39.76 | 31.03 | — | [illegible] | 46.85 | — | 50.59 | — | — | [illegible] |
| 16/17 | — | 40.18 | — | — | — | 46.88 | — | 50.52 | — | — | — |
| 19 | — | 40.70 | 31.40 | — | 48.52 | 46.88 | — | 50.69 | — | — | 21.19 |
| 20 | — | 40.90 | 31.47 | — | 48.52 | 46.91 | — | 50.67 | — | — | 21.19 |
| 21 | — | 41.09 | 31.58 | — | 48.54 | 46.88 | — | 50.66 | — | — | 21.24 |
| 22 | — | 41.28 | 31.64 | — | 48.50 | 46.95 | — | 50.63 | — | — | [illegible] |
| 26 | — | 41.98 | 31.90 | — | 48.50 | 46.93 | — | 50.69 | — | — | [illegible] |
| 28 | — | 42.30 | 32.02 | — | | 47.01 | — | 50.79 | — | — | 21.24 |
| 30 | — | 42.58 | 32.12 | — | 48.82 | 47.03 | — | [illegible] | — | — | [illegible] |
| | | | | | +1.68 | | | +4.25 | | | −0.12 |

KAL 8/13/90

# Table 5.2.4.1 Borehole information at GRJ-03

BOREHOLE INFORMATION AT GRJ-03

| WELL | HOLE TYPE | LOCATION EAST COORDINATE | LOCATION NORTH COORDINATE | ELEVATION TOC* (FT-MSL) | ELEVATION GS (FT-MSL) | BEDROCK ELEVAT. (FT) | TOTAL DEPTH (FT) | SCREENING INTERVAL (DEPTH-FT) | HYDROSTRATIGRAPHIC UNIT SCREENED |
|---|---|---|---|---|---|---|---|---|---|
| 203 | MW | 94389.2 | 11531.4 | 5255.3 | 5254.3 | 5225.8 | 35 | 15-35 | ALLUVIUM,WEATHERED SHALE |
| 205 D | MW | 94389.2 | 11531.4 | 5255.7 | 5254.3 | 5225.8 | 65 | 40-65 | WEATHERED-UNWEATHERED SHALE |
| 206 S | MW | 94629.0 | 13610.2 | 5292.7 | 5291.1 | 5247.1 | 39 | 20-39 | ALLUVIUM,WEATHERED SHALE |
| 206 D | MW | 94629.0 | 13610.2 | 5283.1 | 5281.1 | 5247.1 | 80 | 53-80 | WEATHERED-UNWEATHERED SHALE |
| 207 S | MW | 94794.4 | 12598.6 | 5271.0 | 5270.0 | 5251.0 | 18 | 8-18 | ALLUVIUM |
| 207 D | MW | 94794.4 | 12598.6 | 5271.6 | 5270.0 | 5251.0 | 65 | 33-65 | WEATHERED-UNWEATHERED SHALE |
| 208 | MW | 94793.3 | 11947.7 | 5264.7 | 5263.3 | 5240.8 | 25 | 10-25 | ALLUVIUM,WEATHERED SHALE |
| 209 | MW | 94198.3 | 12834.4 | 5267.6 | 5266.2 | 5236.7 | 31.5 | 15-31.5 | ALLUVIUM,WEATHERED SHALE |
| 210 | MW | 94142.1 | 12180.9 | 5253.5 | 5252.1 | 5245.1 | 35 | 18-35 | WEATHERED MANCOS SHALE |
| 211 S | MW | 95470.1 | 13087.9 | 5292.7 | 5291.6 | 5257.6 | 36.5 | 20-36.5 | ALLUVIUM,WEATHERED SHALE |
| 211 D | MW | 95470.1 | 13087.9 | 5293.2 | 5291.6 | 5257.6 | 62 | 45-62 | UNWEATHERED MANCOS SHALE |
| 212 S | MW | 95562.7 | 12469.0 | 5293.6 | 5292.7 | 5265.7 | 39 | 17-39 | ALLUVIUM,WEATHERED SHALE |
| 212 D | MW | 95562.7 | 12469.0 | 5294.2 | 5292.7 | 5265.7 | 65 | 46-65 | WEATHERED MANCOS SHALE |
| 213 | MW | 95089.4 | 12268.0 | 5277.8 | 5276.4 | 5255.4 | 40 | 8-17 | ALLUVIUM |
| 214 | MW | 94715.0 | 13162.4 | 5281.7 | 5280.2 | 5243.2 | 40 | 23-40 | ALLUVIUM,WEATHERED SHALE |
| 215 | MW | 95193.4 | 11962.5 | 5274.4 | 5273.0 | 5251.5 | 25 | 13-23.5 | ALLUVIUM,WEATHERED SHALE |
| 216 | MW | 95205.6 | 12650.5 | 5282.6 | 5281.1 | 5261.6 | 25 | 12-24 | ALLUVIUM,WEATHERED SHALE |
| 217 | MW | 94981.9 | 11694.4 | 5265.1 | 5263.7 | 5253.7 | 20 | 11-20 | WEATHERED MANCOS SHALE |
| 218 | MW | 93561.2 | 12554.2 | 5251.6 | 5250.2 | 5230.2 | 25 | 10-25 | ALLUVIUM,WEATHERED SHALE |
| 219 | MW | 93714.8 | 11661.3 | 5239.1 | 5237.7 | 5196.7 | 50 | 18-45 | ALLUVIUM,WEATHERED SHALE |
| 220 | MW | 94543.0 | 11141.7 | 5251.2 | 5249.8 | 5226.8 | 30 | 10-30 | ALLUVIUM,WEATHERED SHALE |
| 221 S | MW | 93409.5 | 11204.9 | 5230.0 | 5228.8 | 5197.8 | 31 | 18-31 | ALLUVIUM,WEATHERED SHALE |
| 221 D | MW | 93409.5 | 11204.9 | 5230.4 | 5228.8 | 5197.8 | 65 | 49-65 | UNWEATHERED MANCOS SHALE |
| 222 | MW | 94304.8 | 10758.4 | 5241.6 | 5240.1 | 5215.1 | 35 | 26-35 | WEATHERED MANCOS SHALE |
| [illegible] | MW | 93957.9 | 11244.3 | 5241.8 | 5241.0 | 5214.5 | 38 | 28-38 | WEATHERED MANCOS SHALE |
| [illegible] | MW | 93957.9 | 11244.3 | 5242.3 | 5241.0 | 5214.5 | 60 | 43-60 | UNWEATHERED MANCOS SHALE |
| 224 | MW | 93765.2 | 10834.4 | 5232.6 | 5231.2 | 5182.7 | 50 | 19-50 | ALLUVIUM,UNWEATHERED SHALE |
| 225 S | MW | 93356.4 | 12179.2 | 5240.9 | 5239.5 | 5219.5 | 43 | 26-43 | WEATHERED MANCOS SHALE |
| 225 D | MW | 93356.4 | 12179.2 | 5240.4 | 5239.5 | 5219.5 | 60 | 50-60 | UNWEATHERED MANCOS SHALE |
| 226 | MW | 93677.0 | 11291.4 | 5236.0 | 5234.6 | 5194.6 | 45 | 24-45 | ALLUVIUM-UNWEATHERED SHALE |
| 227 | MW | 93937.2 | 12636.8 | 5225.9 | 5225.1 | 5225.6 | 16 | 6-16 | ALLUVIUM,WEATHERED SHALE |
| 228 | MW | 93286.7 | 13125.6 | 5247.5 | 5245.9 | 5219.9 | 30 | 13-30 | ALLUVIUM,WEATHERED SHALE |
| 229 S | MW | 93744.3 | 13016.5 | 5259.1 | 5258.1 | 5225.1 | 35 | 10-35 | ALLUVIUM,WEATHERED SHALE |
| 229 D | MW | 93744.3 | 13016.5 | 5259.6 | 5258.1 | 5225.1 | 60 | 42-60 | WEATHERED-UNWEATHERED SHALE |
| 230 | MW | 94488.0 | 12457.7 | 5265.4 | 5264.0 | 5243.0 | 30 | 11-29 | ALLUVIUM,WEATHERED SHALE |
| 231 | MW | 94644.0 | 10731.7 | 5241.2 | 5239.8 | 5226.8 | 25 | 15-25 | WEATHERED MANCOS SHALE |
| 232 | MW | 94234.7 | 13236.9 | 5268.4 | 5266.9 | 5243.9 | 28.5 | 11-28.5 | ALLUVIUM,WEATHERED SHALE |
| 233 S | MW | 92960.1 | 11804.3 | 5229.3 | 5228.2 | 5208.2 | 37 | 22-37 | WEATHERED MANCOS SHALE |
| 233 D | MW | 92960.1 | 11804.3 | 5229.9 | 5228.2 | 5208.2 | 65 | 48-65 | UNWEATHERED MANCOS SHALE |
| 234 S | MW | 94414.2 | 12041.9 | 5256.1 | 5255.1 | 5246.1 | 30 | 13-30 | WEATHERED MANCOS SHALE |
| 234 D | MW | 94414.2 | 12041.9 | 5256.9 | 5255.1 | 5246.1 | 65 | 39-65 | UNWEATHERED MANCOS SHALE |
| 235 | MW | 94790.5 | 11940.2 | 5264.6 | 5263.3 | 5240.3 | 25 | 10-25 | ALLUVIUM,WEATHERED SHALE |
| 236 | CH | 92785.8 | 11206.9 | 5218.3 | 5216.4 | 5200.4 | 152.5 | | |
| 237 | CH | 92593.5 | 12486.9 | 5229.5 | 5230.8 | 5202.3 | 157.85 | | |
| 238 | CH | 93562.9 | 10568.9 | 5228.5 | 5226.6 | 5189.1 | 122.7 | | |
| 239 | MW | 93972.3 | 12410.2 | 5257.0 | 5255.5 | 5234.5 | 34 | 24-34 | WEATHERED MANCOS SHALE |
| 240 | MW | 93935.8 | 12120.0 | 5252.5 | 5251.0 | 5213.0 | 40 | 30-40 | ALLUVIUM,WEATHERED SHALE |
| 241 | MW | 93735.0 | 12007.1 | 5247.5 | 5246.1 | 5211.1 | 48 | 38-48 | WEATHERED-UNWEATHERED SHALE |
| 242 | BH | 93776.4 | 11423.2 | 5240.2 | 5238.9 | 5197.9 | 55 | | |
| [illegible] | CH | 94146.6 | 11773.8 | 5248.9 | 5247.8 | 5226.8 | 68 | | |

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-07-90-15-01 DISCIPLINE HYDRO NO. OF SHEETS 22 + 1 Attachment (4p

PROJECT:

UMTRA/DOE

SITE:

Grand Junction Processing Site

FEATURE: Hazardous constituents in the tailings pore water exceeding the laboratory method detection limits.

SOURCES OF DATA:

DART 07/03/90 pp 3-22

SOURCES OF FORMULAE & REFERENCES:

TAD, Revised 1989

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | B. Gallaher | 07-03-90 | D. Metzler | 09/12/90 | [illegible] | 9/90 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

JEG-AL-ENG-51 (6/87)

JACOBS ENGINEERING

DATE 07-03-90 SUBJECT GRJ-01 Haz Constituents SHEET NO. 1/22

BY BJ CHKD. [illegible] 8/90 JOB NO. GRJ-01

Comparison of results of DART all-parm. retrieval for the processing site lysimeters with 40CFR192 list of hazardous constituents yields the following.

HAZARDOUS CONSTITUENTS IN THE TAILINGS PORE ~~FLUID~~ WATER EXCEEDING THE LABORATOR METHOD DETECTION LIMITS:

1) Aluminum * ✓
2) Antimony * ✓
3) Arsenic ✓
4) Barium ✓
5) Beryllium * ✓
6) Cadmium ✓
7) Chromium ✓
8) Cobalt * ✓
9) Copper * ✓
10) Cyanide * ✓
11) Fluoride * ✓
12) (Net) Gross Alpha ✓
13) Lead ✓
14) Mercury ✓
15) Molybdenum ✓
16) Nickel * ✓
17) Nitrate ✓
18) Radium -226 +228 combined ✓
19) Selenium ✓
20) Strontium * ✓ 26) Silver ✓
21) Sulfide * ✓
22) Tin * ✓ (barely yes)
23) Uranium ✓
24) Vanadium * ✓
25) Zinc * ✓

* = Detected elements of potentially hazardous compounds

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE 07-03-90 SUBJECT GRJ-01 Haz Constituents SHEET NO. 2/22

BY BJ CHKD. [illegible] 8/9

JOB NO. GRJ-01

[None of the potentially hazardous Appendix IX organic compounds ~~have~~ were detected in ground water samples collected from three monitoring wells at the processing site.].

Although vicinity property materials will make up ~ 40% of the total volume of waste material, water quality records are available for only one VP lysimeter (556). These data have been pooled with the much larger data set available for the M-K tailings pile, and thus, the VP ~~proper~~ materials are underweighted in the statistical analyses with respect to the M-K tailings. Because VP materials are almost certainly to be less contaminated than the MK tailings, the calculated statistics (Attachment A) probably represent worst case concentrations.

Note: Upon visual inspection of the V.P. lysimeter analysis (556), the concentration of constituents in this sample are within the range of concentrations in the tailings lysimeter samples.

J Cox

FORM 91-005-1 (4/81)

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

y 9/4

(40 CFR 192)
= Hazardous Constituent
Yes = Constituent Detected

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ALKALINITY | 0550 | 01/09/90 | 0001 | TA | O | MG/L CACO3 | | 668. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 163. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 402. | - |
| | 0555 | 01/15/90 | 0001 | TA | O | | | 181. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 175. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 140. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 7. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 123. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 75. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 679. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 502. | - |
| ALUMINUM Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.05 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | < | 0.50 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.09 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.16 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | < | 0.50 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.08 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 98. | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 82.9 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 56. | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 28.6 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 25.3 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 28. | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.11 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | < | 0.50 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.17 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.07 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.05 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 4.60 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.61 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 0.36 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 1.90 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 9.50 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.50 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 1.05 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.05 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.05 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.05 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.05 | - |
| AMMONIUM | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 868. | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 897. | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 912. | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 143. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 1.5 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 471. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 780. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 773. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 207. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 131. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 4.9 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 325. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 286. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 644. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 112. | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

1/22

DMM 07/13/

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| AMMONIUM | 0603 | 01/10/90 | 0001 | TA | O | MG/L | | 167. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 491. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 336. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 27. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 267. | - |
| ANTIMONY Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | < | 0.010 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.020 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.007 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | < | 0.010 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.016 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | < | 0.006 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | < | 0.010 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | < | 0.010 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.010 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | < | 0.010 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.013 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | < | 0.006 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.010 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.027 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.015 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | < | 0.010 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.006 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.010 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 0.006 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 0.007 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.013 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.010 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.013 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.006 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.006 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.008 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.006 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.006 | - |
| ARSENIC Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.14 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.090 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.21 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.03 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.020 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.03 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.08 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 0.050 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.08 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.90 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.640 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.74 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.13 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.100 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.20 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.04 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.03 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.380 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.66 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 0.49 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.080 | - |

FORMATION OF COMPLETION CODE:
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CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ARSENIC | 0602 | 01/10/90 | 0001 | TA | O | MG/L | | 0.35 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.925 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 1.70 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.02 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.01 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.01 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.04 | - |
| BARIUM | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.02 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | < | 0.10 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.03 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.05 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | < | 0.10 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.04 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.15 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | < | 0.10 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.02 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.01 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | < | 0.10 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.01 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.06 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.10 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.04 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.03 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.02 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.10 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | < | 0.10 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.02 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | < | 0.10 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.01 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.01 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.04 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.02 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.03 | - |
| BERYLLIUM | 0550 | 08/17/89 | 0001 | TA | O | MG/L | < | 0.005 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.005 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.007 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.015 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.017 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.008 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.228 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.118 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.007 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | < | 0.005 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.006 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.005 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 0.005 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.005 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.023 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.005 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 0.005 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.005 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.005 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BD 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| BERYLLIUM | 0646 | 01/12/90 | 0001 | SP | O | MG/L | < | 0.005 | - |
| BORON | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.85 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.60 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.64 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.45 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.62 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.85 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 1.00 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.84 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 2.04 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.70 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.26 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.80 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.60 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.88 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.55 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.58 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.26 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.45 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.66 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.28 | - |
| CADMIUM Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.005 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.0071 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.002 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.071 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.0907 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.258 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.274 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 0.3500 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.238 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.211 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.2700 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.123 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | < | 0.005 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.0026 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.011 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.023 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.015 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.1500 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.007 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.001 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.1500 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.197 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.0007 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.001 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.060 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.001 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.001 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.001 | - |
| CALCIUM | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 510. | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 470. | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 470. | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 535. | - |

FORMATION OF COMPLETION CODE:
SP - SAND OR GRAVELLY SAND, POORLY GRADED
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

fnl 8/4/

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CALCIUM | 0551 | 10/01/89 | 0002 | TA | O | MG/L | | 1180. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 1300. | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 455. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 436. | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 455. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 670. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 456. | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 655. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 825. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 695. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 535. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 485. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 431. | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 482. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 520. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 500. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 489. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 447. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 540. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 560. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 540. | - |
| CHLORIDE | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 1460. | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 1450. | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 1550. | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 1000. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 1030. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 1290. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 1100. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 1160. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 1830. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 1150. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 999. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 900. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 745.0 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 1340. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 320. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 273.5 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 492.5 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 809. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 705. | - |
| CHROMIUM Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | < | 0.01 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.10 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | < | 0.01 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | < | 0.10 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.02 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 0.10 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | < | 0.01 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.10 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | < | 0.01 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | < | 0.10 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS 7/3/90

8/22

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| [redacted]ONIUM Yes | 0554 | 01/12/90 | 0001 | TA | O | MG/L | < | 0.01 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | < | 0.02 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.10 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | < | 0.10 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.10 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.01 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.01 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.01 | - |
| COBALT Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.10 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.20 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.09 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.20 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.20 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.41 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.70 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 0.70 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.49 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.35 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.60 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.45 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | < | 0.05 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | < | 0.10 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | < | 0.05 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | < | 0.05 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.03 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.20 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.09 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.05 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.40 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.36 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.20 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.47 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.05 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.05 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.05 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.05 | - |
| COPPER Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.01 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.10 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.02 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.17 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.20 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.10 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 2.95 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 2.70 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 2.94 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 3.70 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 2.90 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 2.50 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| COPPER | 0554 | 08/17/89 | 0001 | TA | O | MG/L | | 0.04 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.20 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.08 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.05 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.06 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.10 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 1.00 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 4.21 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.10 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.01 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.02 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.01 | - |
| CYANIDE | 0550 | 08/17/89 | 0001 | TA | O | MG/L | < | 0.002 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.08 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.043 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.12 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.08 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.006 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.08 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.023 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.093 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.36 | - |
| | 0555 | 01/15/90 | 0001 | TA | O | | | 0.16 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.12 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.006 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.08 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.04 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.006 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.08 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.08 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.08 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.12 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.04 | - |
| FLUORIDE | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 3.9 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 4.1 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 4.2 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 1.9 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 1.0 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 15.2 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 12.8 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 14.4 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 4.8 | - |
| | 0555 | 01/15/90 | 0001 | TA | O | | | 4.8 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 1.8 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 1.2 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 5.7 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 3.5 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 8.0 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 8.0 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 19.2 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS 7/3/90

10/22

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM CONP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| FLUORIDE | 0604 | 01/10/90 | 0001 | TA | O | MG/L | | 0.7 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 12.0 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 1.6 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 4.4 | - |
| GROSS ALPHA | 0550 | 01/09/90 | 0001 | TA | O | PCI/L | | 2151. | 237. |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 302. | 89. |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 8020. | 387. |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 558. | 122. |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 113. | 56. |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 2170. | 161. |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 5471. | 300. |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 133. | 38. |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 244. | 64. |
| GROSS BETA | 0550 | 01/09/90 | 0001 | TA | O | PCI/L | | 1553. | 114. |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 191. | 48. |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 2675. | 108. |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 666. | 77. |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 109. | 36. |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 1404. | 67. |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 2404. | 110. |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 205. | 26. |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 203. | 35. |
| IRON | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 9.2 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 7.60 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 9.60 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.18 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 1.60 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | < | 0.03 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 3.7 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 1.50 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.40 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 58. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 53.0 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 69. | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.70 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.40 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.13 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | < | 0.02 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.03 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 60. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 52. | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 7.80 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 58.0 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 56. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 370. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 57. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 21. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 3.45 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.03 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 54. | - |
| LEAD | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.18 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.016 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| LEAD | 0550 | 01/09/90 | 0001 | TA | O | MG/L | < | 0.01 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | < | 0.02 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.016 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.09 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 0.080 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.03 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.05 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.033 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.12 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.011 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | < | 0.02 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.021 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.004 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.003 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.01 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.01 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.01 | - |
| MAGNESIUM | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 455. | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 410. | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 430. | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 360. | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 415. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 380. | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 4. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 330. | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 290. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 275. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 296. | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 495. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 530. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 385. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 310. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 264. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 125. | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 170. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 261. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 245. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 197. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 158. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 204. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 435. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 232. | - |
| MANGANESE | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 6.9 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 7.50 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 6.80 | - |

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS / 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

12/22

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MANGANESE | 0551 | 08/17/89 | 0001 | TA | O | MG/L | | 5.1 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 5.20 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 14.7 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 8.3 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 8.90 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 6.22 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 7.9 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 7.60 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 7.48 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 2.79 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 2.60 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 2.00 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 2.05 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 2.34 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 5.20 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 3.59 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 1.93 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 8.10 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 6.60 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 5.50 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 6.74 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 3.95 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 5.00 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 3.45 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 3.94 | - |
| MERCURY Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | < | 0.0001 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | < | 0.0001 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | < | 0.0001 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | < | 0.0001 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | < | 0.0001 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | < | 0.0001 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | < | 0.0001 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | < | 0.0001 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | < | 0.0001 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.0002 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | < | 0.0001 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.0001 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.0003 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | < | 0.0001 | - |
| MOLYBDENUM Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 1.00 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.90 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.67 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.47 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | < | 0.50 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.29 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.08 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | < | 0.50 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.10 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.15 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | < | 0.50 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.13 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.47 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | < | 0.50 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.45 | - |

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MOLYBDENUM | 0556 | 08/17/89 | 0001 | TA | O | MG/L | | 0.26 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.08 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.50 | - |
| Yes | 0600 | 01/11/90 | 0001 | TA | O | | | 0.20 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 4.35 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | < | 0.50 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.47 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 1.4 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.83 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.66 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.40 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.08 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.10 | - |
| NICKEL | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.76 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.80 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.69 | - |
| Yes | 0551 | 08/17/89 | 0001 | TA | O | | | 0.44 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.60 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.68 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 3.82 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 4.20 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 3.12 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 1.67 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 1.80 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 1.46 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.62 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.50 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.50 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.12 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.09 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.70 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.38 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.04 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 1.90 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 1.86 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 1.40 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 2.27 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.12 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.25 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.04 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.09 | - |
| NITRATE | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 3.5 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | < | 0.1 | - |
| Yes | 0550 | 01/09/90 | 0001 | TA | O | | | 1.3 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 2330. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 4600. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 32.8 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.2 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | < | 1. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 1420. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 246. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 567. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.3 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 1. | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
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CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

14/22

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| NITRATE | 0602 | 01/10/90 | 0001 | TA | O | MG/L | < | 1. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 17.9 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 1. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 1. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.1 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 1. | - |
| PH | 0550 | 01/09/90 | 0001 | TA | O | SU | | 7.03 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 6.25 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 3.92 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 3.73 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 6.57 | - |
| | 0555 | 01/15/90 | 0001 | TA | O | | | 6.91 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 7.01 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 6.10 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 7.55 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 4.88 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 6.22 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 5.91 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 7.29 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 7.60 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 6.95 | - |
| PHOSPHATE | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.1 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.1 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.8 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.2 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.5 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 4.0 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.3 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 1.5 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 3.1 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.1 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.3 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.4 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 1.2 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 1.2 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | < | 0.1 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 2.8 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.3 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 1.7 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.3 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 3.0 | - |
| POTASSIUM | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 195. | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 180. | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 155. | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 110. | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 90. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 32. | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 110. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 96. | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 130. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 140. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 100. | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 285. | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

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| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| POTASSIUM | 0554 | 01/12/90 | 0001 | TA | O | MG/L | | 182. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 65. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 30. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 60. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 47. | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 33. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 113. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 35. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 37. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 64. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 71. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 21. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 60. | - |
| RADIUM-226 Yes | 0550 | 08/17/89 | 0001 | TA | O | PCI/L | | 33.9 | 0.931 |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 1.45 | 0.631 |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 35.4 | 2.3 |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 12.4 | 1.6 |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 10.2 | 0.693 |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 815.9 | 13.6 |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 11.3 | 1.27 |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 17.4 | 2.9 |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.313 | 0.157 |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 1.8 | 0.7 |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 1.12 | 0.624 |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 74.9 | 4.1 |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 668.9 | 12.3 |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.955 | 0.559 |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 4.4 | 0.8 |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 33.7 | 2.3 |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.0 | 0.2 |
| RADIUM-228 | 0550 | 01/09/90 | 0001 | TA | O | PCI/L | | 0.8 | 1.5 |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 3.8 | 2.3 |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 2.9 | 1.7 |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.0 | 2.3 |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 2.0 | 2.3 |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.6 | 2.2 |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.0 | 2.1 |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.0 | 1.5 |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.5 | 1.9 |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.1 | 0.5 |
| SELENIUM Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.28 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 0.21 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | < | 0.02 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.71 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.5 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.170 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.91 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 0.8 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.900 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.060 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.08 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.032 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.060 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

16/22

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | 0554 | 10/01/89 | 0002 | TA | O | MG/L | | 0.08 | - |
| Yes | 0554 | 01/12/90 | 0001 | TA | O | | | 0.080 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.25 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.026 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.11 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.036 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.05 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.8 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.180 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.35 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.01 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.01 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.02 | - |
| SILICA - SIO2 | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 27.5 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 27.5 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 30. | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 48.5 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 37. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 83. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 82.5 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 64. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 45. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 25.5 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 12.8 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 70. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 26. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 40. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 44.5 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 35. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 32. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 32. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 17.1 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 17.5 | - |
| SILVER | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.05 | - |
| Yes B | 0550 | 10/01/89 | 0002 | TA | O | | < | 0.0001 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.05 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 0.0073 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.05 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 0.0016 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | < | 0.05 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.0004 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | < | 0.05 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | < | 0.0001 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | < | 0.05 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.0001 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS/ 7-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SILVER | 0601 | 01/10/90 | 0001 | TA | O | MG/L | < | 0.01 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.0011 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 0.0002 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.01 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.01 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.01 | - |
| SODIUM | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 1200. | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 1145. | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 1150. | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 865. | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 835. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 810. | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 830. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 790. | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 700. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 670. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 710. | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 1180. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 1230. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 1020. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 870. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 530. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 439. | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 498. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 830. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 380. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 401. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 560. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 740. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 1000. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 740. | - |
| SPECIFIC CONDUCTANCE | 0550 | 01/09/90 | 0001 | TA | O | UMHO/CM | | 15880. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 14400. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 13000. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 12150. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 14550. | - |
| | 0555 | 01/15/90 | 0001 | TA | O | | | 11370. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 9110. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 7800. | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 6680. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 12180. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 6200. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 8520. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 9180. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 8580. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 8660. | - |
| STRONTIUM-90 | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 4.35 | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 4.20 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 3.19 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 4.80 | - |

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 1-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

10/22

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| STRONTIUM Yes | 0551 | 10/01/89 | 0002 | TA | O | MG/L | | 4.90 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 7.30 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 5.25 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 5.50 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 4.91 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 3.55 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 4.80 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 3.59 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 5.25 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 5.40 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 5.70 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 6.30 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 4.53 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 5.20 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 3.55 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 3.97 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 6.10 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 4.97 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 5.40 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 5.88 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 5.13 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 5.92 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 5.82 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 5.48 | - |
| SULFATE | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 6034. | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 2307. | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 5120. | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 2747. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 1650. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 4450. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 2540. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 4130. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 3780. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 3713. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 2440. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 3190. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 1940. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 4390. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 3081. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 2750. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 3770. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 3160. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 3320. | - |
| SULFIDE Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | < | 0.01 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | < | 1. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | < | 1. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | < | 1. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | < | 1. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | < | 1. | - |
| | 0555 | 01/15/90 | 0001 | TA | O | | < | 1. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 1. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.01 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 1. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | < | 1. | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BD 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

19/22

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SULFIDE Yes | 0603 | 10/01/89 | 0001 | TA | O | MG/L | | 0.01 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 1. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 1. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 1. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 42. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 60. | - |
| TEMPERATURE | 0550 | 01/09/90 | 0001 | TA | O | C - DEGREE | | 12.5 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 16.7 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 13.1 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 13.7 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 11.8 | - |
| | 0555 | 01/15/90 | 0001 | TA | O | | | 9.8 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 6.3 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 12.1 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 12.4 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 15.8 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 14.2 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 13.3 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 12.4 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 10.9 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 12.9 | - |
| THALLIUM No | 0550 | 01/09/90 | 0001 | TA | O | MG/L | < | 0.1 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | < | 0.1 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | < | 0.1 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | < | 0.2 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | < | 0.1 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | < | 0.1 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | < | 0.1 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.1 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | < | 0.2 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | < | 0.1 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | < | 0.1 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | < | 0.1 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.1 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.1 | - |
| THORIUM-230 | 0550 | 08/17/89 | 0001 | TA | O | PCI/L | | 1.76 | 1.33 |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 36.0 | 2.22 |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 3.59 | 0.763 |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 6.28 | 0.817 |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 29.6 | 1.25 |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 29.1 | 1.76 |
| TIN Yes | 0550 | 10/01/89 | 0002 | TA | O | MG/L | | 0.010 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | < | 0.010 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | < | 0.010 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | < | 0.010 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | < | 0.010 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | < | 0.010 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.017 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | < | 0.010 | - |
| TOTAL DISSOLVED SOLIDS | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 9432. | - |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 10156. | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

Done 8/6/90

-/22

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 0550 | 01/09/90 | 0001 | TA | O | MG/L | | 8670. | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 11420. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 9270. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 7570. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 8274. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 6640. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 8620. | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 6924. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 5990. | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 5682. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 4400. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 6330. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 4836. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 4290. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 5050. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 5240. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 7130. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 5460. | - |
| TOTAL KJELDAHL NITROGEN | 0550 | 01/09/90 | 0001 | TA | O | MG/L | | 731. | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | < | 1. | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 384. | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 607. | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 123. | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 2. | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 223. | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 520. | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 127. | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 398. | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 269. | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 22. | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 209. | - |
| URANIUM - Yes | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 2.47 | 0.050 |
| | 0550 | 10/01/89 | 0002 | TA | O | | | 2.897 | 0.238 |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 3.18 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 0.910 | 0.030 |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 1.020 | 0.100 |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 0.356 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 3.95 | 0.110 |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 3.050 | 0.530 |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 1.87 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 0.180 | 0.050 |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 0.180 | 0.013 |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 0.144 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 2.88 | 0.080 |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 3.861 | 0.198 |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.81 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.090 | 0.020 |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 0.079 | 0.008 |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 2.29 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | | 29.7 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 0.127 | 0.014 |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 0.051 | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 1.680 | 0.116 |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.220 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

Jue 8/90

-1/22

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETE UNCERTAIN |
|---|---|---|---|---|---|---|---|---|---|
| URANIUM | 0604 | 01/10/90 | 0001 | TA | O | MG/L | | 0.075 | - |
| Yes | 0643 | 01/12/90 | 0001 | SM | O | | | 1.44 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.37 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 1.02 | - |
| VANADIUM | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 1.12 | - |
| Yes | 0550 | 10/01/89 | 0002 | TA | O | | | 1.00 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 1.14 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 2.30 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 2.30 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 3.52 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 0.54 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 0.40 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 0.61 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 41. | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 2.90 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 39. | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 2.30 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 3.00 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 7.7 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 1.93 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 1.12 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 6.90 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 1.29 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.01 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 7.50 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 31. | - |
| | 0603 | 10/01/89 | 0001 | TA | O | | | 2.60 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.68 | - |
| | 0604 | 01/10/90 | 0001 | TA | O | | | 0.18 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.12 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | | 0.13 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | < | 0.01 | - |
| ZINC | 0550 | 08/17/89 | 0001 | TA | O | MG/L | | 0.39 | - |
| Yes | 0550 | 10/01/89 | 0002 | TA | O | | | 0.50 | - |
| | 0550 | 01/09/90 | 0001 | TA | O | | | 0.322 | - |
| | 0551 | 08/17/89 | 0001 | TA | O | | | 2.03 | - |
| | 0551 | 10/01/89 | 0002 | TA | O | | | 2.10 | - |
| | 0551 | 01/09/90 | 0001 | TA | O | | | 6.15 | - |
| | 0552 | 08/17/89 | 0001 | TA | O | | | 7.50 | - |
| | 0552 | 10/01/89 | 0002 | TA | O | | | 6.70 | - |
| | 0552 | 01/09/90 | 0001 | TA | O | | | 5.64 | - |
| | 0553 | 08/17/89 | 0001 | TA | O | | | 7.20 | - |
| | 0553 | 10/01/89 | 0002 | TA | O | | | 7.00 | - |
| | 0553 | 01/09/90 | 0001 | TA | O | | | 6.96 | - |
| | 0554 | 08/17/89 | 0001 | TA | O | | | 0.11 | - |
| | 0554 | 10/01/89 | 0002 | TA | O | | | 0.10 | - |
| | 0554 | 01/12/90 | 0001 | TA | O | | | 0.237 | - |
| | 0556 | 08/17/89 | 0001 | TA | O | | | 0.34 | - |
| | 0556 | 01/15/90 | 0001 | TA | O | | | 0.186 | - |
| | 0600 | 10/01/89 | 0001 | TA | O | | | 3.00 | - |
| | 0600 | 01/11/90 | 0001 | TA | O | | | 0.993 | - |
| | 0601 | 01/10/90 | 0001 | TA | O | | < | 0.005 | - |
| | 0602 | 10/01/89 | 0001 | TA | O | | | 4.40 | - |
| | 0602 | 01/10/90 | 0001 | TA | O | | | 6.92 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B5/7-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 15/90
REPORT DATE: /03/90

fax 9/40

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ZINC | 0603 | 10/01/89 | 0001 | TA | O | MG/L | | 0.40 | - |
| | 0603 | 01/10/90 | 0001 | TA | O | | | 0.165 | - |
| Yes | 0604 | 01/10/90 | 0001 | TA | O | | | 0.277 | - |
| | 0643 | 01/12/90 | 0001 | SM | O | | | 0.017 | - |
| | 0645 | 01/12/90 | 0001 | CH | O | | < | 0.005 | - |
| | 0646 | 01/12/90 | 0001 | SP | O | | | 0.020 | - |

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < = LESS THAN DETECTION LIMIT

DATA FILE NAME: J:\DART\GRJ01\GW010005.DAT

JE JACOBS ENGINEERING

DATE 8-8-90 SUBJECT Tailings Pore Water Quality SHEET NO. ____

BY BJ CHKD. JMR 8/8/90 JOB NO. ____

Attachment A

Tailings Pore Water Quality Statistics by Parameter

FORM 91-005-1 (4/81)

A1

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 11 | 7.0000 | 679.0000 | 175.0000 | 283.1818 | 238.5623 | 0.8424 | 0.0 | 84.3694 | 481.9942 | NORMAL | |
| ALUMINUM | | | MG/L | | | | | | | | |
| 28 | 0.0500 | 98.0000 | 0.1650 | NA | NA | NA | 25.0 | 0.0500 | 4.6000 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 20 | 1.5000 | 912.0000 | 305.5000 | 392.1700 | 315.4505 | 0.8044 | 0.0 | 213.0769 | 571.2631 | NORMAL | |
| ANTIMONY | | | MG/L | | | | | | | | |
| 28 | 0.0015 | 0.0270 | 0.0060 | NA | NA | NA | 46.4 | 0.0015 | 0.0100 | NONPARAMETRIC | 2 |
| ARSENIC | | | MG/L | | | | | | | | |
| 28 | 0.0050 | 1.7000 | 0.0950 | 0.1145 | 4.5245 | NA | 3.6 | 0.0565 | 0.2318 | LOGNORMAL | 7,8 |
| BARIUM | | | MG/L | | | | | | | | |
| 28 | 0.0100 | 0.1500 | 0.0400 | NA | NA | NA | 32.1 | 0.0200 | 0.0500 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 20 | 0.0025 | 0.2280 | 0.0037 | NA | NA | NA | 50.0 | 0.0025 | 0.0150 | NONPARAMETRIC | 2 |
| BORON | | | MG/L | | | | | | | | |
| 20 | 0.2600 | 2.0400 | 0.6300 | 0.6955 | 0.3804 | 0.5469 | 0.0 | 0.4795 | 0.9115 | NORMAL | |
| CADMIUM | | | MG/L | | | | | | | | |
| 28 | 0.0005 | 0.3500 | 0.0190 | 0.0166 | 11.2760 | NA | 14.3 | 0.0054 | 0.0516 | LOGNORMAL | 7,8 |
| CALCIUM | | | MG/L | | | | | | | | |
| 25 | 431.0000 | 1300.0000 | 510.0000 | 585.6400 | 218.4693 | 0.3730 | 0.0 | 476.7549 | 694.5251 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

BS DMY
A-2

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| CHLORIDE | | | MG/L | | | | | | | | |
| 19 | 273.5000 | 1830.0000 | 1030.0000 | 1031.7895 | 414.4132 | 0.4016 | 0.0 | 789.1634 | 1274.4155 | NORMAL | |
| CHROMIUM | | | MG/L | | | | | | | | |
| 28 | 0.0050 | 0.1000 | 0.0050 | NA | NA | NA | 82.1 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| COBALT | | | MG/L | | | | | | | | |
| 28 | 0.0250 | 0.7000 | 0.2000 | NA | NA | NA | 32.1 | 0.0250 | 0.4000 | NONPARAMETRIC | 2 |
| COPPER | | | MG/L | | | | | | | | |
| 28 | 0.0100 | 4.2100 | 0.0900 | NA | NA | NA | 17.9 | 0.0100 | 1.0000 | NONPARAMETRIC | 2 |
| CYANIDE | | | MG/L | | | | | | | | |
| 21 | 0.0050 | 0.3600 | 0.0800 | 0.0810 | 0.0773 | 0.9542 | 4.8 | 0.0384 | 0.1237 | NORMAL | |
| FLUORIDE | | | MG/L | | | | | | | | |
| 21 | 0.7000 | 19.2000 | 4.4000 | 6.3429 | 5.3394 | 0.8418 | 0.0 | 3.3973 | 9.2884 | NORMAL | |
| GROSS ALPHA | | | PCI/L | | | | | | | | |
| 9 | 113.0000 | 8020.0000 | 558.0000 | 794.7962 | 4.9612 | NA | 0.0 | 169.3478 | 3730.1988 | LOGNORMAL | 7,8 |
| GROSS BETA | | | PCI/L | | | | | | | | |
| 9 | 109.0000 | 2675.0000 | 666.0000 | 1045.5556 | 1003.3905 | 0.9597 | 0.0 | 76.9492 | 2014.1619 | NORMAL | |
| IRON | | | MG/L | | | | | | | | |
| 28 | 0.0150 | 370.0000 | 7.7000 | 3.4444 | 21.0144 | NA | 14.3 | 0.8299 | 14.2952 | LOGNORMAL | 7,8 |
| LEAD | | | MG/L | | | | | | | | |
| 28 | 0.0030 | 0.1800 | 0.0050 | NA | NA | NA | 53.6 | 0.0050 | 0.0210 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

A-3

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAGNESIUM | MG/L | 25 | 4.0000 | 530.0000 | 296.0000 | 306.2400 | 125.6630 | 0.4103 | 0.0 | 243.6096 | 368.8704 | NORMAL | |
| MANGANESE | MG/L | 28 | 1.9300 | 14.7000 | 5.3500 | 5.6564 | 2.7957 | 0.4943 | 0.0 | 4.3498 | 6.9630 | NORMAL | |
| MERCURY | MG/L | 14 | 0.0001 | 0.0003 | 0.0001 | NA | NA | NA | 85.7 | 0.0001 | 0.0001 | NONPARAMETRIC | 2 |
| MOLYBDENUM | MG/L | 28 | 0.0050 | 4.3500 | 0.2300 | NA | NA | NA | 21.4 | 0.0800 | 0.4700 | NONPARAMETRIC | 2 |
| NICKEL | MG/L | 28 | 0.0200 | 4.2000 | 0.6850 | 0.5601 | 4.1560 | NA | 7.1 | 0.2878 | 1.0899 | LOGNORMAL | 7,8 |
| NITRATE | MG/L | 19 | 0.2000 | 4600.0000 | 0.5000 | NA | NA | NA | 42.1 | 0.5000 | 567.0000 | NONPARAMETRIC | 2 |
| PHOSPHATE | MG/L | 20 | 0.0500 | 4.0000 | 0.4500 | 0.5430 | 3.7475 | NA | 5.0 | 0.2565 | 1.1495 | LOGNORMAL | 7,8 |
| POTASSIUM | MG/L | 25 | 21.0000 | 285.0000 | 90.0000 | 97.6400 | 64.5703 | 0.6613 | 0.0 | 65.4582 | 129.8218 | NORMAL | |
| RADIUM-226 | PCI/L | 17 | 0.0000 | 815.9000 | 11.3000 | NA | NA | NA | 0.0 | 1.1200 | 35.4000 | NONPARAMETRIC | 9 |
| RADIUM-228 | PCI/L | 10 | 0.0000 | 3.8000 | 0.5500 | NA | NA | NA | 30.0 | 0.0000 | 2.9000 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

By DMY

A-3

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| SELENIUM | | | MG/L | | | | | | | | |
| 28 | 0.0025 | 0.9100 | 0.0800 | NA | NA | NA | 25.0 | 0.0260 | 0.2800 | NONPARAMETRIC | 2 |
| SILICA - SIO2 | | | MG/L | | | | | | | | |
| 20 | 12.8000 | 83.0000 | 33.5000 | 39.8700 | 20.5191 | 0.5147 | 0.0 | 28.2205 | 51.5195 | NORMAL | |
| SILVER | | | MG/L | | | | | | | | |
| 28 | 0.0002 | 0.0500 | 0.0050 | NA | NA | NA | 71.4 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| SODIUM | | | MG/L | | | | | | | | |
| 25 | 380.0000 | 1230.0000 | 810.0000 | 804.9200 | 255.0160 | 0.3168 | 0.0 | 677.8200 | 932.0200 | NORMAL | |
| SPECIFIC CONDUCTANCE | | | UMHO/CM | | | | | | | | |
| 15 | 6200.0000 | 15880.0000 | 9180.0000 | 10550.6667 | 3025.0088 | 0.2867 | 0.0 | 8501.1813 | 12600.1521 | NORMAL | |
| STRONTIUM | | | MG/L | | | | | | | | |
| 28 | 3.1900 | 7.3000 | 5.1650 | 5.0336 | 0.9396 | 0.1867 | 0.0 | 4.5945 | 5.4727 | NORMAL | |
| SULFATE | | | MG/L | | | | | | | | |
| 19 | 1650.0000 | 6034.0000 | 3190.0000 | 3395.3684 | 1105.5274 | 0.3256 | 0.0 | 2748.1165 | 4042.6204 | NORMAL | |
| SULFIDE | | | MG/L | | | | | | | | |
| 17 | 0.0100 | 60.0000 | 0.0500 | NA | NA | NA | 82.4 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| TEMPERATURE | | | C - DEGREE | | | | | | | | |
| 15 | 6.3000 | 16.7000 | 12.5000 | 12.5267 | 2.4344 | 0.1943 | 0.0 | 10.8773 | 14.1760 | NORMAL | |
| THALLIUM | | | MG/L | | | | | | | | |
| 14 | 0.0500 | 0.0500 | 0.0500 | NA | NA | NA | 100.0 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| THORIUM-230 | | | PCI/L | | | | | | | | |
| 6 | 1.7600 | 36.0000 | 17.6900 | 17.7217 | 15.4276 | 0.8705 | 0.0 | -3.4720 | 38.9154 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

A-9
BD

DMW

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| TIN | | | MG/L | | | | | | | | |
| 8 | 0.0025 | 0.0170 | 0.0025 | NA | NA | NA | 75.0 | 0.0025 | 0.0170 | NONPARAMETRIC | 2 |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 20 | 4290.0000 | 11420.0000 | 6782.0000 | 7069.2000 | 2042.2750 | 0.2889 | 0.0 | 5909.7236 | 8228.6764 | NORMAL | |
| TOTAL KJELDAHL NITROGEN | | | MG/L | | | | | | | | |
| 13 | 0.5000 | 731.0000 | 223.0000 | 278.1154 | 236.4778 | 0.8503 | 7.7 | 102.2762 | 453.9545 | NORMAL | |
| URANIUM | | | MG/L | | | | | | | | |
| 27 | 0.0510 | 29.7000 | 1.0200 | 0.7436 | 4.9243 | NA | 0.0 | 0.3476 | 1.5909 | LOGNORMAL | 7,8 |
| VANADIUM | | | MG/L | | | | | | | | |
| 28 | 0.0050 | 41.0000 | 1.6100 | 1.2416 | 8.7078 | NA | 7.1 | 0.4516 | 3.4140 | LOGNORMAL | 7,8 |
| ZINC | | | MG/L | | | | | | | | |
| 28 | 0.0025 | 7.5000 | 0.4500 | 0.5613 | 10.7767 | NA | 7.1 | 0.1848 | 1.7051 | LOGNORMAL | 7,8 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

INPUT DATA FILENAME: J:\DART\GRJ01\GWQ10005.DAT

Final
11/21

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-08-90-12-02-00 DISCIPLINE Geotech/Hydro NO. OF SHEETS 20

PROJECT:
UMTRA

SITE:
GRAND JUNCTION - CHENEY DISPOSAL CELL

FEATURE: 'Determination of Unsaturated Hydraulic Properties, Tailings and Vicinity Property Materials'

SOURCES OF DATA:
Daniel B. Stevens & Assoc., Inc. W/O #5, May 1990

SOURCES OF FORMULAE & REFERENCES:
USDA, 1987., Users Guide: RETC.
Van Genuchten, R., 1980, "A Closed-Form Solution for Predicting the Hydraulic Conductivity of Unsaturated Soils", Journal, Soil Science Society - American, No. 44.

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | G. SMITH | 8/90 | MSK | 8/15/90 | [illegible] | 8/30/90 |
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| | | | | | | | |
| Y. O. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |

B/85

PURPOSE:

The purpose of this calculation is to determine unsaturated hydraulic properties for contaminated materials that will be disposed in the Grand Junction disposal cell at the Cheney site. These materials consist of main pile tailings and vicinity property materials. The hydraulic properties will be used as input to the UNSAT2 computer code to analyze effects of transient drainage. The RETC computer program solves a closed-form equation suggested by Mualem relating soil moisture to hydraulic conductivity. The RETC model was written by Van Genuchten and is utilized in this analysis.

METHOD:

Determination of unsaturated hydraulic properties suggested by Mualem requires input of moisture-pressure capillary data. This data is obtained from laboratory testing. The RETC model computes the volumetric saturated and residual moisture contents in addition to curve fitting parameters, denoted the Mualem parameters, alpha and N. When determining the above parameters for vicinity property materials, they were assumed unknown. The porosity, or saturated volumetric moisture content, was calculated from placement specifications and was not allowed to vary for tailings materials. The Mualem based restriction of $M = 1-1/N$ is used to provide an approximation to the empirically derived capillary curves. This restriction is also necessary for input to the UNSAT2 computer code.

DATA:

The data used in the model were obtained from Daniel B. Stevens & Associates, delivery order #5, May 1990. Copies of the data are reproduced on pages 4 to 6. Samples selected were determined to most closely model expected overall condition of placed contaminated materials in terms of percent minus 200 material contained and placement densities.

REFERENCES:

1) United States Department of Agriculture, 1987. Users Guide: RETC.

2) Van Genuchten, R. Th., 1980. "A Closed-Form Solution for Predicting the Hydraulic Conductivity of Unsaturated Soils", Journal, Soil Science Society - American, No. 44.

## ANALYSIS:

The RETC computer code was run on TAC micro-computers. Data presented on pages 4 to 6 were input to the program to produce the output given on pages 7 to 12.

## RESULTS:

Plots of pressure in centimeters of water versus volumetric moisture content ($cm^3/cm^3$) and pressure versus saturation in percent are illustrated on Figures #1 to #4. Hydraulic conductivity versus volumetric moisture content and saturation for each material are presented on Figures #5 to #8. The use of the restricted model, where M = 1-1/N, appears to be valid for both main pile tailings and vicinity property materials. The coefficient of regression, $r^2$ for both data sets was above 0.98 indicating a good correlation of the fitted curve to the observed data. Additionally, both determined values of N were above 1.25, which according to Van Genuchten is necessary for the restrictive model to be applicable. The values of saturated and residual moisture contents along with the Mualem parameters generated from the RETC analysis are listed in Table 1.

Table 1

| Material | theta(sat), vol/vol | theta(res) vol/vol | alpha, 1/cm | N |
|---|---|---|---|---|
| vicinity property | 0.4025 | 0.2103 | 0.0330 | 1.35 |
| main pile tailings | 0.4670 | 0.2211 | 0.0034 | 1.71 |

## CONCLUSIONS:

The above unsaturated hydraulic parameters are reasonable and can be included in transient drainage analyses.

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve

| Sample No. | Pressure Head (-cm of water) | Moisture Content (% $cm^3/cm^3$) |
|---|---|---|
| 5-1 | 0.0 | 45.66 |
| | 112.2 | 16.49 |
| | 305.9 | 1.98 |
| | 1019.8 | 6.89 |
| | 3059.4 | 5.19 |
| | 7138.6 | 4.38 |
| | 15399.0 | 3.77 |
| 5-2 | 0.0 | 45.17 |
| | 112.2 | 20.15 |
| | 305.9 | 8.70 |
| | 1019.8 | 7.04 |
| | 3059.4 | 5.30 |
| | 7138.6 | 4.60 |
| | 15399.0 | 3.66 |
| 5-3 S5-3 Tailings | 0.0 | 50.36 |
| | 112.2 | 46.27 |
| | 305.9 | 38.91 |
| | 1019.8 | 33.22 |
| | 3059.4 | 25.65 |
| | 7138.6 | 24.33 |
| | 15399.0 | 24.16 |
| 5-4 | 0.0 | 51.35 |
| | 112.2 | 47.28 |
| | 305.9 | 41.07 |
| | 1019.8 | 34.69 |
| | 3059.4 | 26.20 |
| | 7138.6 | 23.88 |
| | 15399.0 | 17.87 |
| 5-5 | 0.0 | 47.19 |
| | 112.2 | 30.62 |
| | 305.9 | 25.49 |
| | 1019.8 | 22.00 |
| | 3059.4 | 17.36 |
| | 7138.6 | 16.54 |
| | 15399.0 | 14.28 |

* measurement error

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

| Sample No. | Pressure Head (-cm of water) | Moisture Content (% $cm^3/cm^3$) |
|---|---|---|
| 5-11 | 0.0 | 48.34 |
| | 112.2 | 34.35 |
| | 305.9 | 32.49 |
| | 1019.8 | 29.72 |
| | 3059.4 | 22.13 |
| | 7138.6 | 20.60 |
| | 15399.0 | 19.38 |
| 5-12 | 0.0 | 45.27 |
| | 112.2 | 35.60 |
| | 305.9 | 33.56 |
| | 1019.8 | 31.14 |
| | 3059.4 | 25.80 |
| | 7138.6 | 24.46 |
| | 15399.0 | 24.76 |
| 5-13 | 0.0 | 46.48 |
| | 112.2 | 37.49 |
| | 305.9 | 35.57 |
| | 1019.8 | 32.68 |
| | 3059.4 | 27.95 |
| | 7138.6 | 26.69 |
| | 15399.0 | 25.77 |
| 5-14 | 0.0 | 47.39 |
| | 112.2 | 39.10 |
| | 305.9 | 35.24 |
| | 1019.8 | 32.05 |
| | 3059.4 | 26.64 |
| | 7138.6 | 24.20 |
| | 15399.0 | 19.45 |
| 5-15 ½ RS-3 Vicinity Property | 0.0 | 40.69 |
| | 102.0 | 33.11 |
| | 305.9 | 29.70 |
| | 1019.8 | 26.71 |
| | 3059.4 | 26.09 |
| | 7138.6 | 23.80 |
| | 15297.0 | 23.25 |

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

| Sample No. | Pressure Head (-cm of water) | Moisture Content ($cm^3/cm^3$) |
|---|---|---|
| 5-16 | 0.0 | 39.78 |
| Vicinity | 102.0 | 33.16 |
| Property | 305.9 | 29.04 |
| | 1019.8 | 25.60 |
| | 3059.4 | 25.50 |
| | 7138.6 | 23.25 |
| ½ RS-3 | 15297.0 | 22.85 |
| 5-17 | 0.0 | 37.53 |
| | 102.0 | 33.79 |
| | 305.9 | 31.82 |
| | 1019.8 | 29.36 |
| | 3059.4 | 29.17 |
| | 7138.6 | 27.96 |
| | 15297.0 | 28.00 |
| 5-18 | 0.0 | 39.84 |
| | 102.0 | 34.27 |
| | 305.9 | 31.93 |
| | 1019.8 | 29.16 |
| | 3059.4 | 28.39 |
| | 7138.6 | 27.35 |
| | 15297.0 | 25.85 |
| 5-19 | 0.0 | 39.85 |
| | 102.0 | 36.29 |
| | 305.9 | 33.62 |
| | 1019.8 | 30.22 |
| | 3059.4 | 29.38 |
| | 7138.6 | 28.46 |
| | 15297.0 | 27.53 |
| 5-20 | 0.0 | 39.41 |
| | 102.0 | 36.36 |
| | 305.9 | 33.67 |
| | 1019.8 | 30.29 |
| | 3059.4 | 28.47 |
| | 7138.6 | 26.90 |
| | 15297.0 | 26.50 |

```
*****************************************************************
*                                                               *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                      *
*                                                               *
*GRJ, VICINITY PROPERTY MATERIALS, (RS-3/ 05-15 & 05-16)        *
*                                                               *
*    MUALEM-BASED RESTRICTION, M=1-1/N                          *
*    ANALYSIS OF RETENTION DATA ONLY                            *
*    MTYPE= 3     METHOD= 2                                     *
*                                                               *
*****************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

| NO | NAME | INITIAL VALUE | INDEX |
|---|---|---|---|
| 1 | WCR | .2285 | 1 |
| 2 | WCS | .4069 | 1 |
| 3 | ALPHA | .0500 | 1 |
| 4 | N | 2.0000 | 1 |
| 5 | M | .5000 | 0 |
| 6 | EXPO | .5000 | 0 |
| 7 | CONDS | 1.09E-04 | 0 |

OBSERVED DATA

| OBS. NO. | PRESSURE HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | .100 | .4069 | 1.0000 |
| 2 | .100 | .3978 | 1.0000 |
| 3 | 102.000 | .3311 | 1.0000 |
| 4 | 102.000 | .3316 | 1.0000 |
| 5 | 305.900 | .2970 | 1.0000 |
| 6 | 305.900 | .2904 | 1.0000 |
| 7 | 1019.800 | .2671 | 1.0000 |
| 8 | 1019.800 | .2560 | 1.0000 |
| 9 | 3059.400 | .2609 | 1.0000 |
| 10 | 3059.400 | .2550 | 1.0000 |
| 11 | 7138.600 | .2380 | 1.0000 |
| 12 | 7138.600 | .2325 | 1.0000 |
| 13 | 15297.000 | .2325 | 1.0000 |
| 14 | 15297.000 | .2285 | 1.0000 |

| NIT | SSQ | WCR | WCS | ALPHA | N |
|---|---|---|---|---|---|
| 0 | .01877 | .2285 | .4069 | .0500 | 2.0000 |
| 10 | .00042 | .2103 | .4025 | .0330 | 1.3504 |

CORRELATION MATRIX

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 1.0000 | | | |
| 2 | -.0354 | 1.0000 | | |
| 3 | -.8130 | .2576 | 1.0000 | |
| 4 | .9671 | -.0485 | -.9117 | 1.0000 |

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .99070334

| VARIABLE | VALUE | S.E.COEFF. | T-VALUE | LOWER | UPPER |
|---|---|---|---|---|---|
| WCR | .21025 | .01530 | 13.74 | .1762 | .2444 |
| WCS | .40246 | .00460 | 87.44 | .3922 | .4127 |
| ALPHA | .03297 | .01231 | 2.68 | .0055 | .0604 |
| N | 1.35042 | .09971 | 13.54 | 1.1283 | 1.5726 |

OBSERVED AND FITTED DATA

| NO | P | LOG-P | WC-OBS | WC-FIT | WC-DIF |
|---|---|---|---|---|---|
| 1 | .10000+00 | -1.0000 | .4069 | .4024 | .0045 |
| 2 | .10000+00 | -1.0000 | .3978 | .4024 | -.0046 |
| 3 | .10200+03 | 2.0086 | .3311 | .3302 | .0009 |
| 4 | .10200+03 | 2.0086 | .3316 | .3302 | .0014 |
| 5 | .30590+03 | 2.4856 | .2970 | .2948 | .0022 |
| 6 | .30590+03 | 2.4856 | .2904 | .2948 | -.0044 |
| 7 | .10200+04 | 3.0085 | .2671 | .2662 | .0009 |
| 8 | .10200+04 | 3.0085 | .2560 | .2662 | -.0102 |
| 9 | .30590+04 | 3.4856 | .2609 | .2484 | .0125 |
| 10 | .30590+04 | 3.4856 | .2550 | .2484 | .0066 |
| 11 | .71390+04 | 3.8536 | .2380 | .2386 | -.0006 |
| 12 | .71390+04 | 3.8536 | .2325 | .2386 | -.0061 |
| 13 | .15300+05 | 4.1846 | .2325 | .2320 | .0005 |
| 14 | .15300+05 | 4.1846 | .2285 | .2320 | -.0035 |

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES

| | UNWEIGHTED | WEIGHTED |
|---|---|---|
| RETENTION DATA | .00042 | .00042 |
| COND/DIFF DATA | .00000 | .00000 |
| ALL DATA | .00042 | .00042 |

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)

| WC | P | LOGP | COND | LOGK | DIF | LOGD |
|---|---|---|---|---|---|---|
| .2115 | .59120+08 | 7.772 | .59650-23 | -23.224 | .83770-12 | -12.077 |
| .2127 | .81790+07 | 6.913 | .17630-20 | -20.754 | .17130-10 | -10.766 |
| .2151 | .11310+07 | 6.054 | .52110-18 | -18.283 | .35020-09 | -9.456 |
| .2199 | .15650+06 | 5.195 | .15400-15 | -15.812 | .71590-08 | -8.145 |
| .2247 | .49210+05 | 4.692 | .42940-14 | -14.367 | .41830-07 | -7.378 |
| .2295 | .21650+05 | 4.335 | .45530-13 | -13.342 | .14640-06 | -6.834 |
| .2343 | .11450+05 | 4.059 | .28430-12 | -12.546 | .38680-06 | -6.412 |
| .2391 | .68050+04 | 3.833 | .12700-11 | -11.896 | .85580-06 | -6.068 |
| .2439 | .43810+04 | 3.642 | .45020-11 | -11.347 | .16750-05 | -5.776 |
| .2487 | .29910+04 | 3.476 | .13480-10 | -10.870 | .29990-05 | -5.523 |
| .2535 | .21350+04 | 3.329 | .35460-10 | -10.450 | .50130-05 | -5.300 |
| .2583 | .15790+04 | 3.198 | .84310-10 | -10.074 | .79440-05 | -5.100 |
| .2631 | .12010+04 | 3.080 | .18460-09 | -9.734 | .12060-04 | -4.919 |
| .2679 | .93510+03 | 2.971 | .37780-09 | -9.423 | .17660-04 | -4.753 |
| .2727 | .74220+03 | 2.871 | .73070-09 | -9.136 | .25110-04 | -4.600 |
| .2775 | .59870+03 | 2.777 | .13470-08 | -8.871 | .34820-04 | -4.458 |
| .2823 | .48980+03 | 2.690 | .23820-08 | -8.623 | .47270-04 | -4.325 |
| .2871 | .40540+03 | 2.608 | .40660-08 | -8.391 | .63020-04 | -4.200 |
| .2919 | .33900+03 | 2.530 | .67260-08 | -8.172 | .82710-04 | -4.082 |
| .2967 | .28590+03 | 2.456 | .10830-07 | -7.965 | .10710-03 | -3.970 |
| .3015 | .24300+03 | 2.386 | .17020-07 | -7.769 | .13700-03 | -3.863 |
| .3064 | .20790+03 | 2.318 | .26170-07 | -7.582 | .17360-03 | -3.760 |
| .3112 | .17880+03 | 2.252 | .39510-07 | -7.403 | .21800-03 | -3.662 |
| .3160 | .15450+03 | 2.189 | .58640-07 | -7.232 | .27170-03 | -3.566 |
| .3208 | .13400+03 | 2.127 | .85740-07 | -7.067 | .33660-03 | -3.473 |

| | | | | | | |
|---|---|---|---|---|---|---|
| .3400 | .77460+02 | 1.889 | .34870-06 | -6.458 | .76160-03 | -3.118 |
| .3448 | .67620+02 | 1.830 | .48450-06 | -6.315 | .93010-03 | -3.031 |
| .3496 | .58940+02 | 1.770 | .66900-06 | -6.175 | .11370-02 | -2.944 |
| .3544 | .51240+02 | 1.710 | .91970-06 | -6.036 | .13920-02 | -2.856 |
| .3592 | .44350+02 | 1.647 | .12610-05 | -5.899 | .17120-02 | -2.766 |
| .3640 | .38140+02 | 1.581 | .17260-05 | -5.763 | .21180-02 | -2.674 |
| .3688 | .32520+02 | 1.512 | .23660-05 | -5.626 | .26450-02 | -2.578 |
| .3736 | .27370+02 | 1.437 | .32560-05 | -5.487 | .33450-02 | -2.476 |
| .3784 | .22620+02 | 1.354 | .45160-05 | -5.345 | .43090-02 | -2.366 |
| .3832 | .18170+02 | 1.259 | .63510-05 | -5.197 | .57060-02 | -2.244 |
| .3880 | .13950+02 | 1.145 | .91440-05 | -5.039 | .78910-02 | -2.103 |
| .3928 | .98350+01 | .993 | .13750-04 | -4.862 | .11780-01 | -1.929 |
| .3977 | .56130+01 | .749 | .22790-04 | -4.642 | .20950-01 | -1.679 |
| .4001 | .32830+01 | .516 | .32400-04 | -4.489 | .33800-01 | -1.471 |
| .4025 | .00000+00 | | .10900-03 | -3.963 | | |

END OF PROBLEM

==========

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*****************************************************************
*                                                               *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                      *
*                                                               *
*GRJ, MAIN PILE TAILINGS, 23.1% -200 (55-3)                      *
*                                                               *
*    MUALEM-BASED RESTRICTION, M=1-1/N                          *
*    ANALYSIS OF RETENTION DATA ONLY                            *
*    MTYPE= 3     METHOD= 2                                     *
*                                                               *
*****************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

| NO | NAME | INITIAL VALUE | INDEX |
|---|---|---|---|
| 1 | WCR | .2420 | 1 |
| 2 | WCS | .4670 | 0 |
| 3 | ALPHA | .0500 | 1 |
| 4 | N | 2.0000 | 1 |
| 5 | M | .5000 | 0 |
| 6 | EXPO | .5000 | 0 |
| 7 | CONDS | 1.50E-05 | 0 |

OBSERVED DATA

| OBS NO | PRESSURE HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | 112.200 | .4627 | 1.0000 |
| 2 | 305.900 | .3891 | 1.0000 |
| 3 | 1019.800 | .3322 | 1.0000 |
| 4 | 3059.400 | .2565 | 1.0000 |
| 5 | 7138.600 | .2433 | 1.0000 |
| 6 | 15399.000 | .2416 | 1.0000 |

| NIT | SSQ | WCR | ALPHA | N |
|---|---|---|---|---|
| 0 | 05790 | .2420 | .0500 | 2.0000 |
| 10 | .00072 | .2211 | .0034 | 1.7099 |

CORRELATION MATRIX

| | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 1.0000 | | |
| 2 | -.4337 | 1.0000 | |
| 3 | .8882 | -.7179 | 1.0000 |

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .98372571

NONLINEAR LEAST-SQUARES ANALYSIS: FINAL RESULTS

| VARIABLE | VALUE | S.E.COEFF. | T-VALUE | 95% CONFIDENCE LIMITS LOWER | UPPER |
|---|---|---|---|---|---|
| WCR | .27115 | .07618 | 8.45 | .1378 | .3045 |
| ALPHA | .00347 | .00097 | 3.53 | .0003 | .0065 |
| N | 1.70993 | .29152 | 5.87 | .7822 | 2.6376 |

OBSERVED AND FITTED DATA

| NO | P | LOG-P | WC-OBS | WC-FIT | WC-DIF |
|---|---|---|---|---|---|
| 1 | .11770+03 | 2.0500 | .4627 | .4495 | .0132 |
| 2 | .30590+03 | 2.4856 | .3891 | .4025 | -.0134 |
| 3 | .10200+04 | 3.0085 | .3327 | .3178 | .0144 |
| 4 | .30590+04 | 3.4856 | .2565 | .2672 | -.0107 |
| 5 | .71390+04 | 3.8536 | .2433 | .2465 | -.0032 |
| 6 | .15400+05 | 4.1875 | .2416 | .2359 | .0057 |

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES

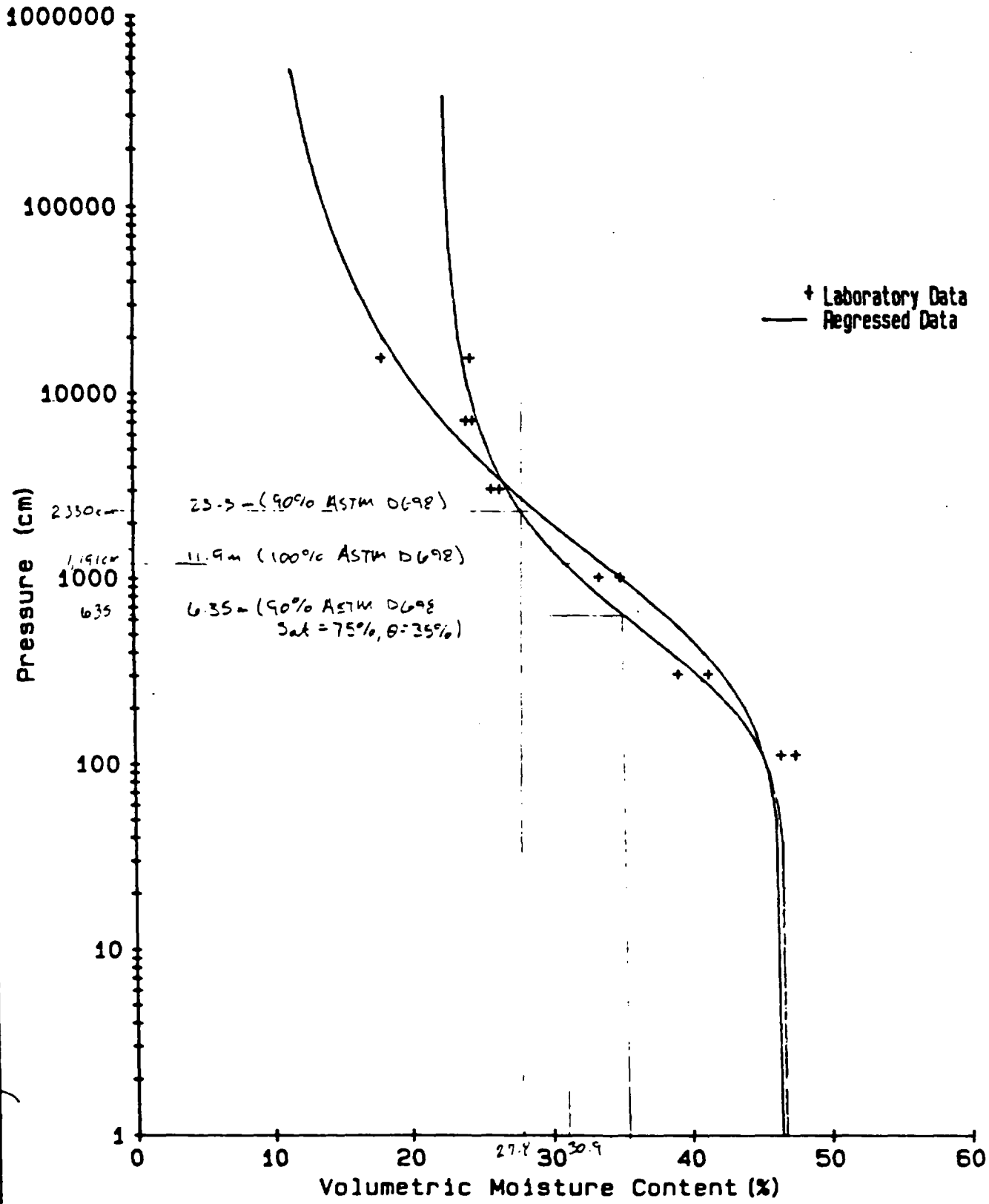
| | UNWEIGHTED | WEIGHTED |
|---|---|---|
| RETENTION DATA | .00072 | .00072 |
| COND/DIFF DATA | .00000 | .00000 |
| ALL DATA | .00072 | .00072 |

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)

| WC | P | LOGP | COND | LOGK | DIF | LOGD |
|---|---|---|---|---|---|---|
| .2227 | .37170+06 | 5.570 | .49300-17 | -17.307 | .16800-08 | -8.775 |
| .2242 | .14000+06 | 5.146 | .19660-15 | -15.706 | .12610-07 | -7.899 |
| .2273 | .52730+05 | 4.722 | .78370-14 | -14.106 | .94720-07 | -7.024 |
| .2334 | .19860+05 | 4.296 | .31260-12 | -12.505 | .71170-06 | -6.148 |
| .2396 | .11210+05 | 4.050 | .27010-11 | -11.568 | .23170-05 | -5.635 |
| .2457 | .74650+04 | 3.873 | .12480-10 | -10.904 | .53610-05 | -5.271 |
| .2519 | .54430+04 | 3.736 | .40960-10 | -10.388 | .10290-04 | -4.988 |
| .2580 | .42010+04 | 3.623 | .10820-09 | -9.966 | .17550-04 | -4.756 |
| .2642 | .33720+04 | 3.528 | .24630-09 | -9.608 | .27610-04 | -4.559 |
| .2703 | .27840+04 | 3.445 | .50270-09 | -9.299 | .40940-04 | -4.388 |
| .2765 | .23490+04 | 3.371 | .94420-09 | -9.025 | .58080-04 | -4.236 |
| .2826 | .20150+04 | 3.304 | .16610-08 | -8.780 | .79550-04 | -4.099 |
| .2888 | .17520+04 | 3.244 | .27730-08 | -8.557 | .10600-03 | -3.975 |
| .2949 | .15400+04 | 3.188 | .44320-08 | -8.353 | .13800-03 | -3.860 |
| .3011 | .13660+04 | 3.135 | .68320-08 | -8.165 | .17630-03 | -3.754 |
| .3072 | .12210+04 | 3.087 | .10210-07 | -7.991 | .22180-03 | -3.654 |
| .3133 | .10970+04 | 3.040 | .14870-07 | -7.828 | .27530-03 | -3.560 |
| .3195 | .99170+03 | 2.996 | .21180-07 | -7.674 | .33800-03 | -3.471 |
| .3256 | .90010+03 | 2.954 | .29560-07 | -7.529 | .41100-03 | -3.386 |
| .3318 | .82000+03 | 2.914 | .40550-07 | -7.392 | .49580-03 | -3.305 |
| .3379 | .74920+03 | 2.875 | .54790-07 | -7.261 | .59410-03 | -3.226 |
| .3441 | .68620+03 | 2.836 | .73050-07 | -7.136 | .70780-03 | -3.150 |
| .3502 | .62980+03 | 2.799 | .96240-07 | -7.017 | .83920-03 | -3.076 |
| .3564 | .57850+03 | 2.762 | .12550-06 | -6.901 | .99130-03 | -3.004 |
| .3625 | .53240+03 | 2.726 | .16200-06 | -6.790 | .11670-02 | -2.933 |
| .3687 | .49000+03 | 2.690 | .20760-06 | -6.683 | .13720-02 | -2.863 |
| .3748 | .45100+03 | 2.654 | .26400-06 | -6.578 | .16100-02 | -2.793 |
| .3810 | .41480+03 | 2.618 | .33360-06 | -6.477 | .18890-02 | -2.724 |
| .3871 | .38120+03 | 2.581 | .41920-06 | -6.378 | .22170-02 | -2.654 |
| .3932 | .34970+03 | 2.544 | .52450-06 | -6.280 | .26050-02 | -2.584 |
| .3994 | .32010+03 | 2.505 | .65390-06 | -6.185 | .30680-02 | -2.513 |

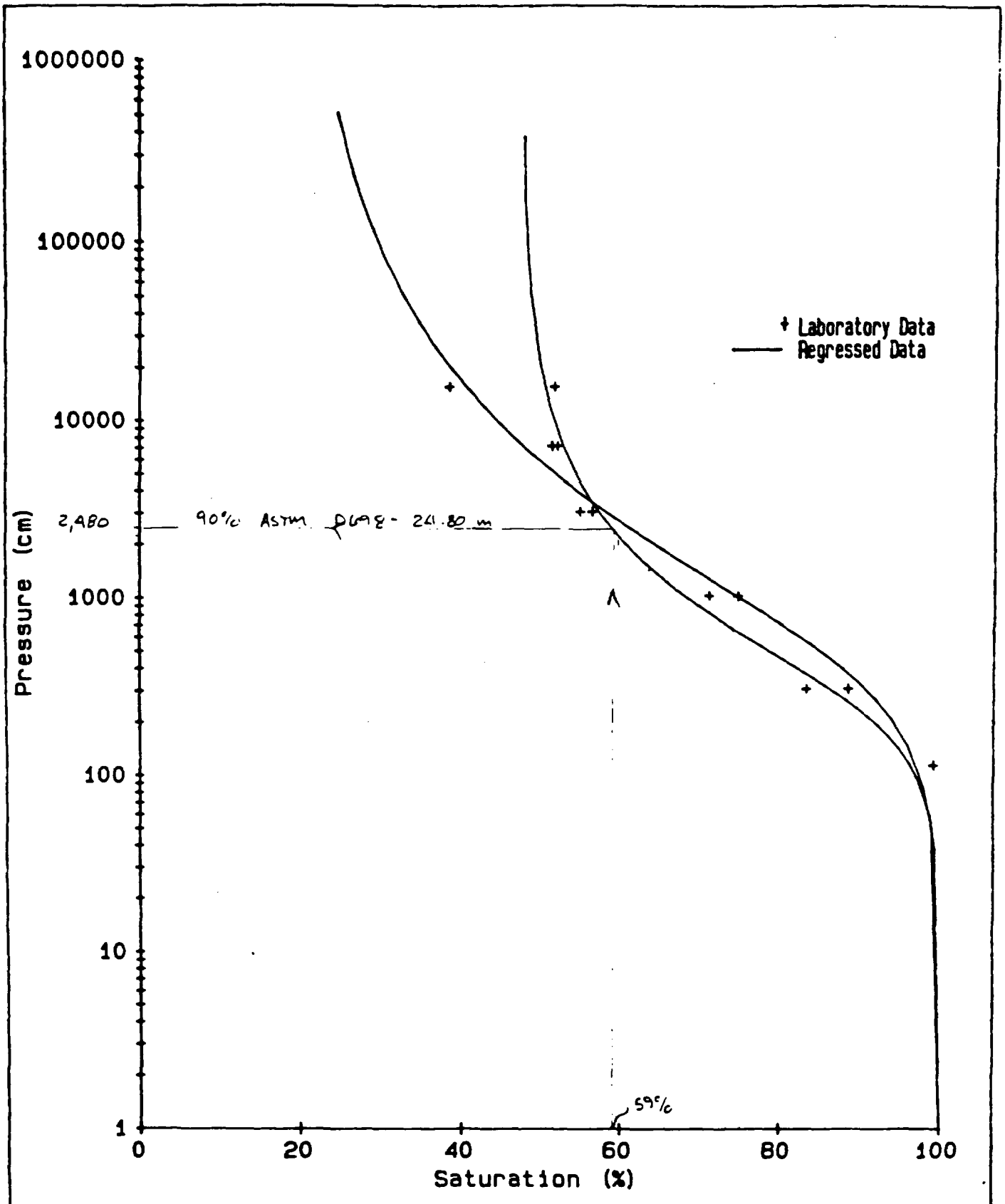
| | | | | | | |
|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| .4363 | .16570+03 | 2.219 | .24150-05 | -5.617 | .95270-02 | -2.021 |
| .4424 | .14130+03 | 2.150 | .30450-05 | -5.516 | .12770-01 | -1.913 |
| .4484 | .11610+03 | 2.065 | .38920-05 | -5.410 | .16350-01 | -1.786 |
| .4547 | .8916D+02 | 1.950 | .51030-05 | -5.292 | .23410-01 | -1.627 |
| .4609 | .5791D+02 | 1.763 | .70690-05 | -5.151 | .40670-01 | -1.391 |
| .4639 | .3817D+02 | 1.581 | .87760-05 | -5.057 | .65050-01 | -1.187 |
| .4670 | .00000+00 | | .15000-04 | -4.824 | | |

END OF PROBLEM



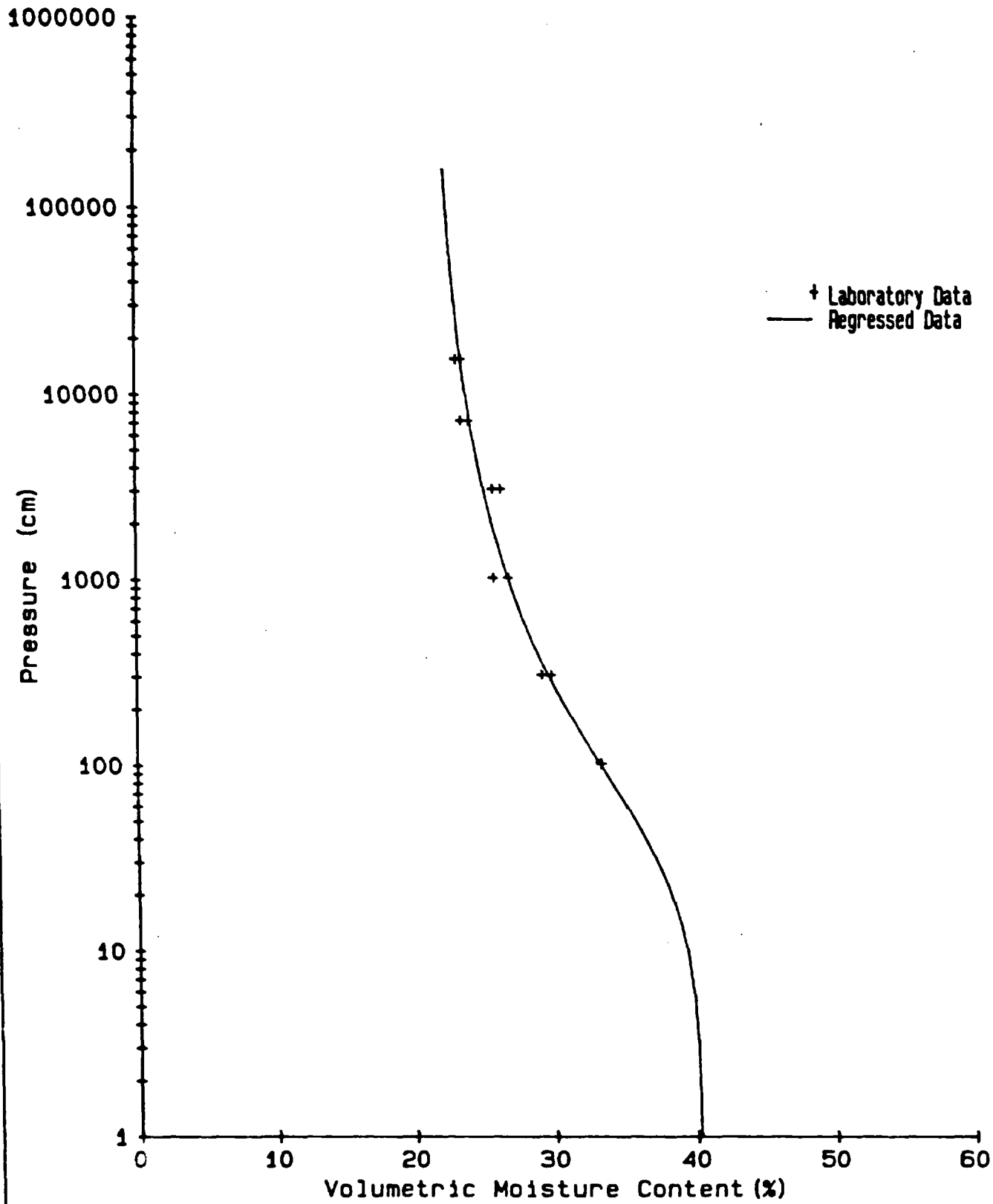

GRJ. MAIN PILE TAILINGS. 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS. 17.7% -200 (S5-4)

FIGURE #1



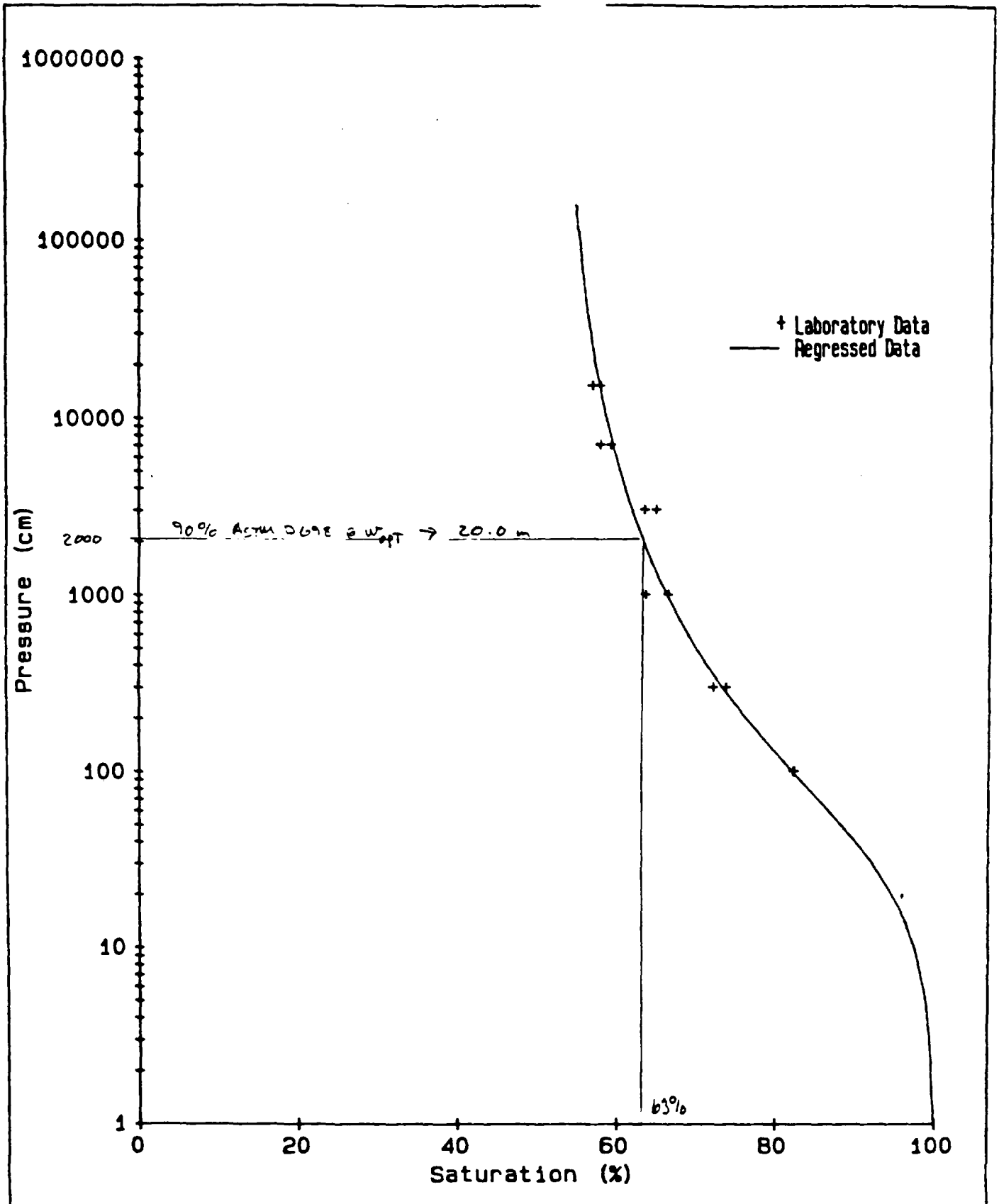

GRJ. MAIN PILE TAILINGS, 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS, 17.7% -200 (S5-4)

FIGURE #2



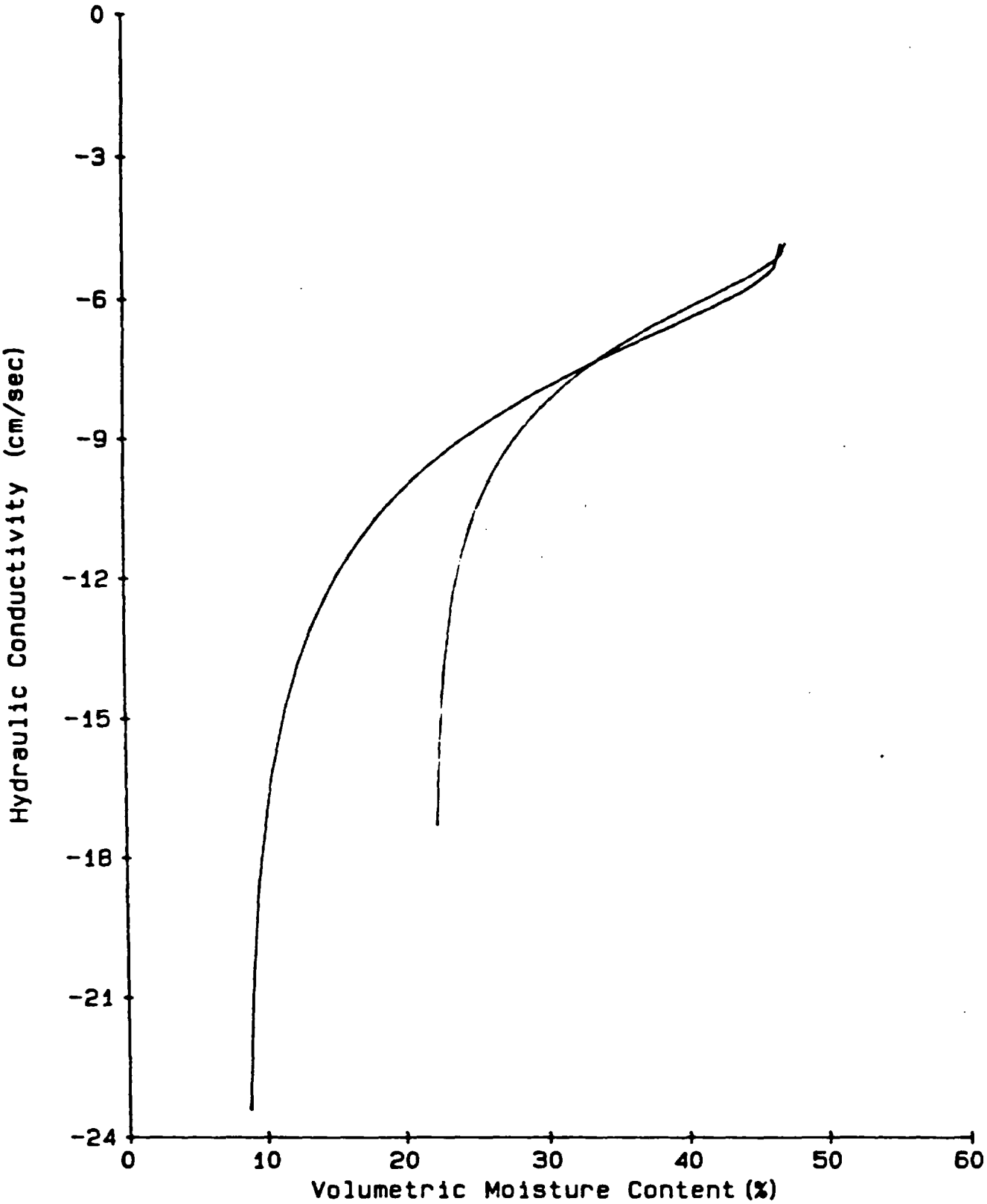

GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE #3



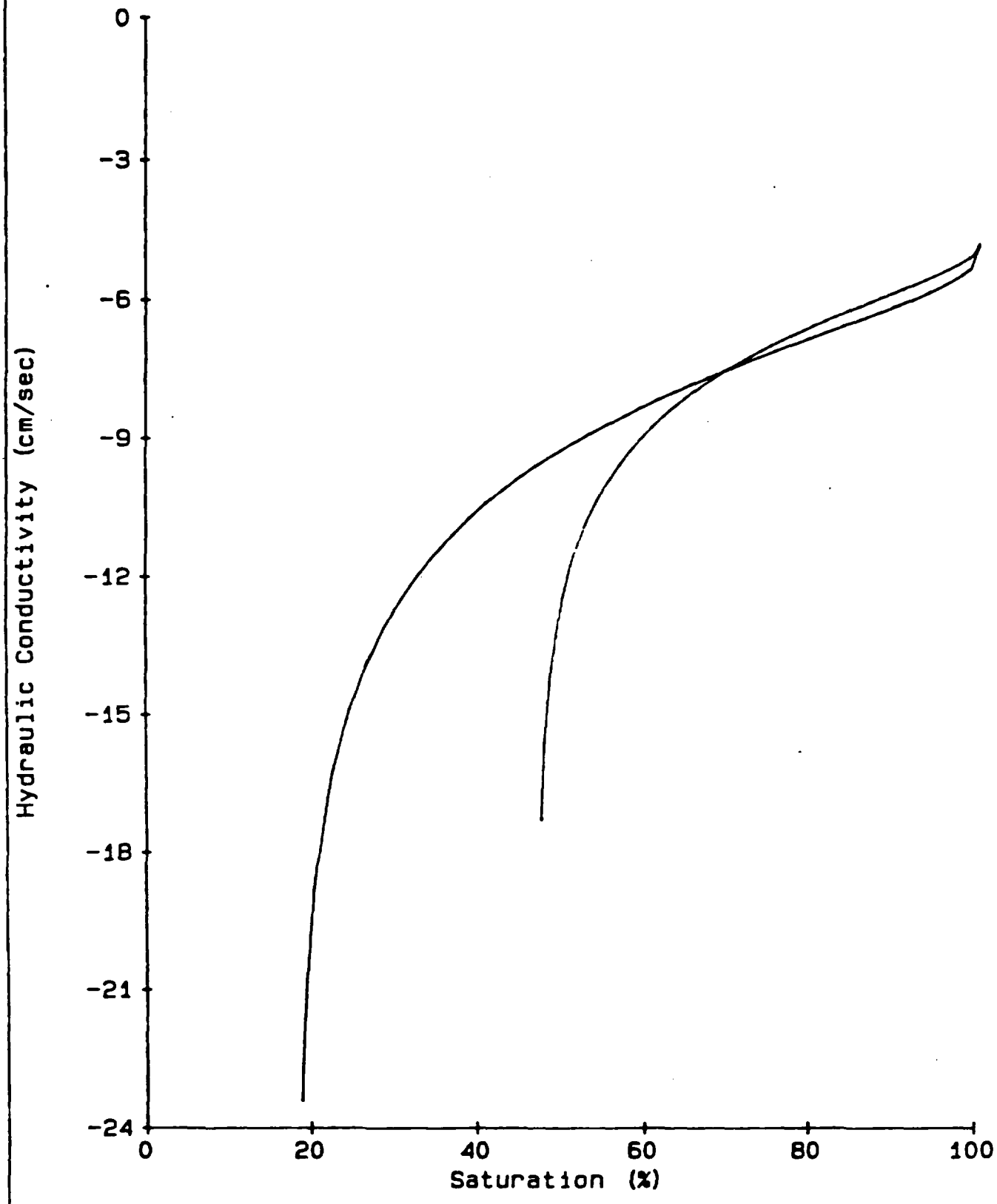

GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE #4



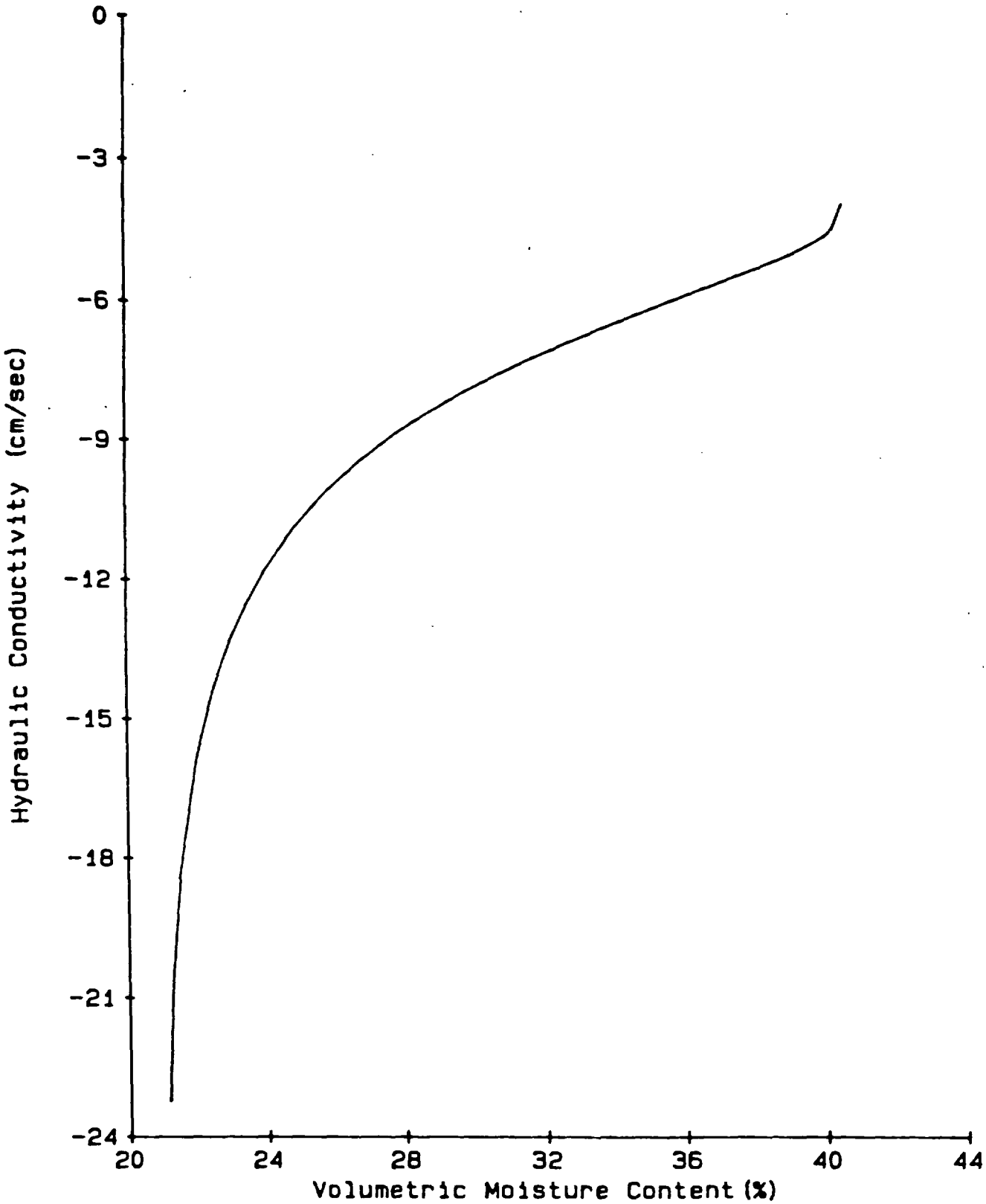

GRJ. MAIN PILE TAILINGS, 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS, 17.7% -200 (S5-4)

FIGURE #5



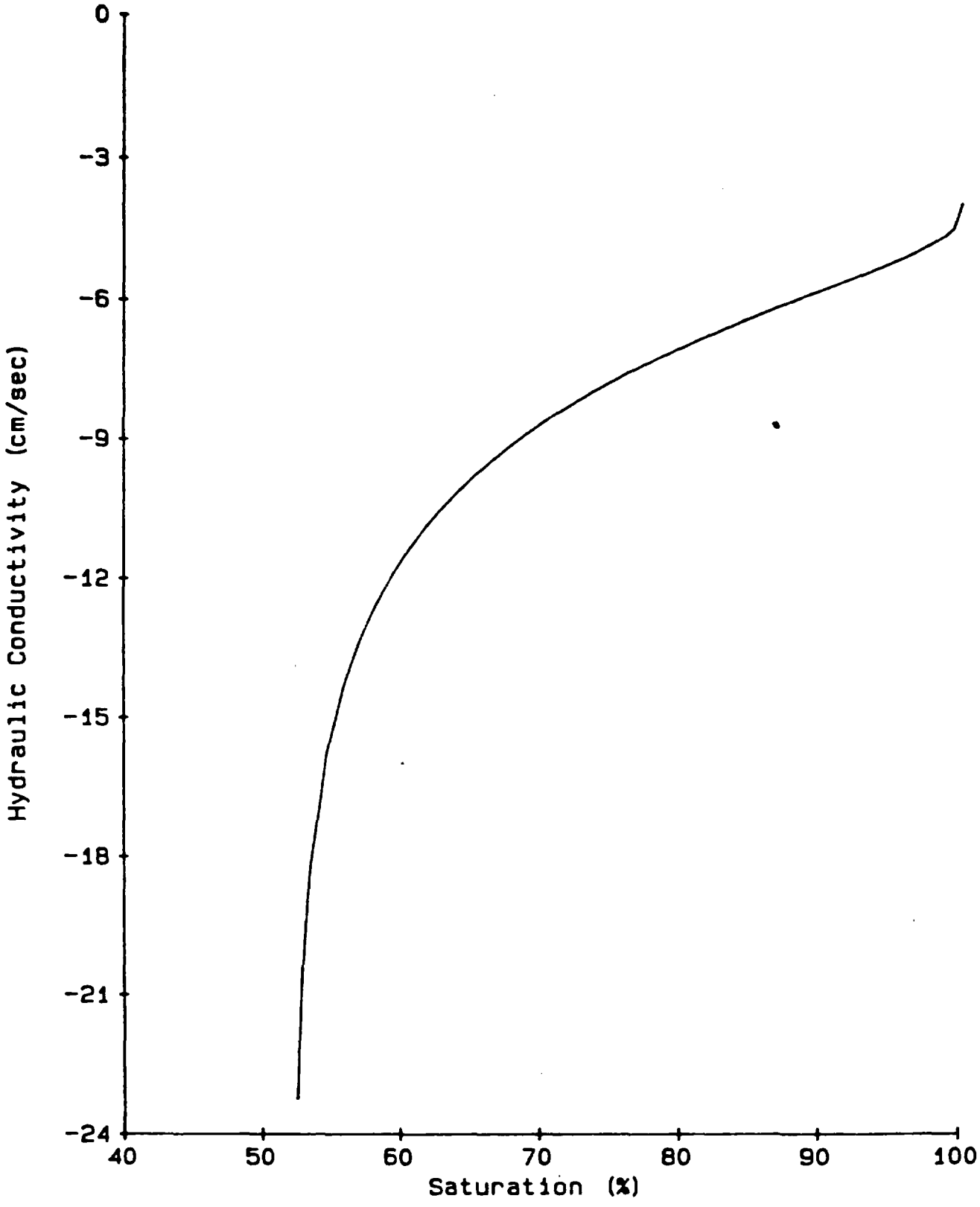

GRJ, MAIN PILE TAILINGS, 23.1% -200 (S5-3)
GRJ, MAIN PILE TAILINGS, 17.7% -200 (S5-4)

FIGURE # 6




GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE # 7




GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE #8

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-08-90-12-05-00 DISCIPLINE Geotech/Hydro NO. OF SHEETS 25

**PROJECT:**
UMTRA

**SITE:**
GRAND JUNCTION

**FEATURE:**
TRANSIENT DRAINAGE AND STEADY STATE SEEPAGE FROM CHENEY DISPOSAL CELL

**SOURCES OF DATA:**
Daniel B. Stevens & Associates
~~Shan Northern Consulting Geotechnical Engineers~~
MKE-5, Final Grading Plans & Embankment Area Excavations

**SOURCES OF FORMULAE & REFERENCES:**

SEE PG 3

PRELIMINARY CALC. [X] FINAL CALC. [ ] SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | G. SMITH | 8/90 | [illegible] | 8/9/90 | [illegible] | 9/6/90 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

8/85

PURPOSE:

To evaluate effects of transient drainage of construction water from placed contaminated materials on overall cell performance. To determine if any ponding and the resulting depth that water is expected to reach within the cell. Compare the resulting water level to the location of the nearest paleochannel and evaluate the possibility of contaminate water leaching from the cell into the channel.

METHOD:

Utilize finite element method (FEM) analysis provided by the UNSAT2 computer code to evaluate the time-drainage effects of transient drainage. Use Maulem's parameters determined from Van Gneuthen's RETC analyses in conjunction with moisture/pressure test data obtained from laboratory analyses performed on the various materials to be used in the final cell construction. Test data were selected from samples that have materials properties and were prepared closest to expected final field conditions. Tailings materials possess any overall slime or fines content (% material passing a #200 mesh sieve) of around 25% (see reference 4). The vicinity property materials have over 60% slimes according to laboratory test results. Samples chosen contain percentage of fine material which are closest to design specifications and were remolded to design densities and water contents.

Two separate analyses are performed to bound the range of estimated material moisture/pressure relationships. Flux rates determined through previous infiltration studies will be applied to the surface of the contaminated materials. These earlier analyses are listed in the reference section. The cover is not included in the model. The condition imposed is the flux through the cover will be governed by the flux rate as determined by the UNSAT-H calculation of 1.78 cm/year (5.68E-08 cm/sec). This rate is conservatively modeled as the design saturated permeability of the radon/infiltration barrier of 1.0E-07 cm/sec.

ASSUMPTIONS:

- laboratory test methods utilized accurately reproduce expected field behavior of placed materials.

- transient drainage of construction waters do not begin until all cell components have been constructed.

- densities and moisture contents of placed materials precisely meet construction specifications.

- all materials are homogenous and isotropic except where specified anisotropity exists.

REFERENCES:

1) Crain, J., March 1990., TAC calculation GRJ-03-90-11-01-00, "Infiltration Through Cover System and Vicinity Properties Material".

2) Crain, J. & Smith, G., Jan. 1990., TAC calculation GRJ-01-90-02-03-00, "Grand Junction, Cheney Disposal Site, Transient Drainage".

3) Davis, L. and Neuman, 1983. Documentation and User's Guide: UNSAT-2 Variably Saturated Flow Model, NRC.

4) Merritt, R.C., 1971., "The Extractive Metallurgy of Uranium", Colorado School of Mines Research Institute.

5) Smith, G., August 1990., TAC calculation GRJ-08-90-12-02-00, "Determination of Unsaturated Hydrologic Properties, Tailings and Vicinity Property Materials".

6) United States Department of Agriculture, 1987. User's Guide: RETC.

7) Van Genuchten, R., 1980. "A Closed-Form Solution for Predicting the Hydraulic Conductivity of Unsaturated Soils", Journal, Soil Science Society - American, No. 44.

DATA SOURCE:

Daniel B. Stevens and Associates

University of Arizona Hydrology Laboratory

MKE preliminary drawings GRJ-DS-10-0220 rev.1 & GRJ-DS-10-0134 rev.2 of Final Gradings Plans & Tailing Embankment Area Excavation Plan.

DATA:

Copies of laboratory determined moisture/pressure relationship test results from the firm of Daniel B. Stevens & Assoc.(DBS&A) are presented on pages 5 to 7. Computer results of the RETC analyses (see references 6 & 7) of these data are presented in the Appendix with the resulting best fit curves shown on Figures #1 to #2. This data is reproduced from calculation GRJ-08-90-12-02-00, "Determination of Unsaturated Hydrologic Properties, Tailings and Vicinity Property Materials".

Capillarity moisture tests were not successfully performed on the Mancos Formation shale material. Therefore, test results for a similar substitute material were used. Data were obtained from testing performed by the University of Arizona Hydrology Laboratory on Wasatch Formation shale. This material was taken from the UMTRA disposal site in Rifle, Colorado at Estes Gulch. Plots of the unsaturated moisture/pressure relationships are presented on Figures #3 to #4 on pages 10 and 11 . A justification for this substitution is presented in the discussion section of this calculation set.

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve

| Sample No. | Pressure Head (-cm of water) | Moisture Content (% $cm^3/cm^3$) |
|---|---|---|
| 5-1 | 0.0 | 45.66 |
| | 112.2 | 16.49 |
| | 305.9 | 1.98* |
| | 1019.8 | 6.89 |
| | 3059.4 | 5.19 |
| | 7138.6 | 4.38 |
| | 15399.0 | 3.77 |
| 5-2 | 0.0 | 45.17 |
| | 112.2 | 20.15 |
| | 305.9 | 8.70 |
| | 1019.8 | 7.04 |
| | 3059.4 | 5.30 |
| | 7138.6 | 4.60 |
| | 15399.0 | 3.66 |
| 5-3 S5-3 Tailings | 0.0 | 50.36 |
| | 112.2 | 46.27 |
| | 305.9 | 38.91 |
| | 1019.8 | 33.22 |
| | 3059.4 | 25.65 |
| | 7138.6 | 24.33 |
| | 15399.0 | 24.16 |
| 5-4 | 0.0 | 51.35 |
| | 112.2 | 47.28 |
| | 305.9 | 41.07 |
| | 1019.8 | 34.69 |
| | 3059.4 | 26.20 |
| | 7138.6 | 23.88 |
| | 15399.0 | 17.87 |
| 5-5 | 0.0 | 47.19 |
| | 112.2 | 30.62 |
| | 305.9 | 25.49 |
| | 1019.8 | 22.00 |
| | 3059.4 | 17.36 |
| | 7138.6 | 16.54 |
| | 15399.0 | 14.28 |

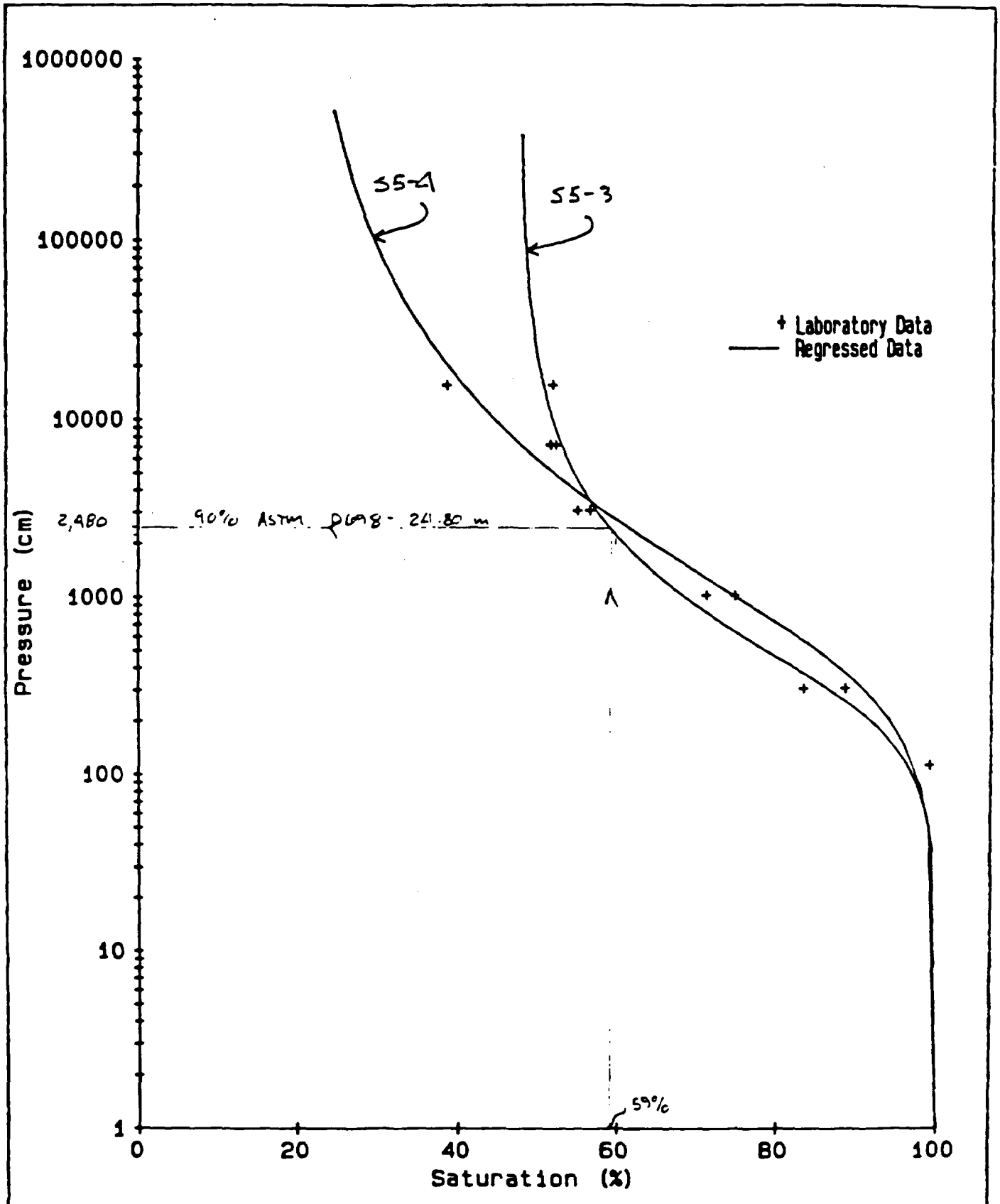
* measurement error

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

| Sample No. | Pressure Head (-cm of water) | Moisture Content (% $cm^3/cm^3$) |
|---|---|---|
| 5-11 | 0.0 | 48.34 |
| | 112.2 | 34.35 |
| | 305.9 | 32.49 |
| | 1019.8 | 29.72 |
| | 3059.4 | 22.13 |
| | 7138.6 | 20.60 |
| | 15399.0 | 19.38 |
| 5-12 | 0.0 | 45.27 |
| | 112.2 | 35.60 |
| | 305.9 | 33.56 |
| | 1019.8 | 31.14 |
| | 3059.4 | 25.80 |
| | 7138.6 | 24.46 |
| | 15399.0 | 24.76 |
| 5-13 | 0.0 | 46.48 |
| | 112.2 | 37.49 |
| | 305.9 | 35.57 |
| | 1019.8 | 32.68 |
| | 3059.4 | 27.95 |
| | 7138.6 | 26.69 |
| | 15399.0 | 25.77 |
| 5-14 | 0.0 | 47.39 |
| | 112.2 | 39.10 |
| | 305.9 | 35.24 |
| | 1019.8 | 32.05 |
| | 3059.4 | 26.64 |
| | 7138.6 | 24.20 |
| | 15399.0 | 19.45 |
| 5-15 ½ RS-3 | 0.0 | 40.69 |
| | 102.0 | 33.11 |
| | 305.9 | 29.70 |
| | 1019.8 | 26.71 |
| Vicinity Property | 3059.4 | 26.09 |
| | 7138.6 | 23.80 |
| | 15297.0 | 23.25 |

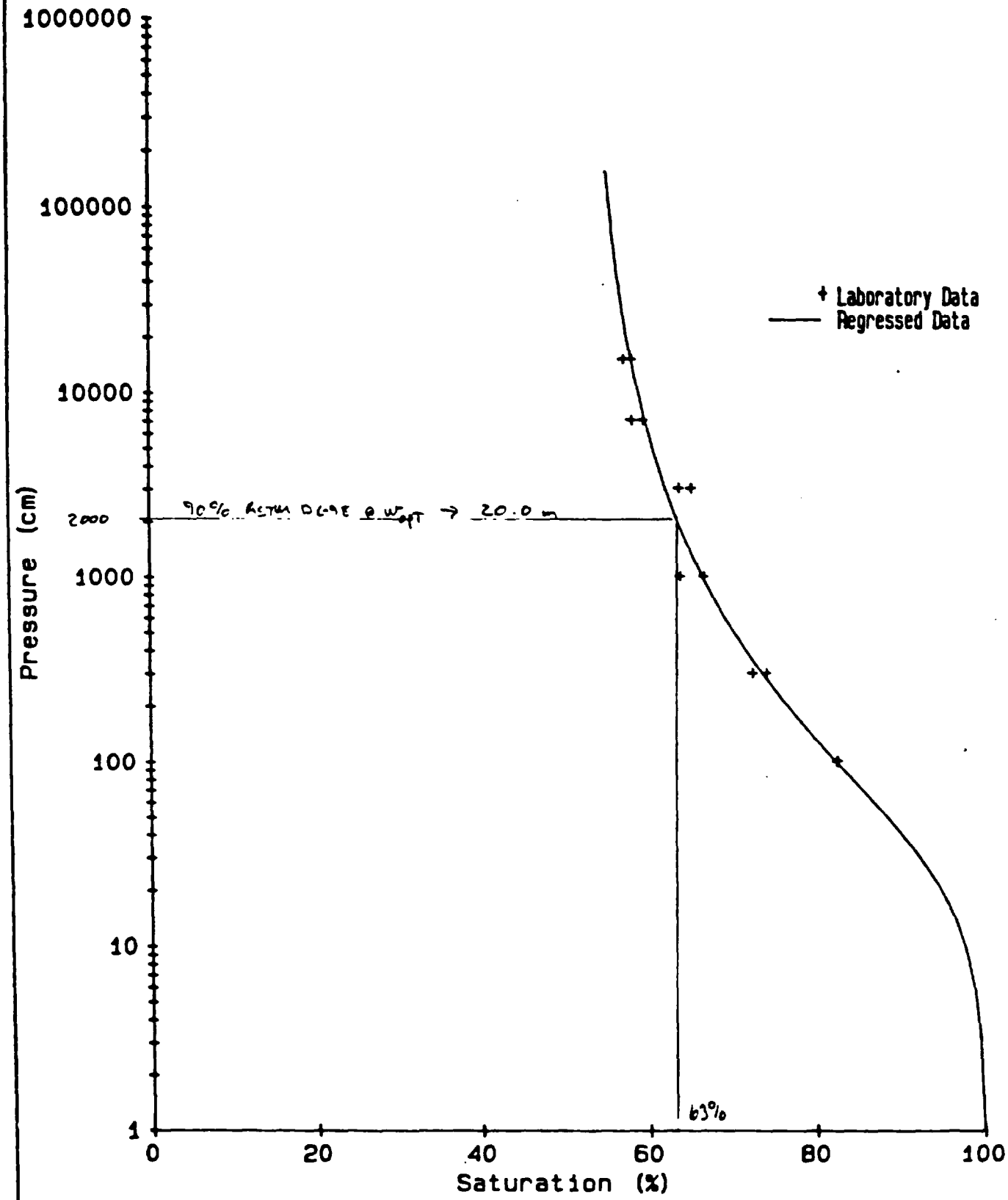
Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

| Sample No. | Pressure Head (-cm of water) | Moisture Content (% $cm^3/cm^3$) |
|---|---|---|
| 5-16 | 0.0 | 39.78 |
| Vicinity | 102.0 | 33.16 |
| | 305.9 | 29.04 |
| Property | 1019.8 | 25.60 |
| | 3059.4 | 25.50 |
| | 7138.6 | 23.25 |
| ½ RS-3 | 15297.0 | 22.85 |
| 5-17 | 0.0 | 37.53 |
| | 102.0 | 33.79 |
| | 305.9 | 31.82 |
| | 1019.8 | 29.36 |
| | 3059.4 | 29.17 |
| | 7138.6 | 27.96 |
| | 15297.0 | 28.00 |
| 5-18 | 0.0 | 39.84 |
| | 102.0 | 34.27 |
| | 305.9 | 31.93 |
| | 1019.8 | 29.16 |
| | 3059.4 | 28.39 |
| | 7138.6 | 27.35 |
| | 15297.0 | 25.85 |
| 5-19 | 0.0 | 39.85 |
| | 102.0 | 36.29 |
| | 305.9 | 33.62 |
| | 1019.8 | 30.22 |
| | 3059.4 | 29.38 |
| | 7138.6 | 28.46 |
| | 15297.0 | 27.53 |
| 5-20 | 0.0 | 39.41 |
| | 102.0 | 36.36 |
| | 305.9 | 33.67 |
| | 1019.8 | 30.29 |
| | 3059.4 | 28.47 |
| | 7138.6 | 26.90 |
| | 15297.0 | 26.50 |



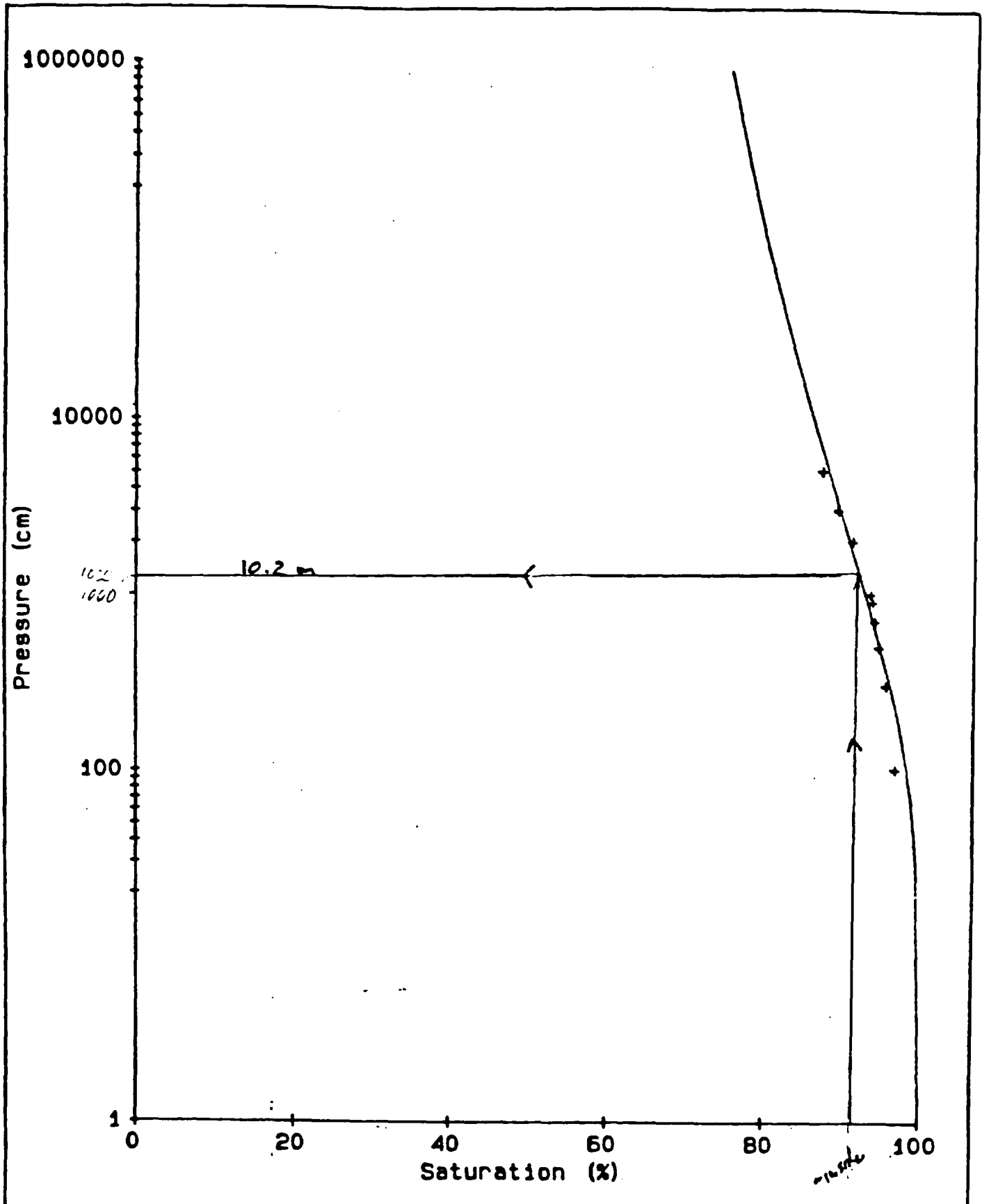

GRJ. MAIN PILE TAILINGS. 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS. 17.7% -200 (S5-4)

FIGURE No. 1



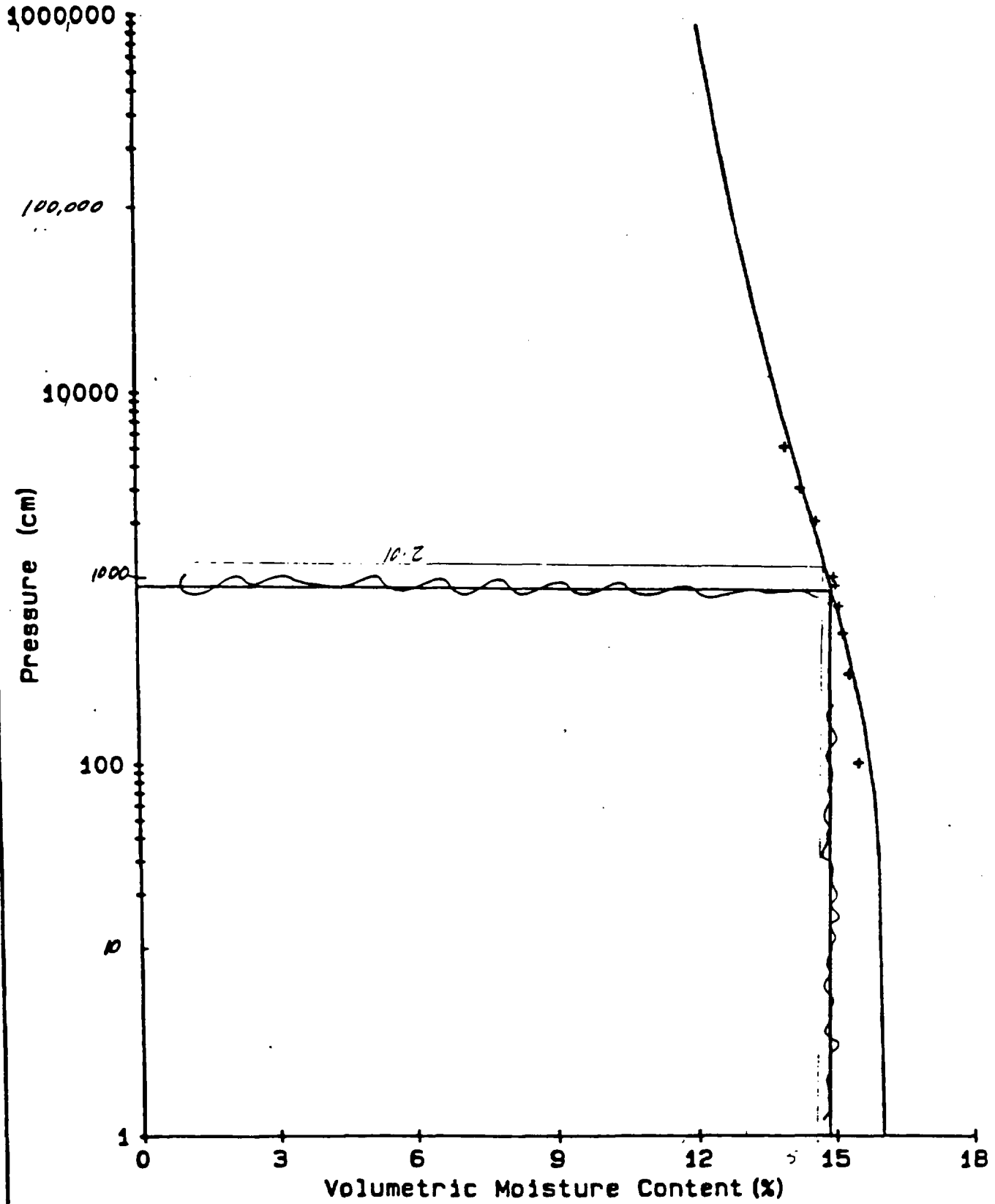

GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE NO. 2




ESTES GULCH, WASATCH FORMATION

Figure #3




ESTES GULCH, WASATCH FORMATION

Figure # 4

CALCULATION:

Utilization of a FEM analysis such as the UNSAT-2 computer code requires construction of a finite element mesh. The FEM mesh utilizied is a two-dimensional (2D) section through the disposal cell. The mesh is required to model the physical system for algorithms to solve partial differential equations governing variably saturated flow simulating both horizontal and vertical movement of water. The mesh used in this analysis was determined by locating the longest downgradient drainage path along the base of the proposed disposal cell excavation. This section is indicated on Figures #5 and #6 showing plan views of the proposed excavation and final grading plans, respectively. This excavation plan is MKE's design of Case 2BX which is for a moderate depth excavation. From these drawings the upper and lower boundaries of the mesh are specified. Thickness of the vicinity property and tailings materials were obtained from a preliminary cross-sectional sketch provided by MKE shown in Figure #7. Using this information the finite element mesh shown in Figure #8 is constructed. Metric units are used in this analysis for consistency with the UNSAT2 computer code. Therefore, all input is in meters or meters/day when units are necessary.

From the moisture/pressure relationships determined in laboratory testing, the unsaturated hydraulic parameters can be obtained. Unsaturated hydraulic properties are given by an analysis suggested by van Genuchten to solve a closed-form equation relating soil moisture contents to hydraulic conductivities derived by Mualem. For input into the UNSAT2 computer code a restriction is placed on determination of the Mualem "m" parameter of $m = 1 - 1/N$. A more detailed discussion on this restriction is provided in the TAC calculation GRJ-01-90-02-03-00 by J. Crain and G. Smith, "Grand Junction, Cheney Disposal Site, Transient Drainage". Unsaturated hydraulic Maulem parameters for each material type are listed in Table I below.

Results of the RETC analyses performed on DBS&A test data indicate the placed materials existing at much drier moisture conditions, holding less moisture at considerably greater negative matric potentials than previous testing had indicated. Therefore, comparative FEM analyses were performed using unsaturated material properties that were utilized in preliminary analyses by Crain and Smith (reference 2) and Crain (reference 1).

FINAL GRADING - COVER

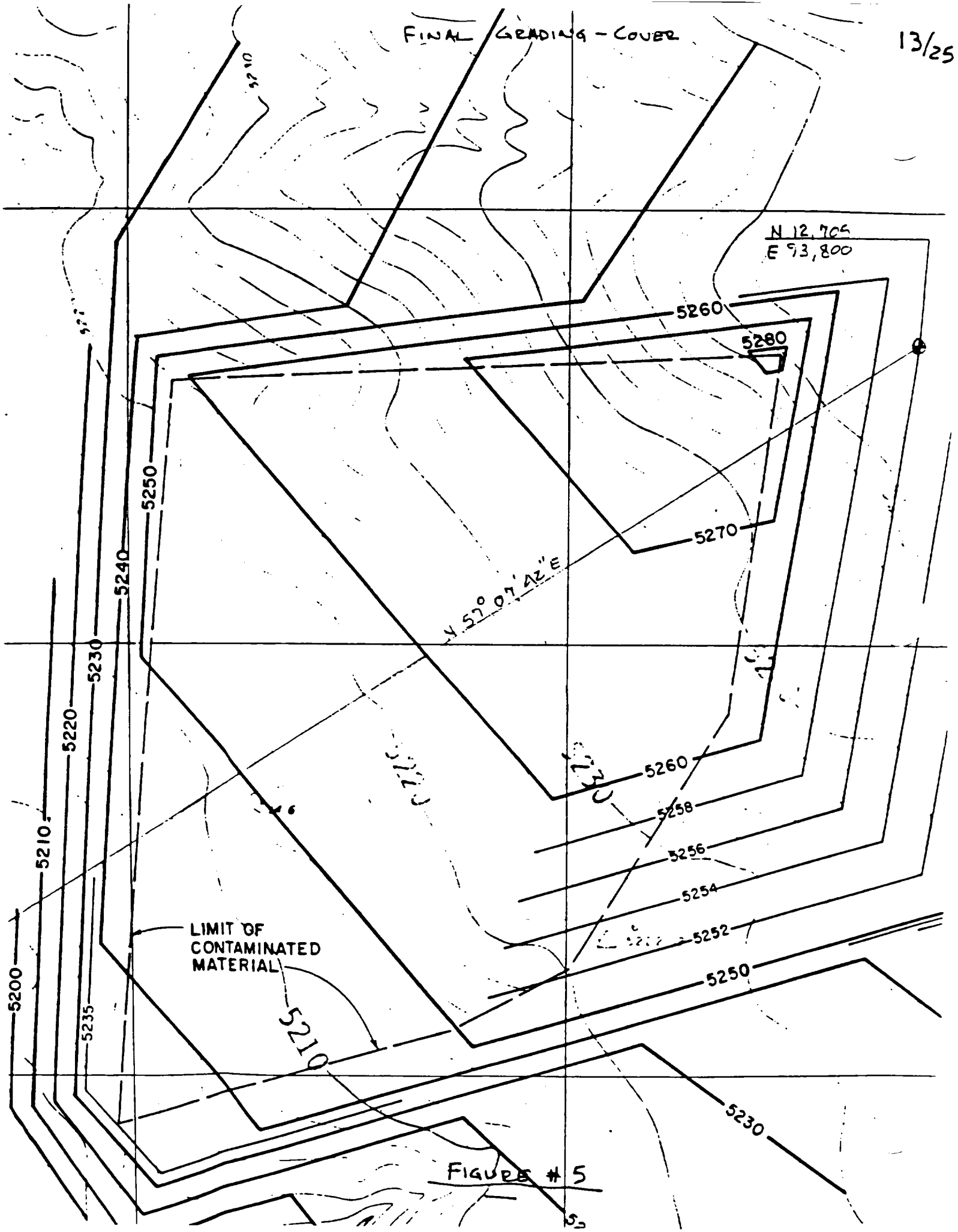



FIGURE # 5

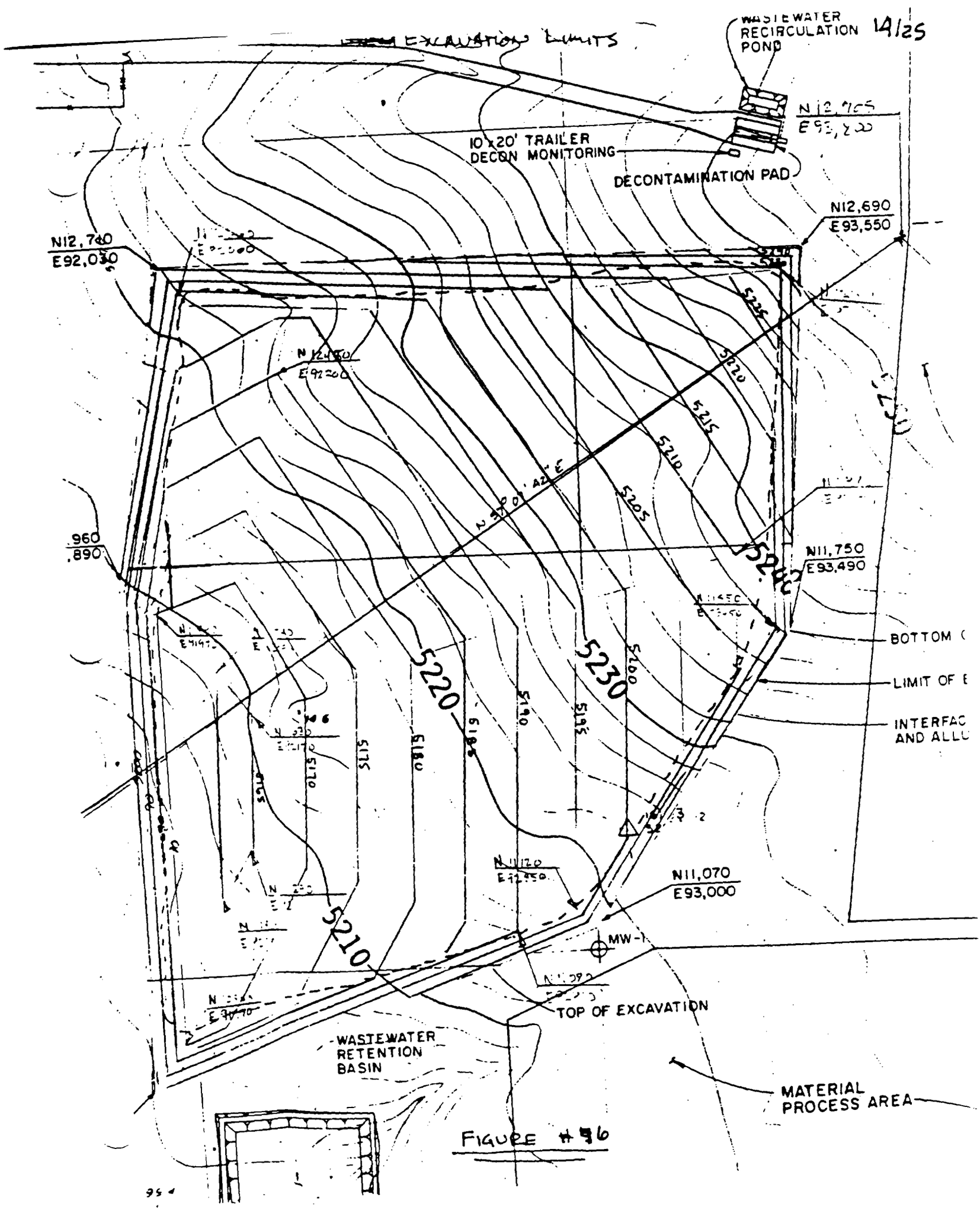
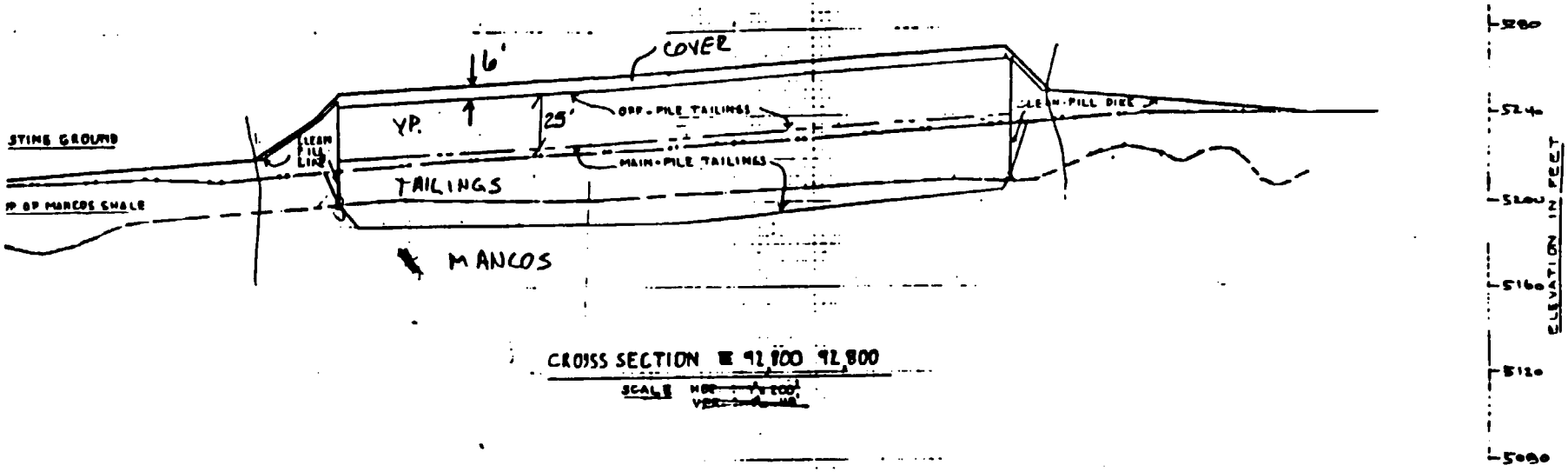

EXCAVATION LIMITS
WASTEWATER RECIRCULATION POND
14/25
10'x20' TRAILER DECON MONITORING
DECONTAMINATION PAD
N12,690
E93,550
N12,740
E92,030
N12,450
E92200
N 20° 00' AZ E
960
890
N11,750
E93,490
BOTTOM
LIMIT OF E
INTERFAC
AND ALLU
N11,070
E93,000
MW-1
TOP OF EXCAVATION
WASTEWATER RETENTION BASIN
MATERIAL PROCESS AREA
5230
5220
5210
5240
5235
5225
5220
5215
5210
5205
5200
5195
5190
5185
5180
5175
5170
5165

FIGURE #6

JACOBS ENGINEERING

DATE ____ BY ____

PRELIM: CASE 2BK 3' DEEPER




PROJECT : UMTRA-GRJ
JOB NUMBER: 5025-16
DATE : APRIL 5, 1990

MK-ENVIRONMENTAL SERVICES

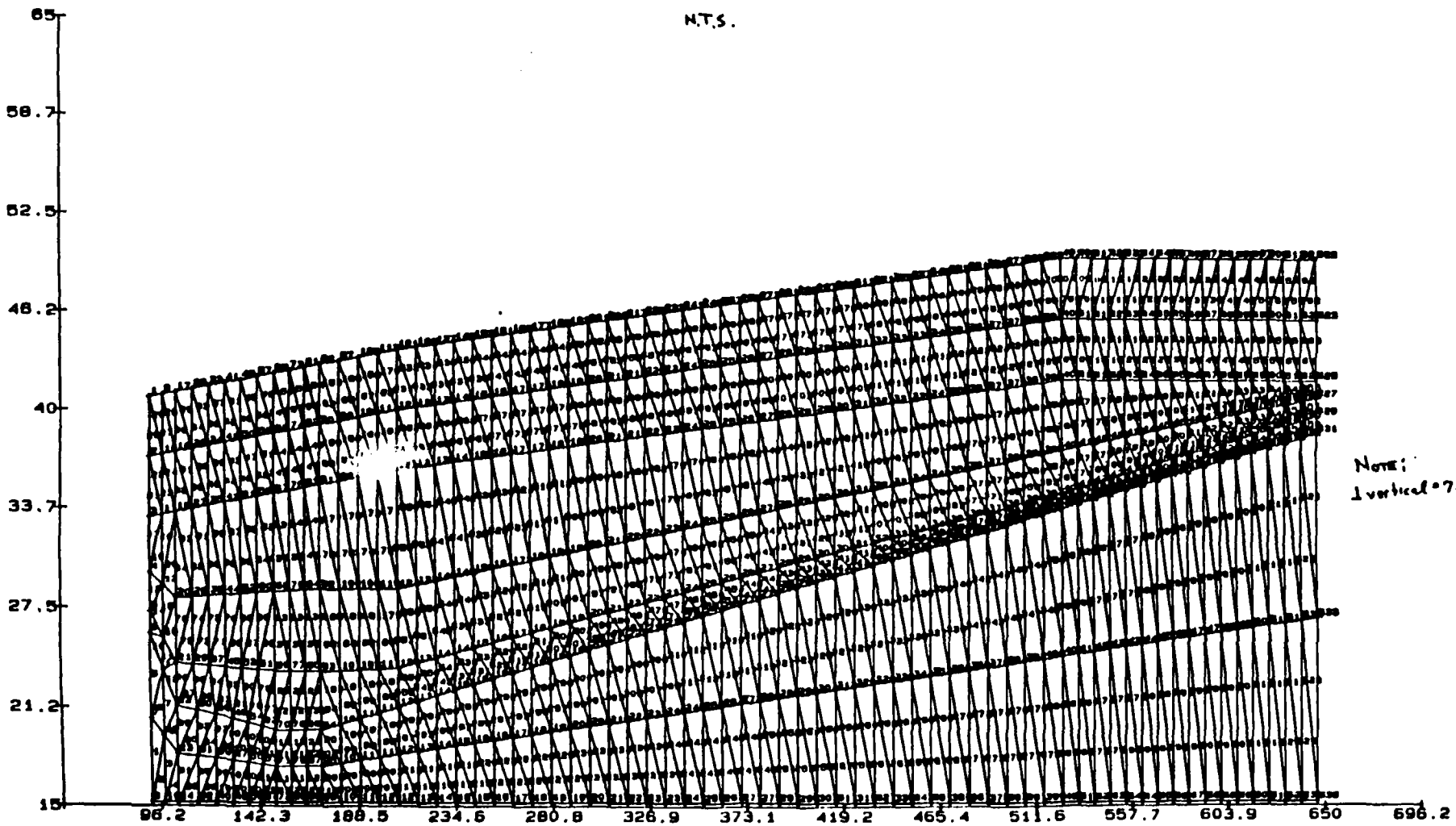
SHEET NO. 15/25 JOB NO. ____

FIGURE #7

NOTE: THIS FIGURE USED TO DETERMINE RELATIVE THICKNESSES OF CONTAMINATED MATERIALS

CHENEY DISPOSAL CELL

N.T.S.




Note:
1 vertical = 7.4 horiz.

Figure #8

## Table I

## Unsaturated Hydraulic Parameters

### (DBS&A)

| material | %-200 sieve | $\theta_s$ (%) | $\theta_r$(%) | $\alpha$ (1/meter) | N |
|---|---|---|---|---|---|
| V.P. | 66.5 | 0.4025 | 0.2103 | 3.30 | 1.35 |
| tailings | 23.8 | 0.4670 | 0.2211 | 0.34 | 1.71 |
| foundation bedrock | - | 0.1600 | 0.0800 | 0.63 | 1.08 |

### (previous)

| material | %-200 sieve | $\theta_s$ (%) | $\theta_r$(%) | $\alpha$ (1/meter) | N |
|---|---|---|---|---|---|
| V.P. | 52 | 0.1969 | 0.0949 | 0.45 | 5.92 |
| tailings | 32 | 0.3613 | 0.1257 | 0.65 | 1.24 |
| foundation bedrock | - | 0.1600 | 0.0800 | 0.63 | 1.08 |

The UNSAT2 computer code also requires data in addition to that provided in Table 1, including saturated hydraulic conductivies and matric potential, in consistent units. These properties should be determined for the materials at initial placement conditions. Saturated permeabilities ($k_{SAT}$) are obtained from laboratory testing and matric potential ($\Psi$)are determined from RETC output.

Determination of $\Psi$ follows this conservative method: from the moisture density relationship defined by ASTM D698 (standard Proctor test), the maximum dry density , $\gamma_d$ and optimum moisture content ,$w_{opt}$ are provided. Construction specifications indicate contaminated materials will be placed at 90% maximum dry density within -3% optimum to optimum moisture content. The placement volumetric moisture content ( $\theta$ ) or corresponding saturation (S) is determined by computing the optimum moisture content at 90% maximum dry density. This provides the most moisture in the materials existing at the lowest dry density or maximum void ratio, e . This computation is outlined below and requires the ratio of material weight of solids to weight of water, or the specific gravity of solids, $G_s$ .

$$0.9 \times \gamma_d = \gamma_{placement} \quad (1)$$

$$e = ((G_s \times \gamma_w)/\gamma_{placement}) - 1.0 \quad (2)$$

$$S = (G_s \times w_c)/e \quad (3)$$

where $\gamma_w$ = unit weight of water = 1.0 g/cc

Using the formulas listed above, information pertaining to remolded materials supplied by DBS&A are presented in Table 2 below. Water contents listed are gravimetric.

Table 2

| material | $G_s$ | $\gamma_d$ (g/cc) | $90\% \gamma_d$ | e | $w_{opt}$ (%) | S(%) |
|---|---|---|---|---|---|---|
| V.P. | 2.66 | 1.88 | 1.69 | 0.592 | 13.6 | 63 |
| tailings | 2.76 | 1.62 | 1.46 | 0.893 | 19.1 | 59 |

From RETC produced plots of saturation versus $\Psi$ given in Figure no. s 1 and 2 the matric potential for each remolded material type is determined. Since the foundation materials will remain in situ, the value of -10.2 meters is determined from computed saturation varying between 87 tO 90%. This determination is presented on Figure no. 3.

Saturated permeabilities are also needed for UNSAT2 input. Remolded values are required for placed contaminated materials while an in situ value is needed for foundation bedrock. Values listed in Table 3 were determined in the laboratory and field accordingly.

Table 3

DBS&A

| material | k (meters/day) | $\Psi$ (meters) |
|---|---|---|
| V.P. | $k_v = k_h = 9.42 \times 10^{-2}$ | -20.0 |
| tailings | $k_v = k_h = 1.25 \times 10^{-2}$ | -24.8 |
| foundation bedrock | $k_h = 3.46 \times 10^{-3}$ | -10.2 |
| | $k_v = 1.73 \times 10^{-4}$ | -10.2 |

previous data

| material | k (meters/day) | $\Psi$ (meters) |
|---|---|---|
| V.P. | $k_v = k_h = 2.62 \times 10^{-3}$ | -2.75 |
| tailings | $k_v = k_h = 4.84 \times 10^{-2}$ | -2.50 |
| foundation bedrock | $k_h = 3.46 \times 10^{-3}$ | -10.2 |
| | $k_v = 1.73 \times 10^{-4}$ | -10.2 |

To model expected field as close as possible, nodes along the base of the mesh were coded intially as unsaturated seepage nodes at there initial matric potential. This allowed moisture to exit the model under atmospheric pressure at a rate controlled by the matric potential of the overlying nodes. A complete copy of the input files used are provided in the Appendix.

In these analyses the mesh extended around 14 feet into the underlying foundation bedrock beneath the lowest portion of the cell. This enables the moisture to be tracked through the upper foundation materials. Analysis indicates any moisture entering the foundation is accepted vertically downward and does not extend laterally beyond the downstream edge of the cell. Since the vertical hydraulic conductivity of the foundation is considered to be homogeneous and isotropic, once water enters the foundation no mounding of water is possible.

## RESULTS

Using the capillarity data provided by DBS&A results in no ponding of any water within the cell. However, changes in matric potential (soil tension) do occur with time as indicated on Figure no.'s 9 and 10 showing pressure contours at variuos times throughout the life of the cell. Soil tensions increase from influx at the top of the cell are indicated by noticing the increasing values of matric potential with time from the surface downward into the cell. From the time progression shown the pressures can be seen to equalize with time through the 87.8 year plot. The next two time plots, (500 and 1000 years) show the influx through the cover being held by the vicinity property material, which is indicated by the closely spaced contours near midheight. This influx is accepted by the tailings before entering the foundation. Tailings are not holding the moisture as indicated by the more widely spaced contours. The closely spaced contours at the edge of the cell shown in the first time plots reflect the high negative matric potentials introduced by compaction of fine grained soils near maximum dry density and optimum moisture content.

When the previous moisture data is utilizied, a ponding depth of 3.75 meters (12.3 feet) is predicted in the cell. Ponding of water is in the base of the cell with the highest pressures indicated at node #94. A plot of positive pressure versus time obtained from node #94 is presented on Figure no. 11. This plot illustrates how moisture is accepted by the underlying foundation clayshales.

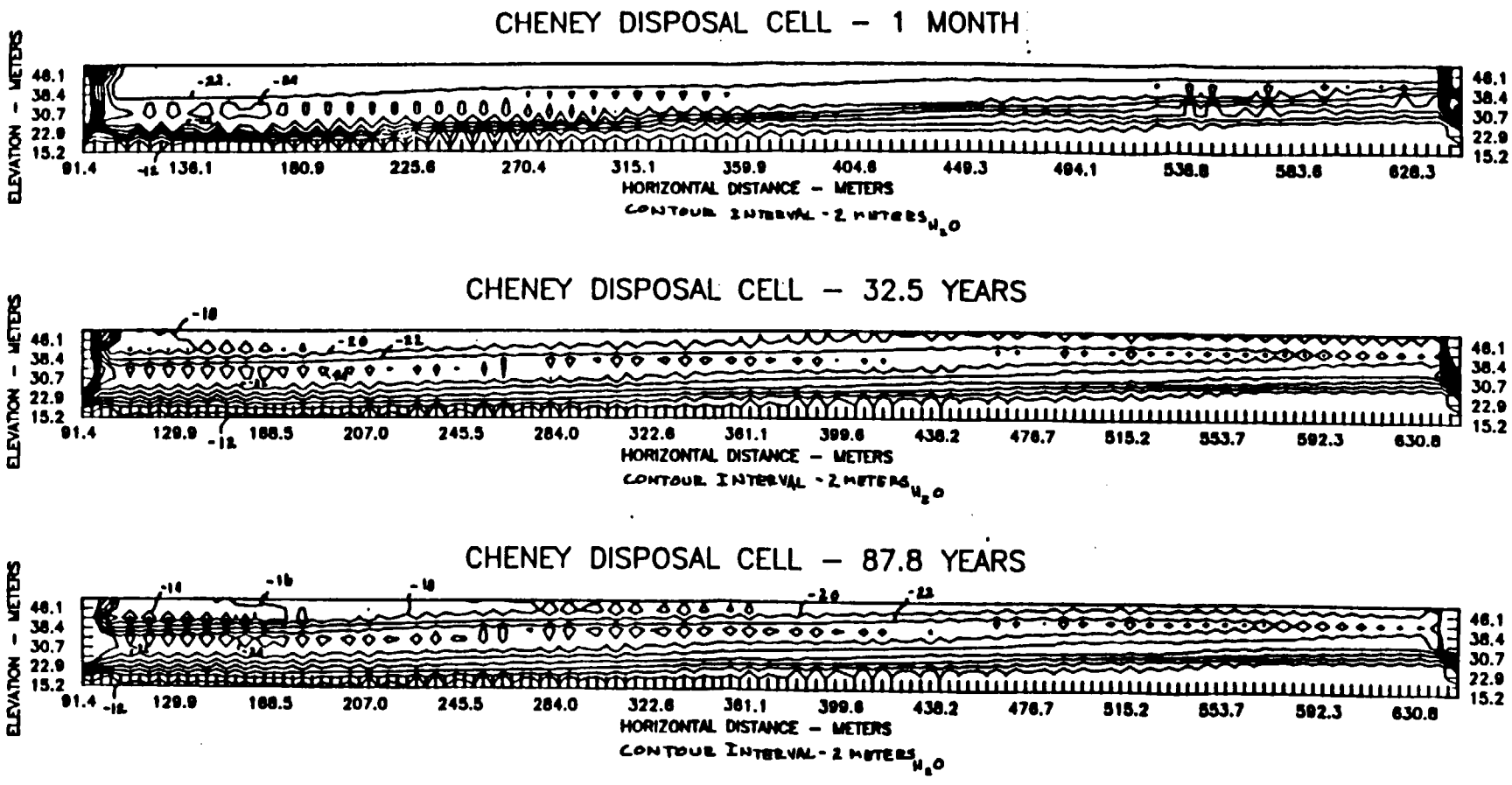
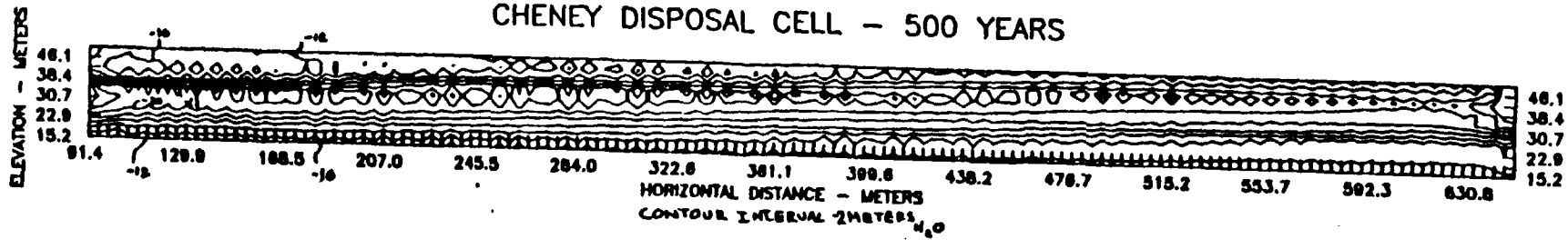

CHENEY DISPOSAL CELL – 1 MONTH
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
136.1
180.9
225.6
270.4
315.1
359.9
404.6
449.3
494.1
538.8
583.6
628.3
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL - 2 METERS $H_2O$
CHENEY DISPOSAL CELL – 32.5 YEARS
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
129.9
168.5
207.0
245.5
284.0
322.6
361.1
399.6
438.2
476.7
515.2
553.7
592.3
630.8
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL - 2 METERS $H_2O$
CHENEY DISPOSAL CELL – 87.8 YEARS
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
129.9
168.5
207.0
245.5
284.0
322.6
361.1
399.6
438.2
476.7
515.2
553.7
592.3
630.8
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL - 2 METERS $H_2O$

FIGURE #9


CHENEY DISPOSAL CELL – 500 YEARS
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
129.9
168.5
207.0
245.5
284.0
322.6
361.1
399.6
438.2
476.7
515.2
553.7
592.3
630.8
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL 2 METERS

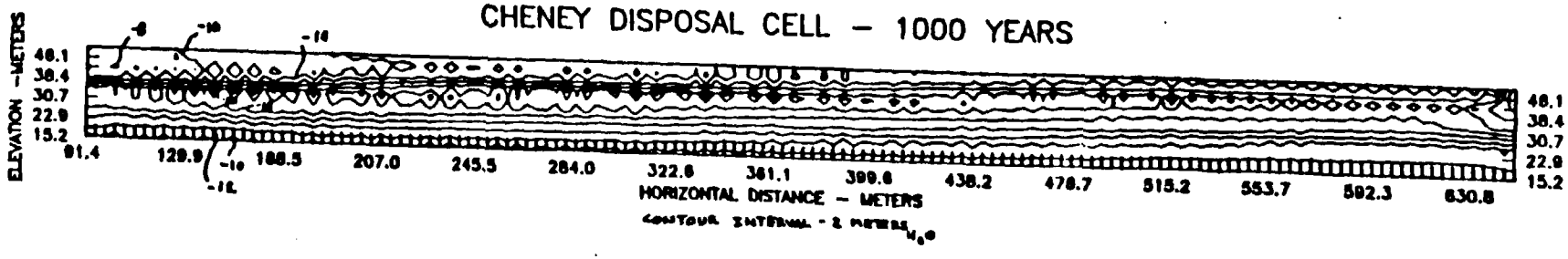

CHENEY DISPOSAL CELL – 1000 YEARS
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
129.9
168.5
207.0
245.5
284.0
322.6
361.1
399.6
438.2
476.7
515.2
553.7
592.3
630.8
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL - 2 METERS

FIGURE # 10

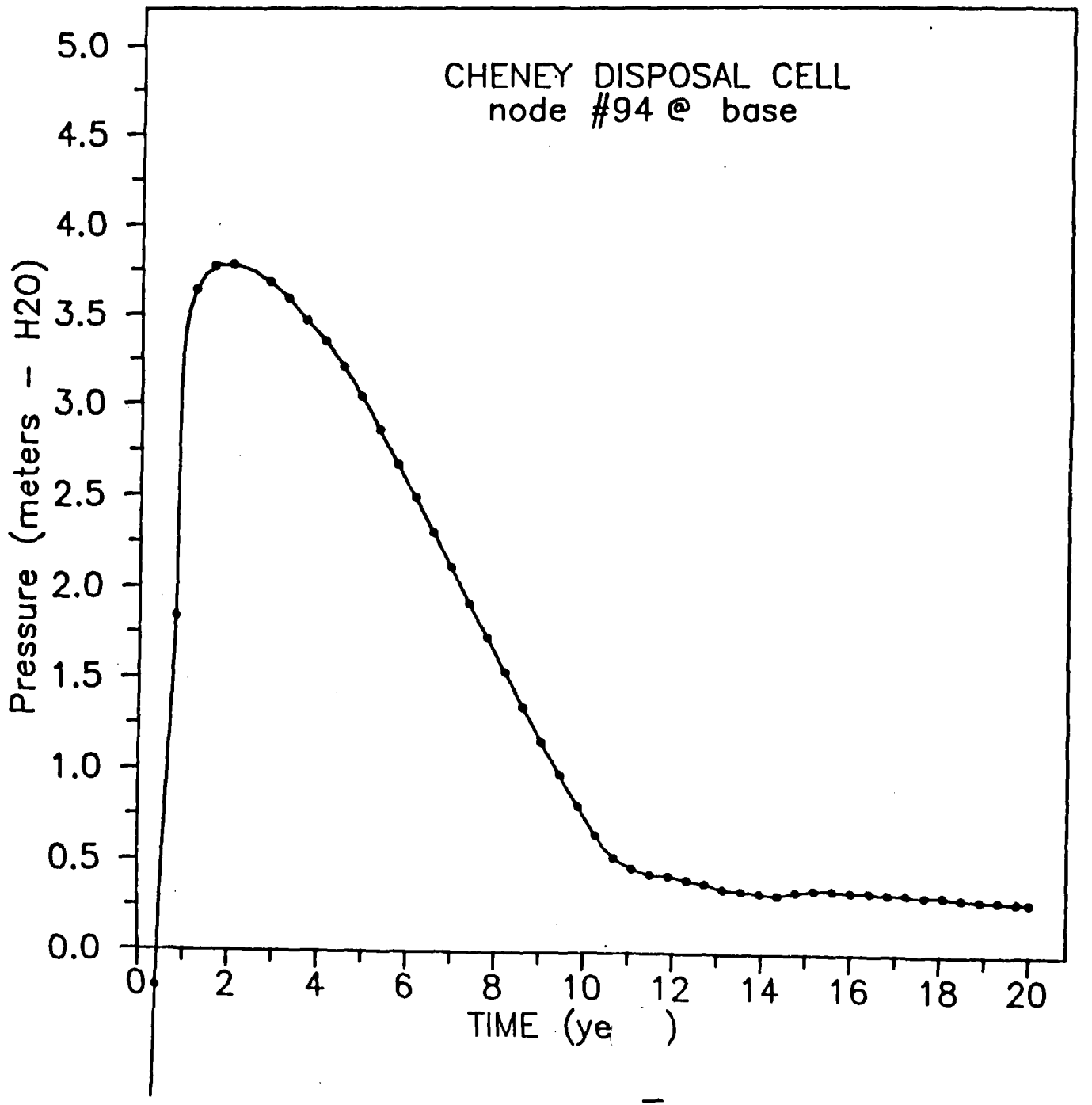

CHENEY DISPOSAL CELL
node #94 @ base
Pressure (meters - H20)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
TIME (ye )

Figure #11

DISCUSSION:

Wasatch Formation in lieu of Mancos Formation:

Geotechnical engineering properties and infiltration characteristics of Mancos Formation shale and Wasatch Formation shale may be considered similar for this analysis because of the following conditions. Both lithologic units would carry the same engineering classification. Both materials are clayshales high in smectite minerals. Although the Mancos material is an older formation of the Cretaceous period while the Wasatch was formed during the much younger Tertiary period, both materials possess similar effects from weathering. Both units occur at similar depths beneath similar overburden materials. This overburden generally consists of silty, sandy clays derived from the underlying parent shale. The consistent overburden material and depth produced a closely matched depth of weathering in both units. Semi-arid climatic conditions exist at both locations which creates a similar force causing the weathering.

Weathering produces fracturing and micro-fracturing and general degradation within the rock mass. These fractures provide flow paths through the material. It is widely accepted that smectite minerals possess a high swell potential. Because the overburden material and depths are similar at both locations, the applied overburden stress will be similar. Thus, the possible degree of swell that can occur upon moisture increases will also be similar. The above swell similarity will produce similar void ratios in both materials. This is confirmed by approximately equal dry unit weights. Similar void ratios and mineral types produce similar pore sizes which control pore fluid tensions which govern unsaturated flow characteristics.

Considering all of the above, differences in hydraulic characteristics between Mancos Formation shales and Wasatch Formation shales are negligible.

## SUMMARY OF RESULTS:

Using results from this analysis in conjunction with results from previous analyses indicated that some ponding will possibly occur. The actual depth of this ponding ranges from no ponding to slightly over 12 feet. The spread in resulting depths is mainly due to varations in the capillarity data. None of the analyses indicate that the level of the water approaches the elevation of the lowest paleochannel. Thus, these models have indicated that seepage of contaminates out of the cell into paleochannels allowing an exit path for the contamination to reach useable aquifers, is not shown to occur.

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

# APPENDIX

TAC CALCULATION GET-08-90-12-05-00

RETC INPUT - VICINITY PROPERTY MATERIALS
- MAIN PILE TAILINGS
- WASATCH FORMATION

UNSAT2 INPUT - DBS&A data
- previous data

```
*************************************************************
*                                                           *
*     ANALYSIS OF SOIL HYDRAULIC PROPERTIES                 *
*                                                           *
*GRJ, VICINITY PROPERTY MATERIALS, (RS-3/ #5-15 & #5-16)    *
*                                                           *
*     MUALEM-BASED RESTRICTION, M=1-1/N                     *
*     ANALYSIS OF RETENTION DATA ONLY                       *
*     MTYPE= 3     METHOD= 2                                *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

| NO | NAME | INITIAL VALUE | INDEX |
|---|---|---|---|
| 1 | WCR | .2285 | 1 |
| 2 | WCS | .4069 | 1 |
| 3 | ALPHA | .0500 | 1 |
| 4 | N | 2.0000 | 1 |
| 5 | M | .5000 | 0 |
| 6 | EXPO | .5000 | 0 |
| 7 | CONDS | 1.09E-04 | 0 |

OBSERVED DATA

| OBS. NO. | PRESSURE HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | .100 | .4069 | 1.0000 |
| 2 | .100 | .3978 | 1.0000 |
| 3 | 102.000 | .3311 | 1.0000 |
| 4 | 102.000 | .3316 | 1.0000 |
| 5 | 305.900 | .2970 | 1.0000 |
| 6 | 305.900 | .2904 | 1.0000 |
| 7 | 1019.800 | .2671 | 1.0000 |
| 8 | 1019.800 | .2560 | 1.0000 |
| 9 | 3059.400 | .2609 | 1.0000 |
| 10 | 3059.400 | .2550 | 1.0000 |
| 11 | 7138.600 | .2380 | 1.0000 |
| 12 | 7138.600 | .2325 | 1.0000 |
| 13 | 15297.000 | .2325 | 1.0000 |
| 14 | 15297.000 | .2285 | 1.0000 |

| NIT | SSQ | WCR | WCS | ALPHA | N |
|---|---|---|---|---|---|
| 0 | .01877 | .2285 | .4069 | .0500 | 2.0000 |
| 10 | .00042 | .2103 | .4025 | .0330 | 1.3504 |

CORRELATION MATRIX

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 1.0000 | | | |
| 2 | -.0354 | 1.0000 | | |
| 3 | -.8130 | .2576 | 1.0000 | |
| 4 | .9671 | -.0485 | -.9117 | 1.0000 |

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .99070334

| VARIABLE | VALUE | S.E.COEFF. | T-VALUE | 95% CONFIDENCE LIMITS LOWER | UPPER |
|---|---|---|---|---|---|
| WCR | .21025 | .01530 | 13.74 | .1762 | .24[illegible] |
| WCS | .40246 | .00460 | 87.44 | .3922 | .41[illegible] |
| ALPHA | .03297 | .01231 | 2.68 | .0055 | .06[illegible] |
| N | 1.35042 | .09971 | 13.54 | 1.1283 | 1.5[illegible] |

OBSERVED AND FITTED DATA
==========

| NO | P | LOG-P | WC-OBS | WC-FIT | WC-DIF |
|---|---|---|---|---|---|
| [illegible] | [illegible]0D+00 | -1.0000 | .4069 | .4024 | .0045 |
| [illegible] | [illegible]D+00 | -1.0000 | .3978 | .4024 | -.0046 |
| [illegible] | [illegible]+03 | 2.0086 | .3311 | .3302 | .0009 |
| [illegible] | [illegible]+03 | 2.0086 | .3316 | .3302 | .0014 |
| [illegible] | [illegible]+03 | 2.4856 | .2970 | .2948 | .0022 |
| [illegible] | [illegible]+03 | 2.4856 | .2904 | .2948 | -.0044 |
| [illegible] | [illegible]+04 | 3.0085 | .2671 | .2662 | .0009 |
| [illegible] | [illegible]0D+04 | 3.0085 | .2560 | .2662 | -.0102 |
| [illegible] | .30590+04 | 3.4856 | .2609 | .2484 | .0125 |
| 10 | .30590+04 | 3.4856 | .2550 | .2484 | .0066 |
| 11 | .71390+04 | 3.8536 | .2380 | .2386 | -.0006 |
| 12 | .71390+04 | 3.8536 | .2325 | .2386 | -.0061 |
| 13 | .15300+05 | 4.1846 | .2325 | .2320 | .0005 |
| 14 | .15300+05 | 4.1846 | .2285 | .2320 | -.0035 |

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES
==========

| | UNWEIGHTED | WEIGHTED |
|---|---|---|
| RETENTION DATA | .00042 | .00042 |
| COND/DIFF DATA | .00000 | .00000 |
| ALL DATA | .00042 | .00042 |

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)
==========

| WC | P | LOGP | COND | LOGK | DIF | LOGD |
|---|---|---|---|---|---|---|
| .2115 | .59120+08 | 7.772 | .5965D-23 | -23.224 | .8377D-12 | -1[illegible] |
| .2127 | .81790+07 | 6.913 | .1763D-20 | -20.754 | .1713D-10 | -1[illegible] |
| .2151 | .11310+07 | 6.054 | .5211D-18 | -18.283 | .3502D-09 | -9.[illegible] |
| .2199 | .15650+06 | 5.195 | .1540D-15 | -15.812 | .7159D-08 | -8.1[illegible] |
| .2247 | .49210+05 | 4.692 | .4294D-14 | -14.367 | .4183D-07 | -7.[illegible] |
| .2295 | .21650+05 | 4.335 | .4553D-13 | -13.342 | .1464D-06 | -6.[illegible] |
| .2343 | .11450+05 | 4.059 | .2843D-12 | -12.546 | .3868D-06 | -6.[illegible] |
| .2391 | .68050+04 | 3.833 | .1270D-11 | -11.896 | .8558D-06 | -6.[illegible] |
| .2439 | .43810+04 | 3.642 | .4502D-11 | -11.347 | .1675D-05 | -5.[illegible] |
| .2487 | .29910+04 | 3.476 | .1348D-10 | -10.870 | .2999D-05 | -5.[illegible] |
| .2535 | .21350+04 | 3.329 | .3546D-10 | -10.450 | .5013D-05 | -5.[illegible] |
| .2583 | .15790+04 | 3.198 | .8431D-10 | -10.074 | .7944D-05 | -5.[illegible] |
| .2631 | .12010+04 | 3.080 | .1846D-09 | -9.734 | .1206D-04 | -4.9[illegible] |
| .2679 | .93510+03 | 2.971 | .3778D-09 | -9.423 | .1766D-04 | -4.[illegible] |
| .2727 | .74220+03 | 2.871 | .7307D-09 | -9.136 | .2511D-04 | -4.[illegible] |
| .2775 | .59870+03 | 2.777 | .1347D-08 | -8.871 | .3482D-04 | -4.[illegible] |
| .2823 | .48980+03 | 2.690 | .2382D-08 | -8.623 | .4727D-04 | -4.[illegible] |
| .2871 | .40540+03 | 2.608 | .4066D-08 | -8.391 | .6302D-04 | -4.[illegible] |
| .2919 | .33900+03 | 2.530 | .6726D-08 | -8.172 | .8271D-04 | -4.[illegible] |
| .2967 | .28590+03 | 2.456 | .1083D-07 | -7.965 | .1071D-03 | -3.9[illegible] |
| .3015 | .24300+03 | 2.386 | .1702D-07 | -7.769 | .1370D-03 | -3.[illegible] |
| .3064 | .20790+03 | 2.318 | .2617D-07 | -7.582 | .1736D-03 | -3.[illegible] |
| .3112 | .17860+03 | 2.252 | .3951D-07 | -7.403 | .2180D-03 | -3.[illegible] |
| .3160 | .15450+03 | 2.189 | .5864D-07 | -7.232 | .2717D-03 | -3.[illegible] |
| .3208 | .13400+03 | 2.127 | .8574D-07 | -7.067 | .3366D-03 | -3.4[illegible] |
| .3256 | .11660+03 | 2.067 | .1237D-06 | -6.908 | .4148D-03 | -3.[illegible] |

| | | | | | | |
|---|---|---|---|---|---|---|
| .3352 | .8870D+02 | 1.948 | .2472D-06 | -6.604 | .6233D-03 | -3.205 |
| .3400 | .7746D+02 | 1.889 | .3487D-06 | -6.458 | .7616D-03 | -3.118 |
| .3448 | .6762D+02 | 1.830 | .4845D-06 | -6.315 | .9301D-03 | -3.031 |
| .3496 | .5894D+02 | 1.770 | .6690D-06 | -6.175 | .1137D-02 | -2.944 |
| .3544 | .5124D+02 | 1.710 | .9197D-06 | -6.036 | .1392D-02 | -2.856 |
| .3592 | .4435D+02 | 1.647 | .1261D-05 | -5.899 | .1712D-02 | -2.766 |
| .3640 | .3814D+02 | 1.581 | .1726D-05 | -5.763 | .2118D-02 | -2.674 |
| .3688 | .3252D+02 | 1.512 | .2366D-05 | -5.626 | .2645D-02 | -2.578 |
| .3736 | .2737D+02 | 1.437 | .3256D-05 | -5.487 | .3345D-02 | -2.476 |
| .3784 | .2262D+02 | 1.354 | .4516D-05 | -5.345 | .4309D-02 | -2.366 |
| .3832 | .1817D+02 | 1.259 | .6351D-05 | -5.197 | .5706D-02 | -2.244 |
| .3880 | .1395D+02 | 1.145 | .9144D-05 | -5.039 | .7891D-02 | -2.103 |
| .3928 | .9835D+01 | .993 | .1375D-04 | -4.862 | .1178D-01 | -1.929 |
| .3977 | .5613D+01 | .749 | .2279D-04 | -4.642 | .2095D-01 | -1.679 |
| .4001 | .3283D+01 | .516 | .3240D-04 | -4.489 | .3380D-01 | -1.471 |
| .4025 | .0000D+00 | | .1090D-03 | -3.963 | | |

END OF PROBLEM
==========

```
*****************************************************************
*                                                               *
*     ANALYSIS OF SOIL HYDRAULIC PROPERTIES                     *
*                                                               *
*SOIL MAIN FILE TAILINGS, 03 1% -200 (55-3)                     *
*                                                               *
*     MULAM-BASED PERTURBATION, M=1-1/N                         *
*     ANALYSIS OF RETENTION DATA ONLY                           *
*     MTYPE= 3,    METHOD= 2                                    *
*                                                               *
*****************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS
==========

| NO | NAME | INITIAL VALUE | INTEX |
|---|---|---|---|
| 1 | WCR | [illegible] | 1 |
| 2 | WCS | [illegible] | 1 |
| 3 | ALPHA | [illegible] | 1 |
| 4 | N | [illegible] | 1 |
| 5 | W | [illegible] | 1 |
| 6 | [illegible] | [illegible] | 1 |
| 7 | [illegible] | [illegible] | 1 |

OBSERVED DATA
==========

| OBS NO | PRESS HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | 112 000 | [illegible] | 1.0000 |
| 2 | 309 900 | [illegible] | 1.0000 |
| 3 | 1019 000 | [illegible] | 1.0000 |
| 4 | [illegible] | [illegible] | 1.0000 |
| 5 | 7139 400 | [illegible] | [illegible] |
| 6 | 15799 000 | [illegible] | [illegible] |

| NO | SSQ | WCR | ALPHA | N |
|---|---|---|---|---|
| 0 | [illegible] | [illegible] | [illegible] | [illegible] |
| 10 | .00072 | .2211 | [illegible] | [illegible] |

CORRELATION MATRIX
==========

| | 1 | 2 | 3 |
|---|---|---|---|
| 1 | [illegible] | | |
| 2 | [illegible] | [illegible] | |
| 3 | [illegible] | [illegible] | [illegible] |

SQ. ROOT MEAN PROPORTION OF OBSERVED VS FITTED VALUES = [illegible]
==========

## [illegible] LEAST-SQUARES ANALYSIS FINAL RESULTS

| VARIABLE | VALUE | S.E.COEFF. | T-VALUE | 95% CONFIDENCE LIMITS LOWER | UPPER |
|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | 6.45 | [illegible] | [illegible] |
| A_F-A | .00342 | .00097 | 3.53 | [illegible] | [illegible] |
| N | 1.70993 | .29152 | 5.87 | .7922 | 2.4774 |

## OBSERVED AND FITTED DATA

| NO | F | LOG-F | WO-OBS | WO-FIT | WO-DIF |
|---|---|---|---|---|---|
| 1 | 11220+03 | 2.0507 | .4427 | .4496 | .0172 |
| 2 | .30590+03 | 2.4954 | .3391 | .4225 | -.0134 |
| 3 | 10200+04 | 3.0088 | .3700 | .3178 | .0144 |
| 4 | .30590+04 | 3.4954 | .2545 | .2472 | -.0107 |
| 5 | 71350+04 | 3.8534 | .2473 | .2445 | -.0032 |
| 6 | 15400+05 | 4.1875 | .2414 | .2399 | .0057 |

## SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES

| | INCLUDED | EXCLUDED |
|---|---|---|
| RETENTION DATA | [illegible] | [illegible] |
| [illegible] DATA | [illegible] | [illegible] |
| ALL DATA | [illegible] | [illegible] |

## [illegible] LATERALLY RESTRICTED (MTYPE = 3)

| N | F | LOG | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
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| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
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| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

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|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 4471 | .19991-07 | 2.079 | .19720-05 | -5.714 | .74881-02 | -2.117 |
| 4473 | .16970-07 | 2.019 | .24150-05 | -5.617 | .88877-02 | -2.[illegible] |
| 4474 | .14130-07 | 2.157 | .27450-05 | -5.516 | .10277-01 | -1.919 |
| 4486 | .11417-07 | 2.745 | .38920-05 | -5.410 | .16357-01 | -1.786 |
| 4547 | .89140-08 | 1.957 | .51030-05 | -5.292 | .2741[illegible]-01 | -1.[illegible] |
| 4609 | .57910-08 | 1.743 | .70690-05 | -5.151 | .40470-01 | -1.391 |
| 4639 | .38120-08 | 1.581 | .87760-05 | -5.057 | .49750-01 | -1.187 |
| 4677 | .00000-00 | | .15000-04 | -4.824 | | |

END OF PROBLEM
==========

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*************************************************************
*                                                           *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                  *
*                                                           *
*ESTES GULCH, WASATCH FORMATION                              *
*                                                           *
*    MUALEM-BASED RESTRICTION, M=1-1/N                      *
*    ANALYSIS OF RETENTION DATA ONLY                        *
*    MTYPE= 3     METHOD= 2                                 *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS
==========

| NO | NAME | INITIAL VALUE | INDEX |
|---|---|---|---|
| 1 | WCR | .0800 | 0 |
| 2 | WCS | .1600 | 0 |
| 3 | ALPHA | .0500 | 1 |
| 4 | N | 2.0000 | 1 |
| 5 | M | .5000 | 0 |
| 6 | EXPO | .5000 | 0 |
| 7 | CONDS | 2.00E-06 | 0 |

OBSERVED DATA
==========

| OBS. NO. | PRESSURE HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | 5103.600 | .1392 | 1.0000 |
| 2 | 3062.200 | .1425 | 1.0000 |
| 3 | 2041.400 | .1456 | 1.0000 |
| 4 | 1020.700 | .1494 | 1.0000 |
| 5 | 918.700 | .1499 | 1.0000 |
| 6 | 714.500 | .1505 | 1.0000 |
| 7 | 510.400 | .1515 | 1.0000 |
| 8 | 306.200 | .1529 | 1.0000 |
| 9 | 102.100 | .1548 | 1.0000 |
| 10 | .000 | .1578 | 1.0000 |

| NIT | SSQ | ALPHA | N |
|---|---|---|---|
| 0 | .03821 | .0500 | 2.0000 |
| 8 | .00002 | .0063 | 1.0803 |

CORRELATION MATRIX
==========

| | 1 | 2 |
|---|---|---|
| 1 | 1.0000 | |
| 2 | -.9610 | 1.0000 |

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .96008671
==========

NONLINEAR LEAST-SQUARES ANALYSIS: FINAL RESULTS
==========

95% CONFIDENCE LIMITS

2/3

| VARIABLE | VALUE | S.E. COEFF. | T-VALUE | LOWER | UPPER |
|---|---|---|---|---|---|
| ALPHA | .00675 | .00241 | 2.60 | .0007 | .0116 |
| N | 1.08007 | .01250 | 86.42 | 1.0514 | 1.1091 |

OBSERVED AND FITTED DATA
**********

| NO | P | LOG-P | WC-OBS | WC-FIT | WC-DIF |
|---|---|---|---|---|---|
| 1 | .5104D+04 | 3.7079 | .1392 | .1405 | -.0013 |
| 2 | .3062D+04 | 3.4860 | .1425 | .1429 | -.0004 |
| 3 | .2041D+04 | 3.3099 | .1456 | .1449 | .0007 |
| 4 | .1021D+04 | 3.0099 | .1494 | .1483 | .0011 |
| 5 | .9187D+03 | 2.9632 | .1499 | .1488 | .0011 |
| 6 | .7145D+03 | 2.8540 | .1505 | .1500 | .0005 |
| 7 | .5104D+03 | 2.7079 | .1515 | .1515 | -.0000 |
| 8 | .3062D+03 | 2.4860 | .1529 | .1537 | -.0008 |
| 9 | .1021D+03 | 2.0090 | .1546 | .1572 | -.0024 |
| 10 | .10000-04 | -5.0000 | .1578 | .1600 | -.0022 |

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES
**********

| | UNWEIGHTED | WEIGHTED |
|---|---|---|
| RETENTION DATA | .00002 | .00002 |
| COND/DIFF DATA | .00000 | .00000 |
| ALL DATA | .00002 | .00002 |

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)
**********

| WC | P | LOGP | COND | LOGK | DIF | LOGD |
|---|---|---|---|---|---|---|
| .0940 | .4283D+12 | 11.632 | .1955D-30 | -30.709 | .7451D-16 | -16.128 |
| .0960 | .8116D+11 | 10.909 | .7603D-29 | -29.119 | .4805D-15 | -15.318 |
| .0980 | .1871D+11 | 10.272 | .1920D-27 | -27.717 | .2487D-14 | -14.604 |
| .1000 | .5036D+10 | 9.702 | .3450D-26 | -26.462 | .1082D-13 | -13.966 |
| .1020 | .1536D+10 | 9.186 | .4705D-25 | -25.327 | .4093D-13 | -13.388 |
| .1040 | .5196D+09 | 8.716 | .5111D-24 | -24.291 | .1379D-12 | -12.861 |
| .1060 | .1917D+09 | 8.283 | .4567D-23 | -23.339 | .4213D-12 | -12.375 |
| .1080 | .7616D+08 | 7.882 | .3498D-22 | -22.456 | .1185D-11 | -11.926 |
| .1100 | .3225D+08 | 7.508 | .2319D-21 | -21.635 | .3105D-11 | -11.509 |
| .1120 | .1443D+08 | 7.159 | .1360D-20 | -20.866 | .7643D-11 | -11.117 |
| .1140 | .6781D+07 | 6.831 | .7169D-20 | -20.145 | .1781D-10 | -10.749 |
| .1160 | .3327D+07 | 6.522 | .3436D-19 | -19.464 | .3956D-10 | -10.403 |
| .1180 | .1696D+07 | 6.230 | .1513D-18 | -18.820 | .8413D-10 | -10.075 |
| .1200 | .8954D+06 | 5.952 | .6173D-18 | -18.210 | .1721D-09 | -9.764 |
| .1220 | .4876D+06 | 5.686 | .2352D-17 | -17.629 | .3402D-09 | -9.468 |
| .1240 | .2731D+06 | 5.436 | .8420D-17 | -17.075 | .6512D-09 | -9.186 |
| .1260 | .1569D+06 | 5.196 | .2849D-16 | -16.545 | .1211D-08 | -8.917 |
| .1280 | .9231D+05 | 4.965 | .9154D-16 | -16.038 | .2195D-08 | -8.659 |
| .1300 | .5547D+05 | 4.744 | .2805D-15 | -15.552 | .3884D-08 | -8.411 |
| .1320 | .3399D+05 | 4.531 | .8230D-15 | -15.085 | .6722D-08 | -8.172 |
| .1340 | .2120D+05 | 4.326 | .2320D-14 | -14.634 | .1141D-07 | -7.943 |
| .1360 | .1344D+05 | 4.128 | .6307D-14 | -14.200 | .1901D-07 | -7.721 |
| .1380 | .8639D+04 | 3.936 | .1658D-13 | -13.780 | .3118D-07 | -7.506 |
| .1400 | .5623D+04 | 3.750 | .4230D-13 | -13.374 | .5044D-07 | -7.297 |
| .1420 | .3696D+04 | 3.568 | .1051D-12 | -12.978 | .8066D-07 | -7.093 |
| .1440 | .2448D+04 | 3.389 | .2551D-12 | -12.593 | .1279D-06 | -6.893 |
| .1460 | .1627D+04 | 3.211 | .6080D-12 | -12.216 | .2019D-06 | -6.695 |
| .1480 | .1080D+04 | 3.033 | .1431D-11 | -11.845 | .3188D-06 | -6.496 |
| .1500 | .7105D+03 | 2.852 | .3349D-11 | -11.475 | .5077D-06 | -6.294 |

| | | | | | | |
|---|---|---|---|---|---|---|
| .1520 | .4576D+03 | 2.661 | .7896D-11 | -11.103 | .8251D-06 | -6.084 |
| .1540 | .2821D+03 | 2.450 | .1912D-10 | -10.718 | .1398D-05 | -5.855 |
| .1560 | .1584D+03 | 2.200 | .4953D-10 | -10.305 | .2579D-05 | -5.589 |
| .1580 | .6911D+02 | 1.840 | .1535D-09 | -9.814 | .5870D-05 | -5.231 |
| .1590 | .3330D+02 | 1.522 | .3311D-09 | -9.480 | .1116D-04 | -4.952 |
| .1600 | .0000D+00 | | .2000D-07 | -7.699 | | |

END OF PROBLEM

==========

CHENEY DISPOSAL CELL - 20 ANALYSIS - 1.0E-0[illegible]
235 17 924 1 3 0 100 1 79 1 0. 0. 0.

CHENEY DISPOSAL CELL
~~DSB~~
DBS&A data

1 -1
2
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64
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72
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80
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88
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96
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104
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112
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120
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127
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135
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456
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  1    -1
480
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488
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496
  1    -1
504
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512
  1    -1
520
  1    -1
528
  1    -1
536
  1    -1
544
  1    -1
552
  1    -1
560
  1    -1
568
  1    -1
576
  1    -1
584
    [illegible]    [illegible]    1.156E+0 1.875E-04    1 [illegible]
 1.05E+00 1.0E+01
9.428E-02  9.428E-02  [illegible]  [illegible]  [illegible]  1.3E+00  [illegible]
1.[illegible]E-02  1.[illegible]E-02  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
[illegible]  1.73[illegible]E-04  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
  1    0    91.4    41.8    -8[illegible].0 2.64E-04
  2   -2    91.4    [illegible]    -8[illegible]
  3   -2    91.4    [illegible]    -8[illegible]
  4   -2    91.4    [illegible]    -8[illegible]
  5   -2    91.4    [illegible]    -8[illegible]
  6   -2    91.4    25.9    -10.2
  7   -2    91.4    20.6    -10.2
  8   -2    91.4    15.2    -10.2
  9    0    97.5    41.0    -2.75 5.27E-04
 10    0    97.5    37.2    -2.75
 11    0    97.5    32.4    -2.5[illegible]
 12    0    97.5    28.9    -2.5[illegible]
 13    0    97.5    25.7    -2.5[illegible]
 14    0    97.5    [illegible]    -10.2
 15    0    97.5    19.4    -10.2
 16   -2    97.5    15.2    -10.2
 17    0   103.6    41.2    -2.75 5.9[illegible]E-04
 18    0   103.6    37.4    -2.75
 19    0   103.6    33.5    -2.5[illegible]
 20    0   103.6    28.1    -2.5[illegible]
 21    0   103.6    24.0    -2.5[illegible]
 22    0   103.6    21.3    -10.2
 23    0   103.6    18.3    -10.2
 24   -2   103.6    15.2    -10.2
 25    0   111.2    41.4    -2.75 6.6[illegible]E-04
 26    0   111.2    37.6    -2.75
 27    0   111.2    33.7    -2.5[illegible]
 28    0   111.2    28.2    -2.5[illegible]
 29    0   111.2    24.0    -2.5[illegible]
```

| | | | | | |
|---|---|---|---|---|---|
| 31 | 0 | 112.9 | 15.2 | [illegible] | |
| 32 | -2 | 112.9 | 15.2 | -10.2 | |
| 33 | 0 | 118.9 | 41.6 | -2.75 | 6.61E-04 |
| 34 | 0 | 118.9 | 37.8 | -2.75 | |
| 35 | 0 | 118.9 | 33.9 | -2.50 | |
| 36 | 0 | 118.9 | 28.3 | -2.50 | |
| 37 | 0 | 118.9 | 23.9 | -2.50 | |
| 38 | 0 | 121.5 | 20.8 | -10.2 | |
| 39 | 0 | 121.5 | 18.0 | -10.2 | |
| 40 | -2 | 121.5 | 15.2 | -10.2 | |
| 41 | 0 | 126.5 | 41.6 | -2.75 | 6.57E-04 |
| 42 | 0 | 126.5 | 38.0 | -2.75 | |
| 43 | 0 | 126.5 | 34.2 | -2.50 | |
| 44 | 0 | 126.5 | 28.3 | -2.50 | |
| 45 | 0 | 126.5 | 23.8 | -2.50 | |
| 46 | 0 | 129.5 | 20.6 | -10.2 | |
| 47 | 0 | 129.5 | 17.9 | -10.2 | |
| 48 | -2 | 129.5 | 15.2 | -10.2 | |
| 49 | 0 | 134.1 | 42.0 | -2.75 | 6.57E-04 |
| 50 | 0 | 134.1 | 38.2 | -2.75 | |
| 51 | 0 | 134.1 | 34.4 | -2.50 | |
| 52 | 0 | 134.1 | 28.4 | -2.50 | |
| 53 | 0 | 134.1 | 23.7 | -2.50 | |
| 54 | 0 | 136.8 | 20.3 | -10.2 | |
| 55 | 0 | 136.8 | 17.8 | -10.2 | |
| 56 | -2 | 136.8 | 15.2 | -10.2 | |
| 57 | 0 | 141.7 | 42.2 | -2.75 | 6.61E-04 |
| 58 | 0 | 141.7 | 38.4 | -2.75 | |
| 59 | 0 | 141.7 | 34.5 | -2.50 | |
| 60 | 0 | 141.7 | 28.5 | -2.50 | |
| 61 | 0 | 141.7 | 23.6 | -2.50 | |
| 62 | 0 | 143.4 | 20.1 | -10.2 | |
| 63 | 0 | 143.4 | 17.7 | [illegible] | |
| 64 | -2 | 143.4 | 15.2 | -10.2 | |
| 65 | 0 | 149.4 | 42.4 | [illegible] | [illegible] |
| 66 | | 149.4 | 38.6 | [illegible] | |
| 67 | 0 | 149.4 | 34.5 | -2.50 | |
| 68 | 0 | 149.4 | 28.6 | -2.50 | |
| 69 | 0 | 149.4 | 23.6 | -2.50 | |
| 70 | 0 | 149.4 | [illegible] | -10.2 | |
| 71 | 0 | 149.4 | 17.5 | -10.2 | |
| 72 | -2 | 149.4 | 15.2 | -10.2 | |
| 73 | 0 | 156.5 | 42.6 | -2.75 | 6.13E-04 |
| 74 | 0 | 156.5 | 38.7 | -2.75 | |
| 75 | 0 | 156.5 | 34.9 | -2.50 | |
| 76 | 0 | 156.5 | 28.6 | -2.50 | |
| 77 | 0 | 156.5 | 23.6 | -2.50 | |
| 78 | 0 | 156.5 | 17.5 | -10.2 | |
| 79 | 0 | 156.5 | 17.5 | -10.2 | |
| 80 | -2 | 156.5 | 15.2 | -10.2 | |
| 81 | 0 | 163.6 | 42.7 | -2.75 | 6.13E-04 |
| 82 | 0 | 163.6 | 38.9 | -2.75 | |
| 83 | 0 | 163.6 | 35.1 | -2.50 | |
| 84 | 0 | 163.6 | 28.6 | -2.50 | |
| 85 | 0 | 163.6 | 23.5 | -2.50 | |
| 86 | 0 | 163.6 | 19.8 | -10.2 | |
| 87 | 0 | 163.6 | 17.5 | -10.2 | |
| 88 | -2 | 163.6 | 15.2 | -10.2 | |
| 89 | 0 | 170.7 | 42.9 | -2.75 | 7.91E-04 |
| 90 | 0 | 170.7 | 39.1 | -2.75 | |
| 91 | 0 | 170.7 | 35.3 | -2.50 | |
| 92 | 0 | 170.7 | 28.7 | -2.50 | |
| 93 | 0 | 170.7 | 23.5 | -2.50 | |
| 94 | 0 | 170.7 | 19.6 | -10.2 | |
| 95 | 0 | 170.7 | 17.5 | -10.2 | |

| | | | | | |
|---|---|---|---|---|---|
| 99 | 0 | 179.6 | 36.6 | -2.50 | |
| 100 | 0 | 179.8 | 28.7 | -2.50 | |
| 101 | 0 | 179.6 | 23.6 | -2.50 | |
| 102 | 0 | 179.8 | 20.2 | -10.2 | |
| 103 | 0 | 1[illegible]8 | 17.7 | -10.2 | |
| 104 | -2 | 1[illegible]8 | 15.2 | -10.2 | |
| 105 | 0 | 189.0 | 43.4 | -2.75 | 7.91E-04 |
| 106 | 0 | 189.0 | 39.6 | -2.75 | |
| 107 | 0 | 189.0 | 35.8 | -2.50 | |
| 108 | 0 | 189.0 | 26.7 | -2.50 | |
| 109 | 0 | 189.0 | 23.6 | -2.50 | |
| 110 | 0 | 189.0 | 20.5 | -10.2 | |
| 111 | 0 | 189.0 | 17.9 | -10.2 | |
| 112 | -2 | 189.0 | 15.2 | -10.2 | |
| 113 | 0 | 198.1 | 43.7 | -2.75 | 7.91E-04 |
| 114 | 0 | 198.1 | 39.8 | -2.75 | |
| 115 | 0 | 198.1 | 36.0 | -2.50 | |
| 116 | 0 | 198.1 | 28.7 | -2.50 | |
| 117 | 0 | 198.1 | 23.7 | -2.50 | |
| 118 | 0 | 198.1 | 20.9 | -10.2 | |
| 119 | 0 | 198.1 | 18.1 | -10.2 | |
| 120 | -2 | 198.1 | 15.2 | -10.2 | |
| 121 | 0 | 207.3 | 43.9 | -2.75 | 7.86E-04 |
| 122 | 0 | 207.3 | 40.1 | -2.75 | |
| 123 | 0 | 207.3 | 36.3 | -2.50 | |
| 124 | 0 | 207.3 | 25.7 | -2.50 | |
| 125 | 0 | 207.3 | 23.7 | -2.50 | |
| 126 | 0 | 207.3 | 21.3 | -10.2 | |
| 127 | -2 | 207.3 | 15.2 | -10.2 | |
| 128 | 0 | 207.3 | 15.3 | -10.2 | |
| 129 | 0 | 216.3 | 44.1 | -2.75 | 7.81E-04 |
| 130 | 0 | 216.3 | 40.3 | -2.75 | |
| 131 | 0 | 216.3 | 36.4 | -2.50 | |
| 132 | 0 | 216.3 | 29.1 | -2.50 | |
| 133 | 0 | 216.3 | 24.1 | -2.50 | |
| 134 | 0 | 216.3 | 21.6 | -10.2 | |
| 135 | -2 | 216.3 | 15.2 | -10.2 | |
| 136 | 0 | 216.3 | 15.4 | -10.2 | |
| 137 | 0 | 225.4 | 44.1 | -2.75 | 7.82E-04 |
| 138 | 0 | 225.4 | 40.4 | -2.75 | |
| 139 | 0 | 225.4 | 36.6 | -2.50 | |
| 140 | 0 | 225.4 | 29.2 | -2.50 | |
| 141 | 0 | 225.4 | 24.4 | -2.50 | |
| 142 | 0 | 225.4 | 22.0 | -10.2 | |
| 143 | -2 | 225.4 | 15.2 | -10.2 | |
| 144 | 0 | 225.4 | 18.6 | -10.2 | |
| 145 | 0 | 234.4 | 44.4 | -2.75 | 7.82E-04 |
| 146 | 0 | 234.4 | 40.6 | -2.75 | |
| 147 | 0 | 234.4 | 36.8 | -2.50 | |
| 148 | 0 | 234.4 | 29.5 | -2.50 | |
| 149 | 0 | 234.4 | 24.7 | -2.50 | |
| 150 | 0 | 234.4 | 22.4 | -10.2 | |
| 151 | -2 | 234.4 | 15.2 | -10.2 | |
| 152 | 0 | 234.4 | 15.8 | -10.2 | |
| 153 | 0 | 243.5 | 44.6 | -2.75 | 7.82E-04 |
| 154 | 0 | 243.5 | 40.8 | -2.75 | |
| 155 | 0 | 243.5 | 36.9 | -2.50 | |
| 156 | 0 | 243.5 | 29.8 | -2.50 | |
| 157 | 0 | 243.5 | 25.0 | -2.50 | |
| 158 | 0 | 243.5 | 22.7 | -10.2 | |
| 159 | -2 | 243.5 | 15.2 | -10.2 | |
| 160 | 0 | 243.5 | 19.0 | -10.2 | |
| 161 | 0 | 252.5 | 44.8 | -2.75 | 7.82E-04 |
| 162 | 0 | 252.5 | 40.9 | -2.75 | |

| | | | | | |
|---|---|---|---|---|---|
| 163 | 0 | 252.5 | 37.1 | -2.75 | |
| 164 | 0 | 252.5 | 30.0 | -2.50 | |
| 165 | 0 | 252.5 | 25.3 | -2.50 | |
| 166 | 0 | 252.5 | 23.1 | -10.2 | |
| 167 | -2 | 252.5 | 15.2 | -10.2 | |
| 168 | 0 | 252.5 | 19.2 | -10.2 | |
| 169 | 0 | 261.6 | 44.9 | -2.75 | 7.82E-04 |
| 170 | 0 | 261.6 | 41.1 | -2.75 | |
| 171 | 0 | 261.6 | 37.3 | -2.50 | |
| 172 | 0 | 261.6 | 30.3 | -2.50 | |
| 173 | 0 | 261.6 | 25.7 | -2.50 | |
| 174 | 0 | 261.6 | 23.4 | -10.2 | |
| 175 | -2 | 261.6 | 15.2 | -10.2 | |
| 176 | 0 | 261.6 | 19.3 | -10.2 | |
| 177 | 0 | 270.7 | 45.1 | -2.75 | 7.82E-04 |
| 178 | 0 | 270.7 | 41.3 | -2.75 | |
| 179 | 0 | 270.7 | 37.5 | -2.50 | |
| 180 | 0 | 270.7 | 30.5 | -2.50 | |
| 181 | 0 | 270.7 | 26.0 | -2.50 | |
| 182 | 0 | 270.7 | 23.8 | -10.2 | |
| 183 | -2 | 270.7 | 15.2 | -10.2 | |
| 184 | 0 | 270.7 | 19.5 | -10.2 | |
| 185 | 0 | 279.7 | 45.3 | -2.75 | 7.82E-04 |
| 186 | 0 | 279.7 | 41.5 | -2.75 | |
| 187 | 0 | 279.7 | 37.6 | -2.50 | |
| 188 | 0 | 279.7 | 30.8 | -2.50 | |
| 189 | 0 | 279.7 | 26.3 | -2.50 | |
| 190 | 0 | 279.7 | 24.2 | -10.2 | |
| 191 | -2 | 279.7 | 15.2 | -10.2 | |
| 192 | 0 | 279.7 | 19.7 | -10.2 | |
| 193 | 0 | 288.8 | 45.5 | -2.75 | 7.82E-04 |
| 194 | 0 | 288.8 | 41.4 | -2.75 | |
| 195 | | 288.8 | 37.5 | -2.50 | |
| 196 | 0 | 288.8 | 31.0 | -2.50 | |
| 197 | 0 | 288.8 | 26.4 | -2.50 | |
| 198 | | 288.8 | 24.5 | -10.2 | |
| 199 | -2 | 288.8 | 15.2 | -10.2 | |
| 200 | 0 | 288.8 | 19.9 | -10.2 | |
| 201 | 0 | 297.8 | 45.6 | -2.75 | 7.82E-04 |
| 202 | 0 | 297.8 | 41.5 | -2.75 | |
| 203 | 0 | 297.8 | 38.0 | -2.50 | |
| 204 | 0 | 297.8 | 31.3 | -2.50 | |
| 205 | 0 | 297.8 | 26.9 | -2.50 | |
| 206 | 0 | 297.8 | 24.9 | -10.2 | |
| 207 | -2 | 297.8 | 15.2 | -10.2 | |
| 208 | 0 | 297.8 | 20.1 | -10.2 | |
| 209 | 0 | 306.9 | 45.8 | -2.75 | 7.82E-04 |
| 210 | 0 | 306.9 | 42.0 | -2.75 | |
| 211 | 0 | 306.9 | 38.1 | -2.50 | |
| 212 | 0 | 306.9 | 31.5 | -2.50 | |
| 213 | 0 | 306.9 | 27.3 | -2.50 | |
| 214 | 0 | 306.9 | 25.3 | -10.2 | |
| 215 | -2 | 306.9 | 15.2 | -10.2 | |
| 216 | 0 | 306.9 | 20.3 | -10.2 | |
| 217 | 0 | 315.9 | 46.0 | -2.75 | 7.82E-04 |
| 218 | 0 | 315.9 | 42.1 | -2.75 | |
| 219 | 0 | 315.9 | 38.3 | -2.50 | |
| 220 | 0 | 315.9 | 31.8 | -2.50 | |
| 221 | 0 | 315.9 | 27.6 | -2.50 | |
| 222 | 0 | 315.9 | 25.6 | -10.2 | |
| 223 | -2 | 315.9 | 15.2 | -10.2 | |
| 224 | 0 | 315.9 | 20.4 | -10.2 | |
| 225 | 0 | 325.0 | 46.2 | -2.75 | 7.82E-04 |
| 226 | 0 | 325.0 | 42.3 | -2.75 | |
| 227 | 0 | 325.0 | 38.5 | -2.50 | |

| | | | | | |
|---|---|---|---|---|---|
| 230 | 0 | 325.0 | 46.6 | -10.2 | |
| 231 | -2 | 325.0 | 15.2 | -10.2 | |
| 232 | 0 | 325.0 | 20.6 | -10.2 | |
| 233 | 0 | 334.1 | 46.3 | -2.75 | 7.82E-04 |
| 234 | 0 | 334.1 | 42.5 | -2.75 | |
| 235 | 0 | 334.1 | 38.6 | -2.50 | |
| 236 | 0 | 334.1 | 32.3 | -2.50 | |
| 237 | 0 | 334.1 | 28.2 | -2.50 | |
| 238 | 0 | 334.1 | 26.3 | -10.2 | |
| 239 | -2 | 334.1 | 15.2 | -10.2 | |
| 240 | 0 | 334.1 | 20.8 | -10.2 | |
| 241 | 0 | 343.1 | 46.5 | -2.75 | 7.82E-04 |
| 242 | 0 | 343.1 | 42.7 | -2.75 | |
| 243 | 0 | 343.1 | 38.8 | -2.50 | |
| 244 | 0 | 343.1 | 32.6 | -2.50 | |
| 245 | 0 | 343.1 | 28.5 | -2.50 | |
| 246 | 0 | 343.1 | 26.7 | -10.2 | |
| 247 | -2 | 343.1 | 15.2 | -10.2 | |
| 248 | 0 | 343.1 | 21.9 | -10.2 | |
| 249 | 0 | 352.2 | 46.7 | -2.75 | 7.82E-04 |
| 250 | 0 | 352.2 | 42.8 | -2.75 | |
| 251 | 0 | 352.2 | 39.0 | -2.50 | |
| 252 | 0 | 352.2 | 32.6 | -2.50 | |
| 253 | 0 | 352.2 | 28.9 | -2.50 | |
| 254 | 0 | 352.2 | 27.1 | -10.2 | |
| 255 | -2 | 352.2 | 15.2 | -10.2 | |
| 256 | 0 | 352.2 | 21.2 | -10.2 | |
| 257 | 0 | 361.2 | 46.9 | -2.75 | 7.82E-04 |
| 258 | 0 | 361.2 | 43.0 | -2.75 | |
| 259 | 0 | 361.2 | 39.2 | -2.50 | |
| 260 | 0 | 361.2 | 33.1 | -2.50 | |
| 261 | 0 | 361.2 | 29.2 | -2.50 | |
| 262 | 0 | 361.2 | 27.4 | -10.2 | |
| 263 | -2 | 361.2 | 15.2 | -10.2 | |
| 264 | 0 | 361.2 | 21.2 | -10.2 | |
| 265 | 0 | 370.3 | 47.0 | -2.75 | 7.82E-04 |
| 266 | 0 | 370.3 | 43.2 | -2.75 | |
| 267 | 0 | 370.3 | 39.3 | -2.50 | |
| 268 | 0 | 370.3 | 33.3 | -2.50 | |
| 269 | 0 | 370.3 | 29.5 | -2.50 | |
| 270 | 0 | 370.3 | 27.5 | -10.2 | |
| 271 | -2 | 370.3 | 15.2 | -10.2 | |
| 272 | 0 | 370.3 | 21.5 | -10.2 | |
| 273 | 0 | 379.3 | 47.2 | -2.75 | 7.82E-04 |
| 274 | 0 | 379.3 | 43.3 | -2.75 | |
| 275 | 0 | 379.3 | 39.5 | -2.50 | |
| 276 | 0 | 379.3 | 33.4 | -2.50 | |
| 277 | 0 | 379.3 | 29.8 | -2.50 | |
| 278 | 0 | 379.3 | 28.2 | -10.2 | |
| 279 | -2 | 379.3 | 15.2 | -10.2 | |
| 280 | 0 | 379.3 | 21.7 | -10.2 | |
| 281 | 0 | 388.4 | 47.4 | -2.75 | 7.82E-04 |
| 282 | 0 | 388.4 | 43.5 | -2.75 | |
| 283 | 0 | 388.4 | 39.7 | -2.50 | |
| 284 | 0 | 388.4 | 33.9 | -2.50 | |
| 285 | 0 | 388.4 | 30.1 | -2.50 | |
| 286 | 0 | 388.4 | 28.5 | -10.2 | |
| 287 | -2 | 388.4 | 15.2 | -10.2 | |
| 288 | 0 | 388.4 | 21.9 | -10.2 | |
| 289 | 0 | 397.5 | 47.6 | -2.75 | 7.82E-04 |
| 290 | 0 | 397.5 | 43.7 | -2.75 | |
| 291 | 0 | 397.5 | 39.8 | -2.50 | |
| 292 | 0 | 397.5 | 34.1 | -2.50 | |
| 293 | 0 | 397.5 | 30.5 | -2.50 | |

| | | | | | |
|---|---|---|---|---|---|
| 296 | 0 | 397.5 | 52.1 | [illegible] | |
| 297 | 0 | 406.5 | 47.7 | -2.75 | 7.82E-04 |
| 298 | 0 | 406.5 | 43.9 | -2.75 | |
| 299 | 0 | 406.5 | 40.0 | -2.50 | |
| 300 | 0 | 406.5 | 34.4 | -2.50 | |
| 301 | 0 | 406.5 | 30.8 | -2.50 | |
| 302 | 0 | 406.5 | 29.2 | -10.2 | |
| 303 | -2 | 406.5 | 15.2 | -10.2 | |
| 304 | 0 | 406.5 | 22.2 | -10.2 | |
| 305 | 0 | 415.6 | 47.9 | -2.75 | 7.82E-04 |
| 306 | 0 | 415.6 | 44.0 | -2.75 | |
| 307 | 0 | 415.6 | 40.2 | -2.50 | |
| 308 | 0 | 415.6 | 34.6 | -2.50 | |
| 309 | 0 | 415.6 | 31.1 | -2.50 | |
| 310 | 0 | 415.6 | 29.6 | -10.2 | |
| 311 | -2 | 415.6 | 15.2 | -10.2 | |
| 312 | 0 | 415.6 | 22.4 | -10.2 | |
| 313 | 0 | 424.6 | 48.1 | -2.75 | 7.82E-04 |
| 314 | 0 | 424.6 | 44.2 | -2.75 | |
| 315 | 0 | 424.6 | 40.3 | -2.50 | |
| 316 | 0 | 424.6 | 34.9 | -2.50 | |
| 317 | 0 | 424.6 | 31.4 | -2.50 | |
| 318 | 0 | 424.6 | 30.0 | -10.2 | |
| 319 | -2 | 424.6 | 15.2 | -10.2 | |
| 320 | 0 | 424.6 | 22.6 | -10.2 | |
| 321 | 0 | 433.7 | 48.2 | -2.75 | 7.82E-04 |
| 322 | 0 | 433.7 | 44.4 | -2.75 | |
| 323 | 0 | 433.7 | 40.5 | -2.50 | |
| 324 | 0 | 433.7 | 35.1 | -2.50 | |
| 325 | 0 | 433.7 | 31.7 | -2.50 | |
| 326 | 0 | 433.7 | 30.3 | -10.2 | |
| 327 | -2 | 433.7 | 15.2 | -10.2 | |
| 328 | 0 | 433.7 | 22.8 | -10.2 | |
| 329 | 0 | 442.7 | 48.4 | -2.75 | 7.82E-04 |
| 330 | 0 | 442.7 | 44.6 | -2.75 | |
| 331 | 0 | 442.7 | 40.7 | -2.50 | |
| 332 | 0 | 442.7 | 35.4 | -2.50 | |
| 333 | 0 | 442.7 | 32.1 | -2.50 | |
| 334 | 0 | 442.7 | 30.7 | -10.2 | |
| 335 | -2 | 442.7 | 15.2 | -10.2 | |
| 336 | 0 | 442.7 | 23.0 | -10.2 | |
| 337 | 0 | 451.8 | 48.6 | -2.75 | 7.82E-04 |
| 338 | 0 | 451.8 | 44.7 | -2.75 | |
| 339 | 0 | 451.8 | 40.9 | -2.50 | |
| 340 | 0 | 451.8 | 35.7 | -2.50 | |
| 341 | 0 | 451.8 | 32.4 | -2.50 | |
| 342 | 0 | 451.8 | 31.1 | -10.2 | |
| 343 | -2 | 451.8 | 15.2 | -10.2 | |
| 344 | 0 | 451.8 | 23.1 | -10.2 | |
| 345 | 0 | 460.9 | 48.8 | -2.75 | 7.82E-04 |
| 346 | 0 | 460.9 | 44.9 | -2.75 | |
| 347 | 0 | 460.9 | 41.0 | -2.50 | |
| 348 | 0 | 460.9 | 35.9 | -2.50 | |
| 349 | 0 | 460.9 | 32.7 | -2.50 | |
| 350 | 0 | 460.9 | 31.4 | -10.2 | |
| 351 | -2 | 460.9 | 15.2 | -10.2 | |
| 352 | 0 | 460.9 | 23.3 | -10.2 | |
| 353 | 0 | 469.9 | 48.9 | -2.75 | 7.82E-04 |
| 354 | 0 | 469.9 | 45.1 | -2.75 | |
| 355 | 0 | 469.9 | 41.2 | -2.50 | |
| 356 | 0 | 469.9 | 36.2 | -2.50 | |
| 357 | 0 | 469.9 | 33.0 | -2.50 | |
| 358 | 0 | 469.9 | 31.8 | -10.2 | |
| 359 | -2 | 469.9 | 15.2 | -10.2 | |
| 360 | 0 | 469.9 | 23.5 | -10.2 | |

| | | | | | |
|---|---|---|---|---|---|
| 360 | 0 | 479.0 | 45.0 | -2.75 | |
| 361 | 0 | 479.0 | 41.4 | -2.50 | |
| 362 | 0 | 479.0 | 36.4 | -2.50 | |
| 363 | 0 | 479.0 | 33.4 | -2.50 | |
| 364 | 0 | 479.0 | 32.1 | -10.2 | |
| 365 | -2 | 479.0 | 15.2 | -10.2 | |
| 366 | 0 | 479.0 | 23.7 | -10.2 | |
| 367 | 0 | 488.0 | 49.3 | -2.75 | 7.82E-04 |
| 368 | 0 | 488.0 | 45.4 | -2.75 | |
| 369 | 0 | 488.0 | 41.5 | -2.50 | |
| 370 | 0 | 488.0 | 36.7 | -2.50 | |
| 371 | 0 | 488.0 | 33.7 | -2.50 | |
| 372 | 0 | 488.0 | 32.5 | -10.2 | |
| 373 | -2 | 488.0 | 15.2 | -10.2 | |
| 374 | 0 | 488.0 | 23.9 | -10.2 | |
| 375 | 0 | 497.1 | 49.5 | -2.75 | 7.82E-04 |
| 376 | 0 | 497.1 | 45.6 | -2.75 | |
| 377 | 0 | 497.1 | 41.7 | -2.50 | |
| 378 | 0 | 497.1 | 36.9 | -2.50 | |
| 379 | 0 | 497.1 | 34.0 | -2.50 | |
| 380 | 0 | 497.1 | 32.9 | -10.2 | |
| 381 | -2 | 497.1 | 15.2 | -10.2 | |
| 382 | 0 | 497.1 | 24.1 | -10.2 | |
| 383 | 0 | 506.1 | 49.6 | -2.75 | 7.82E-04 |
| 384 | 0 | 506.1 | 45.6 | -2.75 | |
| 385 | 0 | 506.1 | 41.9 | -2.50 | |
| 386 | 0 | 506.1 | 37.2 | -2.50 | |
| 387 | 0 | 506.1 | 34.3 | -2.50 | |
| 388 | 0 | 506.1 | 33.2 | -10.2 | |
| 389 | -2 | 506.1 | 15.2 | -10.2 | |
| 390 | 0 | 506.1 | 24.2 | -10.2 | |
| 391 | 0 | 515.2 | 49.5 | -2.75 | 7.82E-04 |
| 392 | 0 | 515.2 | 45.9 | -2.75 | |
| 393 | 0 | 515.2 | 42.0 | -2.50 | |
| 394 | 0 | 515.2 | 37.5 | -2.50 | |
| 395 | 0 | 515.2 | 34.6 | -2.50 | |
| 396 | 0 | 515.2 | 33.6 | -10.2 | |
| 397 | -2 | 515.2 | 15.2 | -10.2 | |
| 398 | 0 | 515.2 | 24.4 | -10.2 | |
| 399 | 0 | 524.3 | 50.0 | -2.75 | 7.21E-04 |
| 400 | 0 | 524.3 | 46.1 | -2.75 | |
| 401 | 0 | 524.3 | 42.2 | -2.50 | |
| 402 | 0 | 524.3 | 37.7 | -2.50 | |
| 403 | 0 | 524.3 | 35.0 | -2.50 | |
| 404 | 0 | 524.3 | 34.0 | -10.2 | |
| 405 | 0 | 524.3 | 24.6 | -10.2 | |
| 406 | -2 | 524.3 | 15.2 | -10.2 | |
| 407 | 0 | 531.9 | 50.0 | -2.75 | 6.57E-04 |
| 408 | 0 | 531.9 | 46.1 | -2.75 | |
| 409 | 0 | 531.9 | 42.2 | -2.50 | |
| 410 | 0 | 531.9 | 37.9 | -2.50 | |
| 411 | 0 | 531.9 | 35.3 | -2.50 | |
| 412 | 0 | 531.9 | 34.3 | -10.2 | |
| 413 | 0 | 531.9 | 24.8 | -10.2 | |
| 414 | -2 | 531.9 | 15.2 | -10.2 | |
| 415 | 0 | 539.5 | 50.0 | -2.75 | 6.57E-04 |
| 416 | 0 | 539.5 | 46.1 | -2.75 | |
| 417 | 0 | 539.5 | 42.2 | -2.50 | |
| 418 | 0 | 539.5 | 38.1 | -2.50 | |
| 419 | 0 | 539.5 | 35.4 | -2.50 | |
| 420 | 0 | 539.5 | 34.6 | -10.2 | |
| 421 | 0 | 539.5 | 24.9 | -10.2 | |
| 422 | -2 | 539.5 | 15.2 | -10.2 | |
| 423 | 0 | 547.1 | 50.0 | -2.75 | 6.57E-04 |

| | | | | | |
|---|---|---|---|---|---|
| 427 | 0 | 547.1 | [illegible] | [illegible] | |
| 428 | 0 | 547.1 | 38.3 | -2.50 | |
| 429 | 0 | 547.1 | 35.9 | -2.50 | |
| 430 | 0 | 547.1 | 34.9 | -10.2 | |
| 431 | 0 | 547.1 | 25.1 | -10.2 | |
| 432 | -2 | 547.1 | 15.2 | -10.2 | |
| 433 | 0 | 554.7 | 50.0 | -2.75 | 6.57E-04 |
| 434 | 0 | 554.7 | 46.1 | -2.75 | |
| 435 | 0 | 554.7 | 42.2 | -2.50 | |
| 436 | 0 | 554.7 | 38.6 | -2.50 | |
| 437 | 0 | 554.7 | 36.2 | -2.50 | |
| 438 | 0 | 554.7 | 35.2 | -10.2 | |
| 439 | 0 | 554.7 | 25.2 | -10.2 | |
| 440 | -2 | 554.7 | 15.2 | -10.2 | |
| 441 | 0 | 562.4 | 50.0 | -2.75 | 6.57E-04 |
| 442 | 0 | 562.4 | 46.1 | -2.75 | |
| 443 | 0 | 562.4 | 42.2 | -2.50 | |
| 444 | 0 | 562.4 | 38.8 | -2.50 | |
| 445 | 0 | 562.4 | 36.5 | -2.50 | |
| 446 | 0 | 562.4 | 35.5 | -10.2 | |
| 447 | 0 | 562.4 | 25.4 | -10.2 | |
| 448 | -2 | 562.4 | 15.2 | -10.2 | |
| 449 | 0 | 570.0 | 50.0 | -2.75 | 6.57E-04 |
| 450 | 0 | 570.0 | 46.1 | -2.75 | |
| 451 | 0 | 570.0 | 42.2 | -2.50 | |
| 452 | 0 | 570.0 | 39.0 | -2.50 | |
| 453 | 0 | 570.0 | 36.8 | -2.50 | |
| 454 | 0 | 570.0 | 35.8 | -10.2 | |
| 455 | 0 | 570.0 | 25.5 | -10.2 | |
| 456 | -2 | 570.0 | 15.2 | -10.2 | |
| 457 | 0 | 577.6 | 50.0 | -2.75 | 6.57E-04 |
| 458 | 0 | 577.6 | 46.1 | -2.75 | |
| 459 | 0 | 577.6 | 42.2 | -2.50 | |
| 460 | 0 | 577.6 | 39.2 | -2.50 | |
| 461 | 0 | 577.6 | 37.1 | -2.50 | |
| 462 | 0 | 577.6 | 36.1 | -10.2 | |
| 463 | 0 | 577.6 | 25.7 | -10.2 | |
| 464 | -2 | 577.6 | 15.2 | -10.2 | |
| 465 | 0 | 585.2 | 50.0 | -2.75 | 6.57E-04 |
| 466 | 0 | 585.2 | 46.1 | [illegible] | |
| 467 | 0 | 585.2 | 42.2 | -2.50 | |
| 468 | 0 | 585.2 | 39.4 | -2.50 | |
| 469 | 0 | 585.2 | 37.5 | -2.50 | |
| 470 | 0 | 585.2 | 36.4 | -10.2 | |
| 471 | 0 | 585.2 | 25.8 | -10.2 | |
| 472 | -2 | 585.2 | 15.2 | -10.2 | |
| 473 | 0 | 592.8 | 50.0 | -2.75 | 6.57E-04 |
| 474 | 0 | 592.8 | 46.1 | -2.75 | |
| 475 | 0 | 592.8 | 42.2 | -2.50 | |
| 476 | 0 | 592.8 | 39.6 | -2.50 | |
| 477 | 0 | 592.8 | 37.8 | -2.50 | |
| 478 | 0 | 592.8 | 36.7 | -10.2 | |
| 479 | 0 | 592.8 | 26.0 | -10.2 | |
| 480 | -2 | 592.8 | 15.2 | -10.2 | |
| 481 | 0 | 600.5 | 50.0 | -2.75 | 6.57E-04 |
| 482 | 0 | 600.5 | 46.1 | -2.75 | |
| 483 | 0 | 600.5 | 42.2 | -2.50 | |
| 484 | 0 | 600.5 | 39.8 | -2.50 | |
| 485 | 0 | 600.5 | 38.1 | -2.50 | |
| 486 | 0 | 600.5 | 37.0 | -10.2 | |
| 487 | 0 | 600.5 | 26.1 | -10.2 | |
| 488 | -2 | 600.5 | 15.2 | -10.2 | |
| 489 | 0 | 608.1 | 50.0 | -2.75 | 6.57E-04 |
| 490 | 0 | 608.1 | 46.1 | -2.75 | |
| 491 | 0 | 608.1 | 42.2 | -2.50 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |

| | | | | | |
|---|---|---|---|---|---|
| 494 | 0 | 608.1 | 37.3 | -10.2 | |
| 495 | 0 | 608.1 | 26.3 | -10.2 | |
| 496 | -2 | 608.1 | 15.2 | -10.2 | |
| 497 | 0 | 615.7 | 50.0 | -2.75 | 6.57E-04 |
| 498 | 0 | 615.7 | 46.1 | -2.75 | |
| 499 | 0 | 615.7 | 42.2 | -2.50 | |
| 500 | 0 | 615.7 | 40.2 | -2.50 | |
| 501 | 0 | 615.7 | 38.7 | -2.50 | |
| 502 | 0 | 615.7 | 37.6 | -10.2 | |
| 503 | 0 | 615.7 | 26.4 | -10.2 | |
| 504 | -2 | 615.7 | 15.2 | -10.2 | |
| 505 | 0 | 623.3 | 50.0 | -2.75 | 6.57E-04 |
| 506 | 0 | 623.3 | 46.1 | -2.75 | |
| 507 | 0 | 623.3 | 42.2 | -2.50 | |
| 508 | 0 | 623.3 | 40.5 | -2.50 | |
| 509 | 0 | 623.3 | 39.0 | -2.50 | |
| 510 | 0 | 623.3 | 37.9 | -10.2 | |
| 511 | 0 | 623.3 | 26.6 | -10.2 | |
| 512 | -2 | 623.3 | 15.2 | -10.2 | |
| 513 | 0 | 630.9 | 50.0 | -2.75 | 6.57E-04 |
| 514 | 0 | 630.9 | 46.1 | -2.75 | |
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| 516 | 0 | 630.9 | 40.7 | -2.50 | |
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| 503 | 205 | 196 | 197 | 197 | 2 |
| 504 | 205 | 204 | 196 | 196 | 2 |
| 505 | 204 | 195 | 196 | 196 | 2 |
| 506 | 204 | 203 | 195 | 195 | 2 |
| 507 | 198 | 189 | 190 | 190 | 2 |
| 508 | 198 | 197 | 189 | 189 | 2 |
| 509 | 197 | 188 | 189 | 189 | 2 |
| 510 | 197 | 196 | 188 | 188 | 2 |
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| 515 | 189 | 180 | 181 | 181 | 2 |
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| 520 | 182 | 181 | 173 | 173 | 2 |
| 521 | 181 | 172 | 173 | 173 | 2 |
| 522 | 181 | 180 | 172 | 172 | 2 |
| 523 | 180 | 171 | 172 | 172 | 2 |
| 524 | 180 | 179 | 171 | 171 | 2 |
| 525 | 174 | 165 | 166 | 166 | 2 |
| 526 | 174 | 173 | 165 | 165 | 2 |
| 527 | 173 | 164 | 165 | 165 | 2 |
| 528 | 173 | 172 | 164 | 164 | 2 |
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| 531 | 166 | 157 | 158 | 158 | 2 |
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| 537 | 158 | 149 | 150 | 150 | 2 |
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| 542 | 156 | 155 | 147 | 147 | 2 |
| 543 | 150 | 141 | 142 | 142 | 2 |
| 544 | 150 | 149 | 141 | 141 | 2 |
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| 548 | 148 | 147 | 139 | 139 | 2 |
| 549 | 142 | 133 | 134 | 134 | 2 |

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|---|---|---|---|---|---|
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| 553 | 140 | 131 | 132 | 132 | 2 |
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| 555 | 134 | 125 | 126 | 126 | 2 |
| 556 | 134 | 133 | 125 | 125 | 2 |
| 557 | 133 | 124 | 125 | 125 | 2 |
| 558 | 133 | 132 | 124 | 124 | 2 |
| 559 | 132 | 123 | 124 | 124 | 2 |
| 560 | 132 | 131 | 123 | 123 | 2 |
| 561 | 123 | 131 | 122 | 122 | 1 |
| 562 | 131 | 130 | 122 | 122 | 1 |
| 563 | 131 | 139 | 130 | 130 | 1 |
| 564 | 139 | 138 | 130 | 130 | 1 |
| 565 | 139 | 147 | 138 | 138 | 1 |
| 566 | 147 | 146 | 138 | 138 | 1 |
| 567 | 147 | 155 | 146 | 146 | 1 |
| 568 | 155 | 154 | 146 | 146 | 1 |
| 569 | 155 | 163 | 154 | 154 | 1 |
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| 576 | 187 | 186 | 178 | 178 | 1 |
| 577 | 187 | 195 | 186 | 186 | 1 |
| 578 | 195 | 194 | 186 | 186 | 1 |
| 579 | 195 | 203 | 194 | 194 | 1 |
| 580 | 203 | 202 | 194 | 194 | 1 |
| 581 | 203 | 211 | 202 | 202 | 1 |
| 582 | 211 | 210 | 202 | 202 | 1 |
| 583 | 211 | 219 | 210 | 210 | 1 |
| 584 | 219 | 218 | 210 | 210 | 1 |
| 585 | 219 | 227 | 218 | 218 | 1 |
| 586 | 227 | 226 | 218 | 218 | 1 |
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| 588 | 235 | 234 | 226 | 226 | 1 |
| 589 | 235 | 243 | 234 | 234 | 1 |
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| 607 | 307 | 315 | 306 | 306 | 1 |
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| 860 | 530 | 532 | 531 | 531 | 2 |
| 861 | 406 | 415 | 414 | 414 | 3 |
| 862 | 406 | 407 | 415 | 415 | 3 |
| 863 | 407 | 416 | 415 | 415 | 3 |
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| 872 | 423 | 424 | 432 | 432 | 3 |
| 873 | 430 | 439 | 438 | 438 | 3 |
| 874 | 430 | 431 | 439 | 439 | 3 |
| 875 | 431 | 440 | 439 | 439 | 3 |
| 876 | 431 | 432 | 440 | 440 | 3 |
| 877 | 438 | 447 | 446 | 446 | 3 |
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| 879 | 439 | 448 | 447 | 447 | 3 |
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| 885 | 454 | 463 | 462 | 462 | 3 |
| 886 | 454 | 455 | 463 | 463 | 3 |
| 887 | 455 | 464 | 463 | 463 | 3 |
| 888 | 455 | 456 | 464 | 464 | 3 |
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| 890 | 462 | 463 | 471 | 471 | 3 |
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| 892 | 463 | 464 | 472 | 472 | 3 |
| 893 | 470 | 479 | 478 | 478 | 3 |
| 894 | 470 | 471 | 479 | 479 | 3 |
| 895 | 471 | 480 | 479 | 479 | 3 |
| 896 | 471 | 472 | 480 | 480 | 3 |
| 897 | 478 | 487 | 486 | 486 | 3 |
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| 900 | 479 | 480 | 488 | 488 | 3 |
| 901 | 486 | 495 | 494 | 494 | 3 |
| 902 | 486 | 487 | 495 | 495 | 3 |
| 903 | 487 | 496 | 495 | 495 | 3 |
| 904 | 487 | 488 | 496 | 496 | 3 |
| 905 | 494 | 503 | 502 | 502 | 3 |
| 906 | 494 | 495 | 503 | 503 | 3 |
| 907 | 495 | 504 | 503 | 503 | 3 |
| 908 | 495 | 496 | 504 | 504 | 3 |
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| 916 | 511 | 512 | 520 | 520 | 3 |
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| 921 | 527 | 533 | 531 | 531 | 3 |
| 922 | 527 | 532 | 533 | 533 | 3 |
| 923 | 534 | 536 | 533 | 533 | 3 |
| 924 | 534 | 535 | 536 | 536 | 3 |

RESTART CHENEY DISPOSAL CELL-2D ANALYSIS-1.0E-07 cm/sec COVER FLUX/100-50 YR-5
2 -1
1.5 25.0 500.0 1.10 1.825E+04 1.0

RESTART CHENEY DISPOSAL CELL-2D ANALYSIS-1.0E-07 cm/sec COVER FLUX/500-1000 YR-5
2 -1
25 365.0 500.0 1.20 1.825E+05 1.0

RESTART CHENEY DISPOSAL CELL-2D ANALYSIS-1.0E-07 cm/sec COVER FLUX/500-1000 Y
2 -1
365 3650.0 3650.0 1.25 3.650E+05 1.0

END

CHELEY DISPOSAL CELL
w/ previous data

279
-1
-1
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295
-1
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-1
-1
-1

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | -1 | | | | | | | |
| 477 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 487 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 488 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 495 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 504 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 512 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 520 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 523 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 525 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 527 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 535 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 537 | | | | | | | | |
| 1 | -1 | | | | | | | |
| 537 | | | | | | | | |
| 1 | | | | | | | | |
| 540 | | | | | | | | |
| 1 | | | | | | | | |
| 5 | | | | | | | | |
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| 7.[illegible] | 7.[illegible] | 7.1[illegible] | 0.0 | 1.[illegible] | [illegible] | 1.[illegible] | | |
| [illegible] | [illegible] | 8.2 | 40.8 | -[illegible] | 7.4[illegible] | | | |
| 2 | -2 | 8.2 | 37.8 | -[illegible] | | | | |
| 3 | -2 | 91.2 | 33.7 | -[illegible] | | | | |
| 4 | -2 | 91.2 | 29.7 | -[illegible] | | | | |
| 5 | -2 | 91.4 | 27.3 | -[illegible] | | | | |
| 6 | -2 | 91.4 | 24.9 | -[illegible] | | | | |
| 7 | -2 | 91.4 | 20.6 | -10.2 | | | | |
| 8 | -2 | 91.4 | 15.2 | -10.2 | | | | |
| 9 | 0 | 97.5 | 41.[illegible] | -2.75 | 5.[illegible] | | | |
| 10 | 0 | 97.5 | 37.3 | -2.75 | | | | |
| 11 | 0 | 97.5 | 33.2 | -[illegible] | | | | |
| 12 | 0 | 97.5 | 29.9 | -[illegible] | | | | |
| 13 | 0 | 97.5 | 25.7 | -[illegible] | | | | |
| 14 | 0 | 97.5 | 23.6 | -[illegible] | | | | |
| 15 | 0 | 97.5 | 19.4 | -[illegible] | | | | |
| 16 | -2 | 97.5 | 15.2 | -10.2 | | | | |
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| 18 | 0 | 103.6 | 37.4 | -2.75 | | | | |
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| 22 | 0 | 103.6 | 21.3 | -10.2 | | | | |
| 23 | 0 | 103.6 | 16.5 | -10.2 | | | | |
| 24 | -2 | 103.6 | 15.2 | -10.2 | | | | |
| 25 | 0 | 111.2 | 41.4 | -2.75 | 6.615-[illegible] | | | |
| 26 | 0 | 111.2 | 37.6 | -2.75 | | | | |
| 27 | 0 | 111.2 | 33.7 | -2.50 | | | | |
| 28 | 0 | 111.2 | 29.2 | -2.50 | | | | |
| 29 | 0 | 111.2 | 24.9 | -2.50 | | | | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 33 | 0 | 118.9 | 41.4 | -2.75 | 6.41E-04 |
| 34 | 0 | 118.9 | 37.6 | -2.75 | |
| 35 | 0 | 118.9 | 33.9 | -2.50 | |
| 36 | 0 | 118.9 | 28.3 | -2.50 | |
| 37 | 0 | 118.9 | 23.9 | -2.50 | |
| 38 | 0 | 121.5 | 20.8 | -10.2 | |
| 39 | 0 | 121.5 | 18.0 | -10.2 | |
| 40 | -2 | 121.5 | 15.2 | -10.2 | |
| 41 | 0 | 126.5 | 41.8 | -2.75 | 6.57E-04 |
| 42 | 0 | 126.5 | 39.0 | -2.75 | |
| 43 | 0 | 126.5 | 34.2 | -2.50 | |
| 44 | 0 | 126.5 | 28.3 | -2.50 | |
| 45 | 0 | 126.5 | 23.5 | -2.50 | |
| 46 | 0 | 129.5 | 20.6 | -10.2 | |
| 47 | 0 | 129.5 | 17.9 | -10.2 | |
| 48 | -2 | 129.5 | 15.2 | -10.2 | |
| 49 | 0 | 134.1 | 42.0 | -2.75 | 6.57E-04 |
| 50 | 0 | 134.1 | 39.2 | -2.75 | |
| 51 | 0 | 134.1 | 34.4 | -2.50 | |
| 52 | 0 | 134.1 | 29.1 | -2.50 | |
| 53 | 0 | 134.1 | 23.7 | -2.50 | |
| 54 | 0 | 136.5 | 20.3 | -10.2 | |
| 55 | 0 | 136.8 | 17.8 | -10.2 | |
| 56 | -2 | 136.8 | 15.2 | -10.2 | |
| 57 | 0 | 141.7 | 42.0 | -2.75 | 6.41E-04 |
| 58 | 0 | 141.7 | 39.4 | -2.75 | |
| 59 | 0 | 141.7 | 34.6 | -2.50 | |
| 60 | 0 | 141.7 | 29.2 | -2.50 | |
| 61 | 0 | 141.7 | 23.9 | -2.50 | |
| 62 | 0 | 147.4 | 20.1 | -10.2 | |
| 63 | 0 | 147.4 | 17.7 | -10.2 | |
| 64 | -2 | 147.4 | 15.0 | -10.2 | |
| 65 | 0 | 149.4 | 40.4 | -2.75 | 6.39E-04 |
| 66 | 0 | 149.4 | 35.5 | -2.75 | |
| 67 | 0 | 149.4 | 30.5 | -2.50 | |
| 68 | 0 | 149.4 | 25.6 | -2.50 | |
| 69 | 0 | 149.7 | 20.6 | -2.50 | |
| 70 | 0 | 149.7 | 18.0 | -10.2 | |
| 71 | 0 | 149.7 | 17.5 | -10.2 | |
| 72 | -2 | 149.4 | 15.2 | -10.2 | |
| 73 | 0 | 156.9 | 40.6 | -2.75 | 6.17E-04 |
| 74 | 0 | 156.9 | 35.7 | -2.75 | |
| 75 | 0 | 156.9 | 30.9 | -2.50 | |
| 76 | 0 | 156.9 | 25.6 | -2.50 | |
| 77 | 0 | 156.9 | 20.1 | -2.50 | |
| 78 | 0 | 162.8 | 19.3 | -10.2 | |
| 79 | 0 | 162.8 | 17.5 | -10.2 | |
| 80 | -2 | 162.8 | 15.2 | -10.2 | |
| 81 | 0 | 163.6 | 42.7 | -2.75 | 6.13E-04 |
| 82 | 0 | 163.6 | 38.9 | -2.75 | |
| 83 | 0 | 163.6 | 35.1 | -2.50 | |
| 84 | 0 | 163.6 | 28.4 | -2.50 | |
| 85 | 0 | 163.6 | 23.5 | -2.50 | |
| 86 | 0 | 167.6 | 19.8 | -10.2 | |
| 87 | 0 | 167.6 | 17.5 | -10.2 | |
| 88 | -2 | 167.6 | 15.2 | -10.2 | |
| 89 | 0 | 170.7 | 42.9 | -2.75 | 7.91E-04 |
| 90 | 0 | 170.7 | 39.1 | -2.75 | |
| 91 | 0 | 170.7 | 35.3 | -2.50 | |
| 92 | 0 | 170.7 | 29.7 | -2.50 | |
| 93 | 0 | 170.7 | 23.5 | -2.50 | |
| 94 | 0 | 170.7 | 19.8 | -10.2 | |
| 95 | 0 | 170.7 | 17.5 | -10.2 | |
| 96 | -2 | 170.7 | 15.2 | -10.2 | |

| | | | | | |
|---|---|---|---|---|---|
| 99 | 0 | 179.8 | 38.6 | -2.50 | |
| 100 | 0 | 179.8 | 26.7 | -2.50 | |
| 101 | 0 | 179.8 | 23.6 | -2.50 | |
| 102 | 0 | 179.8 | 20.2 | -10.2 | |
| 103 | 0 | 179.8 | 17.7 | -10.2 | |
| 104 | -2 | 179.8 | 15.2 | -10.2 | |
| 105 | 0 | 189.0 | 43.4 | -2.75 | 7.91E-04 |
| 106 | 0 | 189.0 | 39.6 | -2.75 | |
| 107 | 0 | 189.0 | 36.6 | -2.50 | |
| 108 | 0 | 189.0 | 25.7 | -2.50 | |
| 109 | 0 | 189.0 | 23.6 | -2.50 | |
| 110 | 0 | 189.0 | 20.5 | -10.2 | |
| 111 | 0 | 189.0 | 17.9 | -10.2 | |
| 112 | -2 | 189.0 | 15.2 | -10.2 | |
| 113 | 0 | 198.1 | 43.7 | -2.75 | 7.91E-04 |
| 114 | 0 | 198.1 | 39.8 | -2.75 | |
| 115 | 0 | 198.1 | 36.0 | -2.50 | |
| 116 | 0 | 198.1 | 25.7 | -2.50 | |
| 117 | 0 | 198.1 | 23.7 | -2.50 | |
| 118 | 0 | 198.1 | 20.9 | -10.2 | |
| 119 | 0 | 198.1 | 18.1 | -10.2 | |
| 120 | -2 | 198.1 | 15.2 | -10.2 | |
| 121 | 0 | 207.3 | 43.9 | -2.75 | 7.56E-04 |
| 122 | 0 | 207.3 | 40.1 | -2.75 | |
| 123 | 0 | 207.3 | 36.3 | -2.50 | |
| 124 | 0 | 207.3 | 28.7 | -2.50 | |
| 125 | 0 | 207.3 | 22.5 | -2.50 | |
| 126 | 0 | 207.3 | 21.3 | -10.2 | |
| 127 | -2 | 207.3 | 15.2 | -10.2 | |
| 128 | 0 | 207.3 | 15.3 | -10.2 | |
| 129 | 0 | 216.3 | 44.1 | -2.75 | 7.87E-04 |
| 130 | 0 | 216.3 | 40.3 | -2.75 | |
| 131 | 0 | 216.3 | 36.4 | -2.50 | |
| 132 | 0 | 216.3 | 28.7 | -2.50 | |
| 133 | 0 | 216.3 | 24.1 | -2.50 | |
| 134 | 0 | 216.3 | 21.6 | -10.2 | |
| 135 | -2 | 216.3 | 15.2 | -10.2 | |
| 136 | 0 | 216.3 | 19.4 | -10.2 | |
| 137 | 0 | 225.4 | 44.2 | -2.75 | 7.87E-04 |
| 138 | 0 | 225.4 | 40.4 | -2.75 | |
| 139 | 0 | 225.4 | 36.6 | -2.50 | |
| 140 | 0 | 225.4 | 29.2 | -2.50 | |
| 141 | 0 | 225.4 | 24.4 | -2.50 | |
| 142 | 0 | 225.4 | 22.0 | -10.2 | |
| 143 | -2 | 225.4 | 15.2 | -10.2 | |
| 144 | 0 | 225.4 | 19.4 | -10.2 | |
| 145 | 0 | 234.4 | 44.4 | -2.75 | 7.80E-04 |
| 146 | 0 | 234.4 | 40.6 | -2.75 | |
| 147 | 0 | 234.4 | 36.9 | -2.50 | |
| 148 | 0 | 234.4 | 29.5 | -2.50 | |
| 149 | 0 | 234.4 | 24.7 | -2.50 | |
| 150 | 0 | 234.4 | 22.4 | -10.2 | |
| 151 | -2 | 234.4 | 15.2 | -10.2 | |
| 152 | 0 | 234.4 | 19.8 | -10.2 | |
| 153 | 0 | 243.5 | 44.6 | -2.75 | 7.83E-04 |
| 154 | 0 | 243.5 | 40.8 | -2.75 | |
| 155 | 0 | 243.5 | 36.9 | -2.50 | |
| 156 | 0 | 243.5 | 29.8 | -2.50 | |
| 157 | 0 | 243.5 | 25.0 | -2.50 | |
| 158 | 0 | 243.5 | 22.7 | -10.2 | |
| 159 | -2 | 243.5 | 15.2 | -10.2 | |
| 160 | 0 | 243.5 | 19.0 | -10.2 | |
| 161 | 0 | 252.5 | 44.8 | -2.75 | 7.83E-04 |
| 162 | 0 | 252.5 | 40.9 | -2.75 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |

| | | | | | |
|---|---|---|---|---|---|
| [illegible] | [illegible] | 251.5 | [illegible] | -2.50 | |
| 165 | [illegible] | 252.5 | [illegible] | [illegible] | |
| 166 | [illegible] | 252.5 | [illegible] | -10.2 | |
| 167 | -2 | 252.5 | 15.2 | -10.2 | |
| 168 | 0 | 252.5 | 19.2 | -10.2 | |
| 169 | 0 | 261.6 | 44.9 | -2.75 | 7.82E-04 |
| [illegible] | 0 | 261.6 | 41.1 | -2.75 | |
| [illegible] | 0 | 261.6 | 37.3 | -2.50 | |
| 172 | 0 | 261.6 | [illegible] | -2.50 | |
| 173 | 0 | 261.6 | 25.7 | -2.50 | |
| 174 | 0 | 261.6 | 23.4 | -10.2 | |
| 175 | -2 | 261.6 | 19.2 | -10.2 | |
| 176 | 0 | 261.6 | 19.3 | -10.2 | |
| 177 | 0 | 270.7 | 45.1 | -2.75 | 7.82E-04 |
| 178 | 0 | 270.7 | 41.3 | -2.75 | |
| 179 | 0 | 270.7 | 37.5 | -2.50 | |
| 180 | 0 | 270.7 | 30.5 | -2.50 | |
| 181 | 0 | 270.7 | 26.0 | -2.50 | |
| 182 | 0 | 270.7 | 23.8 | -10.2 | |
| 183 | -2 | 270.7 | 15.2 | -10.2 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| 185 | 0 | [illegible] | [illegible] | -2.75 | 7.82E-04 |
| 186 | 0 | 279.7 | 41.5 | -2.75 | |
| 187 | 0 | 279.7 | 37.6 | -2.50 | |
| 188 | [illegible] | 279.7 | 30.2 | -2.50 | |
| 189 | 0 | 279.7 | 26.7 | -2.50 | |
| [illegible] | 0 | [illegible] | 24.2 | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | -10.2 | |
| 193 | 0 | 288.8 | [illegible] | -2.75 | 7.82E-04 |
| 194 | [illegible] | 288.8 | 41.4 | [illegible] | |
| [illegible] | [illegible] | 288.8 | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | -2 | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | 45.4 | [illegible] | 7.82E-04 |
| [illegible] | [illegible] | 297.8 | 41.5 | [illegible] | |
| [illegible] | [illegible] | 297.9 | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | 297.8 | 26.9 | -2.50 | |
| 204 | [illegible] | 297.9 | 24.9 | -10.2 | |
| [illegible] | -2 | 297.9 | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | 45.8 | [illegible] | 7.82E-04 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | 0 | 306.9 | 33.1 | -2.50 | |
| [illegible] | 0 | 306.9 | 31.5 | -2.50 | |
| 213 | 0 | 306.9 | 27.3 | [illegible] | |
| 214 | 0 | 306.9 | 25.3 | -10.2 | |
| 215 | -2 | 306.9 | 15.2 | -10.2 | |
| [illegible] | 0 | 306.9 | 20.2 | -10.2 | |
| 217 | 0 | 315.9 | 44.0 | -2.75 | 7.82E-04 |
| [illegible] | 0 | 315.9 | 42.1 | -2.75 | |
| [illegible] | 0 | 315.9 | 38.3 | [illegible] | |
| 220 | [illegible] | 315.9 | 31.8 | -2.50 | |
| 221 | 0 | 315.9 | 27.4 | -2.50 | |
| [illegible] | 0 | 315.9 | 25.6 | -10.2 | |
| [illegible] | -2 | 315.9 | 15.2 | -10.2 | |
| [illegible] | [illegible] | 315.9 | 20.4 | -10.2 | |
| 225 | [illegible] | 325.1 | 44.2 | -2.75 | 7.82E-04 |
| [illegible] | 0 | 325.0 | 42.7 | -2.75 | |
| [illegible] | 0 | 325.0 | 38.5 | -2.50 | |
| [illegible] | 0 | [illegible] | [illegible] | [illegible] | |

| | | | | | |
|---|---|---|---|---|---|
| 230 | 0 | 333.1 | 26.0 | -10.2 | |
| 231 | -2 | 333.1 | 15.2 | -10.2 | |
| 232 | 0 | 333.1 | 20.6 | -10.2 | |
| 233 | 0 | 334.1 | 46.3 | -2.75 | 7.83E-04 |
| 234 | 0 | 334.1 | 42.5 | -2.75 | |
| 235 | 0 | 334.1 | 38.6 | -2.50 | |
| 236 | 0 | 334.1 | 32.3 | -2.50 | |
| 237 | 0 | 334.1 | 28.2 | -2.50 | |
| 238 | 0 | 334.1 | 24.3 | -10.2 | |
| 239 | -2 | 334.1 | 15.2 | -10.2 | |
| 240 | 0 | 334.1 | 20.8 | -10.2 | |
| 241 | 0 | 343.1 | 46.5 | -2.75 | 7.82E-04 |
| 242 | 0 | 343.1 | 42.7 | -2.75 | |
| 243 | 0 | 343.1 | 38.8 | -2.50 | |
| 244 | 0 | 343.1 | 32.6 | -2.50 | |
| 245 | 0 | 343.1 | 28.5 | -2.50 | |
| 246 | 0 | 343.1 | 24.7 | -10.2 | |
| 247 | -2 | 343.1 | 15.2 | -10.2 | |
| 248 | 0 | 343.1 | 21.0 | -10.2 | |
| 249 | 0 | 352.2 | 44.7 | -2.75 | 7.82E-04 |
| 250 | 0 | 352.2 | 42.8 | -2.75 | |
| 251 | 0 | 352.2 | 39.0 | -2.50 | |
| 252 | 0 | 352.2 | 32.8 | -2.50 | |
| 253 | 0 | 352.2 | 28.9 | -2.50 | |
| 254 | 0 | 352.2 | 27.1 | -10.2 | |
| 255 | -2 | 352.2 | 15.2 | -10.2 | |
| 256 | 0 | 352.2 | 21.0 | -10.2 | |
| 257 | 0 | 361.2 | 44.9 | -2.75 | 7.83E-04 |
| 258 | 0 | 361.2 | 43.0 | -2.75 | |
| 259 | 0 | 361.2 | 39.2 | -2.50 | |
| 260 | 0 | 361.2 | 33.1 | -2.50 | |
| 261 | 0 | 361.2 | 29.2 | -2.50 | |
| 262 | 0 | 361.2 | 27.4 | -10.2 | |
| 263 | -2 | 361.2 | 15.2 | -10.2 | |
| 264 | 0 | 361.2 | 21.9 | -10.2 | |
| 265 | 0 | 370.3 | 47.0 | -2.75 | 7.83E-04 |
| 266 | 0 | 370.3 | 43.2 | -2.75 | |
| 267 | 0 | 370.3 | 39.3 | -2.50 | |
| 268 | 0 | 370.3 | 33.3 | -2.50 | |
| 269 | 0 | 370.3 | 29.5 | -2.50 | |
| 270 | 0 | 370.3 | 27.8 | -10.2 | |
| 271 | -2 | 370.3 | 15.2 | -10.2 | |
| 272 | 0 | 370.3 | 21.5 | -10.2 | |
| 273 | 0 | 379.3 | 47.2 | -2.75 | 7.83E-04 |
| 274 | 0 | 379.3 | 43.3 | -2.75 | |
| 275 | 0 | 379.3 | 39.5 | -2.50 | |
| 276 | 0 | 379.3 | 33.6 | -2.50 | |
| 277 | 0 | 379.3 | 29.8 | -2.50 | |
| 278 | 0 | 379.3 | 26.2 | -10.2 | |
| 279 | -2 | 379.3 | 15.2 | -10.2 | |
| 280 | 0 | 379.3 | 21.7 | -10.2 | |
| 281 | 0 | 388.4 | 47.4 | -2.75 | 7.83E-04 |
| 282 | 0 | 388.4 | 43.5 | -2.75 | |
| 283 | 0 | 388.4 | 39.7 | -2.50 | |
| 284 | 0 | 388.4 | 33.9 | -2.50 | |
| 285 | 0 | 388.4 | 30.1 | -2.50 | |
| 286 | 0 | 388.4 | 26.5 | -10.2 | |
| 287 | -2 | 388.4 | 15.2 | -10.2 | |
| 288 | 0 | 388.4 | 21.9 | -10.2 | |
| 289 | 0 | 397.5 | 47.6 | -2.75 | 7.83E-04 |
| 290 | 0 | 397.5 | 43.7 | -2.75 | |
| 291 | 0 | 397.5 | 39.9 | -2.50 | |
| 292 | 0 | 397.5 | 34.1 | -2.50 | |
| 293 | 0 | 397.5 | 30.3 | -2.50 | |
| 294 | 0 | 397.5 | 26.9 | -10.2 | |

| | | | | | |
|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | 0 | 406.5 | 29.2 | -10.2 | |
| [illegible] | -2 | 406.5 | 15.2 | -10.2 | |
| 304 | 0 | 406.5 | 22.0 | -10.2 | |
| 305 | 0 | 415.6 | 47.9 | -2.75 | 7.82E-04 |
| 306 | 0 | 415.6 | 44.0 | -2.75 | |
| 307 | 0 | 415.6 | 40.0 | -2.50 | |
| 308 | 0 | 415.6 | 34.6 | -2.50 | |
| 309 | 0 | 415.6 | 31.1 | -2.50 | |
| 310 | 0 | 415.6 | 29.6 | -10.2 | |
| 311 | -2 | 415.6 | 15.2 | -10.2 | |
| 312 | 0 | 415.6 | 22.4 | -10.2 | |
| 313 | 0 | 424.6 | 48.1 | -2.75 | 7.82E-04 |
| 314 | 0 | 424.6 | 44.0 | -2.75 | |
| 315 | 0 | 424.6 | 40.0 | -2.50 | |
| 316 | 0 | 424.6 | 34.9 | -2.50 | |
| 317 | 0 | 424.6 | 31.1 | -2.50 | |
| 318 | 0 | 424.6 | 30.0 | -10.2 | |
| 319 | -2 | 424.6 | 15.2 | -10.2 | |
| 320 | 0 | 424.6 | 22.4 | -10.2 | |
| 321 | 0 | 433.7 | 48.0 | -2.75 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| 337 | 0 | 451.6 | 46.6 | -2.75 | 7.82E-04 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| 343 | -2 | [illegible] | 15.2 | [illegible] | |
| 344 | 0 | 451.8 | 23.1 | -10.2 | |
| 345 | 0 | 460.9 | 48.8 | -2.75 | 7.82E-04 |
| 346 | 0 | 460.9 | 44.9 | -2.75 | |
| 347 | 0 | 460.9 | 41.0 | -2.50 | |
| 348 | 0 | 460.9 | 35.9 | -2.50 | |
| 349 | 0 | 460.9 | 32.7 | -2.50 | |
| [illegible] | 0 | 460.9 | 31.2 | -10.2 | |
| [illegible] | -2 | 460.9 | 15.2 | -10.2 | |
| [illegible] | 0 | 460.9 | 23.3 | -10.2 | |
| 353 | 0 | 469.9 | 48.9 | -2.75 | 7.82E-04 |
| 354 | 0 | 469.9 | 45.1 | -2.75 | |
| [illegible] | 0 | 469.9 | 41.0 | -2.50 | |
| [illegible] | 0 | 469.9 | 36.2 | -2.50 | |
| 357 | 0 | 469.9 | 33.0 | -2.50 | |
| 358 | 0 | 469.9 | 31.6 | -10.2 | |
| 359 | -2 | 469.9 | 15.2 | -10.2 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |

| | | | | | |
|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | 547.1 | 38.9 | -2.50 | |
| 430 | [illegible] | 547.1 | 34.9 | -10.2 | |
| 431 | 0 | 547.1 | 25.1 | -10.2 | |
| 432 | -2 | 547.1 | 15.2 | -10.2 | |
| 433 | 0 | 554.7 | 50.0 | -2.75 | 6.57E-04 |
| [illegible] | 0 | 554.7 | 46.1 | -2.75 | |
| [illegible] | 0 | 554.7 | 42.2 | -2.50 | |
| 436 | 0 | 554.7 | 38.6 | -2.50 | |
| 437 | 0 | 554.7 | 36.2 | -2.50 | |
| 438 | 0 | 554.7 | 35.2 | -10.2 | |
| 439 | 0 | 554.7 | 25.2 | -10.0 | |
| 440 | -2 | 554.7 | 15.2 | -10.2 | |
| 441 | 0 | 562.4 | 50.0 | -2.75 | 6.57E-04 |
| 442 | 0 | 562.4 | 46.1 | -2.75 | |
| 443 | 0 | 562.4 | 42.2 | -2.50 | |
| 444 | 0 | 562.4 | 38.8 | -2.50 | |
| 445 | 0 | 562.4 | 36.5 | -2.50 | |
| 446 | [illegible] | 562.4 | 35.5 | -10.2 | |
| 447 | [illegible] | 562.4 | 25.4 | -10.0 | |
| 448 | -2 | 562.4 | 15.2 | -10.2 | |
| 449 | 0 | 570.0 | 50.0 | -2.75 | 6.57E-04 |
| 450 | 0 | 570.0 | 46.1 | -2.75 | |
| 451 | 0 | 570.0 | 42.2 | -2.50 | |
| 452 | [illegible] | 570.0 | 38.0 | [illegible] | |
| 453 | 0 | 570.0 | 34.8 | -2.50 | |
| 454 | [illegible] | 570.0 | 34.8 | -10.2 | |
| 455 | [illegible] | 570.0 | 25.8 | [illegible] | |
| 456 | -2 | 570.0 | 15.2 | [illegible] | |
| 457 | 0 | 577.6 | 50.0 | -2.75 | 6.57E-04 |
| 458 | 0 | 577.6 | 46.1 | [illegible] | |
| 459 | 0 | 577.6 | 42.2 | [illegible] | |
| [illegible] | [illegible] | 577.6 | 38.2 | [illegible] | |
| [illegible] | [illegible] | [illegible] | 34.1 | [illegible] | |
| 462 | [illegible] | [illegible] | 34.1 | [illegible] | |
| 463 | [illegible] | 577.6 | 25.7 | [illegible] | |
| [illegible] | -2 | 577.6 | 15.2 | [illegible] | |
| 465 | 0 | 585.2 | 50.0 | -2.75 | 6.57E-04 |
| [illegible] | [illegible] | [illegible] | 46.1 | -2.75 | |
| 467 | 0 | [illegible] | 42.2 | -2.50 | |
| 468 | [illegible] | 585.2 | 38.4 | -2.50 | |
| 469 | 0 | 585.2 | 37.5 | -2.50 | |
| 470 | 0 | 585.2 | 34.4 | -10.2 | |
| 471 | [illegible] | 585.2 | 25.8 | -10.2 | |
| 472 | -2 | 585.2 | 15.2 | [illegible] | |
| 473 | 0 | 592.8 | 50.0 | -2.75 | 6.57E-04 |
| 474 | 0 | 592.8 | 46.1 | -2.75 | |
| 475 | 0 | 592.8 | 42.2 | -2.50 | |
| 476 | 0 | 592.8 | 38.2 | -2.50 | |
| 477 | 0 | 592.8 | 37.8 | -2.50 | |
| 478 | 0 | 592.8 | 34.7 | -10.2 | |
| 479 | 0 | 592.8 | 25.0 | -10.0 | |
| 480 | -2 | 592.8 | 15.2 | -10.2 | |
| 481 | 0 | 600.5 | 50.0 | -2.75 | 6.57E-04 |
| 482 | 0 | 600.5 | 46.1 | -2.75 | |
| 483 | 0 | 600.5 | 42.2 | -2.50 | |
| 484 | 0 | 600.5 | 38.8 | -2.50 | |
| 485 | 0 | 600.5 | 38.1 | -2.50 | |
| 486 | 0 | 600.5 | 37.0 | -10.2 | |
| 487 | 0 | 600.5 | 34.1 | -10.2 | |
| 488 | -2 | 600.5 | 15.2 | -10.2 | |
| 489 | 0 | 608.1 | 50.0 | -2.75 | 6.57E-04 |
| 490 | 0 | 608.1 | 46.1 | -2.75 | |
| 491 | 0 | 608.1 | 42.2 | -2.50 | |
| 492 | 0 | 608.1 | 40.0 | -2.50 | |

| | | | | | |
|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | 1 | 1 | 1 |
| 25 | 10 | 9 | 1 | 1 | 1 |
| [illegible] | 10 | 18 | 9 | 9 | 1 |
| [illegible] | 18 | 17 | 9 | 9 | 1 |
| 29 | 17 | 24 | 25 | 25 | 1 |
| 30 | 17 | 18 | 24 | 26 | 1 |
| 31 | 18 | 27 | 26 | 26 | 1 |
| [illegible] | 18 | 19 | 27 | 27 | 1 |
| 33 | 25 | 34 | 33 | 33 | 1 |
| 34 | 25 | 26 | 34 | 34 | 1 |
| 35 | 26 | 35 | 34 | 34 | 1 |
| 36 | 26 | 27 | 35 | 35 | 1 |
| 37 | 33 | 42 | 41 | 41 | 1 |
| 38 | 33 | 34 | 42 | 42 | 1 |
| 39 | 34 | 43 | 42 | 42 | 1 |
| 40 | 34 | 35 | 43 | 43 | 1 |
| 41 | 41 | 50 | 49 | 49 | 1 |
| 42 | 41 | 42 | 50 | 50 | 1 |
| 43 | 42 | 51 | 50 | 50 | 1 |
| 44 | 42 | 43 | 51 | 51 | 1 |
| 45 | 48 | 58 | 57 | 57 | 1 |
| 46 | 49 | 57 | 58 | 58 | 1 |
| 47 | 50 | 59 | 58 | 58 | 1 |
| 48 | 50 | 51 | 59 | 59 | 1 |
| 49 | 57 | 66 | 65 | 65 | 1 |
| 50 | 57 | 58 | 66 | 66 | 1 |
| 51 | 58 | 67 | 66 | 66 | 1 |
| 52 | 58 | 59 | 67 | 67 | 1 |
| 53 | 47 | 55 | 49 | 65 | 2 |
| 54 | 55 | 67 | 49 | 65 | 2 |
| 55 | 54 | 61 | 60 | 60 | 2 |
| 56 | 51 | 57 | 60 | 60 | 2 |
| [illegible] | 51 | 49 | 50 | 50 | 2 |
| [illegible] | 49 | [illegible] | 50 | 50 | 2 |
| 59 | 43 | [illegible] | 44 | 44 | 2 |
| [illegible] | 73 | 74 | 44 | 44 | 2 |
| [illegible] | 38 | [illegible] | 74 | 74 | 2 |
| 47 | 77 | 78 | 74 | 74 | 2 |
| 48 | 77 | 19 | 78 | 78 | 2 |
| [illegible] | 18 | 77 | 78 | 78 | 2 |
| 65 | 63 | 61 | 65 | 65 | 2 |
| 66 | 68 | 60 | 61 | 61 | 2 |
| 67 | 67 | 57 | 61 | 61 | 2 |
| 68 | 67 | 57 | 53 | 53 | 2 |
| 69 | 57 | 45 | 53 | 53 | 2 |
| 70 | 57 | 44 | 45 | 45 | 2 |
| 71 | 44 | 37 | 45 | 45 | 2 |
| 72 | 44 | 36 | 37 | 37 | 2 |
| 73 | 36 | 29 | 37 | 37 | 2 |
| 74 | 36 | 28 | 29 | 29 | 2 |
| 75 | 28 | 21 | 29 | 29 | 2 |
| 76 | 28 | 20 | 21 | 21 | 2 |
| 77 | 69 | 62 | 70 | 70 | 2 |
| 78 | 69 | 61 | 62 | 62 | 2 |
| 79 | 61 | 54 | 62 | 62 | 2 |
| 80 | 61 | 53 | 54 | 54 | 2 |
| 81 | 53 | 46 | 54 | 54 | 2 |
| 82 | 53 | 45 | 46 | 46 | 2 |
| 83 | 45 | 38 | 46 | 46 | 2 |
| 84 | 45 | 37 | 38 | 38 | 2 |
| 85 | 37 | 30 | 38 | 38 | 2 |
| 86 | 30 | 29 | 30 | 30 | 2 |
| 87 | 29 | 22 | 30 | 30 | 2 |
| 88 | 22 | 21 | 22 | 22 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| 157 | 99 | 107 | 99 | 99 | 1 |
| 158 | 107 | 106 | 99 | 99 | 1 |
| 159 | 107 | 115 | 106 | 106 | 1 |
| 160 | 115 | 114 | 106 | 106 | 1 |
| 161 | 115 | 123 | 114 | 114 | 1 |
| 162 | 123 | 122 | 114 | 114 | 1 |
| 3 | 90 | 98 | 89 | 89 | 1 |
| 4 | 98 | 97 | 89 | 89 | 1 |
| 165 | 98 | 106 | 97 | 97 | 1 |
| 166 | 106 | 105 | 97 | 97 | 1 |
| 167 | 106 | 114 | 105 | 105 | 1 |
| 168 | 114 | 113 | 105 | 105 | 1 |
| 169 | 114 | 122 | 113 | 113 | 1 |
| 170 | 122 | 121 | 113 | 113 | 1 |
| 171 | 123 | 115 | 124 | 124 | 2 |
| 172 | 115 | 116 | 124 | 124 | 2 |
| 173 | 115 | 107 | 116 | 116 | 2 |
| 174 | 107 | 108 | 116 | 116 | 2 |
| 175 | 107 | 99 | 108 | 108 | 2 |
| 176 | 99 | 100 | 108 | 108 | 2 |
| 177 | 99 | 91 | 100 | 100 | 2 |
| 178 | 91 | 92 | 100 | 100 | 2 |
| 179 | 124 | 116 | 125 | 125 | 2 |
| 180 | 116 | 117 | 125 | 125 | 2 |
| 181 | 116 | 109 | 117 | 117 | 2 |
| 182 | 109 | 108 | 117 | 117 | 2 |
| 183 | 109 | 100 | 109 | 109 | 2 |
| 184 | [illegible] | 101 | 109 | 109 | 2 |
| 185 | 100 | 92 | 101 | 101 | 2 |
| 186 | 92 | 93 | 101 | 101 | 2 |
| 187 | 125 | 117 | 126 | 126 | 2 |
| 188 | 117 | 118 | 126 | 126 | 2 |
| 9 | 117 | 109 | 118 | 118 | 2 |
| 190 | 109 | 110 | 118 | 118 | 2 |
| 191 | 109 | 101 | 110 | 110 | 2 |
| 192 | 101 | 102 | 110 | 110 | 2 |
| 193 | 101 | 93 | 102 | 102 | 2 |
| 194 | 93 | 94 | 102 | 102 | 2 |
| 195 | 126 | 118 | 127 | 127 | 2 |
| 196 | 118 | 119 | 127 | 127 | 2 |
| 197 | 118 | 110 | 119 | 119 | 2 |
| 198 | 110 | 111 | 119 | 119 | 2 |
| 199 | 110 | 102 | 111 | 111 | 2 |
| 200 | 102 | 103 | 111 | 111 | 2 |
| 201 | 102 | 94 | 103 | 103 | 2 |
| 202 | 94 | 95 | 103 | 103 | 2 |
| 203 | 128 | 119 | 127 | 127 | 3 |
| 204 | 119 | 120 | 127 | 127 | 3 |
| 205 | 119 | 111 | 120 | 120 | 3 |
| 206 | 111 | 112 | 120 | 120 | 3 |
| 207 | 111 | 103 | 112 | 112 | 3 |
| 208 | 103 | 104 | 112 | 112 | 3 |
| 209 | 103 | 95 | 104 | 104 | 3 |
| 210 | 95 | 96 | 104 | 104 | 3 |
| 211 | 127 | 135 | 128 | 128 | 3 |
| 212 | 135 | 134 | 128 | 128 | 3 |
| 213 | 135 | 143 | 136 | 136 | 3 |
| 214 | 143 | 144 | 136 | 136 | 3 |
| 215 | 143 | 15 | 144 | 144 | 3 |
| 216 | 151 | 152 | 144 | 144 | 3 |
| 217 | 151 | 159 | 152 | 152 | 3 |
| 218 | 159 | 167 | 152 | 152 | 3 |
| 219 | 159 | 167 | 160 | 160 | 3 |
| 220 | 167 | 168 | 160 | 160 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3 |
| [illegible] | [illegible] | [illegible] | 158 | [illegible] | 3 |
| [illegible] | [illegible] | 164 | [illegible] | [illegible] | 3 |
| 291 | 165 | 174 | 166 | 165 | 3 |
| 292 | 174 | [illegible] | 166 | 166 | 3 |
| 293 | 176 | [illegible] | 174 | 174 | 3 |
| [illegible] | 184 | [illegible] | 174 | 174 | 3 |
| [illegible] | 184 | 192 | [illegible] | 182 | 3 |
| 296 | [illegible] | [illegible] | [illegible] | [illegible] | 3 |
| 297 | 192 | 200 | [illegible] | 190 | 3 |
| 298 | 200 | 198 | 190 | 190 | 3 |
| 299 | 200 | 208 | 198 | 198 | 3 |
| 300 | 208 | 206 | 198 | 198 | 3 |
| 301 | 208 | 216 | 206 | 206 | 3 |
| 302 | 216 | 214 | 206 | 206 | 3 |
| 303 | 216 | 224 | 214 | 214 | 3 |
| 304 | [illegible] | [illegible] | 214 | 214 | 3 |
| 305 | 224 | [illegible] | [illegible] | 222 | 3 |
| [illegible] | [illegible] | [illegible] | 222 | [illegible] | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 238 | [illegible] | 3 |
| 311 | 248 | [illegible] | 246 | 246 | 3 |
| [illegible] | 254 | [illegible] | [illegible] | 244 | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 270 | 270 | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | 278 | 3 |
| [illegible] | [illegible] | [illegible] | 278 | 278 | 3 |
| [illegible] | [illegible] | [illegible] | 286 | [illegible] | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 328 | 318 | 318 | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3 |
| [illegible] | [illegible] | 336 | [illegible] | [illegible] | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3 |
| [illegible] | 344 | [illegible] | 342 | [illegible] | 3 |
| [illegible] | 352 | [illegible] | [illegible] | 342 | 3 |
| 337 | 352 | 360 | [illegible] | 350 | 3 |
| [illegible] | 360 | 358 | 350 | [illegible] | 3 |
| [illegible] | 360 | 368 | 358 | 356 | 3 |
| [illegible] | 368 | 366 | [illegible] | 358 | 3 |
| [illegible] | 368 | 376 | [illegible] | 366 | 3 |
| [illegible] | [illegible] | 374 | [illegible] | [illegible] | 3 |
| [illegible] | [illegible] | 384 | 374 | 374 | 3 |
| [illegible] | [illegible] | [illegible] | 374 | 374 | 3 |
| [illegible] | [illegible] | [illegible] | 382 | [illegible] | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | 382 | 3 |
| [illegible] | 392 | [illegible] | [illegible] | 390 | 3 |
| [illegible] | 400 | [illegible] | [illegible] | 390 | 3 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3 |
| [illegible] | [illegible] | 406 | [illegible] | 398 | 3 |
| [illegible] | 404 | 397 | [illegible] | 398 | 2 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-08-90-14-11 DISCIPLINE Hydro NO. OF SHEETS 92

PROJECT:
UMTRA Site Characterization

SITE:
Grand Junction processing site, Colorado

FEATURE:
Statistical evaluation of existing groundwater contamination

SOURCES OF DATA:
DART water quality records

SOURCES OF FORMULAE & REFERENCES:
EPA, 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance."

TAD, 1989

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | B Gallaher | 08/10/90 | S Reinert | 8/13/90 | | |
| | | | | S Reinert | 8/20/90 | Karl Fredrickson | 8/20/90 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

JEG-AL-ENG-51 (6/87)

JE JACOBS ENGINEERING

DATE 7 August 1990 SUBJECT SHEET NO. i

BY BJ CHKD. EK JOB NO. JL

A. PURPOSE OF CALCULATION:

To assess alluvial groundwater contamination with hazardous constituents at the Grand Junction processing site using only statistical methods. Statistics are applied to those hazardous constituents in which contamination is not readily evident.

B. METHODS AND PROCEDURES

Water quality data available for monitor wells at the processing site were analyzed using the EPA approach outlined in the TAD. This approach is presented in the attached flowchart. The statistical approach is designed for comparing background water quality to onsite / downgradient water quality for constituents with no MCLs. The statistical comparison method selected depends on whether concentrations in the onsite / downgradient wells exceed statistical maximum background concentrations, and on the percentage of "nondetects" in the sample population.

Comparison is made of the concentrations of hazardous constituents in upgradient and downgradient wells. The list of hazardous constituents in the Grand Junction tailings was determined previously (Calc Set GRJ-07-90-15-01).

FORM 91-005-1 (4/81)

Not all of the identified hazardous constituents, have ~~one~~ were statistically analyzed.

were not analyzed because of their insolubility in groundwater geochemical conditions, thus precluding the possibility of contamination. constituents

C. DATA SOURCES

Groundwater quality records and general statistical descriptions were obtained from DART. To represent recent conditions, only data available from 1987 were used in the analysis. The ~~data~~ wells are grouped according to flow relationships as follows:

| Upgradient | Downgradient | Cross-Gradient |
|---|---|---|
| 588 | 585 | 737 |
| 710 | 586 | 742 |
| 744 | 589 | |
| 745 | 590 | |
| 746 | 733 | |
| | 736 | |
| | 740 | |

DART water quality data tables are presented in Attachment 1.

D. CALCULATIONS AND ANALYSES

Following EPA protocol (1989), the under quality data were analyzed using one of two background well to compliance well procedures: the test of proportions or the one-way analysis of variance (AN 7 If more than 50% of the observation

are below the detection limit (MDL), then the appropriate comparison is a test of proportions. One-way ANOVAs were performed for other constituents (no evidence of seasonality were seen in the data to require useage of an alternate ANOVA approach). The test of proportions is presented in attachment II and the ANOVA is presented in attachment III

E. RESULTS

Results of the calculations are summarized in the attached table.

F. CONCLUSIONS

The statistical analyses show the likelihood that alluvial groundwater downgradient of the processing site is contaminated with uranium and molybdenum. KB ~~and gross alpha~~. There are insufficient data, however, to statistically determine which individual well(s), if any, is contaminated, but maximum concentrations appear to be found in the southwest corner of the processing site. This corresponds to the pattern of uranium contamination. Although net gross alpha concentrations exceed the mcls in downgradient monitor wells the concentrations are within the range of background and net gross alpha is not a groundwater contaminant

JE JACOBS ENGINEERING

DATE 09 August 1990 SUBJECT

BY BD CHKD. [illegible]

SHEET NO. 4

JOB NO. [illegible]

# Results of Analysis Summary

| Hazardous Constituent | Contamination Indicated? | Reason/Remarks |
|---|---|---|
| 1) Aluminum | No | NS* |
| 2) Antimony | No | Passed Test of Proportions (TOP) |
| 3) Arsenic | No | Passed ANOVA |
| 4) Barium | No | Passed TOP |
| 5) Beryllium | No | Not detected in groundwater |
| 6) Cadmium | No | Passed ANOVA |
| 7) Chromium | No | Passed TOP |
| 8) Cobalt | No | Not detected in groundwater |
| 9) Copper Stat Max = .014 Secondary St[illegible] | No | Downgradient wells do not exceed secondary's |
| 10) Cyanide | No | NS |
| 11) Fluoride | No | NS |
| 12) (Net) Gross alpha | No | Passed ANOVA |
| 13) Lead | No | Passed TOP |
| 14) Mercury | No | Not detected in ground-w[illegible] |
| 15) Molybdenum | Likely | Failed ANOVA |
| 16) Nickel | No | Passed TOP |
| 17) Nitrate | No | Passed TOP |
| 18) Radium-226 & | No | Passed TOP |
| 19) Selenium | No | Passed ANOVA |
| 20) Silver | No | Passed TOP |
| 21) Strontium | No | NS |
| 22) Tin Stat Max .0465 3 Mo 2 Lo 1 Hi | No | Passed ANOVA |
| 23) Uranium | Yes | Downgradient concs. 5X upgradient |
| 24) Vanadium de an [illegible] | No | Passed TOP |
| 25) Sulfide | No | NS |
| 26) Zinc | No | Downgradient Wells do not exceed sec. standar |

*NS = Element of hazardous compound that is not soluble in ground water conditions.

FORM 91-005-1 (4/81)

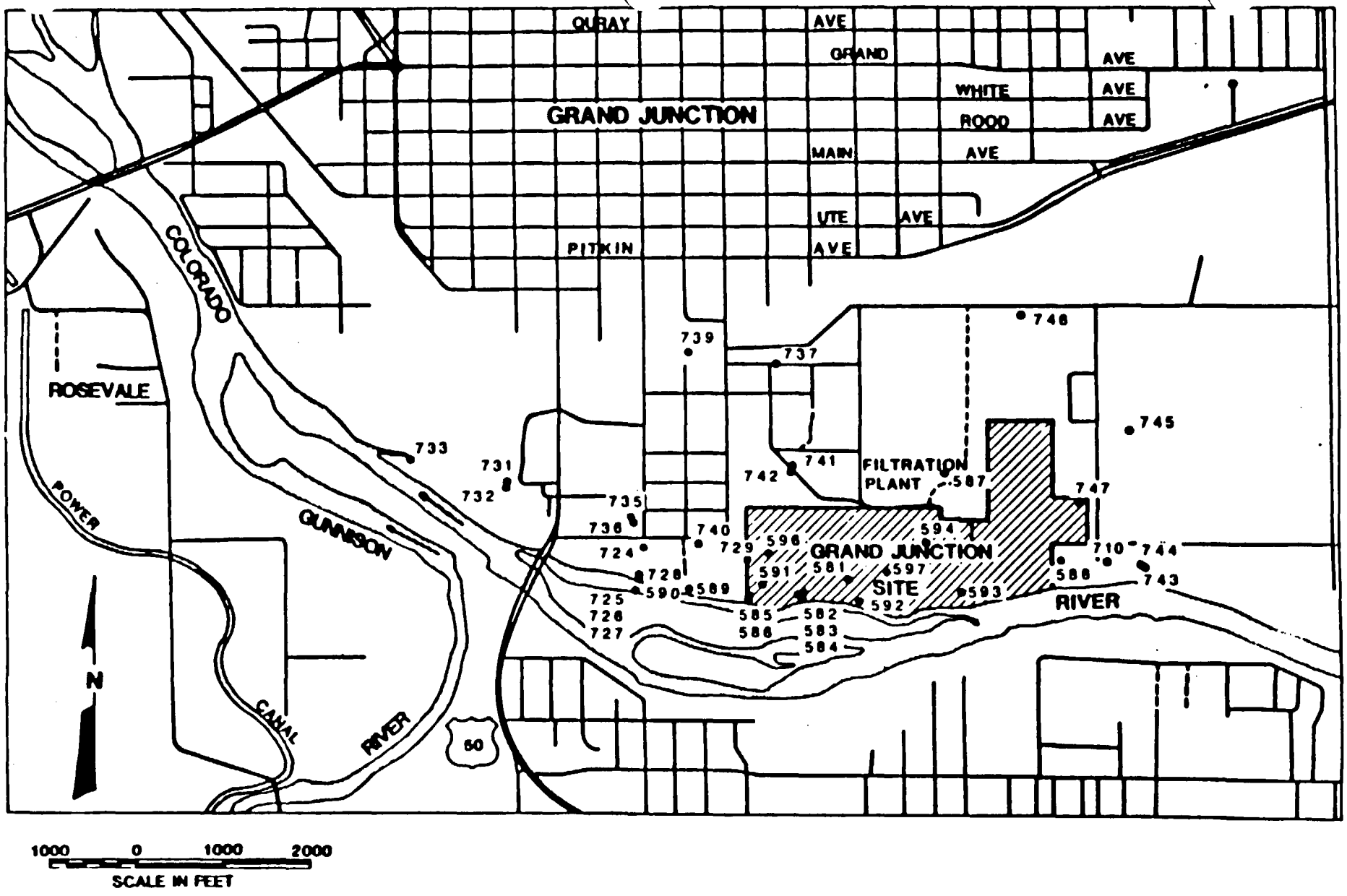


FIGURE F.3.1
MONITORING WELL LOCATIONS NEAR GRAND JUNCTION SITE

# BACKGROUND WELL TO COMPLIANCE WELL COMPARISONS

EPA (1989) protocol.

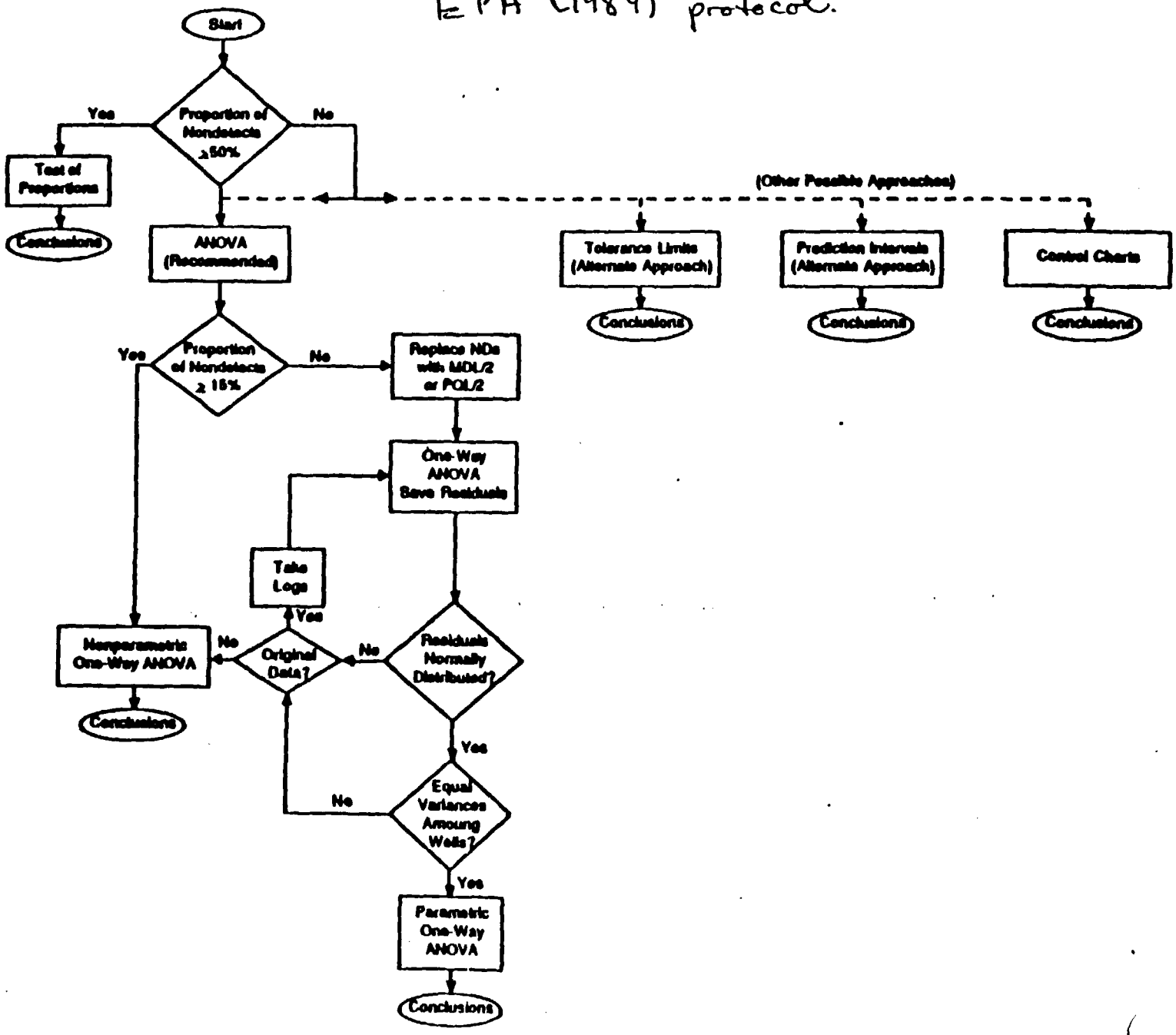


Figure 5-1. Background well [illegible] compliance well comparisons.

8/20/90

JACOBS ENGINEERING

DATE 9 August 1990 SUBJECT

BY BY CHKD. SM 8/20/90

SHEET NO. 7

JOB NO. SM 8/20/90

References:

EPA, 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities", U.S. Environmental Protection Agency, Office of Solid Waste, EPA/530-SW-89-026

FORM 91-005-1 (4/81)

JE JACOBS ENGINEERING

DATE _____ SUBJECT

BY BS CHKD. [illegible] 8/10/90

SHEET NO. 8

JOB NO. _____

Attachment I.

DART Water Quality Records.

FORM 91-005-1 (4/81)

Table . , Alluvial water quality by parameter
SITE: CRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ALKALINITY | 0581 | 03/07/89 | 0001 | AL | O | MG/L CACO3 | | 539. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 563. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 629. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 229. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 588. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 572. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 488. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 448. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 485. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 467. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 465. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 456. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 651. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 633. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 631. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 632. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 503. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 534. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 591. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 456. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 462. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 420. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 468. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 491. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 411. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 471. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 328. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 20.5 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 306. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 526. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 518. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 532. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 554. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 529. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 419. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 426. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 438. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ALKALINITY | 0746 | 08/03/89 | 0001 | AL | U | MG/L CACO3 | | 442. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 439. | - |
| ALUMINUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.1 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.3 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0733 | 09/17/87 | 0001 | AL | O | | | 0.38 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.3 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.1 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.3 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.55 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.3 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.72 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.33 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.2 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ALUMINUM | 0746 | 09/17/87 | 0001 | AL | U | MG/L | | 0.38 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.3 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| AMMONIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 170. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 300. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 300. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 9.5 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 1.4 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 160. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 21. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 20.2 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 20.5 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 2.0 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 61. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.4 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.4 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 50. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 31.1 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.3 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 1.7 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 1.3 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 1.0 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.3 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | < | 0.1 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| AMMONIUM | 0745 | 03/05/89 | 0001 | AL | U | MG/L | | 0.3 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| ANTIMONY | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.003 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.017 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.009 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.012 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.014 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.017 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.016 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.014 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.003 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.013 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.003 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.009 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.012 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B.2

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ANTIMONY | 0746 | 11/02/89 | 0001 | AL | U | MG/L | | 0.004 | - |
| ARSENIC | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.01 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.04 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.015 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.05 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.013 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.015 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.012 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.05 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.01 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.012 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.016 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.02 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.015 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ARSENIC | 0746 | 09/22/88 | 0001 | AL | U | MG/L | | 0.04 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.016 | - |
| BARIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.1 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.02 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.02 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.03 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.02 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| BARIUM | 0745 | 08/03/89 | 0001 | AL | U | MG/L | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.02 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| BERYLLIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.005 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| BROMIDE | 0590 | 11/02/89 | 0001 | AL | D | MG/L | | .1 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1.0 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1.2 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | .1 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | .2 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | .1 | - |
| CADMIUM | 0581 | 03/07/89 | 0001 | AL | D | MG/L | | 0.001 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.025 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.023 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.001 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.010 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.002 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.016 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.013 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.001 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.014 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.002 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.005 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.018 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.001 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.029 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.005 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.001 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.006 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | < | 0.005 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CADMIUM | 0745 | 09/22/88 | 0001 | AL | U | MG/L | | 0.013 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.012 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.002 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.005 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.017 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.039 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.002 | - |
| CALCIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 600. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 560. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 560. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 102. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 540. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 489. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 549. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 540. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 488. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 463. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 427. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 418. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 439. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 434. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 417. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 399. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 510. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 487. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 492. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 473. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 523. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 530. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 497. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 517. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 370. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 570. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 257. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CALCIUM | 0744 | 08/03/89 | 0001 | AL | U | MG/L | | 139. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 93.1 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 378. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 429. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 394. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 372. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 466. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 448. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 483. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 510. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 452. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 451. | - |
| CHLORIDE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 720. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 850. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 870. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 195. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 910. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 1000. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 810. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 851. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 750. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 740. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 640. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 1100. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 1170. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 1150. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 1200. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1200. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 980. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 960. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1000. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 1060. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 1170. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 1200. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 1300. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 890. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B3

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CHLORIDE | 0740 | 02/28/89 | 0001 | AL | D | MG/L | | 700. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 920. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 310. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 149. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 160. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 600. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 500. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 430. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 490. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 570. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 695. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 700. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 720. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 730. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 720. | - |
| CHROMIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.14 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.14 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.16 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CHROMIUM | 0737 | 03/04/89 | 0001 | AL | C | MG/L | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.13 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.15 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| COBALT | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.05 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.05 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.05 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| COBALT | 0740 | 02/28/89 | 0001 | AL | D | MG/L | < | 0.05 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.05 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.05 | - |
| COPPER | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.02 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.02 | - |
| Stat Max of B: | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.02 | - |
| 0.014 | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.03 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.02 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.03 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.03 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.04 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.02 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.02 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.02 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.07 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.02 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B9
21

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| COPPER | 0742 | 03/03/89 | 0001 | AL | C | MG/L | < | 0.02 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.02 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | < | 0.02 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.02 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.02 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.02 | - |
| CYANIDE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CYANIDE | 0744 | 11/02/89 | 0001 | AL | U | MG/L | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| FLUORIDE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 4.4 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 3.4 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 3.7 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.4 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.4 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.4 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.5 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.4 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.4 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.5 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 1.0 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.66 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.7 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.7 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.6 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.7 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.7 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.7 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.7 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 1.08 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 1.0 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 1.3 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.9 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.65 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.8 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.9 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.5 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.5 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.7 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| FLUORIDE | 0745 | 09/17/87 | 0001 | AL | U | MG/L | | 0.76 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.7 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.8 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.6 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.7 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 1.45 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 1.3 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 1.6 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 1.2 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 1.3 | - |
| GROSS ALPHA | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 71. | 33. |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 182. | 58. |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 223. | 50. |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 3. | 6.3 |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 115. | 45. |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 130. | 60. |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 110. | 50. |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 135. | 53. |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 140. | 60. |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 130. | 40. |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 21. | 33. |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 3. | 41. |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 65. | 49. |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0. | 41. |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 160. | 70. |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 49. | 50. |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 60. | 50. |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 110. | 70. |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 58. | 59. |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 15. | 42. |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 100. | 60. |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0. | 46. |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 31. | 62. |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 69. | 51. |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 30. | 36. |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 101. | 52. |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
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C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| GROSS ALPHA | 0744 | 03/05/89 | 0001 | AL | U | PCI/L | | 19. | 15. |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 6.7 | 8.5 |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 14. | 8. |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 2. | 35. |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 15. | 34. |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 29. | 24. |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 41. | 26. |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 38. | 28. |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0. | 38. |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 27. | 38. |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0. | 28. |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 58. | 61. |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 56. | 48. |
| GROSS BETA | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 76. | 26. |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 176. | 43. |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 147. | 34. |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 12. | 5. |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 145. | 35. |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 110. | 30. |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 110. | 30. |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 57. | 35. |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 120. | 30. |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 72. | 24. |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 58. | 29. |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 51. | 29. |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 64. | 28. |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 21. | 35. |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 93. | 32. |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 34. | 28. |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 42. | 37. |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 87. | 30. |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 39. | 32. |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 77. | 31. |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 100. | 30. |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 36. | 40. |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 55. | 37. |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
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C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| GROSS BETA | 0740 | 09/24/87 | 0001 | AL | D | PCI/L | | 140. | 40. |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 24. | 27. |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 48. | 36. |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 12. | 11. |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 13. | 5. |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 11. | 4. |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 57. | 29. |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 41. | 24. |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0. | 16. |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 19. | 13. |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 23. | 17. |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 64. | 30. |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 65. | 24. |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 40. | 26. |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 32. | 32. |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 110. | 40. |
| IRON | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 14. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 12. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 16. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.35 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 5.7 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 9.75 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.11 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.12 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.12 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 1.56 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.34 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.94 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.97 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 1.10 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.94 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.16 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.11 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| IRON | 0737 | 09/22/88 | 0001 | AL | C | MG/L | | 0.16 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.06 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.19 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.25 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.03 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.04 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.11 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.39 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.82 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.59 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.57 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.01 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.15 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.12 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.12 | - |
| LEAD | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.02 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.02 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.02 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| LEAD | 0737 | 08/07/89 | 0001 | AL | C | MG/L | | 0.02 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| MAGNESIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 259. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 382. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 374. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 39.5 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 332. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 319. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 383. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 390. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 332. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 334. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 310. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 408. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 432. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 432. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 374. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 395. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 462. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 421. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 449. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 485. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 548. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 550. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 565. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 406. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MAGNESIUM | 0740 | 02/28/89 | 0001 | AL | D | MG/L | | 310. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 500. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 147. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 81.0 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 52.1 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 289. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 301. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 256. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 252. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 281. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 458. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 504. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 525. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 478. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 469. | - |
| MANGANESE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 4.90 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 3.62 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 4.16 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.28 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 2.17 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 2.11 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 1.52 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 1.22 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 1.49 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 1.51 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 1.93 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 1.69 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 1.49 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 1.27 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 1.54 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1.50 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.94 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 1.64 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1.88 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 2.21 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 2.02 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MANGANESE | 0737 | 03/04/89 | 0001 | AL | C | MG/L | | 1.80 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 2.08 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 3.50 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 2.46 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 1.78 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 1.07 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.58 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.43 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 1.34 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 1.32 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 1.13 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 1.20 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 1.38 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 1.37 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 1.34 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 1.38 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 1.38 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 1.39 | - |
| MECHANICAL SIEVE TEST 3/8 INCH | 0746 | 08/03/89 | 0001 | AL | U | % PASSING | | 3690. | - |
| MERCURY | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.0002 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.0002 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MERCURY | 0737 | 03/04/89 | 0001 | AL | C | MG/L | < | 0.0002 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.0002 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.0002 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.0002 | - |
| MOLYBDENUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.10 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.24 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.14 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.04 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.06 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.04 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.04 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.06 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.05 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.04 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.09 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.04 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.07 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.09 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.07 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.03 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.02 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
D - DOWN GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MOLYBDENUM | 0745 | 03/05/89 | 0001 | AL | U | MG/L | | 0.02 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.03 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.05 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.15 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.14 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.15 | - |
| NICKEL | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.04 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.06 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.04 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.11 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.05 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.01 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.12 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.05 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.05 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.13 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.04 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.04 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.04 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| NICKEL | 0745 | 09/22/88 | 0001 | AL | U | MG/L | | 0.09 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.12 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.04 | - |
| NITRATE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 1.0 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 1.0 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 1. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 5.7 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 2.0 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 1. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 1.0 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.4 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | < | 1. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 4.0 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 2.5 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.4 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | < | 1. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 1.0 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 1. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 2.2 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 2.0 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 1.0 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 1.0 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| NITRATE | 0744 | 08/03/89 | 0001 | AL | U | MG/L | | 29. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 1.5 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 3.5 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | < | 1. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 1.0 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 1. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 3.5 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | < | 1. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 1.0 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 1. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| PH | 0581 | 03/07/89 | 0001 | AL | O | SU | | 7.10 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 7.0 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 7.05 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 7.87 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 7.06 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 7.03 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 6.85 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 6.97 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 7.03 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 6.83 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 7.0 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 6.90 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 7.77 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 7.03 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 7.09 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 7.30 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 7.04 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 6.89 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 6.83 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 7.0 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 7.12 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 7.07 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 7.12 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 6.80 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| PH | 0740 | 02/28/89 | 0001 | AL | D | SU | | 7.11 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 7.02 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 7.18 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 7.16 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 7.27 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 6.90 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 7.08 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 7.02 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 7.03 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 6.85 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 7.0 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 7.03 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 7.20 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 7.18 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 7.10 | - |
| POTASSIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 56. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 68. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 71. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 6.5 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 49. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 66.6 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 23.4 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 15.8 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 25.5 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 25.7 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 19. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 8.82 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 9.1 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 8.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 9.2 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 10.2 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 8.4 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 12.7 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 13.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 10.5 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 10.9 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| POTASSIUM | 0737 | 03/04/89 | 0001 | AL | C | MG/L | | 10.1 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 11.9 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 26.0 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 16.0 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 6.9 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 6.4 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 7.5 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 5.9 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 5.05 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 5.7 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 4.9 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 5.0 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 6.0 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 8.28 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 9.4 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 8.4 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 10.9 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 10.7 | - |
| RADIUM-226 | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 1.2 | 0.5 |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.8 | 0.4 |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.0 | 0.2 |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.1 | 0.2 |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.1 | 0.1 |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.1 | 0.1 |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.1 | 0.1 |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.2 | 0.2 |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.0 | 0.1 |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.1 | 0.1 |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.0 | 0.1 |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.0 | 0.1 |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.0 | 0.1 |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| RADIUM-226 | 0736 | 11/02/89 | 0001 | AL | D | PCI/L | | 0.0 | 0.1 |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.0 | 0.1 |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.2 | 0.2 |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.1 | 0.2 |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.0 | 0.1 |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.0 | 0.1 |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.0 | 0.1 |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.2 | 0.2 |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.1 | 0.1 |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.0 | 0.2 |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.1 | 0.2 |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.1 | 0.2 |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.1 | 0.1 |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.1 | 0.2 |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| RADIUM-228 | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 0.5 | 1.3 |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 2.3 | 1.2 |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 2.0 | 1.3 |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.4 | 1.4 |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 2.3 | 1.4 |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.2 | 0.8 |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.0 | 0.7 |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.7 | 1.3 |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 1.0 | 0.9 |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.0 | 1.0 |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.0 | 1.3 |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.4 | 1.6 |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.0 | 0.7 |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.5 | 1.3 |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.2 | 0.9 |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
D - DOWN GRADIENT
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O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| RADIUM-228 | 0733 | 11/02/89 | 0001 | AL | D | PCI/L | | 1.0 | 0.9 |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.3 | 1.3 |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.9 | 0.9 |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.7 | 0.9 |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 2.0 | 1.9 |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 1.3 | 1.0 |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 1.5 | 1.3 |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 1.0 | 0.8 |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.5 | 1.0 |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 2.0 | 1.5 |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 1.7 | 1.4 |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.1 | 1.5 |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.7 | 0.8 |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.3 | 1.0 |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.4 | 0.8 |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.3 | 0.9 |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 1.0 | 1.1 |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.0 | 0.9 |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.7 | 0.9 |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 1.0 | 0.9 |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.1 | 0.7 |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 1.2 | 1.2 |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.6 | 0.9 |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.7 | 0.8 |
| SELENIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.025 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.025 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.025 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.028 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.142 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.025 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.036 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.025 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.164 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | 0733 | 09/22/88 | 0001 | AL | D | MG/L | | 0.196 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.025 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.039 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.026 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.038 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.159 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.199 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.026 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.127 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.012 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.011 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.067 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.060 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.018 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.030 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.060 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.191 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.05 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.057 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.060 | - |
| SILICA - SIO2 | 0590 | 11/02/89 | 0001 | AL | D | MG/L | | 20. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 17. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 21. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 17. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 17. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 17. | - |
| SILVER | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SILVER | 0586 | 03/01/89 | 0001 | AL | D | MG/L | < | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.01 | - |
| SODIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 805. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 985. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 990. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 144. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 1080. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 1070. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 975. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 950. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 953. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SODIUM | 0590 | 11/02/89 | 0001 | AL | D | MG/L | | 944. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 736. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 1327. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 1220. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 1220. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 1250. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1200. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 1190. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 1200. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1180. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 1400. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 1220. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 1230. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 1230. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 1240. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 728. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 950. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 309. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 234. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 186. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 668. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 573. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 540. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 404. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 554. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 909. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 871. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 910. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 841. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 843. | - |
| SPECIFIC CONDUCTANCE | 0581 | 03/07/89 | 0001 | AL | O | UMHO/CM | | 4500. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 4600. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 4600. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 800. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 4400. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 2700. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
D - DOWN GRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 0590 | 09/22/88 | 0001 | AL | D | UMHO/CM | | 6000. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 3500. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 3220. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 1700. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 3600. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 7000. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 7500. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 4100. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 3400. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1000. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 4400. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 1280. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1050. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 7100. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 7000. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 6000. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 3780. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 7000. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 3400. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 4900. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 1800. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 980. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 75. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 4000. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 3550. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 2950. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 2000. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 405. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 5500. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 4900. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 4300. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 3700. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 900. | - |
| STRONTIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 7.3 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 4.65 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 4.44 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| STRONTIUM | 0588 | 03/06/89 | 0001 | AL | U | MG/L | | 1.04 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 5.3 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 4.49 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 6.2 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 4.93 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 4.9 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 5.36 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 4.89 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 6.95 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 6.5 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 5.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 5.2 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 6.15 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 5.0 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 4.6 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 6.45 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 7.30 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 7.2 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 7.3 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 6.22 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 6.25 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 4.10 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 5.7 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 2.39 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 1.41 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 1.06 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 4.50 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 4.1 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 4.18 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 3.47 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 4.88 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 6.60 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 6.5 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 7.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 5.83 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 6.48 | - |
| SULFATE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 2940. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
D - DOWN GRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SULFATE | 0585 | 03/01/89 | 0001 | AL | D | MG/L | | 3950. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 3940. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 179. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 3510. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 3660. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 3420. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 3420. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 3310. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 3140. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 2770. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 3310. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 3130. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 3240. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 3170. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 3230. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 3850. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 3720. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 3960. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 4130. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 3880. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 3920. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 4060. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 3930. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 2520. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 3880. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 1020. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 611. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 385. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 2140. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 2210. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 1990. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 1760. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 2460. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 3450. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 3550. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 3620. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 3690. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 3620. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | 0581 | 03/07/89 | 0001 | AL | O | C - DEGREE | | 14. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 10.0 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 9.5 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 7.5 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 11.5 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 17.5 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 17.0 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 9.0 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 16.5 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 16.0 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 11.0 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 17.0 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 21.0 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 14.5 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 17.5 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 16.0 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 12.0 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 22.5 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 20.0 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 15.5 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 16.5 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 15.0 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 16.5 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 17.0 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 11.0 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 14. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 10. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 20.5 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 20.0 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 14.0 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 14. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 13. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 14.0 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 15.0 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 15.0 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 14. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 15. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | 0746 | 08/03/89 | 0001 | AL | U | C - DEGREE | | 16.0 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 14.0 | - |
| THALLIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.1 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| THORIUM-230 | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 0.2 | 0.2 |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.2 | 0.3 |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.8 | 0.3 |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.2 | 0.2 |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| THORIUM-230 | 0589 | 03/01/89 | 0001 | AL | D | PCI/L | | 0.4 | 0.2 |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.3 | 0.8 |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.6 | 0.5 |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.3 | 0.2 |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.1 | 0.4 |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.3 | 0.4 |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.3 | 0.2 |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.0 | 0.6 |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.1 | 0.3 |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.6 | 0.3 |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.0 | 0.3 |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.0 | 0.3 |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.3 | 0.2 |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.3 | 0.5 |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.0 | 0.3 |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.1 | 0.7 |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.1 | 0.3 |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.3 | 0.2 |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.0 | 0.6 |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 1.2 | 1.0 |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 1.1 | 0.5 |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.4 | 0.3 |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.5 | 0.2 |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.2 | 0.8 |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.0 | 0.3 |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.0 | 0.7 |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.0 | 0.3 |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.1 | 0.2 |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.0 | 0.5 |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.1 | 0.4 |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.2 | 0.8 |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.2 | 0.4 |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.4 | 0.4 |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.6 | 0.9 |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.0 | 0.3 |
| TIN | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.03 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TIN | 0585 | 03/01/89 | 0001 | AL | D | MG/L | < | 0.03 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.03 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.029 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.020 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.117 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.03 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.024 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.116 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.020 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.120 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.03 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.030 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.03 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.03 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.013 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.010 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.052 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.029 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.108 | - |
| TOTAL DISSOLVED SOLIDS | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 5380. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 6890. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 6820. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 844. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 6680. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 7090. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 6690. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 6780. | - |

3 hits over Std max.
2 hits are downgradient
1 hits is backgrounds
Std max =
.0465
Std min:
0.0025

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 0590 | 08/03/89 | 0001 | AL | D | MG/L | | 6180. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 5770. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 5260. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 7790. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 7100. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 7100. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 6730. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 6970. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 7740. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 7120. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 7580. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 8670. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 8050. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 7940. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 8250. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 7850. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 5390. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 7300. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 2270. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 1420. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 1050. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 4920. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 4480. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 4170. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 3790. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 4710. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 7010. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 6680. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 6720. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 6820. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 6890. | - |
| TOTAL ORGANIC CARBON | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 18. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 28. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 34. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 1. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 21. | - |

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
U - UPGRADIENT
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O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TOTAL ORGANIC CARBON | 0589 | 08/03/89 | 0001 | AL | D | MG/L | | 146. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 159. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 11. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 95. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 130. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 10. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 180. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 193. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 9.0 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 141. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 110. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 9.0 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 142. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 87. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 144.6 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 142. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 10. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 115. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 150.2 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 10. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 9.0 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 2. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 62. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 52. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 150.2 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 156. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 5. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 91. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 110. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 130.4 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 138. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 9.0 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 111. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 100. | - |
| URANIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.043 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.29 | - |

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| URANIUM | 0586 | 03/01/89 | 0001 | AL | D | MG/L | | 0.29 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.18 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.071 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.229 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.19 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.112 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.125 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.027 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.0678 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.0711 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.08 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.050 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.0003 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.129 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.083 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.095 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.0529 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.0684 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.064 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.059 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.213 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.12 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.093 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.021 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.010 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.0087 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.0427 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.0397 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.045 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.034 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.035 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.0564 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.0512 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.059 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.058 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.057 | - |
| VANADIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.01 | - |

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| VANADIUM | 0585 | 03/01/89 | 0001 | AL | D | MG/L | | 0.11 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.14 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.07 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| Stat | 0733 | 09/17/87 | 0001 | AL | D | | | 0.09 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.07 | - |
| Max | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| 0.035 | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.04 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.13 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.08 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.15 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.07 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.06 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.09 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.07 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
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D - DOWN GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ZINC | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.016 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.019 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.006 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.027 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.006 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.009 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.014 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.005 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.015 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.005 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.362 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.021 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.005 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.017 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ZINC | 0746 | 08/03/89 | 0001 | AL | U | MG/L | < | 0.005 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.005 | - |

FORMATION OF COMPLETION CODE:

FLOW RELATIONSHIP CODE:

PARAMETER VALUE INDICATOR (PVI): < = LESS THAN DETECTION LIMIT

DATA FILE NAME: J:\DART\GRJ01\GWQ10015.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 53

BY BJ CHKD. _____ JOB NO. _____

Attachment II.

Test of Proportions Analyses

FORM 91-005-1 (4/81)

Test of Proportions Procedure

54
BY
SL 8/20/90

be appropriate when the number of detected compounds is quite small relative to the number of compounds analyzed for as might occur in detection monitoring.

**PURPOSE**

The test of proportions determines whether the proportion of compounds detected in the compliance well data differs significantly from the proportion of compounds detected in the background well data. If there is a significant difference, this is statistically significant evidence of contamination.

**PROCEDURE**

- The procedure uses the normal distribution approximation to the binomial distribution. This assumes that the sample size is reasonably large. Generally, if the proportion of detected values is denoted by P, and the sample size is n, then the normal approximation is adequate, provided that nP and n(1-P) both are greater than or equal to 5.

Step 1. Determine X, the number of background well samples in which the compound was detected. Let n be the total number of background well samples analyzed. Compute the proportion of detects:

$$\hat{P}_u = x/n$$

Step 2. Determine Y, the number of compliance well samples in which the compound was detected. Let M be the total number of compliance well samples analyzed. Compute the proportion of detects:

$$\hat{P}_d = y/m$$

Step 3. Compute the standard error of the difference in proportions:

$$S_D = [[(x+y)/(n+m)][1 - (x+y)/(n+m)][1/n + 1/m]]^{1/2}$$

and form the statistic:

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

Step 4. Compare the absolute value of Z to the 97.5th percentile from the standard normal distribution, 1.96. If the absolute value of Z exceeds 1.96, this provides statistically significant evidence at the 5% significance level that the proportion of compliance well samples where the compound was detected exceeds the proportion of background well samples where the compound was detected. This would be interpreted as evidence of contamination. (The two-sided test is used to provide information about differences in either direction.)

**EXAMPLE**

Table 8-2 contains data on cadmium concentrations measured in background well and compliance wells at a facility. In the table, "BDL" is used for below detection limit.

Test of Proportions (TOP)

All Alluvial Wells

| Analytes to be tested: | Percent of Non-Detects |
|---|---|
| Antimony | 62.1 |
| Barium | 87.2 |
| Chromium | 87.2 |
| Lead | 79.3 |
| Nickel | ~~64.1~~ 71.8 |
| Nitrate | 64.1 |
| Ra-226 | 56.4 |
| Silver | 86.2 |

Antimony

Upgradient – Number of Samples (N) = 11

$\hat{P}_u$ = Proportion of Detects = (100−72.7)/100 (% of non-detects)

= 0.273

x = Number of samples w detects = 3

Downgradient – Number of Samples (M) = 14

~~Proportion~~ Percentage of non-detects = 50.0

$\hat{P}_d$ = Proportion of Detects = (100−50)/100

y = 7 (Number of hits) = 0.500

Standard error of the difference in proportions:

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m] \right\}^{1/2}$$

$$= \left\{ [(3+7)/(11+14)][1-(3+7)/(11+14)][1/11 + 1/14] \right\}^{1/2}$$

$$= \left\{ [\tfrac{10}{25}][1 - 10/25][0.0909 + 0.0714] \right\}^{1/2}$$

$$= \left\{ [0.4][0.6][0.1623] \right\}^{1/2}$$

$$= \cancel{\sqrt{1.162}} = \sqrt{.0389}$$

$$= \cancel{1.078} = .197$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D = \cancel{(0.273 - 0.5)/1.078} = -0.211$$

$$(.273 - 0.5)/.197 = \quad = 1.15$$

$$|-1.15| = 1.15 \le 1.97$$

To determine if there is statistical evidence of contamination, compare the absolute value of Z to the 97.5 th percentile from the standard normal distribution, 1.96.

Because $|-0.211| < 1.96$, contamination with antimony is not indicated statistically at the 5% significance level

Barium (TOP)

Upgradient Wells: Number of samples (N) = 15
Percent of non-detects = 86.7
$\hat{P}_u$ = Proportion of detects ~~= 0.137~~ 0.137
X = Number of detects = 2

Downgradient wells:
Number of samples (m) = 18
Percent of non-detects = 88.9
$\hat{P}_d$ = Proportion of detects = ~~[illegible]~~ 0.111
y = 2 (number of hits)

$$S_D = \left\{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\right\}^{1/2}$$

$$= \left\{[(2+2)/(15+18)][1-(2+2)/(15+18)]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{[0.1212][0.878][0.1222]\right\}^{1/2}$$

$$= 0.114$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

$$= \frac{(0.137 - 0.111)}{0.114} = 0.228$$

Since $Z < 1.96$, no evidence of contamination w. Barium

JE JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO 58

BY BD CHKD. SK 8/20/90 JOB NO. _____

Chromium (TOP)

Upgradient Wells:

$n$ = number of samples = 15

Percent of non-detects = 86.7

$\hat{P}_u$ = Proportion of detects = 0.133

$x$ = number of detects = 2

Downgradient Wells:

$m$ = 18

Percent of non-detects = 88.9

$\hat{P}_d$ = 0.111

$y$ = 2

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ \left[\frac{(2+2)}{(15+18)}\right]\left[1-\frac{2+2}{15+18}\right]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{ [0.1212][0.8788][0.1222]\right\}^{1/2}$$

$$= 0.114$$

$$Z = (\hat{P}_u - \hat{P}_d)/0.114$$

$$= (0.133 - 0.111)/0.114 = 0.193$$

Since $Z < 1.96$, no evidence of contamination w. Chromium.

FORM 91-005-1 (4/81)

Lead (TOP)

Upgradient wells:

$n$ = number of samples = 11
Percent of non-detects = 90.9
$\hat{P}_u$ = Proportion of detects = (100 − 90.9)/100 = 0.091
$x$ = number of detects = 1

Downgradient wells
$m$ = 14
Percent non-detects = 71.4
$\hat{P}_d$ = 0.286
$y$ = 4

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)][\tfrac{1}{n}+\tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(1+4)/(11+14)][1-(1+5)/(11+14)][\tfrac{1}{11}+\tfrac{1}{14}] \right\}^{1/2}$$

$$= \left\{ [0.2][0.76][0.162] \right\}^{1/2}$$

$$= 0.157$$

$$Z = (\hat{P}_u - \hat{P}_d)/0.157$$

$$= (0.091 - 0.286)/0.157 = -1.24$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with lead.

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 6c

BY BJ CHKD. SL 8/20/90 JOB NO. _____

Nickel (TOP)

Upgradient wells:

$n$ = number of samples = 15

Percent of non-detects = 86.7

$\hat{P}_u$ = proportion of detects = 0.133 $[(100-86.7)/100]$

$x$ = number of detects = 2

Downgradient wells:

$m$ = 18

% non-detects = 55.6

$\hat{P}_d$ = $(100-55.6)/100$ = 0.446

$y$ = # detects = 8

$$S_D = \left\{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\right\}^{1/2}$$

$$= \left\{[(2+8)/(15+18)][1-(2+8)/(15+18)][\tfrac{1}{15}+\tfrac{1}{18}]\right\}^{1/2}$$

$$= \left\{[0.303][0.697][0.122]\right\}^{1/2}$$

$$= 0.161$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

$$= (0.091 - 0.286)/0.161 = -1.21$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with nickel

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 61

BY BD CHKD. _____ JOB NO. _____

SK

Nitrate (TOP)

Upgradient wells:

$n = 15$

% non-detects = 66.7

$\hat{p}_u = (100 - 66.7)/100 = 0.333$

$x$ = # detects = 5

Downgradient wells:

$m = 18$

% non-detects = 61.1

$\hat{p}_d = (100 - 61.1)/100 = .389$

$y = 7$

$$S_D = \left\{ [(x+y)/(n+m)][1 - (x+y)/(n+m)][\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(5+7)/(15+18)][1 - (x+y)/(n+m))][\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [0.36][0.636][0.122] \right\}^{1/2}$$

$$= 0.167$$

$$Z = (\hat{p}_u - \hat{p}_d)/S_D$$

$$= (0.333 - 0.389)/0.167$$

$$= -0.335$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with nitrate.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO 62

BY BM CHKD. _____ JOB NO. _____

Ra-226 (TOP)

Upgradient wells:

$n = 15$

% non-detects = 46.7

$\hat{p}_u = (100 - 46.7)/100 = 0.533$

$x = 8$

Downgradient wells:

$m = 18$

% non-detects = 61.1

$\hat{p}_d = (100 - 61.1)/100 = 0.389$

$y = 7$

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ [(8+7)/(15+18)][1-(8+7)/(15+18)]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{ [0.45][0.55][0.12]\right\}^{1/2}$$

$$= 0.172$$

$$Z = (\hat{p}_u - \hat{p}_d)/S_D$$

$$= (0.533 - .389)/0.172$$

$$= 0.83$$

Since $Z < 1.96$, there is no statistical evidence of contamination w. Ra-226.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 63

BY BD CHKD. _____ JOB NO. _____

Silver (TOP)

Upgradient wells:

$n = 11$

% non-detects $= 90.9$

$\hat{p}_u = (100 - 90.9)/100 = 0.091$

$x = 1$

Downgradient wells:

$m = 14$

% non-detects $= 78.6$

$\hat{p}_d = 0.214$

$y = 3$

$$S_D = \left\{ [(x+y)/(n+m)] [1 - (x+y)/(n+m)] [\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(1+3)/(11+14)] [1 - (1+3)/(11+14)] [\tfrac{1}{11} + \tfrac{1}{14}] \right\}^{1/2}$$

$$= \left\{ [0.16] [0.84] [0.16] \right\}^{1/2}$$

$$= 0.148$$

$$Z = (0.091 - 0.214)/0.148$$

$$= -0.83$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination w. Silver.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Vanadium: (ug/l)

Upgradient Wells
Number of Samples (n) = 15
Percent of non-detects: 73.3
$\hat{P}_u$ = Proportion of detects: .267
x = Number of detects: 4

Downgradient Wells
Number of Samples (m) = 18
Percent of non-detects = 61.1
$\hat{P}_u$ = Proportion of detects = .389
y = Number of detects = 7

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m] \right\}^{1/2}$$

$$= \left\{ [(4+7)/(15+18)][1-(4+7)/(15+18)][1/15 + 1/18] \right\}^{1/2}$$

$$\left\{ (.33)(.67)(.12) \right\}^{1/2}$$

$$S_D = .162$$

$$Z = (.267 - .389)/.162$$

$$Z = -.75$$

$$|Z| = .75$$

$.75 \leq 1.96$, No evidence of Contamination w. Vanadium.

FORM 91-005-1 (4/81)

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 15 | 20.5000 | 554.0000 | 439.0000 | 411.4333 | 142.1499 | 0.3455 | 0.0 | 315.1248 | 507.7419 | NORMAL | |
| ALUMINUM | | | MG/L | | | | | | | | |
| 15 | 0.0500 | 0.3800 | 0.0500 | NA | NA | NA | 73.3 | 0.0500 | 0.3000 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 15 | 0.0500 | 61.0000 | 0.1000 | NA | NA | NA | 46.7 | 0.0500 | 1.7000 | NONPARAMETRIC | 2 |
| ANTIMONY | | | MG/L | | | | | | | | |
| 11 | 0.0015 | 0.0120 | 0.0015 | NA | NA | NA | 72.7 | 0.0015 | 0.0090 | NONPARAMETRIC | 2 |
| ARSENIC | | | MG/L | | | | | | | | |
| 15 | 0.0050 | 0.0400 | 0.0050 | NA | NA | NA | 66.7 | 0.0050 | 0.0160 | NONPARAMETRIC | 2 |
| BARIUM | | | MG/L | | | | | | | | |
| 15 | 0.0200 | 0.0500 | 0.0500 | NA | NA | NA | 86.7 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 11 | 0.0025 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0025 | 0.0050 | NONPARAMETRIC | 2 |
| BROMIDE | | | MG/L | | | | | | | | |
| 3 | 0.0500 | 0.2000 | 0.1000 | NA | NA | NA | 33.3 | NA | NA | UNKNOWN | 1 |
| CADMIUM | | | MG/L | | | | | | | | |
| 15 | 0.0005 | 0.0390 | 0.0005 | NA | NA | NA | 53.3 | 0.0005 | 0.0130 | NONPARAMETRIC | 2 |
| CALCIUM | | | MG/L | | | | | | | | |
| 15 | 93.1000 | 510.0000 | 427.0000 | 360.0733 | 141.7940 | 0.3938 | 0.0 | 264.0059 | 456.1407 | NORMAL | |
| CHLORIDE | | | MG/L | | | | | | | | |
| 15 | 149.0000 | 730.0000 | 570.0000 | 507.2667 | 212.8646 | 0.4196 | 0.0 | 363.0479 | 651.4854 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| CHROMIUM | | | MG/L | | | | | | | | |
| 15 | 0.0050 | 0.1500 | 0.0050 | NA | NA | NA | 86.7 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| COBALT | | | MG/L | | | | | | | | |
| 11 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2 |
| COPPER | | | MG/L | | | | | | | | |
| 15 | 0.0100 | 0.0200 | 0.0100 | NA | NA | NA | 80.0 | 0.0100 | 0.0200 | NONPARAMETRIC | 2 |
| CYANIDE | | | MG/L | | | | | | | | |
| 11 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| FLUORIDE | | | MG/L | | | | | | | | |
| 15 | 0.4000 | 1.6000 | 0.7600 | 0.9007 | 0.3800 | 0.4220 | 0.0 | 0.6432 | 1.1582 | NORMAL | |
| GROSS ALPHA | | | PCI/L | | | | | | | | |
| 15 | 0.0000 | 58.0000 | 19.0000 | NA | NA | NA | 13.3 | 2.0000 | 41.0000 | NONPARAMETRIC | 9 |
| GROSS BETA | | | PCI/L | | | | | | | | |
| 15 | 0.0000 | 110.0000 | 32.0000 | NA | NA | NA | 6.7 | 12.0000 | 64.0000 | NONPARAMETRIC | 9 |
| IRON | | | MG/L | | | | | | | | |
| 15 | 0.0100 | 1.5600 | 0.1200 | 0.1274 | 4.9406 | NA | 13.3 | 0.0432 | 0.3759 | LOGNORMAL | 7,8 |
| LEAD | | | MG/L | | | | | | | | |
| 11 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 90.9 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| MAGNESIUM | | | MG/L | | | | | | | | |
| 15 | 39.5000 | 525.0000 | 289.0000 | 296.1733 | 165.3434 | 0.5583 | 0.0 | 184.1509 | 408.1958 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| MANGANESE | | | MG/L | | | | | | | | |
| 15 | 0.2800 | 1.9300 | 1.3400 | 1.1680 | 0.4292 | 0.3675 | 0.0 | 0.8772 | 1.4588 | NORMAL | |
| MECHANICAL SIEVE TEST 3/8 INCH | | | % PASSING | | | | | | | | |
| 1 | 3690.0000 | 3690.0000 | 3690.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| MERCURY | | | MG/L | | | | | | | | |
| 11 | 0.0001 | 0.0001 | 0.0001 | NA | NA | NA | 100.0 | 0.0001 | 0.0001 | NONPARAMETRIC | 2 |
| MOLYBDENUM | | | MG/L | | | | | | | | |
| 11 | 0.0050 | 0.1500 | 0.0300 | NA | NA | NA | 18.2 | 0.0050 | 0.1500 | NONPARAMETRIC | 2 |
| NICKEL | | | MG/L | | | | | | | | |
| 15 | 0.0200 | 0.1200 | 0.0200 | NA | NA | NA | 86.7 | 0.0200 | 0.0200 | NONPARAMETRIC | 2 |
| NITRATE | | | MG/L | | | | | | | | |
| 15 | 0.5000 | 29.0000 | 0.5000 | NA | NA | NA | 66.7 | 0.5000 | 3.5000 | NONPARAMETRIC | 2 |
| POTASSIUM | | | MG/L | | | | | | | | |
| 15 | 4.9000 | 19.0000 | 6.5000 | 7.9753 | 3.6348 | 0.4558 | 0.0 | 5.5127 | 10.4379 | NORMAL | |
| RADIUM-226 | | | PCI/L | | | | | | | | |
| 15 | 0.0000 | 0.2000 | 0.0000 | NA | NA | NA | 46.7 | 0.0000 | 0.1000 | NONPARAMETRIC | 2 |
| RADIUM-228 | | | PCI/L | | | | | | | | |
| 15 | 0.0000 | 1.2000 | 0.4000 | NA | NA | NA | 13.3 | 0.1000 | 1.0000 | NONPARAMETRIC | 9 |
| SELENIUM | | | MG/L | | | | | | | | |
| 15 | 0.0025 | 0.1910 | 0.0300 | NA | NA | NA | 26.7 | 0.0025 | 0.0600 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| SILICA - SIO2 | | | MG/L | | | | | | | | |
| 3 | 17.0000 | 17.0000 | 17.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| SILVER | | | MG/L | | | | | | | | |
| 11 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 90.9 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| SODIUM | | | MG/L | | | | | | | | |
| 15 | 144.0000 | 910.0000 | 573.0000 | 581.4667 | 272.9403 | 0.4694 | 0.0 | 396.5458 | 766.3875 | NORMAL | |
| SPECIFIC CONDUCTANCE | | | UMHO/CM | | | | | | | | |
| 15 | 75.0000 | 5500.0000 | 2950.0000 | 2630.6667 | 1746.8123 | 0.6640 | 0.0 | 1447.1771 | 3814.1562 | NORMAL | |
| STRONTIUM | | | MG/L | | | | | | | | |
| 15 | 1.0400 | 7.1000 | 4.5000 | 4.2953 | 2.0643 | 0.4806 | 0.0 | 2.8968 | 5.6939 | NORMAL | |
| SULFATE | | | MG/L | | | | | | | | |
| 15 | 179.0000 | 3690.0000 | 2210.0000 | 2230.3333 | 1240.7943 | 0.5563 | 0.0 | 1389.6780 | 3070.9886 | NORMAL | |
| TEMPERATURE | | | C - DEGREE | | | | | | | | |
| 15 | 7.5000 | 20.5000 | 14.0000 | 14.2000 | 3.3048 | 0.2327 | 0.0 | 11.9610 | 16.4390 | NORMAL | |
| THALLIUM | | | MG/L | | | | | | | | |
| 11 | 0.0050 | 0.0500 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0500 | NONPARAMETRIC | 2 |
| THORIUM-230 | | | PCI/L | | | | | | | | |
| 15 | 0.0000 | 0.6000 | 0.2000 | NA | NA | NA | 26.7 | 0.0000 | 0.4000 | NONPARAMETRIC | 2 |
| TIN | | | MG/L | | | | | | | | |
| 11 | 0.0025 | 0.1080 | 0.0025 | NA | NA | NA | 54.5 | 0.0025 | 0.0520 | NONPARAMETRIC | 2 |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 15 | 844.0000 | 7010.0000 | 4710.0000 | 4468.9333 | 2207.1403 | 0.4939 | 0.0 | 2973.5651 | 5964.3015 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL ORGANIC CARBON | MG/L | 15 | 0.5000 | 156.0000 | 91.0000 | 75.1400 | 58.3794 | 0.7769 | 6.7 | 35.5871 | 114.6929 | NORMAL | |
| URANIUM | MG/L | 15 | 0.0015 | 0.0590 | 0.0397 | 0.0364 | 0.0192 | 0.5273 | 6.7 | 0.0234 | 0.0494 | NORMAL | |
| VANADIUM | MG/L | 15 | 0.0050 | 0.0900 | 0.0050 | NA | NA | NA | 73.3 | 0.0050 | 0.0700 | NONPARAMETRIC | 2 |
| ZINC | MG/L | 15 | 0.0025 | 0.3620 | 0.0025 | NA | NA | NA | 80.0 | 0.0025 | 0.0170 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: C:\DART\GRJ01\GWQ10015.DAT

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 18 | 411.0000 | 651.0000 | 548.5000 | 542.9444 | 76.2978 | 0.1405 | 0.0 | 496.7807 | 589.1082 | NORMAL | |
| ALUMINUM | | | MG/L | | | | | | | | |
| 18 | 0.0500 | 0.7200 | 0.0500 | NA | NA | NA | 66.7 | 0.0500 | 0.3000 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 18 | 0.0500 | 300.0000 | 1.7000 | NA | NA | NA | 38.9 | 0.0500 | 50.0000 | NONPARAMETRIC | 2 |
| ANTIMONY | | | MG/L | | | | | | | | |
| 14 | 0.0015 | 0.0170 | 0.0052 | NA | NA | NA | 50.0 | 0.0015 | 0.0160 | NONPARAMETRIC | 2 |
| ARSENIC | | | MG/L | | | | | | | | |
| 18 | 0.0050 | 0.0500 | 0.0100 | NA | NA | NA | 38.9 | 0.0050 | 0.0150 | NONPARAMETRIC | 2 |
| BARIUM | | | MG/L | | | | | | | | |
| 18 | 0.0200 | 0.0500 | 0.0500 | NA | NA | NA | 88.9 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 14 | 0.0025 | 0.0050 | 0.0037 | NA | NA | NA | 100.0 | 0.0025 | 0.0050 | NONPARAMETRIC | 2 |
| BROMIDE | | | MG/L | | | | | | | | |
| 3 | 0.1000 | 1.2000 | 1.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| CADMIUM | | | MG/L | | | | | | | | |
| 18 | 0.0005 | 0.0250 | 0.0010 | NA | NA | NA | 44.4 | 0.0005 | 0.0140 | NONPARAMETRIC | 2 |
| CALCIUM | | | MG/L | | | | | | | | |
| 18 | 370.0000 | 560.0000 | 488.5000 | 481.7778 | 58.3454 | 0.1211 | 0.0 | 446.4760 | 517.0795 | NORMAL | |
| CHLORIDE | | | MG/L | | | | | | | | |
| 18 | 700.0000 | 1200.0000 | 935.0000 | 951.7222 | 160.7789 | 0.1689 | 0.0 | 854.4433 | 1049.0011 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| CHROMIUM | | | MG/L | | | | | | | | |
| 18 | 0.0050 | 0.1400 | 0.0050 | NA | NA | NA | 88.9 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| COBALT | | | MG/L | | | | | | | | |
| 14 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2 |
| COPPER | | | MG/L | | | | | | | | |
| 18 | 0.0100 | 0.0700 | 0.0100 | NA | NA | NA | 72.2 | 0.0100 | 0.0300 | NONPARAMETRIC | 2 |
| CYANIDE | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| FLUORIDE | | | MG/L | | | | | | | | |
| 18 | 0.4000 | 3.7000 | 0.6800 | 0.7071 | 1.8820 | NA | 0.0 | 0.4823 | 1.0366 | LOGNORMAL | 7,8 |
| GROSS ALPHA | | | PCI/L | | | | | | | | |
| 18 | 0.0000 | 223.0000 | 110.0000 | NA | NA | NA | 5.6 | 49.0000 | 140.0000 | NONPARAMETRIC | 9 |
| GROSS BETA | | | PCI/L | | | | | | | | |
| 18 | 21.0000 | 176.0000 | 79.5000 | 85.1111 | 47.4191 | 0.5571 | 0.0 | 56.4203 | 113.8020 | NORMAL | |
| IRON | | | MG/L | | | | | | | | |
| 18 | 0.0150 | 16.0000 | 0.2500 | NA | NA | NA | 22.2 | 0.0150 | 5.7000 | NONPARAMETRIC | 2 |
| LEAD | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.0200 | 0.0050 | NA | NA | NA | 71.4 | 0.0050 | 0.0200 | NONPARAMETRIC | 2 |
| MAGNESIUM | | | MG/L | | | | | | | | |
| 18 | 310.0000 | 462.0000 | 386.5000 | 385.2778 | 45.5603 | 0.1183 | 0.0 | 357.7116 | 412.8439 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
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REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| MANGANESE | | | MG/L | | | | | | | | |
| 18 | 0.9400 | 4.1600 | 1.5900 | 1.9839 | 0.8992 | 0.4532 | 0.0 | 1.4398 | 2.5279 | NORMAL | |
| MERCURY | | | MG/L | | | | | | | | |
| 14 | 0.0001 | 0.0001 | 0.0001 | NA | NA | NA | 100.0 | 0.0001 | 0.0001 | NONPARAMETRIC | 2 |
| MOLYBDENUM | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.2400 | 0.0400 | 0.0625 | 0.0619 | 0.9907 | 7.1 | 0.0186 | 0.1064 | NORMAL | |
| NICKEL | | | MG/L | | | | | | | | |
| 18 | 0.0100 | 0.1200 | 0.0200 | NA | NA | NA | 55.6 | 0.0200 | 0.0500 | NONPARAMETRIC | 2 |
| NITRATE | | | MG/L | | | | | | | | |
| 18 | 0.4000 | 5.7000 | 0.5000 | NA | NA | NA | 61.1 | 0.5000 | 2.2000 | NONPARAMETRIC | 2 |
| POTASSIUM | | | MG/L | | | | | | | | |
| 18 | 8.1000 | 71.0000 | 15.9000 | 25.9233 | 22.0474 | 0.8505 | 0.0 | 12.5836 | 39.2631 | NORMAL | |
| RADIUM-226 | | | PCI/L | | | | | | | | |
| 18 | 0.0000 | 0.8000 | 0.0000 | NA | NA | NA | 61.1 | 0.0000 | 0.1000 | NONPARAMETRIC | 2 |
| RADIUM-228 | | | PCI/L | | | | | | | | |
| 18 | 0.0000 | 2.3000 | 0.6000 | NA | NA | NA | 16.7 | 0.2000 | 2.0000 | NONPARAMETRIC | 2 |
| SELENIUM | | | MG/L | | | | | | | | |
| 18 | 0.0025 | 0.1960 | 0.0255 | NA | NA | NA | 38.9 | 0.0025 | 0.1270 | NONPARAMETRIC | 2 |
| SILICA - SIO2 | | | MG/L | | | | | | | | |
| 3 | 17.0000 | 21.0000 | 20.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| SILVER | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 78.6 | 0.0050 | 0.0100 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| SODIUM | | | MG/L | | | | | | | | |
| 18 | 728.0000 | 1327.0000 | 1130.0000 | 1094.5556 | 154.4391 | 0.1411 | 0.0 | 1001.1125 | 1187.9986 | NORMAL | |
| SPECIFIC CONDUCTANCE | | | UMHO/CM | | | | | | | | |
| 18 | 1000.0000 | 7500.0000 | 3800.0000 | 3936.1111 | 2012.9847 | 0.5114 | 0.0 | 2718.1593 | 5154.0630 | NORMAL | |
| STRONTIUM | | | MG/L | | | | | | | | |
| 18 | 4.1000 | 6.9500 | 5.1500 | 5.3650 | 0.8413 | 0.1568 | 0.0 | 4.8560 | 5.8740 | NORMAL | |
| SULFATE | | | MG/L | | | | | | | | |
| 18 | 2520.0000 | 3960.0000 | 3420.0000 | 3467.2222 | 385.8650 | 0.1113 | 0.0 | 3233.7555 | 3700.6890 | NORMAL | |
| TEMPERATURE | | | C - DEGREE | | | | | | | | |
| 18 | 9.0000 | 22.5000 | 16.2500 | 15.3056 | 4.0079 | 0.2619 | 0.0 | 12.8806 | 17.7305 | NORMAL | |
| THALLIUM | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.0500 | 0.0275 | NA | NA | NA | 100.0 | 0.0050 | 0.0500 | NONPARAMETRIC | 2 |
| THORIUM-230 | | | PCI/L | | | | | | | | |
| 18 | 0.0000 | 1.2000 | 0.3000 | NA | NA | NA | 22.2 | 0.0000 | 0.6000 | NONPARAMETRIC | 2 |
| TIN | | | MG/L | | | | | | | | |
| 14 | 0.0025 | 0.1200 | 0.0265 | NA | NA | NA | 28.6 | 0.0025 | 0.1160 | NONPARAMETRIC | 2 |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 18 | 5390.0000 | 7850.0000 | 6930.0000 | 6903.8889 | 653.0214 | 0.0946 | 0.0 | 6508.7798 | 7298.9980 | NORMAL | |
| TOTAL ORGANIC CARBON | | | MG/L | | | | | | | | |
| 18 | 9.0000 | 193.0000 | 102.5000 | 91.9556 | 66.4230 | 0.7223 | 0.0 | 51.7665 | 132.1446 | NORMAL | |
| URANIUM | | | MG/L | | | | | | | | |
| 18 | 0.0015 | 0.2900 | 0.1160 | 0.1332 | 0.0819 | 0.6146 | 5.6 | 0.0837 | 0.1827 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
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| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| VANADIUM | | | MG/L | | | | | | | | |
| 18 | 0.0050 | 0.1500 | 0.0050 | NA | NA | NA | 61.1 | 0.0050 | 0.0900 | NONPARAMETRIC | 2 |
| ZINC | | | MG/L | | | | | | | | |
| 18 | 0.0025 | 0.0270 | 0.0025 | NA | NA | NA | 66.7 | 0.0025 | 0.0090 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: C:\DART\GRJ01\GWQ10016.DAT

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DATE _____ SUBJECT _____ SHEET NO 74

BY BJ CHKD. _____ JOB NO. _____

Attachment III.

ANOVA Analyses

FORM 91-005-1 (4/81)

Based on a DART statistical analysis of the pooled under quality data set, the statistical distributions for the ANOVA analyses are as follows:

| | Distribution | Recommended ANOVA |
|---|---|---|
| Arsenic | Nonparametric | Nonparametric |
| Cadmium | ↓ | ↓ |
| Gross alpha | | |
| Molybdenum | Normal | Parametric |
| Selenium | Nonparametric | Nonparametric |

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| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 38 | 20.5000 | 651.0000 | 478.0000 | 479.5132 | 119.5044 | 0.2492 | 0.0 | 432.3854 | 526.6410 | NORMAL | |
| ALUMINUM | | | MG/L | | | | | | | | |
| 38 | 0.0500 | 0.7200 | 0.0500 | NA | NA | NA | 68.4 | 0.0500 | 0.1000 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 38 | 0.0500 | 300.0000 | 0.3000 | NA | NA | NA | 44.7 | 0.0500 | 1.7000 | NONPARAMETRIC | 2 |
| ANTIMONY | | | MG/L | | | | | | | | |
| 28 | 0.0015 | 0.0170 | 0.0015 | NA | NA | NA | 60.7 | 0.0015 | 0.0120 | NONPARAMETRIC | 2 |
| ARSENIC | | | MG/L | | | | | | | | |
| 38 | 0.0050 | 0.0500 | 0.0075 | NA | NA | NA | 50.0 | 0.0050 | 0.0120 | NONPARAMETRIC | 2 |
| BARIUM | | | MG/L | | | | | | | | |
| 38 | 0.0200 | 0.0500 | 0.0500 | NA | NA | NA | 86.8 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 28 | 0.0025 | 0.0050 | 0.0037 | NA | NA | NA | 100.0 | 0.0025 | 0.0050 | NONPARAMETRIC | 2 |
| BROMIDE | | | MG/L | | | | | | | | |
| 6 | 0.0500 | 1.2000 | 0.1500 | NA | NA | NA | 16.7 | 0.0500 | 1.2000 | NONPARAMETRIC | 2,6 |
| CADMIUM | | | MG/L | | | | | | | | |
| 38 | 0.0005 | 0.0390 | 0.0008 | NA | NA | NA | 50.0 | 0.0005 | 0.0100 | NONPARAMETRIC | 2 |
| CALCIUM | | | MG/L | | | | | | | | |
| 38 | 93.1000 | 570.0000 | 464.5000 | 438.5816 | 116.5657 | 0.2658 | 0.0 | 392.6127 | 484.5505 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

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| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHLORIDE | MG/L | 38 | 149.0000 | 1300.0000 | 830.0000 | 799.7368 | 303.2459 | 0.3792 | 0.0 | 680.1487 | 919.3250 | NORMAL | |
| CHROMIUM | MG/L | 38 | 0.0050 | 0.1600 | 0.0050 | NA | NA | NA | 86.8 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| COBALT | MG/L | 28 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2 |
| COPPER | MG/L | 38 | 0.0100 | 0.0700 | 0.0100 | NA | NA | NA | 73.7 | 0.0100 | 0.0100 | NONPARAMETRIC | 2 |
| CYANIDE | MG/L | 28 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| FLUORIDE | MG/L | 38 | 0.4000 | 3.7000 | 0.7000 | 0.9289 | 0.6987 | 0.7521 | 0.0 | 0.6534 | 1.2045 | NORMAL | |
| GROSS ALPHA | PCI/L | 38 | 0.0000 | 223.0000 | 45.0000 | NA | NA | NA | 10.5 | 19.0000 | 100.0000 | NONPARAMETRIC | 9 |
| GROSS BETA | PCI/L | 38 | 0.0000 | 176.0000 | 56.0000 | NA | NA | NA | 2.6 | 36.0000 | 77.0000 | NONPARAMETRIC | 9 |
| IRON | MG/L | 38 | 0.0100 | 16.0000 | 0.1550 | NA | NA | NA | 18.4 | 0.1100 | 0.5700 | NONPARAMETRIC | 2 |
| LEAD | MG/L | 28 | 0.0050 | 0.0200 | 0.0050 | NA | NA | NA | 78.6 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

Alluvial water quality statistics for down, cross, and upgradient wells
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| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| MAGNESIUM | | | MG/L | | | | | | | | |
| 38 | 39.5000 | 565.0000 | 386.5000 | 369.0947 | 131.1267 | 0.3553 | 0.0 | 317.3836 | 420.8059 | NORMAL | |
| MANGANESE | | | MG/L | | | | | | | | |
| 38 | 0.2800 | 4.1600 | 1.4950 | 1.6611 | 0.7796 | 0.4693 | 0.0 | 1.3536 | 1.9685 | NORMAL | |
| MECHANICAL SIEVE TEST 3/8 INCH | | | % PASSING | | | | | | | | |
| 1 | 3690.0000 | 3690.0000 | 3690.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| MERCURY | | | MG/L | | | | | | | | |
| 28 | 0.0001 | 0.0001 | 0.0001 | NA | NA | NA | 100.0 | 0.0001 | 0.0001 | NONPARAMETRIC | 2 |
| MOLYBDENUM | | | MG/L | | | | | | | | |
| 28 | 0.0050 | 0.2400 | 0.0400 | 0.0609 | 0.0568 | 0.9330 | 10.7 | 0.0343 | 0.0874 | NORMAL | |
| NICKEL | | | MG/L | | | | | | | | |
| 38 | 0.0100 | 0.1300 | 0.0200 | NA | NA | NA | 71.1 | 0.0200 | 0.0200 | NONPARAMETRIC | 2 |
| NITRATE | | | MG/L | | | | | | | | |
| 38 | 0.4000 | 29.0000 | 0.5000 | NA | NA | NA | 65.8 | 0.5000 | 0.5000 | NONPARAMETRIC | 2 |
| POTASSIUM | | | MG/L | | | | | | | | |
| 38 | 4.9000 | 71.0000 | 10.1500 | 12.1114 | 2.0769 | NA | 0.0 | 9.0787 | 16.1573 | LOGNORMAL | 7,8 |
| RADIUM-226 | | | PCI/L | | | | | | | | |
| 38 | 0.0000 | 0.8000 | 0.0000 | NA | NA | NA | 57.9 | 0.0000 | 0.1000 | NONPARAMETRIC | 2 |
| RADIUM-228 | | | PCI/L | | | | | | | | |
| 38 | 0.0000 | 2.3000 | 0.7000 | NA | NA | NA | 13.2 | 0.3000 | 1.0000 | NONPARAMETRIC | 9 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

Alluvial water quality statistics for down, cross, and upgradient wells
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| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | MG/L | 38 | 0.0025 | 0.1990 | 0.0260 | NA | NA | NA | 34.2 | 0.0025 | 0.0570 | NONPARAMETRIC | 2 |
| SILICA - SIO2 | MG/L | 6 | 17.0000 | 21.0000 | 17.0000 | 18.1667 | 1.8348 | 0.1010 | 0.0 | 15.6460 | 20.6873 | NORMAL | |
| SILVER | MG/L | 28 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 85.7 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| SODIUM | MG/L | 38 | 144.0000 | 1400.0000 | 951.5000 | 906.6842 | 337.8274 | 0.3726 | 0.0 | 773.4585 | 1039.9099 | NORMAL | |
| SPECIFIC CONDUCTANCE | UMHO/CM | 38 | 75.0000 | 7500.0000 | 3650.0000 | 3660.2632 | 2072.2539 | 0.5661 | 0.0 | 2843.0485 | 4477.4778 | NORMAL | |
| STRONTIUM | MG/L | 38 | 1.0400 | 7.3000 | 5.1500 | 5.1242 | 1.6303 | 0.3182 | 0.0 | 4.4813 | 5.7672 | NORMAL | |
| SULFATE | MG/L | 38 | 179.0000 | 4130.0000 | 3420.0000 | 3045.6579 | 1060.5553 | 0.3482 | 0.0 | 2627.4170 | 3463.8988 | NORMAL | |
| TEMPERATURE | C - DEGREE | 38 | 7.5000 | 22.5000 | 15.0000 | 14.8947 | 3.4586 | 0.2322 | 0.0 | 13.5308 | 16.2587 | NORMAL | |
| THALLIUM | MG/L | 28 | 0.0050 | 0.0500 | 0.0275 | NA | NA | NA | 100.0 | 0.0050 | 0.0500 | NONPARAMETRIC | 2 |
| THORIUM-230 | PCI/L | 38 | 0.0000 | 1.2000 | 0.2000 | NA | NA | NA | 23.7 | 0.1000 | 0.3000 | NONPARAMETRIC | 2 |
| TIN | MG/L | 28 | 0.0025 | 0.1200 | 0.0165 | NA | NA | NA | 42.9 | 0.0025 | 0.0300 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

Alluvial water quality statistics for down, cross, and upgradient wells
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| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 38 | 844.0000 | 8670.0000 | 6800.0000 | 6092.4737 | 1992.1555 | 0.3270 | 0.0 | 5306.8467 | 6878.1007 | NORMAL | |
| TOTAL ORGANIC CARBON | | | MG/L | | | | | | | | |
| 38 | 0.5000 | 193.0000 | 97.5000 | 84.2868 | 62.4133 | 0.7405 | 2.6 | 59.6735 | 108.9001 | NORMAL | |
| URANIUM | | | MG/L | | | | | | | | |
| 38 | 0.0015 | 0.2900 | 0.0615 | 0.0863 | 0.0733 | 0.8488 | 5.3 | 0.0574 | 0.1152 | NORMAL | |
| VANADIUM | | | MG/L | | | | | | | | |
| 38 | 0.0050 | 0.1500 | 0.0050 | NA | NA | NA | 65.8 | 0.0050 | 0.0600 | NONPARAMETRIC | 2 |
| ZINC | | | MG/L | | | | | | | | |
| 38 | 0.0025 | 0.3620 | 0.0025 | NA | NA | NA | 73.7 | 0.0025 | 0.0025 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

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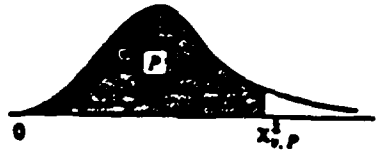
Table used to obtain "tabulated" H statistic for one-way nonparametric ANOVA analyses

S1

TABLE 1. PERCENTILES OF THE $\chi^2$ DISTRIBUTION WITH $\nu$ DEGREES OF FREEDOM, $\chi^2_{\nu,P}$




| $\nu$ \ $P$ | 0.750 | 0.900 | 0.950 | 0.975 | 0.990 | 0.995 | 0.999 |
|---|---|---|---|---|---|---|---|
| 1 | 1.323 | 2.706 | 3.841 | 5.024 | 6.635 | 7.879 | 10.83 |
| 2 | 2.773 | 4.605 | 5.991 | 7.378 | 9.210 | 10.60 | 13.82 |
| 3 | 4.108 | 6.251 | 7.815 | 9.348 | 11.34 | 12.84 | 16.27 |
| 4 | 5.385 | 7.779 | 9.488 | 11.14 | 13.28 | 14.86 | 18.47 |
| 5 | 6.626 | 9.236 | 11.07 | 12.83 | 15.09 | 16.75 | 20.52 |
| 6 | 7.841 | 10.64 | 12.59 | 14.45 | 16.81 | 18.55 | 22.46 |
| 7 | 9.037 | 12.02 | 14.07 | 16.01 | 18.48 | 20.28 | 24.32 |
| 8 | 10.22 | 13.36 | 15.51 | 17.53 | 20.09 | 21.96 | 26.12 |
| 9 | 11.39 | 14.68 | 16.92 | 19.02 | 21.67 | 23.59 | 27.88 |
| 10 | 12.55 | 15.99 | 18.31 | 20.48 | 23.21 | 25.19 | 29.59 |
| 11 | 13.70 | 17.28 | 19.68 | 21.92 | 24.72 | 26.76 | 31.26 |
| 12 | 14.85 | 18.55 | 21.03 | 23.34 | 26.22 | 28.30 | 32.91 |
| 13 | 15.98 | 19.81 | 22.36 | 24.74 | 27.69 | 29.82 | 34.53 |
| 14 | 17.12 | 21.06 | 23.68 | 26.12 | 29.14 | 31.32 | 36.12 |
| 15 | 18.25 | 22.31 | 25.00 | 27.49 | 30.58 | 32.80 | 37.70 |
| 16 | 19.37 | 23.54 | 26.30 | 28.85 | 32.00 | 34.27 | 39.25 |
| 17 | 20.49 | 24.77 | 27.59 | 30.19 | 33.41 | 35.72 | 40.79 |
| 18 | 21.60 | 25.99 | 28.87 | 31.53 | 34.81 | 37.16 | 42.31 |
| 19 | 22.72 | 27.20 | 30.14 | 32.85 | 36.19 | 38.58 | 43.82 |
| 20 | 23.83 | 28.41 | 31.41 | 34.17 | 37.57 | 40.00 | 45.32 |
| 21 | 24.93 | 29.62 | 32.67 | 35.48 | 38.93 | 41.40 | 46.80 |
| 22 | 26.04 | 30.81 | 33.92 | 36.78 | 40.29 | 42.80 | 48.27 |
| 23 | 27.14 | 32.01 | 35.17 | 38.08 | 41.64 | 44.18 | 49.73 |
| 24 | 28.24 | 33.20 | 36.42 | 39.36 | 42.98 | 45.56 | 51.18 |
| 25 | 29.34 | 34.38 | 37.65 | 40.65 | 44.31 | 46.93 | 52.62 |
| 26 | 30.43 | 35.56 | 38.89 | 41.92 | 45.64 | 48.29 | 54.05 |
| 27 | 31.53 | 36.74 | 40.11 | 43.19 | 46.96 | 49.64 | 55.48 |
| 28 | 32.62 | 37.92 | 41.34 | 44.46 | 48.28 | 50.99 | 56.89 |
| 29 | 33.71 | 39.09 | 42.56 | 45.72 | 49.59 | 52.34 | 58.30 |
| 30 | 34.80 | 40.26 | 43.77 | 46.98 | 50.89 | 53.67 | 59.70 |
| 40 | 45.62 | 51.80 | 55.76 | 59.34 | 63.69 | 66.77 | 73.40 |
| 50 | 56.33 | 63.17 | 67.50 | 71.42 | 76.15 | 79.49 | 86.66 |
| 60 | 66.98 | 74.40 | 79.08 | 83.30 | 88.38 | 91.95 | 99.61 |
| 70 | 77.58 | 85.53 | 90.53 | 95.02 | 100.4 | 104.2 | 112.3 |
| 80 | 88.13 | 96.58 | 101.9 | 106.6 | 112.3 | 116.3 | 124.8 |
| 90 | 98.65 | 107.6 | 113.1 | 118.1 | 124.1 | 128.3 | 137.2 |
| 100 | 109.1 | 118.5 | 124.3 | 129.6 | 135.8 | 140.2 | 149.4 |

SOURCE: Johnson, Norman L. and F. C. Leone. 1977. *Statistics and Experimental Design in Engineering and the Physical Sciences.* Vol. I. Second Edition. John Wiley and Sons, New York.

## TABLE 2. 95th PERCENTILES OF THE F-DISTRIBUTION WITH $\nu_1$ AND $\nu_2$ DEGREES OF FREEDOM, $F_{\nu_1,\nu_2,0.95}$

§2

Table used to obtain "tabulated" F statistic for ANOVA analyses.
(one-way parametric)

| $\nu_2$ \ $\nu_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 | 236.8 | 238.9 | 240.5 | 241.9 | 243.9 | 245.9 | 248.0 | 249.1 | 250.1 | 251.1 | 252.2 | 253.3 | 254.3 |
| 2 | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 | 19.35 | 19.37 | 19.38 | 19.40 | 19.41 | 19.43 | 19.45 | 19.45 | 19.46 | 19.47 | 19.48 | 19.49 | 19.5[illegible] |
| 3 | 10.13 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.89 | 8.85 | 8.81 | 8.79 | 8.74 | 8.70 | 8.66 | 8.64 | 8.62 | 8.59 | 8.57 | 8.55 | 8.5[illegible] |
| 4 | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.09 | 6.04 | 6.00 | 5.96 | 5.91 | 5.86 | 5.80 | 5.77 | 5.75 | 5.72 | 5.69 | 5.66 | 5.6[illegible] |
| 5 | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.88 | 4.82 | 4.77 | 4.74 | 4.68 | 4.62 | 4.56 | 4.53 | 4.50 | 4.46 | 4.43 | 4.40 | 4.3[illegible] |
| 6 | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.21 | 4.15 | 4.10 | 4.06 | 4.00 | 3.94 | 3.87 | 3.84 | 3.81 | 3.77 | 3.74 | 3.70 | 3.6[illegible] |
| 7 | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.79 | 3.73 | 3.68 | 3.64 | 3.57 | 3.51 | 3.44 | 3.41 | 3.38 | 3.34 | 3.30 | 3.27 | 3.2[illegible] |
| 8 | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.50 | 3.44 | 3.39 | 3.35 | 3.28 | 3.22 | 3.15 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 | 2.9[illegible] |
| 9 | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.29 | 3.23 | 3.18 | 3.14 | 3.07 | 3.01 | 2.94 | 2.90 | 2.86 | 2.83 | 2.79 | 2.75 | 2.7[illegible] |
| 10 | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.14 | 3.07 | 3.02 | 2.98 | 2.91 | 2.85 | 2.77 | 2.74 | 2.70 | 2.66 | 2.62 | 2.58 | 2.5[illegible] |
| 11 | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 3.01 | 2.95 | 2.90 | 2.85 | 2.79 | 2.72 | 2.65 | 2.61 | 2.57 | 2.53 | 2.49 | 2.45 | 2.4[illegible] |
| 12 | 4.75 | 3.89 | 3.49 | 3.26 | 3.11 | 3.00 | 2.91 | 2.85 | 2.80 | 2.75 | 2.69 | 2.62 | 2.54 | 2.51 | 2.47 | 2.43 | 2.38 | 2.34 | 2.3[illegible] |
| 13 | 4.67 | 3.81 | 3.41 | 3.18 | 3.03 | 2.92 | 2.83 | 2.77 | 2.71 | 2.67 | 2.60 | 2.53 | 2.46 | 2.42 | 2.38 | 2.34 | 2.30 | 2.25 | 2.2[illegible] |
| 14 | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.76 | 2.70 | 2.65 | 2.60 | 2.53 | 2.46 | 2.39 | 2.35 | 2.31 | 2.27 | 2.22 | 2.18 | 2.1[illegible] |
| 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.71 | 2.64 | 2.59 | 2.54 | 2.48 | 2.40 | 2.33 | 2.29 | 2.25 | 2.20 | 2.16 | 2.11 | 2.0[illegible] |
| 16 | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.66 | 2.59 | 2.54 | 2.49 | 2.42 | 2.35 | 2.28 | 2.24 | 2.19 | 2.15 | 2.11 | 2.06 | 2.0[illegible] |
| 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.61 | 2.55 | 2.49 | 2.45 | 2.38 | 2.31 | 2.23 | 2.19 | 2.15 | 2.10 | 2.06 | 2.01 | 1.9[illegible] |
| 18 | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.58 | 2.51 | 2.46 | 2.41 | 2.34 | 2.27 | 2.19 | 2.15 | 2.11 | 2.06 | 2.02 | 1.97 | 1.9[illegible] |
| 19 | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.54 | 2.48 | 2.42 | 2.38 | 2.31 | 2.23 | 2.16 | 2.11 | 2.07 | 2.03 | 1.98 | 1.93 | 1.8[illegible] |
| 20 | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.51 | 2.45 | 2.39 | 2.35 | 2.28 | 2.20 | 2.12 | 2.08 | 2.04 | 1.99 | 1.95 | 1.90 | 1.8[illegible] |
| 21 | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.49 | 2.42 | 2.37 | 2.32 | 2.25 | 2.18 | 2.10 | 2.05 | 2.01 | 1.96 | 1.92 | 1.87 | 1.8[illegible] |
| 22 | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.46 | 2.40 | 2.34 | 2.30 | 2.23 | 2.15 | 2.07 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.7[illegible] |
| 23 | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.44 | 2.37 | 2.32 | 2.27 | 2.20 | 2.13 | 2.05 | 2.01 | 1.96 | 1.91 | 1.86 | 1.81 | 1.7[illegible] |
| 24 | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.42 | 2.36 | 2.30 | 2.25 | 2.18 | 2.11 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.79 | 1.7[illegible] |
| 25 | 4.24 | 3.39 | 2.99 | 2.76 | 2.60 | 2.49 | 2.40 | 2.34 | 2.28 | 2.24 | 2.16 | 2.09 | 2.01 | 1.96 | 1.92 | 1.87 | 1.82 | 1.77 | 1.7[illegible] |
| 26 | 4.23 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 | 2.39 | 2.32 | 2.27 | 2.22 | 2.15 | 2.07 | 1.99 | 1.95 | 1.90 | 1.85 | 1.80 | 1.75 | 1.6[illegible] |
| 27 | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 | 2.37 | 2.31 | 2.25 | 2.20 | 2.13 | 2.06 | 1.97 | 1.93 | 1.88 | 1.84 | 1.79 | 1.73 | 1.6[illegible] |
| 28 | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.45 | 2.36 | 2.29 | 2.24 | 2.19 | 2.12 | 2.04 | 1.96 | 1.91 | 1.87 | 1.82 | 1.77 | 1.71 | 1.6[illegible] |
| 29 | 4.18 | 3.33 | 2.93 | 2.70 | 2.55 | 2.43 | 2.35 | 2.28 | 2.22 | 2.18 | 2.10 | 2.03 | 1.94 | 1.90 | 1.85 | 1.81 | 1.75 | 1.70 | 1.6[illegible] |
| 30 | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.33 | 2.27 | 2.21 | 2.16 | 2.09 | 2.01 | 1.93 | 1.89 | 1.84 | 1.79 | 1.74 | 1.68 | 1.6[illegible] |
| 40 | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.25 | 2.18 | 2.12 | 2.08 | 2.00 | 1.92 | 1.84 | 1.79 | 1.74 | 1.69 | 1.64 | 1.58 | 1.5[illegible] |
| 60 | 4.00 | 3.15 | 2.76 | 2.53 | 2.37 | 2.25 | 2.17 | 2.10 | 2.04 | 1.99 | 1.92 | 1.84 | 1.75 | 1.70 | 1.65 | 1.59 | 1.53 | 1.47 | 1.3[illegible] |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.17 | 2.09 | 2.02 | 1.96 | 1.91 | 1.83 | 1.75 | 1.66 | 1.61 | 1.55 | 1.50 | 1.43 | 1.35 | 1.2[illegible] |
| ∞ | 3.84 | 3.00 | 2.60 | 2.37 | 2.21 | 2.10 | 2.01 | 1.94 | 1.88 | 1.83 | 1.75 | 1.67 | 1.57 | 1.52 | 1.46 | 1.39 | 1.32 | 1.22 | 1.0[illegible] |

NOTE: $\nu_1$: Degrees of freedom for numerator
$\nu_2$: Degrees of freedom for denominator

SOURCE: Johnson, Norman L. and F. C. Leone. 1977. *Statistics and Experimental Design in Engineering and the Physical Sciences*. Vol. I. Second Edition. John Wiley and Sons, New York.

SHEET NO. 63 JOB NO.

SUBJECT Arsenic ANOVA's

DATE BY CHKD.

# Arsenic

| Sampling Points | ← Upgradient → | | | | | ← Downgradient → | | | | | | | ← Cross-gradient → | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B 588 | B 710 | B 744 | B 745 | B 746 | M 585 | M 586 | M 589 | M 590 | M 723 | M 736 | M 740 | M 737 | M 742 |
| Fall 1987 | M | M | M | 0.016 | 0.015 | M | M | M | M | 0.015 | M | 0.012 | 0.012 | M |
| Fall 1988 | M | M | M | 0.02 | 0.04 | M | M | M | 0.04 | 0.05 | M | M | 0.05 ↓ | M ↓ |
| Spring 1989 | 0.005 ~~<0.01~~ | 0.005 ~~<0.01~~ | 0.005 ~~<0.01~~ | 0.005 ~~<0.01~~ | 0.005 | 0.01 | 0.01 | 0.01 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| Summer 1989 | M | M | 0.005 ~~<0.01~~ | 0.005 | 0.005 | M | M | 0.005 | 0.005 | 0.01 | 0.01 | M | 0.01 | M |
| Fall 1989 | M | M | 0.005 ~~<0.01~~ | 0.005 | 0.016 | M | M | M | 0.005 | 0.013 | 0.015 | M | M | M |

M = missing data

N = number of samples = 39

P = number of wells = 14

39 - 14 = 25

Note: Sample results reported as < MDL, are assumed to be $\frac{1}{2}$ MDL.

file name: GRJAS.SX

Arsenic

# 84
# 20

AS

VARIABLE A...A. ...E ONEWAY NONPARAMETRIC AOV

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| 3588 | 10.0 | 1 |
| 3712 | 10.0 | 1 |
| 3744 | 10.0 | 3 |
| 3745 | 19.3 | 5 |
| 3746 | 23.6 | 5 |
| M585 | 22.5 | 1 |
| M586 | 22.5 | 1 |
| M589 | 16.3 | 2 |
| M590 | 16.4 | 4 |
| M733 | 25.6 | 5 |
| M736 | 20.8 | 3 |
| M740 | 15.3 | 2 |
| M737 | 24.1 | 4 |
| M742 | 10.0 | 1 |
| TOTAL | 19.5 | 38 |

KRUSKAL-WALLIS STATISTIC 9.1524
P VALUE, USING CHI-SQUARED APPROXIMATION 0.7613

PARAMETRIC AOV APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 984.0 | 75.69 | 0.61 | 0.8249 |
| WITHIN | 24 | 2.994E+03 | 124.7 | | |
| TOTAL | 37 | 3.978E+03 | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED 36
MAX DIFF ALLOWED BETWEEN TIES 1.00E-05

CASES INCLUDED 38 MISSING CASES 32

13 degrees of freedom. Table 1 @ 5% significance level to find tabulated H value = 22.36

Since the calculated value (9.15) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

SHEET NO. 7 (7)

JOB NO.

SUBJECT Cadmium ANOVAs

DATE

BY CHKD.

Cadmium

| Sampling Points | ← Upgradient → | | | | | ← Downgradient → | | | | | | | ← Cross-gradient → | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 744 | 745 | 746 | 515 | 516 | 519 | 530 | 731 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | 0.003 | 0.003 | M | M | M | M | 0.003 | M | M | .002 | M |
| Fall 1988 | M | M | M | 0.013 | 0.017 | M | M | M | 0.023 | 0.016 | M | M | .018 | M |
| Spring 1989 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | .0005 | .0005 | .0005 | 0.001 | .0005 | .0005 | .003 | .0005 | .0005 |
| Summer 1989 | M | M | 0.006 | 0.012 | 0.039 | M | M | 0.025 | 0.010 | 0.013 | 0.014 | .0005 | .029 | M |
| Fall 1989 | M | M | 0.005 | 0.002 | 0.002 | M | M | M | 0.002 | 0.001 | 0.002 | M | M | M |

File name: GRJCD.SX

Note: Sample results reported as < method detection limit, are assumed to be $= \frac{MDL}{2}$

# Cadmium

KRUSKAL-WALLIS ONE-WAY NONPARAMETRIC ANOVA

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| 3555 | 7.0 | 1 |
| 3710 | 7.0 | 1 |
| 3746 | 19.3 | 3 |
| 3765 | 21.0 | 5 |
| 3766 | 23.7 | 5 |
| M555 | 7.0 | 1 |
| M556 | 7.0 | 1 |
| M559 | 21.5 | 2 |
| M570 | 23.6 | 4 |
| M733 | 21.1 | 5 |
| M736 | 18.7 | 3 |
| M740 | 14.7 | 2 |
| M737 | 24.0 | 4 |
| M742 | 7.0 | 1 |
| TOTAL | 19.5 | 33 |

KRUSKAL-WALLIS STATISTIC 9.2974
P VALUE USING CHI-SQUARE APPROXIMATION 0.7575

PARAMETRIC ANOVA APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 1.0985E-03 | 84.49 | 0.62 | 0.8148 |
| WITHIN | 19 | 3.0748E-03 | 136.4 | | |
| TOTAL | 32 | 4.1733E-03 | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED 26
MAX DIFF ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 33 MISSING CASES 33

13 DF. At 5% significance level tabulated H value = 22.36
Since the calculated value (9.29) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

SHEET NO. 8 of 8 JOB NO. 65

DATE ____ SUBJECT Molybdenum ANOVA

BY ____ CHKD. ____

Molybdenum

| Sampling Points | Upgradient | | | | | | | Downgradient | | | | | Cross-gradient | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 744 | 745 | 746 | 515 | 516 | 519 | 530 | 723 | 736 | 740 | 737 | 742 |
| Fall 1987 | | | | | | | | | | | | | | |
| Fall 1988 | | | | | | | | | | | | | | |
| Spring 1989 | .005 | .06 | .005 | .02 | .15 | .24 | .14 | .04 | .01 | .01 | .005 | .07 | .07 | .03 |
| Summer 1989 | M | M | .01 | .03 | .14 | M | M ~~.005~~ | .06 | .04 | .05 | .09 | M | .09 | M |
| Fall 1989 | M | M | .02 | .05 | .15 | M | M | M | .04 | .04 | .04 | M | M | M |

N = # of samples = 27
P = number of wells = 14

27 − 14 = 13 ∴ sample size large enough to conduct ANOVA

file name: GRJMO.SX

Note: values < MDL are assumed to be = $\frac{MDL}{2}$

88

Molybdenum

ONE WAY AOV

| VARIABLE | MEAN | SAMPLE SIZE | GROUP VARIANCE |
|---|---|---|---|
| B588 | 5.000E-03 | 1 | M |
| B710 | 6.000E-02 | 1 | M |
| B744 | 1.167E-02 | 3 | 5.833E-05 |
| B745 | 3.333E-02 | 3 | 2.333E-04 |
| B746 | 1.467E-01 | 3 | 3.333E-05 |
| M585 | 2.400E-01 | 1 | M |
| M586 | 1.400E-01 | 1 | M |
| M589 | 5.000E-02 | 2 | 2.000E-04 |
| M590 | 3.000E-02 | 3 | 3.000E-04 |
| M733 | 3.333E-02 | 3 | 4.333E-04 |
| M736 | 4.500E-02 | 3 | 1.825E-03 |
| M740 | 7.000E-02 | 1 | M |
| M737 | 8.000E-02 | 2 | 2.000E-04 |
| M742 | 3.000E-02 | 1 | M |
| TOTAL | 6.089E-02 | 28 | |

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 8.099E-02 | 6.230E-03 | 14.14 | 0.0000 |
| WITHIN | 14 | 6.167E-03 | 4.405E-04 | | |
| TOTAL | 27 | 8.715E-02 | | | |

| | CHI SQ | DF | P |
|---|---|---|---|
| BARTLETT'S TEST OF EQUAL VARIANCES | 8.11 | 7 | 0.3230 |

COCHRAN'S Q 0.5558
LARGEST VAR / SMALLEST VAR 54.75

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.919E-03
EFFECTIVE CELL SIZE 2.0

CASES INCLUDED 28 MISSING CASES 42

The calculated F statistic (14.14) ~~is~~ ~~less than~~ exceeds the tabulated F (2.51), and the hypothesis of equal well means must be rejected. Contamination is suggested.

SHEET NO. 43 of 53

JOB NO.

JACOBS ENGINEERING

DATE

SUBJECT Selenium ANOVAs

BY

CHKD.

## Selenium

| Sampling Points | Upgradient | | | | | Downgradient | | | | | | | Cross-gradient | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 741 | 745 | 746 | 515 | 516 | 519 | 520 | 723 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | .067 | .060 | M | M | M | M | .164 | M | .127 | .159 | M |
| Fall 1988 | M | M | M | .060 | 0.191 | M | M | M | .142 | .196 | M | M | .199 | M |
| Spring 1989 | .005 | .012 | .005 | .005 | .05 | .012 | .012 | M | .005 | .005 | .005 | .005 | .005 | .005 |
| Summer 1989 | M | M | .012 | .018 | 0.057 | M | M | .028 | .026 | .025 | .026 | M | .026 | M |
| Fall 1989 | M | M | .011 | .030 | .060 | M | M | M | .036 | .039 | .038 | M | M | M |

N = 37 samples
P = 14 wells

37 - 14 = 23 ∴ sample size large enough

file name: GRTSE.SX

Note. Values < MDL are assumed to be = $\frac{MDL}{2}$

9C ~~9C~~
BD 4

# Selenium

KRUSKAL-WALLIS ONE-WAY NONPARAMETRIC AOV

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| 3588 | 5.0 | 1 |
| 3711 | 12.5 | 1 |
| 3744 | 9.2 | 3 |
| 3745 | 19.8 | 5 |
| 3746 | 28.4 | 5 |
| M585 | 12.5 | 1 |
| M586 | 12.5 | 1 |
| M589 | 22.0 | 1 |
| M592 | 18.9 | 4 |
| M733 | 23.0 | 5 |
| M736 | 15.5 | 3 |
| M740 | 19.0 | 2 |
| M737 | 23.4 | 4 |
| M742 | 5.0 | 1 |
| TOTAL | 19.0 | 37 |

KRUSKAL-WALLIS STATISTIC 12.6183
P VALUE USING CHI-SQUARED APPROXIMATION 0.4782

PARAMETRIC AOV APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 1.454E-03 | 111.9 | 0.95 | 0.5190 |
| WITHIN | 23 | 2.696E-03 | 117.0 | | |
| TOTAL | 36 | 4.150E-03 | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED 22
MAX DIFF ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 37 MISSING CASES 33

At 5% significance level, tabulated H value = 22.36.
Since the calculated value (12.6) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

1 in Non-parametric ANOVA

| Sampling Periods | ← Upgradient → | | | | | ← Downgradient → | | | | | | | ← Cross-Gradient → | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 749 | 745 | 746 | 585 | 586 | 589 | 590 | 733 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | M | M | M | M | M | M | M | M | M | M | M |
| Fall 1988 | .015 | M | M | M | M | M | M | M | M | M | M | M | M | M |
| Spring 1989 | M | .085 | .015 | .015 | .015 | .015 | .015 | .03 | .015 | .03 | .015 | .03 | .075 | .015 |
| Summer 1989 | M | M | .0025 | .01 | .027 | M | M | .029 | .02 | .024 | .02 | M | .03 | M |
| Fall 1989 | M | M | .013 | .052 | .108 | M | M | M | .117 | .116 | .12 | M | M | M |

M indicates Missing data

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22

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CHKD.

SHEET NO.

JOB NO.

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KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV Tin

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| 3333 | [illegible] | [illegible] |
| 3712 | [illegible] | [illegible] |
| 3722 | [illegible] | [illegible] |
| 3723 | [illegible] | [illegible] |
| 3726 | [illegible] | [illegible] |
| 3333 | [illegible] | [illegible] |
| 3336 | [illegible] | [illegible] |
| 3337 | [illegible] | [illegible] |
| 3372 | [illegible] | [illegible] |
| 3733 | [illegible] | [illegible] |
| 3736 | [illegible] | [illegible] |
| 3742 | [illegible] | [illegible] |
| 3737 | [illegible] | [illegible] |
| 3742 | [illegible] | [illegible] |
| TOTAL | [illegible] | [illegible] |

At 5% significance level,
tabulated H value = 22.36
Since the calculated value (12.91)
is less than tabulated value (22.4)
Accept the hypothesis of no-contamination
at the 5% level.

KRUSKAL-WALLIS STATISTIC [illegible]
P VALUE: USING CHI-SQUARED APPROXIMATION [illegible]

PARAMETRIC AOV APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | [illegible] | [illegible] | [illegible] | [illegible] |
| WITHIN | [illegible] | [illegible] | [illegible] | | |
| TOTAL | [illegible] | [illegible] | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED [illegible]
MAX DIFF. ALLOWED BETWEEN TIES [illegible]

CASES INCLUDED [illegible] MISSING CASES [illegible]

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KRUSKAL-WALLIS ONEWAY NONPARAMETRIC ANOVA

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| 3555 | 19.0 | 1 |
| 3712 | 22.0 | 1 |
| 3744 | 20.7 | 3 |
| 3745 | 15.6 | 5 |
| 3746 | 17.7 | 4 |
| 3555 | 9.0 | 1 |
| 3556 | 29.0 | 1 |
| 3559 | 22.5 | 2 |
| 3590 | 24.2 | 4 |
| 3733 | 22.6 | 5 |
| 3735 | 17.3 | 3 |
| 3740 | 9.0 | 2 |
| 3737 | 15.0 | 4 |
| 3742 | 30.0 | 1 |
| TOTAL | 19.0 | 37 |

Net Gross Alpha

One-Way Non-Parametric Anova

KRUSKAL-WALLIS STATISTIC 5.1852
P VALUE USING CHI-SQUARED APPROXIMATION 0.0228

At the 5% significance level, tabulated H value = 22.36

Since the calculated value (5.18) is less than the tabulated value (22.36) Accept the hypothesis of no contamination at the 5% level.

PARAMETRIC ADV APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 866.3 | 66.66 | 0.52 | 0.8664 |
| WITHIN | 23 | 2.9445E-03 | 128.0 | | |
| TOTAL | 36 | 3.8102E-03 | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED 17
MAXIMUM DIFF ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 37 MISSING CASES 33

Net Gross Alpha Non-Parametric ANOVA.

| Sampling Periods | ← Upgradient → | | | | | ← Downgradient → | | | | | | | Cross-Gradient | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 749 | 745 | 746 | 585 | 586 | 589 | 590 | 733 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | -.27 Ø | Ø | M | M | M | M | -.45 Ø | M | -.15 Ø | -.20 Ø | M |
| Fall 1988 | M | M | M | -.12 Ø | 7.3 Ø | M | M | M | .47 Ø | 16.9 | M | -.22 Ø | 51.9 | M |
| Spring 1989 | 1.02 | 2.5 | 4.59 | -1.57 Ø | 0 | -.17 Ø | 24 | -.84 Ø | 4.64 | 0 | -.28 Ø | M | 0 | 36.19 |
| Summer 1989 | M | M | .139 | 17.6 | 18.21 | M | M | 81.9 | 63.1 | 125.7 | 53 | M | -10.16 Ø | M |
| Fall 1989 | M | M | 8.04 | 14.0 | 16.87 | M | M | M | 44.23 | 98.9 | -7.7 Ø | M | M | M |

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BY ____ CHKD. SML 8/20/96

SHEET NO. ____ JOB NO. ____

Uranium Parametric ANOVA

| Sampling Periods | ← Upgradient → | | | | | ← Downgradient → | | | | | | | ← Cross-Gradient → | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 744 | 745 | 746 | 585 | 586 | 589 | 590 | 733 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | .04 | .056 | M | M | M | M | .07 | M | .213 | .052 | M |
| Fall 1988 | M | M | M | .04 | .05 | M | M | M | .229 | .07 | M | M | .07 | M |
| Spring 1989 | .0015 | .027 | .021 | .04 | .06 | 0.29 | .29 | .18 | .19 | .08 | .129 | .12 | .06 | .093 |
| Summer 1989 | M | M | .010 | .03 | .06 | M | M | .071 | .112 | .05 | .083 | .11 | .06 | M |
| Fall 1989 | M | M | .009 | .03 | .06 | M | M | M | .125 | .0015 | .095 | M | M | M |

File name

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SHEET NO ____ JOB NO. ____ SUBJECT ____ DATE ____ BY ____ CHKD. ____

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ONE WAY ANOVA

| VARIABLE | MEAN | SAMPLE SIZE | GROUP VARIANCE |
|---|---|---|---|
| 3333 | 1.8000E-03 | 1 | * |
| 3712 | 2.7000E-02 | 1 | * |
| 3744 | 1.3000E-02 | 3 | 4.6300E-03 |
| 3745 | 3.6000E-02 | 5 | 3.0000E-03 |
| 3746 | 5.7200E-02 | 5 | 1.9200E-03 |
| 3888 | 2.9000E-01 | 1 | * |
| 3886 | 2.9000E-01 | 1 | * |
| 3889 | 1.0500E-01 | 2 | 4.0500E-03 |
| 3892 | 1.6400E-01 | 4 | 3.0400E-03 |
| 3932 | 5.4000E-02 | 5 | 1.0200E-03 |
| 3936 | 1.0100E-01 | 3 | 6.3000E-04 |
| 3940 | 1.6650E-01 | 2 | 4.3250E-03 |
| 3937 | 6.0500E-02 | 4 | 5.4300E-03 |
| 3942 | 4.3000E-02 | 1 | * |
| TOTAL | 5.5860E-02 | 38 | |

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 1.7510E-01 | 1.3470E-02 | 12.77 | 0.0000 |
| WITHIN | 24 | 2.5310E-02 | 1.0550E-03 | | |
| TOTAL | 37 | 2.0050E-01 | | | |

| | CHI SQ | DF | P |
|---|---|---|---|
| BARTLETT'S TEST OF EQUAL VARIANCES | 34.09 | 8 | 0.0000 |

COCHRAN'S C 0.3975
LARGEST VAR / SMALLEST VAR 315.1

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 4.6795E-03
EFFECTIVE CELL SIZE 2.7

CASES INCLUDED 38 MISSING CASES 32

Uranium

Parametric ANOVA

tabulated value = 2.19

The calculated F statistic (12.77) exceeds the tabulated value (2.19) and the hypotheses of equal well means must be rejected. Contamination is suggested.

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JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ03-07-90-13-06(01)-00 DISCIPLINE Hydrology NO. OF SHEETS 77

PROJECT:

UMTRA

SITE: GRJ03: Cheney disposal site for the GRJ Tailings, Grand Junction, CO

FEATURE: Geochemical Attenuation of Contaminations by Soil: Attenuation capacities of the geologic materials beneath the proposed disposal cell

SOURCES OF DATA:

All included in the attachments

SOURCES OF FORMULAE & REFERENCES:

~~ASME~~

Standard arithmetic calculations

1. ASA/SSSA (American Society of Agronomy, Inc./Soil Science Society of America, Inc.) 1986. Methods of Soil Analysis: Physical and Mineralogical Methods Part 1, 2nd Edition, A. Klute et all., eds, Agronomy, Number 9 (Part 1), Madison Wisconsin

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | [illegible] | 9/11/90 | [illegible] | 9/90 | [illegible] | 9/90 |
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| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

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SEP 90

GEOCHEMICAL ATTENUATION OF CONTAMINA~~TIONS~~ATS BY SOIL: ATTENUATION CAPACITIES OF THE GEOLOGIC MATERIALS BENEATH THE PROPOSED DISPOSAL CELL AT THE CHENEY, GRAND JUNCTION, SITE.

CALCULATION NUMBER: GRJ03-07-90-13-06(01)-00.

## A. Purpose

The purpose of this calculation is to develop quantitatively the capacities for attenuation of the hazardous constituents in the tailings pore water by the geologic materials beneath the Grand Junction tailings disposal cell at the proposed Cheney site.

The attenuation capacities thus determined will be incorporated in the overall design data base for the tailings disposal cell, and will be used in particular to develop groundwater protection strategy at the Cheney site.

## B. Overview of Method

The attenuation capacities were determined using data from column and batch tests performed following the general procedures described in Attachment A of this calculation. Several composite samples for the Quaternary alluvium and the Mancos shale were tested. The composite samples were prepared using the available drill cuttings, and grab samples from the freshly opened pits at the Cheney site. The composite samples are described in Attachment B. Additionally, samples of a peat from a bog near grand Junction and supplied by local vendor were also tested, in the event a geochemical barrier with peat were needed for contaminant attenuation. Two types of samples containing the peat were tested: one containing 100 percent peat and the other composed of 10 percent peat mixed with one of the alluvium composite samples (sample 179-4).

The composite samples of alluvium and Mancos shale were characterized for the physical and chemical parameters that control attenuation capacities. These parameters include grain size distribution, acid neutralization potential, soil pH, cation exchange capacities, and content of various reactive minerals and chemical constituents. The physical and chemical parameters on the composite samples are provided in Attachment C.

Two test fluids were used during the tests. The groundwater from the monitor well 589 at the Grand Junction processing site spiked with known amounts of arsenic, cadmium, molybdenum, lead and selenium were used for the batch tests, and also for the initial column tests. The composition of this groundwater after spiking is shown in Attachment D-1. The test fluid used for the subsequent tests was a composite water sample prepared by mixing the water samples collected using lysimeters installed at the bottom of the

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tailings but within the unsaturated zone of the Grand Junction tailings pile. The concentrations of the hazardous constituents arsenic, beryllium, cadmium, cobalt, chromium, nickel, selenium, uranium, vanadium and zinc in this test fluid were elevated by spiking with known amounts of soluble salts of these constituents. Attachment D-2 shows the composition of this test fluid.

In order to estimate reproducibility of the column tests, triplicate columns were tested for several of the composite sample. The reproducibility data are provided in Attachment D-3.

A complete chemical analysis was conducted on each of the leachates from the batch and the column tests. For the column tests, each effluent pore volume was separately analyzed. The chemical analysis was performed using the EPA approved analytical methods by the Core Laboratories, an EPA Contract Laboratory Participant, under a subcontractors agreement to the Jacobs Engineering Group.

C. Assumptions

1. The composite samples used for the tests represent the Quaternary alluvium and the Mancos Shale beneath the disposal site at Cheney. This is a reasonable assumption given the fact that a) the composites were prepared thoroughly mixing all available drill cuttings from a large number of wells that are geographically well distributed at the site and b) in case of the composites from the experimental pits, these composites were prepared mixing several randomly collected subsamples; however, these latter composites do not reflect the special variability unlike the drill-cuttings composites.

2. The simulated test fluids represent the chemistry of the tailings pore water expected to present at the bottom of the stabilized tailings pile.

This is a reasonable assumption for both of the test fluids used because of the following reasons. The chemistry of the groundwater from the well 589 is generally similar to that of the tailings pore water. The composite test solution prepared by mixing water samples from the lysimeters installed in the tailings should closely represent the chemistry of the tailings pore water. The first test fluid (groundwater from well 589) was not spiked with all of the hazardous constituents present in the tailings. This fact however, does not affect the chemical behavior of the test fluid.

3. The flow rates used in the column tests is applicable to the flow rate of the tailings leachate through the subsurface materials at the Cheney site.

The flow rate used in the column tests were more rapid than the expected flow rate of tailings leachate in the alluvium and the Mancos Shale underlying the proposed disposal cell. This fact however, indicates that the hazardous constituents are likely to

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be attenuated more effectively than in the laboratory tests due to longer residence time of the pore fluid in the alluvium and the Mancos Shale at the Cheney site. (this is a conservative assumption)

## D. Material Properties

The physical and chemical properties of the composite samples used in the batch and column tests are presented in Attachment C.

## E. Data Sources

All data used in calculations of the attenuation capacities are presented in the text and Attachments D. Additional supporting data are presented in Attachments A, B, C and E.

## F. Calculation

Assume that the concentration of a hazardous constituent "X" in test fluid is A mg/l, and the concentration of "X" in the leachate from the batch or column test is B mg/l. The percent of "X" attenuated is calculated as follows:

$$\text{Percent "X" attenuated} = \frac{A - B}{A} \times 100.$$

For example, the concentration of As in test solution is 2.3 mg/l and that in the batch leachate of the Mancos Shale composite is 0.007 mg/l (Table 1). Percent As attenuated is calculated as follows:

$$\text{Percent } \underline{\text{As}} \text{ attenuated} = \frac{2.3 - 0.007}{2.3} \times 100 = 99.7.$$

The concentration of the hazardous constituents in the test fluid and the percent attenuation of these constituents for the batch test is given in Table 1.

Table 2 shows the concentrations of the hazardous constituents in the first effluent pore volumes for the column tests and Table 3 shows the corresponding percent attenuation data for arsenic, cadmium, molybdenum, nickel, selenium, uranium and zinc. Because of the very slow flow rate through the shale samples, column test data are vailable only for the alluvium samples.

## G. Conclusions and Recommendations

The test solution for the batch tests was spiked with only four hazardous constituents: arsenic, cadmium, selenium and molybdenum. The data show that arsenic and cadmium were almost completely attenuated by the alluvium and the Mancos Shale. Both selenium and molybdenum are partially attenuated by the Mancos Shale. The alluvium also partially attenuated selenium, but shows no

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measurable attenuation for molybdenum.

Chemical analysis of the first effluent pore volumes through the columns of the alluvium samples are shown in Table 2. The data show that all hazardous constituents that were detected in the tailings pore water (Attachment D-4) are below or close to their detection limits in the first effluent pore volumes except arsenic, cadmium, molybdenum, nickel, selenium, uranium, zinc, strontium, fluoride and nitrate; small amounts of strontium and fluoride were released by the test materials except the two samples containing peat which partially attenuated fluoride; all materials released nitrate.

The concentrations of strontium, fluoride and nitrate in the groundwater of the Mancos Shale and the Dakota Sandstone (Attachment E) at the Cheney disposal site are below or close to those in the first effluent pore volumes (Table 2). This implies that strontium, fluoride and nitrate leached naturally by meteoric water from the geologic materials above the groundwater at the Cheney disposal site do not significantly elevate their concentrations in the groundwater.

Table 3 shows that all column test materials attenuated arsenic and cadmium below their EPA MCLs; attenuated more than 85 percent of uranium, vanadium and zinc, and attenuated variable but significant amounts of molybdenum, selenium and nickel. It should be noted that the concentrations of all of these hazardous constituents in the test fluid were higher than those in the tailings pore water (Attachment D-4). If the tailings pore water concentrations were used in the column tests, it is likely that the concentrations of these constituents in the effluent solutions of the first pore volumes would be close to, or below, the EPA groundwater standards.

In summary, the batch and column test data demonstrate that the alluvium and the Mancos Shale underlying the proposed disposal site will attenuate the hazardous constituents present in the tailings pore water; and it is likely that the concentrations of the hazardous constituents in the tailings leachate would be reduced to below the EPA standards due to attenuation by the alluvium.
some constituents, but not all

Results

the results are presented in tables 1, 2 and 3. See the last paragraph above for conclusions.

References

All included in the attachments.

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# TABLES AND ATTACHMENTS

## Tables

| Table | Description |
|---|---|
| 1 | Results of the batch tests ... Test fluid composition and hazardous constituents attenuation data from batch tests. |
| 2 | Chemical analysis of the first effluent pore volumes in column tests |
| 3 | Percent hazardous constituents attenuated from the first effluent pore volumes in column tests. |

| Attachment | Description |
|---|---|
| A | Batch and column test procedures. |
| B | Description of the composite samples used in the batch and column tests. |
| C | Mineralogical and Chemical Characterization ... Physical and chemical properties of the composite samples. |
| D-1 | Composition of the spiked groundwater from well 589. |
| D-2 | Hazardous constituents detected in the pore water of the Grand Junction tailings. |
| D-3 | Compositions of the test fluids prepared by mixing water samples from the lysimeters installed in the tailings pile, and spiking with known concentrations of hazardous constituents. |
| D-4 | Reproducibility of column tests: Chemical analyses of the first effluent pore volumes of the triplicate columns of individual test materials. |
| E | Groundwater quality of the Mancos Shale and the Dakota Sandstone. |

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SEP '90

Table 1

Results of the batch tests, cheney disposal site, Grand Junction, Colorado

| | Concentration of hazardous constituents, mg/l (percent attenuated) | | | |
|---|---|---|---|---|
| | As | Cd | Mo | Se |
| Test solution | 2.30 | 0.076 | 6.20 | 8.4 |
| Test pad Alluvium (GCM-2, -3 and -4) | 0.016 (99.3) | <0.005 (93.4) | 6.20 (0) | 4.80 (42.9) |
| Homogenized Alluvium (GCM-1) | 0.024 (99.0) | 0.006 (92.1) | 6.30 (0) | 3.50 58.5) |
| Mancos Shale (GCM-5) | 0.007 (99.7) | 0.005 (93.4) | 5.25 (15.3) | 2.10 (75) |

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Table 2

Chemical analysis of the first effluent pore volume from column tests, Cheney disposal site, Grand Junction, Colorado .

| | Concentration in mg/l | | | | | |
|---|---|---|---|---|---|---|
| Sample No | 179-1 | 179-2 | 179-3 | 179-4 | 179-4+10% peat | Peat |
| Hazardous constituents | | | | | | |
| Al | < 0.50 | <0.50 | <0.50 | <0.50 | 0.533 | 0.566 |
| Sb | <0.001 | <0.004 | 0.0013 | 0.006 | <0.001 | 0.001 |
| As | 0.003 | 0.005 | 0.0057 | 0.005 | 0.006 | 0.012 |
| Ba | 0.100 | <0.10 | <0.10 | 0.10 | <0.1 | 0.10 |
| Be | <0.050 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 |
| B | 3.583 | 2.85 | 2.75 | 4.23 | 3.867 | 0.1 |
| Br | 0.420 | 0.85 | 14.33 | 5.47 | 2.077 | 0.2133 |
| Cd | 0.0006 | 0.0009 | 0.001 | 0.0008 | 0.001 | 0.0012 |
| Ca | 548.33 | 503 | 908 | 503 | 650 | 1600 |
| Cl | 1900 | 2033 | 3433 | 3067 | 1966 | 1400 |
| Cr | <0.100 | <0.1 | <0.10 | <0.10 | <0.1 | 0.1 |
| Co | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 |
| Cu | 0.20 | 0.10 | <0.10 | 0.167 | <0.133 | 0.10 |
| F | 1.6 | 1.67 | 1.733 | 2.533 | 0.467 | 0.20 |
| Fe | <0.2 | <0.2 | <0.20 | <0.20 | 0.133 | 0.433 |
| Pb | <0.001 | <0.001 | <0.001 | <0.001 | ,0.001 | 0.001 |
| Mg | 531.77 | 500 | 423 | 673 | 505 | 473 |
| Mn | 0.533 | 0.50 | 0.10 | <0.10 | 0.60 | 2.933 |
| Hg | <.0002 | <.0001 | <.0001 | <.0001 | <.0001 | 0.0001 |
| Mo | 3.033 | 2.6 | 1.10 | 1.67 | 0.633 | 0.50 |
| Ni | 1.2 | 1.167 | 1.033 | 1.33 | 1.533 | 0.90 |
| NO3 | 340.20 | 77.43 | 438.4 | 584 | 668 | 1935 |
| PO4 | 0.167 | 0.167 | 0.233 | 0.10 | 0.233 | 0.967 |
| K | 26.67 | 20.0 | 5.0 | 25.0 | 16.70 | 26.67 |
| Se | 0.567 | 0.67 | 0.20 | 1.43 | 0.70 | 0.03 |
| SiO2 | 26.16 | 22.0 | 17.83 | 26.83 | 36.0 | 55.83 |
| Ag | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 |
| Na | 3076 | 3720 | 4193 | 5682 | 3358 | 458 |
| Sr | 8.92 | 8.8 | 11.92 | 10.32 | 7.7 | 9.33 |
| SO4 | 7486 | 8150 | 7066 | 11566 | 6130 | 2879 |
| Tl | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| Sn | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.02 |
| TDS | 14528 | 15589 | 16286 | 21822 | 13220 | 8755 |
| U | 0.5633 | 0.114 | 0.0427 | 0.108 | 0.094 | 0.0057 |
| V | <0.100 | <0.10 | <0.1 | <0.10 | <0.10 | 0.10 |
| Zn | 0.233 | 0.167 | 0.20 | 0.133 | 0.267 | 0.267 |

(1) Arithmetic mean of three column-effluents for each material

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L.M. COCKS PE, PHG
SEP '90

Table 3

Percent hazardous constituents attenuated from the first pore volumes in the column tests, Cheney disposal site, Grand Junction, Colorado

| Hazardous constituents | Percent hazardous constituents attenuated | | | | | |
|---|---|---|---|---|---|---|
| Sample No | 179-1 | 179-2 | 179-3 | 179-4 | 179-4+10% peat | peat |
| As | 99.4 | 99.91 | 99.99 | 99.91 | 99.89 | 99.76 |
| Cd | 99.91 | 99.86 | 99.86 | 99.89 | 99.83 | 99.86 |
| Mo | 31.14 | 40.91 | 96.07 | 62.05 | 85.61 | 86.64 |
| Ni | 78.95 | 79.53 | 97.32 | 80.12 | 73.10 | 84.21 |
| Se | 82.82 | 79.79 | 93.94 | 56.58 | 78.79 | 99.09 |
| U | 85.38 | 97.04 | 99.96 | 97.20 | 97.56 | 99.84 |
| Zn | 96.97 | 97.83 | 97.40 | 98.27 | 96.53 | 97.40 |

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L.M. COCHS PE, PHE

SEP '90

7/27/90

7/5/90

(The Original signed copy of Attachment A is in Attachment A of Calc # GUN08-05-90-13-06(01)-00 for the Gunnison Landfill disposal site)

ATTACHMENT A

BATCH AND COLUMN TESTING PROCEDURES

L.M. COONS PE, PHD
SEP '90

Date: March 7, 1990

REVISED PROCEDURE: Section 16-1-8 Date: 09-12-88 Effective: 10-27-88

TITLE: Batch and Column Testing

## 1.0 PURPOSE

Provide a procedure to perform batch and column leach tests on uranium mill tailings, soils, sediments, or combinations and mixtures thereof.

## 2.0 SCOPE

This procedure is applicable to TAC and its contractors or subcontractors who have responsibilities and duties to perform batch or column leach experiments. Further, portions of Section 10.8.2 entitled "Packaging and Shipping Procedure for Unassayed Tailings Samples", Section 14.4.1 entitled "Soil and Rock Core Borehole and Test Pit Logging", Section 16.1.10 entitled "Field Measurements of Water Samples for Temperature, Conductivity, pH, Alkalinity, and Total Acid", and Section 16.1.13 entitled "Field Measurements of Oxidation/Reduction Potential ($E_h$) in Water Samples", are also applicable to this procedure.

## 3.0 SAFETY GUIDANCE

Safety procedures outlined in this section must be followed when applicable to sample collection, moisture content determination, batch leach experiments and column leach experiments. Exposures to hazardous chemicals and radioactive materials must be kept as low as reasonably achievable in accordance with the ALARA principle. All hazardous and radioactive materials must be properly stored and transported (Section 10.8.2).

3.1 Analysts handling hazardous and/or radioactive samples must wear appropriate attire (e.g., rubber gloves, lab coat, glasses and dust masks) to limit unnecessary exposure.

3.2 Attire, where practicable, shall be disposable and will be disposed of in a designated container.

3.3 All analysts working at the Rad Lab must have and wear a TLD badge to document radiation exposure(s).

3.4 Analysts must be properly trained in the use of radiation survey meters prior to conducting sample or contamination surveys.

3.5 All radioactive materials stored in the North Bay or Geotech areas must be signed out using the Log Books for each area.

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3.6 Analysts must exercise caution and provide controls when practicable to prevent unnecessary exposure, contamination of laboratory equipment and release of hazardous and/or radioactive materials.

3.7 All hazardous chemicals such as acids must be properly stored when not in use.

3.8 Containment must be provided when liquids containing hazardous and/or radioactive materials are being used.

3.9 Every attempt must be made to avoid production of mixed wastes by separating chemical and radioactive wastes whenever possible.

3.10 Analysts must immediately notify the Radiation Protection Officer if radioactive materials are released and notify the Laboratory Manager if hazardous chemicals are released.

3.11 Spilled or released hazardous and/or radioactive materials must be cleaned up as quickly as possible following notification procedures of 3.10.

3.12 Contaminated labware and decontamination wash solutions must be placed in separate designated disposal containers.

## 4.0 CHEMICALS AND REAGENTS

4.1 Laboratory Reagent(s)–Consult with Geochemist or Hydrologist to determine reagent grade chemicals, reagents, or other solutions required for experiment.

4.2 Synthetic Ground Water–an aqueous solution comprised of reagent grade chemicals or solutions that approximate ground water sample concentrations based on previous laboratory results. See 8.1 and 9.1.

A. ALTERNATE. Mix distilled water with tailings, soil, sediments, or other combination(s) and mixture(s) of samples. Filter and use the filtrate for the experiment. Record weight of sample and volume of distilled water used.

4.3 Lixiviants–an aqueous solution that contains a compound which will promote the dissolution or desorption of soluble constituents within the aquifer matrix. See 8.1 and 9.1.

A. Prepare lixiviant solution(s) as required by the Geochemist or Hydrologist. Record weight of lixiviant(s) added to liquid and volume of liquid used to prepare solution. Specify lixiviant(s) used. NOTE: Liquid may be distilled water, ground water, or other suitable liquid.

B. Prepare lixiviant(s) in solid form, as required by the Geochemist or Hydrologist. Weigh lixiviant(s), mix with sample or add lixiviant to column. See B.1 or B.2 below. Record weight of lixiviant(s) and sample used. Specify lixiviant(s) used. NOTE: Sample may consist of tailings, soil, sediment, or a pre-determined combination and mixture of these media. See 8.1 and 9.1.

1. Determine lixiviant(s) to be used, weigh out appropriate aliquot, and mix well with sample. Add mixture to column as directed in 9.4.

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2. Determine lixiviant(s) to be used, weigh out an appropriate aliquot, and add to column as a single unmixed layer. NOTE: Place lixiviant on top or bottom of column.

4.4 Water, deionized (ASTM Class II or better). See Reference 11.2.

4.5 Nitric Acid: $HNO_3$. Reagent Grade (~70%: ~16 M or ~16 N).

4.6 Silica sand

4.7 Radiac Wash or equivalent (Use for radioactive decontamination).

A. 30% (v/v) Radiac Wash Solution: Add ~600 mL of Radiac Wash to a 2,000 mL graduate cylinder containing ~1300 mL of deionized water and mix well. Add deionized water to the 2,000 mL mark and mix well. Pour solution into a polyethylene container labelled with "~30% (v/v) Radiac Wash Solution", "600 mL Radiac Wash/2,000 mL deionized water", date, and initials.

B. ALTERNATE. 5% (w/v) $Na_4EDTA$ Solution: Add 50 grams of Tetrasodium EDTA reagent powder to a 1000 mL volumetric flask and add ~500 mL of distilled water to dissolve the EDTA powder. Add distilled water to the 1000 mL mark on the flask and mix solution well. Pour solution into plastic container. Label container with "DeCon Solution", "~5% (W/V) $Na_4EDTA$ Solution", "50 g $Na_4EDTA$/liter of distilled water", add date, and initial. Dispose of solution into toxic or hazardous waste container after 6-8 weeks and replenish solution with a fresh batch of EDTA solution.

## 5.0 EQUIPMENT AND SUPPLIES

5.1 Portable Radiation Survey Meters:

A. Beta-Gamma

B. Alpha Scintillation

5.2 Top Loading Balance, 0.1 g

5.3 Analytical Balance, 0.10 mg.

5.4 Wrist Action Shaker: with timer and automatic/manual operation

5.5 Conductivity Meter with thermometer

5.6 pH Meter, with automatic temperature compensator (ATC) and with expandable readout.

5.7 Thermometer

5.8 Refrigerator set at 4° C.

5.9 Drying Oven: 0-200° C. Range

5.10 Pump, peristaltic: with variable speed, with 3/16" I.d. tubing.

5.11 Pyrex or polyethylene beakers: 50, 100, 150, 250, 400 mL

5.12 Pyrex or polyethylene Erlenmeyer flasks: 125, 250, 500, 1000 mL

5.13 Pyrex or polythylene graduate cylinders: 50, 100, 250, and 500 mL

5.14 Pyrex filter flask, heavy duty: 2000 mL

5.15 Pyrex or polyethylene filter apparatus: 50 , 300, 500 mL

5.16 Filters:

A. Membrane filter; 0.45 u , 2" diameter

B. Glass fiber filter (for column(s); 75 mm diameter, Micron Separations, inc.

C. Polyethylene filter disc (for column(s); ~4" diameter and with 15-25 holes in the disc.

D. Mini-Capsule filter (No. 12123) or equivalent: 0.45 um, Gelman Sciences

5.17 Stoppers:

A. Rubber; Nos. 7, 8, 9, and 10

B. Bakelite or equivalent (for columns); machined, 4" diameter with 3/16" o.d. x ~3" length glass or polyethylene tube located in center of stopper. Two (2) each for each column.

5.18 Column(s), polycarbonate. Purchase from local supplier and cut into appropriate lengths.

A. ~12" x ~4" i.d.

B. ~48" x ~4" i.d.

5.19 Tygon tubing or equivalent:

A. 3/16" i.d. x 1/16" wall

B. 1/2" i.d. x 1/8" wall

5.20 Plastic Pans: ~12" width x ~14" length x ~8" height

5.21 Aluminum pans (to hold sample): disposable

5.22 Laboratory Log Book

6.0 PROCEDURE: Sample Collection

- Safety guidance provided in 3.0 must be followed, as applicable, for this procedure.

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- If the samples are contaminated, portions of Section 10.8.2, are applicable to this procedure. If the samples are uncontaminated, portions of Section 14.4.1 are applicable to this procedure. Sample collectors must be familiar with and use appropriate portions of Section 10.8.2 and Section 14.4.1.

6.1 Collect tailings, soil, or sediment samples with clean utensils and store in sample containers. Mix sample well.

6.2 Determine radioactivity of sample and record value in uR/hr on sample data sheet and on sample container. NOTE: Use calibrated portable radiation survey meter(s).

6.3 Prepare logs of test pits and core holes according to Section 14.1.4 of the Albuquerque Operations Manual.

6.4 The methods for cleaning labware used to collect the sample(s) will be dependent upon the components of interest, (e.g., samples collected for organic analyses should not come in contact with plastic, etc).

7.0 PROCEDURE: Moisture Content Determination or Preparation of a Dried Sample

- Safety guidance provided in 3.0 must be followed, as applicable, for this procedure.
- Use ASTM Method 2216, see Reference 11.1.

7.1 Weigh 100 g aliquot of sample into a sample container labelled with sample identification number. Record net weight as "wet weight". Sample consists of tailings, soil, sediments or any combination and mixture thereof.

A. ALTERNATE. If sample is to be analyzed as a wet sample, omit all of 7.0 and proceed directly with 8.2 or 9.2.

7.2 Place sample container into a drying oven, set temperature controller to 100° C., close oven door, and turn oven on. Check temperature reading on the thermometer periodically.

A. Oven should be located in an exhaust hood or should be vented out of the building with appropriate exhaust tubing.

7.3 Dry sample for 4-12 hours. Upon completion of drying time, shut off oven, and allow sample to cool to room temperature. NOTE: Length of drying time depends on type of sample and amount of moisture in the sample.

7.4 Weigh sample and record net weight as "Dry Weight". Record the following information in the laboratory log book: A) date and time of determination, B) sample number, location, and description, C) mass of sample before drying ("Wet Weight"), D) drying time and temperature, and E) mass of dry sample ("Dry Weight").

7.5 Calculate and report percent moisture as follows:

% = (Wet Weight - Dry Weight) ÷ Wet Weight x 100%.

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7.6 Pulverize dried sample by placing sample into 3 or 4 heavy duty plastic bags and crush sample into fine dust by beating bag with a rubber mallet. Mix sample by shaking and tumbling bag. NOTE: If necessary, use additional bags if bag(s) are punctured.

A. ALTERNATE. Use a mortar and pestle to pulverize the sample.

7.7 Sample now ready for analysis.

## 8.0 PROCEDURE: Batch Leach Experiments

- Safety guidance provided in 3.0 must be followed, as applicable, for this procedure.
- Perform Batch Leach Experiments according to the JEG-modified version of ASTM Method 4319-83. See Reference 11.2.

8.1 Consult with Geochemist or Hydrologist to determine method of batch preparation and use of solution.

A. Should sample(s) be analyzed in wet or dry form? Should solid lixiviant(s) be mixed with the sample?

B. What kind of lixiviant(s) will be used? Will lixiviants require mixing before use? What is the composition of the lixiviant(s)? Mixtures? What will "groundwater" consist of (i.e. distilled water, synthetic groundwater, site specific groundwater, or other solution)?

C. What volume in mL will constitute a "Pore Volume?" After what pore volume(s) should samples be collected?

8.2 Weigh 200 g of a wet sample into a 1000 mL Erlenmeyer flask labelled with sample number. Weigh sample to the nearest 0.01 g and record weight as wet weight. NOTE: Sample is tailings, soil, sediment, or a combination and mixture thereof.

A. ALTERNATE. Weigh out 75 $\pm$ 5 g of a dried and pulverized sample into a 500 mL Erlenmeyer flask. Weigh sample to the nearest 0.01 and record weight as dry weight.

8.3 Add ~800 mL of distilled water to the flask and mix solution. Record volume in log book. Stopper flask. NOTE: Use, if required, synthetic ground water (see 3.2), site specific ground water, or lixiviant solution (see 3.3) as a leach medium. Add liquid volume equal to ~four (4) times the amount of solid sample.

A. ALTERNATE. Add ~300 mL of distilled water to the flask of 8.2A. Stopper flask. Record volume in log book. See NOTE of 8.3.

8.4 Mount flasks on Wrist Action Shaker and tighten clamps so that flasks do not move. Place a plastic pan beneath flasks so that leaks or spills may be caught in the pans. CAUTION: Neck of flask or clamp may break due to excess pressure.

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8.5 Turn on shaker and shake samples for 60 minutes. During shaking period, check flasks periodically to make sure they are secure and to see if liquid and samples are mixing well. If necessary, stop shaker and tighten clamps. After shaker stops, allow samples to set for 2-4 hours.

8.6 Repeat 8.5 once more. Allow samples to set overnight. Check stoppers and flasks for leakage.

8.7 Repeat 8.5 and 8.6 each day for two (2) more days. NOTE: Samples must be shaken twice a day for three (3) days.

8.8 Without agitating sample solution, loosen clamps and carefully remove flasks from the shaker, loosen stoppers, and place samples on lab bench.

8.9 Filter sample solution into a clean 1000 mL erlenmeyer flask labelled with sample number and gently mix solution. Observe and record physical description of the filtrate (e.g., clear, cloudy, color, etc.). NOTE: Record date and time of sample collection, sample number, and description.

A. NOTE: Assemble filter apparatus as follows: Place ~ 5-6 feet of clean 3/16" i.d. tygon tubing into peristaltic pump and hand tighten screws. To outlet end of filter apparatus, add Mini-Capsule filter (see 5.15D) and tighten hose clamp. Rinse unit with ~1000 mL of distilled water. Unit now ready for sample and filtration. NOTE: Adjust pump rate to desired speed.

8.10 Divide filtrate into appropriate aliquots for field or laboratory analysis.

A. Pour a 200 mL aliquot into a pre-cleaned 16 oz. sample bottle. Acidify aliquot to pH 2.0 with 2-3 mL of $HNO_3$ and mix well. Label bottle with sample identification, "M", "$HNO_3$ added", date, initials and comments (if any). Refrigerate sample at 4° C. Ship samples to the laboratory for metals determination.

B. Pour a 200 mL aliquot into a pre-cleaned 16 oz. sample bottle. Label bottle with sample identification, "A-1", "No preservative added", date, initials, and comments (if any). Refrigerate sample at 4° C. Ship samples to the laboratory for anion determinations.

C. Pour a 100 mL aliquot into a pre-cleaned 16 oz. sample bottle. Label bottle with sample identification, "Parameters", "No preservative added", date, initials, and comments (if any). Refrigerate sample at 4° C.

8.11 Perform chemical measurements at the time of collection according to sample analysis requirements (e.g., pH, $E_h$, Conductivity, excess lixiviant, and alkalinity). Use aliquot from 8.10C above. Use paragraphs 7.0, 8.0, and 9.0 of Section 16.1.10 for these measurements.

A. Calibrate pH Meter. Record standard(s) used as well as date and time of calibration. Measure sample pHs and record data.

B. Calibrate Redox Potential ($E_h$) Meter. Record standard used as well as date and time of calibration. Measure sample $E_{hs}$ and record data. NOTE: Use Section 16.1.13 for these measurements.

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C. Calibrate Conductance Meter. Record date and time of calibration as well as standard(s) used. Measure sample conductance and record data.

D. If sample volume permits, determine alkalinity of sample. Record data on sample analysis sheet.

8.12 Dispose of sample by adding ~50 mL of distilled water to flask and swirling sample mixture until sample is suspended. Quickly pour sample solution into a radwaste container. Rinse flask with ~50 mL of distilled water and repeat swirling. Pour solution into a radwaste container labelled with "Radioactive Waste", Site name, and date. Add contaminated labware and sample waste solution(s). Store in Radwaste storage area.

8.13 Clean uncontaminated labware (e.g., beakers, flasks, etc.) by soaking labware overnight in ~30% (v/v) Radiac Wash and by washing them with a laboratory detergent. Rinse labware a minimum of three (3) times with hot water followed by a minimum of three (3) rinses of deionized water (see 3.1) and allow labware to air dry.

A. Soak uncontaminated labware overnight in a 30% (v/v) Radiac Wash Solution. Save solution for 6-8 weeks. Dispose of solution into designated radwaste containers and fill the soak container with fresh solution of diluted Radiac Wash. NOTE: As an alternate, use ~5% (w/v) $Na_4EDTA$ Solution.

9.0 PROCEDURE: Column Leach Experiment

o Safety guidance provided in 3.0 must be followed, as applicable, for this procedure.

9.1 Consult with Geochemist or Hydrologist to determine method of column preparation and collection of eluates.

A. Should sample(s) be analyzed in wet or dry form? Should solid lixiviant(s) be mixed with the sample and added to the column or added to the column as a single layer? Should vacuum be used during part or all of column procedure? Should groundwater or lixiviant be added to the top or bottom of the column? Should sample be eluted from the top or bottom of the column?

B. What kind of lixiviant(s) will be used? Will lixiviants require mixing before use? What is the composition of the lixiviant(s)? Mixtures?

C. What volume in mL will constitute a "Pore Volume?" After what pore volume(s) should samples be collected? What liquid, if required, will be contained in the reservoir (e.g., distilled water, synthetic groundwater, site specific groundwater, lixiviant solution, etc.)

9.2 Determine radioactivity of the sample in uR/hr. Record value on sample data sheet and on sample container. NOTE: Compare radioactivity values of that on the sample container to the sample to be processed. If necessary, consult with Geochemist/Hydrologist to determine laboratory precautions to be exercised when processing the sample.

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9.3 Assemble column for experiment.

A. Take a clean column (~12" x 4" i.d.) and insert a machined stopper. NOTE: Apply a small amount of inert lubricant on the side of the stopper and push stopper into column. Use same procedure for longer column (i.e., ~48" x ~4" i.d.).

B. Place column onto column rack and tighten clamp.

C. Place a plastic pan directly underneath the column so that any leaks or spills from the column may be collected.

D. Through the open end of the column, add a filter disc (~4" dia.).

E. Add a glass fiber filter (75mm dia.). Place the filter so that it is adjacent to and lies flat on the filter disc. NOTE: Use a rod or other suitable instrument to properly insert and place the filter.

F. Add ~100 g of silica sand onto filter and level layer of sand.

G. Column now ready for sample (i.e., tailings, soil, sediment, or pre-determined combination and mixture).

9.4 Weigh out a predetermined amount of sample and add sample to the column. Record weight of sample. Pack column. This is one "lift".

A. In the event that solid lixiviants are to be added, prepare sample according to 3.3 B.

9.5 Continue 9.4 until ten (10) lifts or ~10" of sample have been added to and packed in the column. NOTE: The density should result in a transmissivity factor equal to $10^{-3}$ to $10^{-5}$ cm/sec. The upper two inches of the column will serve as a fluid reservoir.

9.6 Complete filling of the column by adding ~100 g of silica sand onto the topmost layer of the sample.

9.7 Place a 4" diameter glass fiber filter on top of the silica sand layer and a filter disc on top of the filter.

9.8 Place a Bakelite stopper into the top of the column and push stopper into the column. NOTE: Lubricate the sides of the stopper with petroleum or silicone jelly.

9.9 Connect one end of the column to a 2000 mL filter flask with 9/16 i.d. tygon tubing and the other end of the column to a reservoir with 3/16" i.d. tygon tubing. Adjust reservoir height to ~60 inches from top of column. This is sometimes called "head". NOTE: Reservoir will contain a solution specified by the Geochemist or Hydrologist. See 9.1.

9.10 Open reservoir and allow liquid to flow into column. Allow the column to fill with liquid and the solids to become saturated with the liquid. When column has been saturated with liquid and liquid begins collecting in the collection flask, adjust column exit flow rate to one pore volume per day OR to flow rate specified by Geochemist or Hydrologist. Adjust the head to ensure a minimum flow rate of one

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pore volume per five days. NOTE: A pore volume is the amount of liquid required to saturate the sample in the column.

9.11 Collect sample(s) for analysis directly from the column effluent stream and after elution of the following pore volumes: 2, 5, 10, and immediately before termination of the experiment. NOTE: Determine and record effluent characteristics [e.g., date and time of sample collection, sample number and description, physical description (i.e., clear, cloudy, brown, yellow, etc.), excess lixiviant, or any other parameters that may be specific to the type of experiment].

9.12 Divide sample into appropriate aliquots for field or laboratory analysis.

A. Pour a 100 mL aliquot into a pre-cleaned 16 oz. sample bottle. Acidify aliquot to pH 2.0 with 1-2 mL of $HNO_3$ and mix well. Label bottle with sample identification, "M", "$HNO_3$ added", date, initials and comments (if any). Refrigerate sample at 4° C.

B. Pour a 100 mL aliquot into a pre-cleaned 16 oz. sample bottle. Label bottle with sample identification, "A-1", "No preservative added", date, initials, and comments (if any). Refrigerate sample at 4° C.

C. Pour a 100 mL aliquot into a pre-cleaned 16 oz. sample bottle. Label bottle with sample identification, "Parameters", "No preservative added", date, initials, and comments (if any). Refrigerate sample at 4° C.

9.13 Perform chemical measurements at the time of collection according to sample analysis requirements (e.g., pH, $E_h$, Conductivity, excess lixiviant, and alkalinity). Use aliquot from 9.12C above. Use paragraphs 7.0, 8.0, and 9.0 of Section 16.1.10 for these measurements.

A. Calibrate pH Meter. Record standard(s) used as well as date and time of calibration. Measure sample pHs and record data.

B. Calibrate Redox Potential ($E_h$) Meter. Record standard used as well as date and time of calibration. Measure sample $E_{hs}$ and record data. NOTE: Use Section 16.1.13 for these measurements.

C. Calibrate Conductance Meter. Record date and time of calibration as well as standard(s) used. Measure sample conductance and record data.

D. If sample volume permits, determine alkalinity of sample. Record data on sample analysis sheet.

9.14 Conclude the experiment at the end of 20 days or upon addition and elution of a specified number of pore volumes.

9.15 Disassemble column apparatus and dispose of sample into a radwaste container labelled with "Radioactive Waste", Site name, and date. Add sample waste solution(s) and contaminated labware.

9.16 Clean uncontaminated labware (e.g., beakers, flasks, etc.) by soaking labware overnight in ~30% (v/v) Radiac Wash and by washing them with a laboratory detergent. Rinse labware a minimum of three (3) times with hot water followed by a

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minimum of three (3) rinses of deionized water (see 3.1) and allow labware to air dry.

A. Soak uncontaminated labware overnight in a 30% (v/v) Radiac Wash Solution. Save solution for 6-8 weeks. Dispose of solution into designated radwaste containers and fill the soak container with fresh solution of diluted Radiac Wash. NOTE: As an alternate, use ~5% (w/v) $Na_4EDTA$ Solution.

## 10.0 ATTACHMENTS

## 11.0 REFERENCES


11.1 ASTM, 1984. "Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures", Method D2216. Soil and Rock, Building Stones; Volume 04.08. ASTM, 1916 Race St., Philadelphia, PA.

11.2 ASTM, 1984. "Distribution Ratios by the Short-Term Batch Method", Method 4319. Soil and Rock, Building Stones; Volume 04.08. ASTM, 1916 Race St., Philadelphia, PA.


## 12.0 PROCEDURE REVIEW AND APPROVAL

Prepared By: _____
TAC Representative — Date

Reviewed By: _____
Task Manager — Date

Reviewed By: _____
Quality Assurance Manager — Date

Approved By: _____
Project Manager/
Deputy Project Manager — Date

ATTACHMENT B

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# ATTACHMENT B

**Description of the composite samples used in the batch and column tests.**

| Sample No | Sample Type |
|---|---|
| GCM-1 | Drill cuttings composite of the alluvium: well 835 cuttings were used |
| GCM-2 | Test pad composite for the alluvium; the composite was prepared by mixing several subsamples of the alluvium collected from the test pad 2 used for the infiltrometer tests |
| GCM-3 | Same as GCM-2 but from a different location within the test pad 2 |
| GCM-4 | Same as GCM-3 above but from another location within the test Pad 2. |
| GCM-5 | Mancos Shale composite prepared by using several subsamples form the test pad 1 used for the infiltrometer test. |
| 179-1 | Alluvium composite without the clayey gravel (GC) and the low plastic clay (CL) fractions prepared using drill cuttings from several drill holes at the Cheney disposal site. |
| 179-2 | The 179-1 composite mixed with 10 percent Mancos Shale. |
| 179-3 | Top Soil composite prepared using the available cuttings from the drill holes at the Cheney disposal site. |
| 179-4 | Alluvium composite prepared using the available grill cuttings and screened to finer than one inch. |

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**ATTACHMENT C**

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PREPARED FOR:

JACOBS ENGINEERING GROUP, INC.
ALBUQUERQUE OPERATIONS

# MINERALOGICAL AND CHEMICAL CHARACTERIZATION OF SEDIMENT SAMPLES FROM COLORADO

FOR SAMPLES GCM-1, GCM-2, GCM-3, GCM-4 AND GCM-5

(See Attachment B for sample description)

By

Wolfgang Baum

August 21, 1989

Project 9 M 12

9/12/90

SEP 30

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## BACKGROUND AND OBJECTIVE

Jacobs Engineering Group, Inc. requested a chemical and mineralogical characterization of five sediment samples from Colorado. ~~The samples originated from a lake bed and a weathered shale outcrop.~~

The objective of the study was as follows:

- Bulk Mineralogy

  Includes a preliminary stereomicroscopic examination with a description of the overall mineralogical features and bulk x-ray diffraction analysis. Special attention will be given to any minerals other than clays or zeolites which could exhibit sorptive capacity (e.g. hydrous Fe/Mn oxides, jarosites, Al-hydroxides).

- Detailed Clay Mineralogy

  Includes the identification of clay and clay-like minerals by x-ray diffraction analysis on the clay fraction in various sample mounts (random, oriented, glycolated, heat-treated mounts). SEM analysis may be used to assist in microchemical characterization.

- Size Analysis for Sand, Silt and Clay Fractions

  Size analysis for sand, silt and clay fractions will be made followed by x-ray diffraction analysis of the size fractions.

- Cation Exchange Capacity
- Acid Neutralization
- Acid-Soluble Fe and Mn
- Gypsum Content
- Pyrite Content
- Total Carbon and Organic Carbon

The laboratory work was performed under Jacobs Engineering Purchase Order No. Subcontract 34-6705-S-89-0052.

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## SAMPLES RECEIVED AND METHODS OF STUDY

Five sediment samples were received at the PMET laboratories on August 3, 1989. The samples were subjected to routine chain of custody procedures (PMET letter of August 7, 1989). The sample designations are given in Table 1 below.

**Table 1**

**Sample Designations**

| PMET No. | Customer I.D. | Weight(g) |
|---|---|---|
| 108-1 | GCM-1 : Alluvium Composite | 807.11 |
| 108-2 | GCM-2 : Test Pad Alluvium | 809.60 |
| 108-3 | GCM-3 : " " " | 809.60 |
| 108-4 | GCM-4 : " " " | 288.98 |
| 108-5 | GCM-5 : Test Pad | 804.15 |

See Attachment B for additional description

The laboratory work included sample preparation, chemical analyses, optical microscopy, x-ray diffraction analyses, and micro-screen analyses.

The as-received samples were weighed and thoroughly blended. Thereafter, adequate portions were split out for the laboratory work. The methodology of the chemical and mineralogical analyses as well as the quality control procedures were according to our report of July 10, 1989.

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## Chemical Characterization

The samples are characterized by a low cation exchange capacity which ranges from 15.1 to 17.4 meq/100 g and reflects a clay mineralogy which is dominated by micas, illite and kaolinite with minor amounts of swelling clays. Due to elevated carbonate contents, the samples exhibit a high neutralization potential. The sulfide content is very low whereas sulfate concentrations are elevated. However, substantial amounts of the sulfates are due to iron sulfates.

The results of the chemical characterization are presented in Table 2.

Table 2

Chemical Characterization of Sediment Samples

| Element | Sample Designations GCM-1 | GCM-2 | GCM-3 | GCM-4 | GCM-5 |
|---|---|---|---|---|---|
| Total C,% | 1.80 | 1.02 | 1.38 | 0.91 | 3.18 |
| Organic C,% | 0.35 | 0.41 | 0.06 | 0.03 | 0.64 |
| Total S,% | 0.64 | 0.37 | 0.25 | 0.37 | 0.08 |
| Sulfide S,% | 0.04 | <0.01 | <0.01 | <0.01 | <0.01 |
| Sulfate S,% | 1.73 | 1.07 | 0.87 | 1.01 | 0.13 |
| Acid Sol. Fe,% | 2.82 | 2.26 | 2.26 | 2.81 | 1.77 |
| Acid Sol. Mn,% | 0.055 | 0.062 | 0.086 | 0.051 | 0.03 |
| Cat.Ex.Cap., (meq/100 g) | 17.2 | 17.4 | 15.1 | 16.2 | 15.6 |
| Exchangeable Ca, (meq/100 g) | 98.3 | 79.6 | 80.3 | 58.6 | 71.1 |
| Exchangeable Mg, (meq/100 g) | 5.13 | 4.48 | 5.57 | 7.09 | 4.80 |
| Exchangeable Na, (meq/100 g) | 4.54 | 4.76 | 4.58 | 2.79 | 4.53 |
| Exchangeable K, (meq/100 g) | 0.82 | 0.75 | 0.88 | 1.39 | 0.71 |
| Neutr. Potent. (t $CaCO_3$/ 1000 t soil) | 170 | 107 | 155 | 94.3 | 271 |
| Potential Acidity (t $H^+$/1000 t soil) | 0.13 | 0.06 | 0.16 | 0.10 | 0.22 |

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## Mineralogical Characterization

The (alluvial?) sediment samples (GCM-1 to GCM-4) consist of gray-brown, sandy, calcareous material which contains significant amounts of heavily altered volcanic rocks. The alteration has resulted in the formation of various clay minerals and considerable amounts of (hydrous) iron oxidation products. Except for sample GCM-2, all samples including the shale are characterized by substantial amounts of carbonates.

Sample GCM-5 consists of a slick, laminated heavily altered gray-green clay shale containing noticeable amounts of disseminated mica.

The UV-light examination did not indicate the presence of fluorescent minerals. Minor to trace amounts of magnetite and ferromagnetic rock fragments (mostly of volcanic origin) were found in Samples GCM-1 to GCM-4. A microchemical staining test with 4-hydroxyaniline indicates the presence of minor amounts of swelling clay in all samples. A Geiger counter scan showed a very weak response level in samples GCM-1 and GCM-2.

Mineralogically all samples contain major amounts of quartz and clay minerals with variable concentrations of calcite and feldspar (albite). Very low concentrations (<1% volume) of ultrafine sulfides (pyrite) were found in samples GCM-1, -2 and -3. Most of the disseminated and matrix sulfides have been oxidized into hematite and magnetite both of which locally act as a cementing matrix to brecciated/agglomerated gangue.

The sediment samples also contain noticeable amounts of zeolites (primarily analcite and minor wairakite). Zeolites are common authigenic silicates in (saline) lake sediments. It is tentatively concluded that the wairakite (hydrated Ca-Al-silicate) may have formed through zeolite alteration.

Following are the petrographic sample descriptions.

### Sample GCM-1

Brown-gray, calcareous sediment with high calcite content. The calcite is in part well crystallized. The sample contains considerable amounts of altered volcanic rock fragments which consist of dark gray to red porphyritic fine grained rocks. The fine particle fraction contains considerable amounts of micaceous clay minerals with minor amount of swelling clay, iron oxidation products and carbonaceous matter as grain coatings. Approximately less than 1% volume of ultrafine (<10 micron) disseminated pyrite. The clay minerals contain large amounts of pigment-like hematite. Some brecciated and/or agglomerated particles which are cemented by hydrous iron oxides, hematite and magnetite. A minor amount of the iron

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oxides contain unoxidized residual sulfides. Noticeable levels of spinels in the heavy mineral fraction.

Sample GCM-2

Gray, sandy gravel with moderately rounded rock fragments which include tuffs, pyroclastic breccias, sandstones, lava flows, chert and quartz particles as well as ferruginous carbonate concretions (caliche-like). The finer particle fractions contain minor amounts of bleached mica and chlorite-bearing volcanic rock fragments. Most of the rock particles contained in the sample are heavily altered - some beyond the possibility of conclusive identification. Contains small aggregates of swelling clay. Major source of clay minerals appears to be heavily altered fragments of volcanic rocks and/or their pyroclastics.

Sample GCM-3

Gray-brown, calcareous gravel fraction with angular to subrounded, heavily altered rock fragments. This sample is petrographically similar to sample GCM-2. Many of the limonitic particles exhibit coatings of manganese dentrites. Alteration of rock fragments appears to be more intense than in sample GCM-2. Considerable amounts of clay agglomerations and clay coatings on larger rock particles. Approximately 30% of brecciated/agglomerated rock material which is cemented by iron oxides.

Sample GCM-4

Light brown, calcareous, fine grained sandy sediment with high carbonate (calcite) content. Distinctly more quartz. Sample contains traces of cinnabar. The rock fragments consist of heavily altered volcanic rocks and clay-sand agglomerations. Most of the quartz fragments are angular. Minor amounts of hornblende and traces of carbonaceous matter and bleached mica. Many of the rock fragments exhibit clay coatings which are 30 to 100 microns in thickness.

Sample GCM-5

Gray-green, heavily altered shale containing fine disseminations of less than 20 micron mica flakes. The sample shows some lamination and disintegration. Minor to trace amounts of swelling clay minerals and a very high carbonate content. Small amounts of jarosite.

The petrographic and mineralogical characteristics are summarized and quantified in Tables 3A and 3B.

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## Table 3

## Overall Petrographic and Mineralogical Characteristics of Sediment/Shale Samples

### A. Petrographic Characteristics*

| Component | GCM-1 | GCM-2 | GCM-3 | GCM-4 | GCM-5 |
|---|---|---|---|---|---|
| | | (in % volume) | | | |
| Rock fragments | 35-45 | >50 | >50 | 30 | <10 |
| Clay | 8-15 | 10-20 | 20-25 | 8-15 | >>50 |
| Iron Oxidation | 15-20 | 20 | 10-20 | 20-25 | <10 |
| Carbonates | 10-15 | <10 | 10-20 | 20-30 | 20-30 |

### B. Mineralogical Characteristics** BULK MINERALOGY (other than clay minerals)

| Mineral | | | | | |
|---|---|---|---|---|---|
| Quartz | Major | Major | Major | Major | Major |
| Calcite | Moderate | Minor | Moderate | Moderate | Major |
| Dolomite | Minor | Minor | Minor | Minor | Minor |
| Zeolites | Minor | Moderate | Minor | Min-Mod. | - |
| Muscovite | Min-Tr. | Trace | Trace | Minor | Min-Mod. |
| Albite | Moderate | Major | Min-Mod. | Minor | Trace |

---

Major = 30->50%
Moderate = 10-30%
Minor = 5-10%
Trace = <5%

* Based on stereomicroscope examination

** Based on bulk x-ray diffraction analysis
Further details would require petrographic thin section study and subsequent modal analyses.

### Clay Mineralogy

Prior to the x-ray diffraction analyses of the clay fraction, the total amounts of sand, silt and clay were determined by wet screen analyses of large (50-100 g) blended and split sample portions. (Reference 1). The results are summarized in Table 4.

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## Table 4

### Total Amounts of Sand, Silt and Clay Fractions

| Sample | Sand (+63 micron) | Silt (-63+5 micron) | Clay (-5 micron) |
|---|---|---|---|
| GCM-1 | 57 % wt. | 21 % wt. | 22 % wt. |
| GCM-2 | 90 " | 4 " | 6 " |
| GCM-3 | 86 " | 7 " | 7 " |
| GCM-4 | 70 " | 14 " | 16 " |
| GCM-5 | 2 " | 23 " | 75 " |

When evaluating the total clay content as established in Table 4 by physical classification, the following features should be considered. In soil/sediment samples containing larger feldspathic rock fragments and which are partially or completely altered to clay or clay-like minerals, the actual total clay content may be slightly higher than obtained by sizing. This is due to the fact that many of the gravel and sand-sized rock fragments contain alteration-related, encapsulated clay which will not report to the clay fraction in a sedimentation or screen analysis. Furthermore, the occurrence of iron oxide-cemented coarse clay aggregates will also retain some of the clay in the sand or silt fractions.

For any clay analysis of sediments or soil samples containing rock fragments which have been exposed to clay-producing alteration (i.e. argillic, sericitic, propylitic, alunitic), a petrographic thin section study concurrent with the sedimentation screen analysis is recommended.

Based upon the x-ray analysis of the size fractions and microscopic work, the following semi-quantitative clay distribution has been established.

| | Contained Clay (% distribution) | | |
|---|---|---|---|
| Sample | Sand Fraction | Silt Fraction | Clay Fraction |
| GCM-1 | <5 | 15-20 | 75 |
| GCM-2 | 20-25 | 20 | 60 |
| GCM-3 | 15 | 20 | 65-70 |
| GCM-4 | 10-15 | 15 | 60-70 |
| GCM-5 | <5 | 10 | 85-90 |

The determination of clay minerals was facilitated through x-ray diffraction analysis of various sample mounts (random, oriented, glycolated, heat-treated) prepared from -2 micron clay fractions.

This work showed that the samples investigated contain a complex clay mineralogy which is dominated by micas, illite and kaolinite. Swelling clays (montmorillonite, interstratified

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kaolinite-smectite, smectite-illite) occur mostly in minor amounts. The clay minerals in samples GCM-1 and GCM-4 exhibit poor crystallinity and/or submicron particle sizes. The major clay minerals in the weathered shale sample GCM-5, i.e. kaolinite and dioctahedral illite, show a good degree of crystallization.

Samples GCM-2, -3 and -4 contain minor but distinct amounts of zeolites (analcite). The presence of the analcite-related zeolite (alteration?) mineral wairakite in samples GCM-1 to GCM-4 was already described earlier in this report. In addition, minor to trace amounts of a interstratified chlorite-mica were found in Sample GCM-2.

A summary of the clay mineralogy and a semi-quantitative assessment of the clays is shown in Table 5.

Table 5

Semi-Quantitative Clay Mineralogy of Sediment Samples
(-2 micron fraction)

| Clay Minerals | Samples | | | | |
|---|---|---|---|---|---|
| | GCM-1 | GCM-2 | GCM-3 | GCM-4 | GCM-5 |
| Montmorillonite | Minor | Moder. | Minor | - | Minor |
| Muscovite (Sericite) | Major | Major | Moder. | Trace | Trace |
| Kaolinite-Smectite* | Moder. | Trace | Trace | - | - |
| Kaolinite | Moder. | Major | Major | Major | Major |
| Dioctahedral Illite | - | - | - | Major | Major |
| Smectite-Illite* | - | - | - | Major | - |
| Analcite | - | Trace | Minor | Trace | - |

* interstratified

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## CONCLUSIONS

- The sediment samples (GCM-1 to GCM-4) analyzed during this chemical-mineralogical characterization contain clay fractions representing 5 to 20% of the sample. However, clay-type alteration is also prevalent in the silt and sand fractions due to argillic/sericitic alteration of feldspathic (volcanic) rock fragments. The overall clay content may therefore be slightly higher than indicated by the size classification alone. The weathered shale sample exhibits a clay content of 75%.

- All samples are characterized by a complex clay mineralogy which consists primarily of micas, illite and kaolinite with minor amounts of swelling clays (montmorillonite, interstratified kaolinite-smectite, smectite-illite). In addition, there are noticeable amounts of zeolites (analcite and wairakite).

- The cation exchange measurements are in agreement with the clay mineralogy which showed that kaolinite, muscovite and illite are the dominating clay phases. These minerals exhibit low cation exchange capacities of less than 20 meq/100 g. The analyzed cation exchange capacity of the five samples ranged from 15.1 to 17.4 meq/100 g.

- A typical feature of the samples is a significant carbonate content which consists of calcite and dolomite.

- The presence of minor to trace amounts of zeolites may increase the selective sorption potential for solubilized heavy metals.

- In addition to clay minerals and zeolites, minor adsorptive effects can be expected from hydrous iron oxidation products which occur in pigment-like disseminations and as particle coatings throughout the sample material.

WB/mkf

L.M. COOKE

SEP '90

PREPARED FOR:

JACOBS ENGINEERING GROUP INC.

ALBUQUERQUE OPERATIONS

# CHEMICAL AND MINERALOGICAL CHARACTERIZATION OF 17 SOIL SAMPLES FROM THE CHENEY RESERVOIR SITE

FOR SAMPLES 179-1, 179-2, 179-3 AND 179-4

(See Attachment B for sample description)

By

Wolfgang Baum

January 16, 1990

Project 9 M 12

9/17/90

LM. COONS PE...
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## BACKGROUND AND OBJECTIVE

Jacobs Engineering Group Inc. requested a chemical and mineralogical characterization of seventeen soil samples from the Cheney Reservoir site near Grand Junction, Colorado.

The objective of the work was as follows:

- Bulk Mineralogy

  Includes a preliminary stereomicroscopic examination with a description of the overall petrographic and mineralogical features and a bulk x-ray analysis. Special attention will be given to any minerals other than clays or zeolites which could exhibit sorptive capacity (e.g., hydrous Fe/Mn oxides, jarosites, Al-hydroxides).

- Detailed Clay Mineralogy

  Includes the identification of clay and clay-like minerals by x-ray diffraction analysis on the clay fraction in various sample mounts (random, oriented, glycolated, heat-treated). SEM analysis may be used to assist in microchemical characterization.

- Size Analysis for Sand, Silt and Clay Fractions

  Size analysis for sand, silt and clay fractions will be made followed by mineralogical analysis of the size fractions.

- Total Clay Content
- Cation Exchange Capacity
- Acid Neutralization
- HCl-Soluble Fe
- HCl-Soluble Mn
- Gypsum Content
- Pyrite Content
- Calcium Carbonate Content
- Total Carbon
- Organic Carbon
- Soil pH & Eh
- Determine the Overall Mineralogy of an Unknown Rock Sample

The laboratory work was performed under Jacobs Engineering subcontract purchase order 34-6705-S-90-0014.

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## SAMPLES RECEIVED AND METHODS OF STUDY

Seventeen samples were received at the PMET laboratories on December 13, 1989. The samples were subjected to routine chain of custody procedures (PMET letter of December 18, 1989). The sample designations are given in Table 1 below.

Table 1

Sample Designations

| PMET No. | Jacobs Designation | | Weight(g) |
|---|---|---|---|
| 179-1 | GRJ-03 | 5-Mancos Contact w/o CL&GC Comp. | 1111.0 |
| -2 | " | " " " " | |
| | | + 10% Mancos Shale | 1091.25 |
| -3 | " | 1-5' Composite Top Soil | 952.66 |
| -4 | " | Screened Alluvium MK | 1047.46 |
| -5 | GRJ-03 | 818 | 170.0 |
| -6 | " | 821 | 140.0 |
| -7 | " | 825 | 199.0 |
| -8 | " | 833 1-5' | 193.0 |
| -9 | " | 901 1-5' | 142.0 |
| -10 | " | 933 1-5' | 190.0 |
| -11 | " | 938 1-5' | 244.0 |
| -12 | " | 941 1-5' | 179.0 |
| -13 | " | 953 | 232.0 |
| -14 | " | 958 | 166.0 |
| -15 | " | 959 1-5' | 190.0 |
| -16 | " | 964 1-5' | 183.0 |
| -17 | " | Flint/Chalcedony | 65.8 |

For samples 179-1 to 179-4, a complete chemical characterization was requested. Samples 179-5 to 179-16 were submitted for measurement of soil pH, Eh and carbonate content. One sample, 179-17, was submitted for bulk x-ray diffraction analysis only.

The laboratory work included sample preparation, chemical analyses, optical microscopy with modal analyses, microchemical staining, screen analyses, x-ray diffraction analyses, and SEM microscopy.

The samples as received were examined microscopically prior to any separation work. Thereafter, each sample was thoroughly blended and adequate portions were split out for the laboratory work. In addition to the standard microscopic carbonate analyses of samples 179-5 to 179-16, bulk x-ray diffraction

analyses were also performed on each of these samples. This work was done free of charge. The carbonate and gypsum contents of samples 179-1 to 179-16 were cross-examined by selective microchemical staining tests (Alizarin Red S and Clayton Yellow respectively) followed by microscopic quantification of the stained particles. The pH of the drill core samples was determined on -10 mesh material using ASTM method 9045 for measuring soil pH. The Eh was measured according to ASTM procedure D 1498-76 (electrometric measurement of oxidation-reduction potential). For solution extraction, a saturated soil paste was prepared. The methodology of the chemical and mineralogical analyses as well as the quality control procedures were according to our report submitted to JE on July 10, 1989.

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## DISCUSSION OF RESULTS

### Chemical Characterization

Samples 179-1 to 179-4 are characterized by increased carbonate carbon contents ranging from 1.2 to 1.86%. Virtually all of the sulfur occurs as sulfate sulfur. The potential acidity is very low. Significant amounts of HCl-soluble iron (3.6 to 5.4%) were found in all samples. The cation exchange capacity in the four samples is low, ranging from 11.7 to 17.8 meq/100 g. However, all samples exhibit a high neutralization potential ranging from 110 to 183 tons $CaCO_3$/1000 tons of soil due to the presence of vast amounts of carbonates. The pH measurements indicate weakly alkaline soil pH.

The results of the chemical characterization are presented in the following Table 2.

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Table 2

Chemical Analysis of Sediment Samples
From Cheney Reservoir

| Element | 179-1 | 179-2 | 179-3 | 179-4 | 179-5 | 179-6 | 179-7 | 179-8 | 179-9 | 179-10 | 179-11 | 179-12 | 179-13 | 179-14 | 179-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample Designations | | | | | | | | | | | | | | |
| Total C, % | 1.44 | 1.61 | 2.07 | 1.51 | 1.35 | 3.64 | 2.47 | 4.31 | 1.48 | 1.49 | 1.27 | 2.28 | 1.86 | 2.53 | 2.04 |
| Carbonate C, % | 1.23 | 1.38 | 1.86 | 1.42 | 1.01 | 3.33 | 2.22 | 3.97 | 1.11 | 1.18 | 1.11 | 2.05 | 1.67 | 2.26 | 1.82 |
| Organic C, % | 0.21 | 0.23 | 0.21 | 0.09 | 0.34 | 0.31 | 0.25 | 0.34 | 0.37 | 0.31 | 0.16 | 0.23 | 0.19 | 0.27 | 0.22 |
| Total S, % | 0.70 | 0.75 | 0.78 | 0.77 | | | | | | | | | | | |
| Sulfide S, % | <0.02 | <0.02 | <0.02 | <0.02 | | | | | | | | | | | |
| Sulfate S, % | 0.70 | 0.75 | 0.78 | 0.77 | | | | | | | | | | | |
| HCl-Sol Fe, % | 5.4 | 5.0 | 3.6 | 3.6 | | | | | | | | | | | |
| HCl-Sol Mn, % | 0.091 | 0.083 | 0.057 | 0.062 | | | | | | | | | | | |
| Eh, mV* | 108 | 100 | 102 | 110 | 85 | 108 | 112 | 88 | 118 | 115 | 70 | 80 | 87 | 90 | 85 |
| pH | 7.85 | 7.97 | 8.05 | 8.12 | 7.79 | 8.18 | 8.28 | 8.49 | 7.81 | 7.99 | 8.17 | 8.25 | 8.14 | 8.11 | 8.34 |
| Cation Exch. Capacity** | 11.7 | 13.2 | 17.8 | 15.6 | | | | | | | | | | | |
| Exchangeable Ca** | 62.4 | 73.6 | 137 | 69.4 | | | | | | | | | | | |
| Exchangeable Mg** | 2.82 | 3.78 | 5.64 | 4.51 | | | | | | | | | | | |
| Exchangeable Na** | 0.563 | 2.28 | 2.77 | 3.56 | | | | | | | | | | | |
| Exchangeable K** | 0.297 | 0.377 | 0.373 | 0.345 | | | | | | | | | | | |
| Exchangeable Na Percentage | 4.83 | 17.3 | 15.6 | 22.8 | | | | | | | | | | | |
| Neutralis. Potential (Tons $CaCO_3$/1000 Tons Soil) | 176 | 110 | 183 | 110 | | | | | | | | | | | |
| Potential Acidity (Tons $H^+$/1000 Tons Soil) | 0.03 | 0.02 | <0.01 | 0.02 | | | | | | | | | | | |

*Relative to Hydrogen, American Sign Convention
**In meq/100g

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## Mineralogical Characterization

All four samples represent similar petrographic characteristics and can be classified as lithic, calcareous-clayey, sandy soils. The samples contain substantial amounts of rock fragments most of which appear to be of basic igneous or volcanic origin. The rock fragments also contain substantial amounts of ultrafine hematite with minor magnetite. Some of the lithic components are complex and would require thin section study for further characterization.

The samples contain large amounts of carbonates most of which consist of fine-grained calcite which is often intimately admixed with clay or iron oxidation products. Sample 179-4 contains distinctly more ferruginous carbonates. Microchemical staining tests did not give any evidence for the presence of dolomite. This conclusion was also confirmed through subsequent x-ray analysis.

Considerable amounts of the carbonates constitute a cementing matrix for silica sand particles. Some of the carbonates have originated from the alteration of feldspathic and/or ferromagnesian rock-forming minerals. Certain amounts of the carbonates occur as calcareous nodules and layers known to be typical products of caliche (calcrete) formation. During megascopic examination and effervescence testing, the carbonate content of the samples appears to be extremely high which is primarily due to the presence of fine carbonate coatings on coarser, noncarbonate particles.

Another characteristic feature of the samples is the presence of moderate amounts of gypsum which occur primarily as rosette-like aggregates. Minor amounts of acicular-fibrous gypsum were also found.

The soil sample material exhibits poor consolidation. Minor to trace amounts of zeolites are associated with the dark (volcanic?) rock fragments primarily in form of vesicular occurrences.

A summary of the overall petrographic characteristics is given in Table 3 and additional details of the mineralogical features are described in the following petrographic sample characteristics.

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Table 3

Overall Petrographic Characteristics
of Soil Samples from the Cheney Reservoir Site

| Petrographic Feature | Sample Designations | | | |
|---|---|---|---|---|
| | 179-1 | 179-2 | 179-3 | 179-4 |
| Color | Gray-green | Gray-black | Red-brown | Brown-gray |
| Geiger Counter Response | - | - | - | - |
| Effervescence Carbonate Test | High | High | High | High |
| Short-wave UV Response | Gypsum Calcite | Gypsum Calcite | Gypsum Calcite | Gypsum Calcite |
| Presence of Ferromagnetics | 1-3% | 1-3% | 1-3% | 3-4% |
| Rock Fragments | 30% | 30-35% | 25-30% | 30-35% |
| Carbonate Content* | 10-15% | 10-15% | 15-18% | 15% |
| Gypsum Content* | 5-10% | 5-10% | 3-5% | 10-15% |
| Classification | Lithic Calcareous-Clayey Sand | Lithic Calcareous-Clayey Sand with High Shale Content | Lithic Ferruginous Calcareous-Clayey Sand | Lithic Ferrugin. Calcar.-Clayey Sand |

All data in volume %.
* Estimate based on selective staining.

Sample 179-1

Black to light brown sample material with considerable amounts of rock fragments. The sample is characterized by a high calcite content and consists primarily of a micaceous sand with relict feldspar. The rock fragments consist of ferruginous porphyritic fine-grained volcanic (or igneous) rocks, limonite aggregates, basic igneous or volcanic rocks, chert, calcareous

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sandstone and rhyolite. Significant amounts of the rock fragments exhibit attachments/coatings of clay minerals. Relatively coarse-grained gypsum occurs as light brown, rosette-like aggregates.

Sample 179-2

Black to light brown lithology characterized by large amounts of basic volcanic (or igneous) rock fragments, calcite and significant amounts of shale fragments (15%). Due to the higher amounts of clay introduced by the shale, this sample exhibits considerably more particle agglomerations. The suite of rock fragments is virtually identical with the lithic material found in Sample 179-2. Zeolite minerals appear to occur in the vesicular volcanic rocks. Most of the limonite particles are coated with manganese dentrites. Noticeable amounts of heavily oxidized clayey to feldspathic rock fragments with hematite dispersion. Minor amounts of rosette-like, coarse-grained gypsum particles. Some of the heavily altered, carbonate-bearing material may represent volcanic ash.

Sample 179-3

Light brown, clayey sand with greenish dark gray rock fragments some of which are several centimeters in diameter. Considerable amounts of gypsum. The rock fragments consist primarily of heavily altered porphyritic volcanic (or igneous) rocks which contained significant amounts of biotite and/or hornblende. The sample contains swelling clays most of which appear to be iron-bearing. Presence of zeolites is indicated in association with vesicular volcanic rocks. The sand fraction contains large amounts of roots and wood particles. Minor amounts of volcanic glass (obsidian-like material). The clay content in the coarser size fractions is primarily related to argillized rock fragments. Minor amounts of limonite nodules with admixed clay and carbonates. Moderate amounts of chalcedony. The silt size particle fraction is high in mica minerals (=mostly muscovite).

Sample 179-4

Light brown, sulfate and carbonate-rich silica sand with large amounts of heavily altered rock fragments. Most of the rock particles appear to be from basic to intermediate volcanics and/or igneous rocks which have been exposed to argillization of feldspars and iron oxidation and bleaching of the ferromagnesian minerals. The sample contains noticeable

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amounts of rosette-like and acicular gypsum as well as sandstone fragments with calcite cement.

The bulk x-ray diffraction analyses of the as-received material confirmed that quartz and calcite are major sample constituents followed by moderate amounts of feldspar (anorthite), gypsum, and titanite. In addition, minor amounts the Ca-carbonate-silicate tilleyite and traces of portlandite (Ca-hydroxide) were detected. Tilleyite is almost exclusively of metamorphic origin where it forms in calc-silicate rocks or in contact marbles.

## Additional Samples

In addition to the four main characterization samples, eleven soil samples were submitted for determination of pH, Eh, and carbonate content only. One sample, 179-17, was submitted for x-ray diffraction analysis. The eleven samples exhibit overall mineralogical-petrographic characteristics which are similar to sample 179-1 to 179-4.

## X-Ray Diffraction Analysis of Sample 179-17

This sample was received as a two-inch specimen described as flint or chalcedony. The megascopic examination showed that the sample consisted of a gray to light gray, moderately hard, slightly porous material which exhibited precipitation texture and contained embedded (fossil?) wood fragments (branches). The XRD analysis showed that this sample contains large amounts of portlandite (Ca-hydroxide). Table 4 summarizes the mineral phases identified in this sample.

Table 4

Mineralogy of Sample 179-17

| Mineral | Frequency |
|---|---|
| Portlandite | Major |
| Calcite | Minor |
| Wermlandite (Ca-Mg-Al-Fe-carbonate hydrate) | Minor |
| Ca-Silicate (hydrated) | Minor |

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The mineralogical modal analysis of the soil samples are summarized in Table 5.

Table 5

Mineralogical Modal Analyses of Cheney Reservoir Samples

| Sample | Vol.% Sulfide* | Vol.% Total Clay** | Vol.% Carbonate | Vol.% Gypsum |
|---|---|---|---|---|
| 179-1 | 2 | 26 | 17 | 12 |
| -2 | 1 | 30 | 13 | 10 |
| -3 | <1 | 40 | 10 | 5 |
| -4 | <1 | 29 | 19 | 15 |
| -5 | n.a. | n.a. | 9 | n.a. |
| -6 | " | " | 19 | " |
| -7 | " | " | 17 | " |
| -8 | " | " | 16 | " |
| -9 | " | " | 10 | " |
| -10 | " | " | 11 | " |
| -11 | " | " | 17 | " |
| -12 | " | " | 20 | " |
| -13 | " | " | 12 | " |
| -14 | " | " | 11 | " |
| -15 | " | " | 18 | " |
| -16 | " | " | 11 | " |

Based on point count and cross-count analyses of dry bulk samples, oil immersion grain mounts and polished sections.

* Primarily pyrite

** Includes all clay and clay-like minerals contained in all size fractions

n.a. = not analyzed

## Clay Mineralogy

(Reference 1)

Prior to the x-ray diffraction analyses of the -2 micron clay fraction, the total amounts of sand, silt and clay were determined by wet screening of a 50-gram blended sample split. All size fractions were thoroughly examined by optical and x-ray methods for major and minor mineral constituents. The results of the screen analyses are summarized in Table 6.

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Table 6

Total Amounts of Sand, Silt and Clay Fractions

| Sample | Sand Fraction (+63 micron) Wt. % | Silt Fraction (-63+5 micron) Wt. % | Clay Fraction (-5 micron) Wt. % |
|---|---|---|---|
| 179-1 | 66.09 | 11.84 | 22.07 |
| -2 | 66.96 | 11.62 | 21.27 |
| -3 | 44.75 | 12.34 | 42.91 |
| -4 | 63.72 | 13.29 | 22.99 |

The subsequent optical microscope analyses showed the following mineralogical characteristics of the sand, silt and clay fractions.

## Sand Fractions

Contains primarily rock fragments and silica sand particles with minor amounts of sulfates and mixed argillic/iron oxide/hydroxide particles. Minor clay concentrations occur in this fraction due to partially altered feldspathic rock fragments and/or clay minerals being aggregated with other sand fraction constituents. The sand fractions of samples 179-1 and 179-2 consist basically of rock fragments (>60%) whereas sample 179-3 is dominated by silica sand with only 5-10% rock fragments. Sample 179-4 is characterized by increased amounts of iron alteration products admixed with silica sand particles and 10-20% rock fragments.

## Silt Fractions

The silt fractions consist predominantly of quartz particles with considerable amounts (25-45%) of mica (muscovite), carbonates and minor sulfates. The clay content of the silt fractions is low ranging from 1 to 5%.

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## Clay Fractions

The -5 micron clay fractions are characterized by major amounts of clay minerals (25 to 59 vol. %) admixed with substantial concentrations of clay-sized quartz and minor to trace amounts of calcite and gypsum. The determination of the clay minerals was facilitated through x-ray diffraction analyses of various sample mounts (random, oriented, glycolated, heat-treated) prepared from -2 micron clay fractions.

This work showed that the Cheney Reservoir samples are characterized by the dominance of montmorillonite, mica (muscovite) and kaolinite. A summary of the clay mineralogy and a semi-quantitative assessment is given in Table 7.

Table 7

Semi-Quantitative Clay Mineralogy of Cheney Reservoir Samples (-2 micron fraction)

| Sample | Major | Frequency<br>Major-Moderate | Minor-Trace |
|---|---|---|---|
| 179-1 | Montmorillonite | Muscovite*<br>Kaolinite | Dioct. Illite<br>Smectite-mica |
| 179-2 | Montmorillonite** | Kaolinite<br>Muscovite | Dioct. Illite<br>Smectite-mica |
| 179-3 | - | Montmorillonite<br>Kaolinite***<br>Dioct. Illite | Muscovite |
| 179-4 | Montmorillonite | Muscovite<br>Kaolinite | |

* Mixed layering of the mica is indicated by a series of reflections on the low-angle side of the 10 Å spacing.

** When compared to sample 179-1, sample 179-2 has a slightly higher (5%) montmorillonite and muscovite content.

*** Both the montmorillonite as well as the kaolinite show distinctly less crystallinity than in the other samples.

L.M. CO...
SEP '90



## CONCLUSIONS

- The four soil samples received from the Cheney Reservoir site represent calcareous-clayey and sandy soils with a high amount of rock fragments and gypsum. The additional eleven soil samples exhibit a similar mineralogical composition. The hand specimen sample (179-17) consists primarily of portlandite with minor amounts of calcite and hydrated calcium silicates. The portlandite formation may be due to the decomposition of calcium silicates.

- The clay mineralogy of the four soil samples is characterized by the dominance of montmorillonite, muscovite and kaolinite. Minor amounts of dioctahedral illite and smectite-mica were also observed.

- The samples are characterized by a very low potential acidity, low cation exchange capacities ranging from 11 to 17 meq/100 g, weakly alkaline pH and high neutralization potentials ranging from 110 to 183 tons $CaCO_3$/1000 tons of soil. The determination of the quantitative significance of zeolites introduced by certain vesicular volcanic rocks would require additional laboratory work.

WB/mkf

9/24/90

L.M. COOKS PE, PHR
SEP '90

ATTACHMENT D

9/12/90

D-1 Composition of the spiked groundwater from well 589 PH3

L.M. COCKS P.E., PH3
SEP '89

:e Code: GRJ03
:ation ID: 528 : Dopped Feed Solution
mple ID: 01
mple Date Time: 08/07/89

Lab No. : 89-W1/04855
Date Received: 08/08/89

Parameters

| | | |
|---|---|---|
| Chloride | 1100. | mg/l |
| Sulfate | 3589. | mg/l |
| Sodium, dissolved | 990 | mg/l |
| Potassium, dissolved | 54. | mg/l |
| Magnesium, dissolved | 305 | mg/l |
| Calcium, dissolved | 500 | mg/l |
| Boron, dissolved | .55 | mg/l |
| Fluoride | .3 | mg/l |
| Nitrogen, ammonia | 132. | mg/l |
| Nitrate as NO3 | -.1 | mg/l |
| Silica, dissolved | 16 | mg/l |
| Phosphate | .5 | mg/l |
| Aluminum, dissolved | .21 | mg/l |
| Antimony, dissolved | .002 | mg/l |
| Arsenic, dissolved | 2.3 | mg/l |
| Barium, dissolved | .03 | mg/l |
| Cadmium, dissolved | .076 | mg/l |
| Chromium, dissolved | -.01 | mg/l |
| Cobalt, dissolved | .01 | mg/l |
| Copper, dissolved | .01 | mg/l |
| Iron, dissolved | -.02 | mg/l |
| Lead, dissolved | -.001 | mg/l |
| Manganese, dissolved | 1.67 | mg/l |
| Mercury, dissolved | -.0002 | mg/l |
| Molybdenum, dissolved | 6.20 | mg/l |
| Nickel, dissolved | -.02 | mg/l |
| Selenium, dissolved | 8.4 | mg/l |
| Silver, dissolved | .01 | mg/l |
| Strontium, dissolved | 5. | mg/l |
| Tin, dissolved | -.1 | mg/l |
| Vanadium, dissolved | -.01 | mg/l |
| Zinc, dissolved | .02 | mg/l |
| Solids, total dissolved | 6554. | mg/l |

pH - 8.08
Eh - 222 mv
Zobell - 233 mv
Temp - 24.0 °C
Ec - 8,000 umhos
Alkalinity - 449 at 4.50

emarks:

ote: Negative sign "-" denotes that the value is less than "<"

h V. Poulsen, Laboratory Director

Ralph V. Poulsen B.H.

9/11/90

L.M. COUN
SEP '90

D-2

Compositions of the test fluids prepared by mixing water samples from the lysimeters installed in the tailings pile, and spiking with known concentrations of hazardous constituents.

| Hazardous constituents | Analysis date and concentration, mg/l December 19. 1989 | December 28, 1989 |
|---|---|---|
| AG | < .05 | < .1 |
| AL | < .50 | < .5 |
| AS | 5.9 | 5.4 |
| B | .65 | .8 |
| BA | < .10 | < .1 |
| BE | .180 | < .05 |
| BR | .99 | .08 |
| CA | 675. | 670. |
| CD | .9000 | .7000 |
| CL | 900. | 710. |
| CO | 5.25 | < .1 |
| CR | .10 | < .1 |
| CU | 1.10 | .2 |
| F | .7 | .7 |
| FE | .30 | < .2 |
| HG | < .0001 | < .0001 |
| K | 85. | 90. |
| MG | 305. | 340. |
| MN | 7.10 | 5.6 |
| MO | 5.00 | 4.4 |
| NA | 820. | 896. |
| NI | 5.90 | 5.7 |
| NO3 | 256.1 | < .1 |
| PB | < .001 | < .01 |
| PO4 | .5 | .7 |
| SB | .008 | .004 |
| SE | 4.0 | 3.3 |
| SIO | 49.5 | 48. |
| SN | < .020 | < .020 |
| SO4 | 4017. | 4042. |
| SR | 7.40 | 5.5 |
| TDS | 6536. | 6696. |
| TL | < .010 | < .010 |
| U | 4.760 | 3.851 |
| V | 21.3 | 15.8 |
| ZN | 13.1 | 7.7 |

(1) The composite water sample was prepared by mixing water samples from the tailings lysimeters

L.N. CO
SEP '90

D-3 Reproducibility of column tests: Chemical analyses of the first effluent pore volumes of the triplicate columns of individual test materials.

L.M. COOKS PE, PHG
SEP '90

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR ALLUVIUM (-GC,-CL)
FIRST PORE VOLUME

Sample # 179-1

| | COLUMN NUMBER 650 | COLUMN NUMBER 651 | COLUMN NUMBER 652 | MEAN | STD |
|---|---|---|---|---|---|
| AL | < 0.5 | < 0.5 | < 0.5 | 0.5 | 0 |
| SB | < 0.001 | < 0.001 | < 0.001 | 0.001 | 0 |
| AS | 0.002 | 0.004 | 0.004 | 0.003333 | 0.001154 |
| BA | < 0.1 | < 0.1 | 0.1 | 0.1 | 0 |
| BE | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| B | 3.9 | 3.2 | 3.65 | 3.583333 | 0.354729 |
| BR | 0.6 | 0.51 | 0.15 | 0.42 | 0.238117 |
| CD | 0.0007 | 0.0006 | 0.0005 | 0.0006 | 0.0001 |
| CA | 570 | 545 | 530 | 548.3333 | 20.20725 |
| CL | 2200 | 1700 | 1800 | 1900 | 264.5751 |
| CR | < 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| CO | 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| CU | 0.3 | 0.1 | 0.2 | 0.2 | 0.1 |
| F | 1.7 | 1.5 | 1.6 | 1.6 | 0.1 |
| FE | < 0.2 | < 0.2 | < 0.2 | 0.2 | 0 |
| PB | < 0.001 | < 0.001 | < 0.001 | 0.001 | 0 |
| MG | 565 | 530 | 500 | 531.6666 | 32.53203 |
| MN | 0.5 | 0.6 | 0.5 | 0.533333 | 0.057735 |
| HG | 0.0003 | 0.0001 | 0.0001 | 0.000166 | 0.000115 |
| MO | 2.7 | 3.2 | 3.2 | 3.033333 | 0.288675 |
| NI | 1.1 | 1.2 | 1.3 | 1.2 | 0.1 |
| NO3 | 154.9 | 60.7 | 805 | 340.2 | 405.2748 |
| PO4 | 0.2 | 0.1 | 0.2 | 0.166666 | 0.057735 |
| K | 20 | 30 | 30 | 26.66666 | 5.773502 |
| SE | 0.7 | 0.5 | 0.5 | 0.566666 | 0.115470 |
| SIO | 27 | 25.5 | 26 | 26.16666 | 0.763762 |
| AG | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| NA | 1795 | 3510 | 3925 | 3076.666 | 1129.184 |
| SR | 8.2 | 9.35 | 9.2 | 8.916666 | 0.625166 |
| SO4 | 7837 | 6651 | 7969 | 7485.666 | 725.8493 |
| TL | < 0.01 | < 0.01 | < 0.01 | 0.01 | 0 |
| SN | < 0.02 | < 0.02 | < 0.02 | 0.02 | 0 |
| TDS | 15696 | 12898 | 14990 | 14528 | 1455.089 |
| U | 0.463 | 0.865 | 0.362 | 0.563333 | 0.266087 |
| V | < 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| ZN | 0.3 | 0.2 | 0.2 | 0.233333 | 0.057735 |

9/12/90

Sample # 174 - 2

L.H. COLLINS PE...
SEP '90

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR ALLUVIUM (-GC,-CL)+10% MANCOS SHALE
FIRST PORE VOLUME

| | 653 | 654 | 655 | MEAN | STD |
|---|---|---|---|---|---|
| AL | < 0.5 | < 0.5 | < 0.5 | 0.5 | 0 |
| SB | 0.01 | < 0.001 | < 0.001 | 0.004 | 0.005196 |
| AS | 0.004 | 0.005 | 0.005 | 0.004666 | 0.000577 |
| BA | 0.1 | < 0.1 | 0.1 | 0.1 | 0 |
| BE | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| B | 3.05 | 2.8 | 2.7 | 2.85 | 0.180277 |
| BR | 0.82 | 0.93 | 0.81 | 0.853333 | 0.066583 |
| CD | 0.001 | 0.0007 | 0.0009 | 0.000866 | 0.000152 |
| CA | 540 | 500 | 470 | 503.3333 | 35.11884 |
| CL | 2000 | 2100 | 2000 | 2033.333 | 57.73502 |
| CR | < 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| CO | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| CU | < 0.1 | 0.1 | 0.1 | 0.1 | 0 |
| F | 1.6 | 1.7 | 1.7 | 1.666666 | 0.057735 |
| FE | < 0.2 | < 0.2 | < 0.2 | 0.2 | 0 |
| PB | < 0.001 | < 0.001 | < 0.001 | 0.001 | 0 |
| MG | 530 | 470 | 500 | 500 | 30 |
| MN | 0.5 | 0.5 | 0.5 | 0.5 | 0 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0 |
| MO | 2.8 | 2.4 | 2.6 | 2.6 | 0.2 |
| NI | 1.2 | 1.2 | 1.1 | 1.166666 | 0.057735 |
| NO3 | 13.6 | 0.9 | 217.8 | 77.43333 | 121.7268 |
| PO4 | 0.2 | 0.2 | 0.1 | 0.166666 | 0.057735 |
| K | 35 | 15 | 10 | 20 | 13.22875 |
| SE | 0.7 | 0.7 | 0.6 | 0.666666 | 0.057735 |
| SIO | 24 | 21.5 | 20.5 | 22 | 1.802775 |
| AG | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| NA | 4125 | 3855 | 3720 | 3900 | 206.2159 |
| SR | 7.6 | 8.15 | 8.8 | 8.183333 | 0.600694 |
| SO4 | 7508 | 8257 | 8150 | 7971.666 | 405.0954 |
| TL | < 0.01 | < 0.01 | < 0.01 | 0.01 | 0 |
| SN | < 0.02 | < 0.02 | < 0.02 | 0.02 | 0 |
| TDS | 14662 | 16324 | 15780 | 15588.66 | 847.3590 |
| U | 0.176 | 0.068 | 0.099 | 0.114333 | 0.055608 |
| V | < 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| ZN | 0.2 | 0.1 | 0.2 | 0.166666 | 0.057735 |

9/12/90

L.M. COOKS PE. PhD
SEP '90

57

Sample #

179-3

ON OF LEACHATE DATA FROM COLUMN
TESTS FOR TOP SOIL
FIRST PORE VOLUME

| | 659 | 660 | 661 | MEAN | STD |
|---|---|---|---|---|---|
| AL | < 0.5 | < 0.5 | < 0.5 | 0.5 | 0 |
| SB | < 0.001 | 0.001 | 0.002 | 0.001333 | 0.000577 |
| AS | 0.006 | 0.006 | 0.005 | 0.005666 | 0.000577 |
| BA | < 0.1 | < 0.1 | 0.1 | 0.1 | 0 |
| BE | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| B | 3.2 | 2.9 | 2.15 | 2.75 | 0.540832 |
| BR | 14 | 14 | 15 | 14.33333 | 0.577350 |
| CD | 0.001 | 0.0009 | 0.001 | 0.000966 | 0.000057 |
| CA | 900 | 900 | 925 | 908.3333 | 14.43375 |
| CL | 3200 | 3500 | 3600 | 3433.333 | 208.1665 |
| CR | < 0.1 | 0.1 | < 0.1 | 0.1 | 0 |
| CO | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| CU | < 0.1 | < 0.1 | 0.1 | 0.1 | 0 |
| F | 1.8 | 1.6 | 1.8 | 1.733333 | 0.115470 |
| FE | < 0.2 | < 0.2 | < 0.2 | 0.2 | 0 |
| PB | 0.001 | < 0.001 | < 0.001 | 0.001 | 0 |
| MG | 435 | 400 | 435 | 423.3333 | 20.20725 |
| | 0.1 | < 0.1 | 0.1 | 0.1 | 0 |
| | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0 |
| MO | 1.2 | 1.2 | 0.9 | 1.1 | 0.173205 |
| NI | 0.9 | 1.2 | 1 | 1.033333 | 0.152752 |
| NO3 | 440 | 427.7 | 447.5 | 438.4 | 9.996499 |
| PO4 | 0.1 | 0.1 | < 0.5 | 0.233333 | 0.230940 |
| K | 5 | 5 | 5 | 5 | 0 |
| SE | 0.2 | 0.2 | 0.2 | 0.2 | 0 |
| SIO | 21 | 18 | 14.5 | 17.83333 | 3.253203 |
| AG | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| NA | 4135 | 4210 | 4235 | 4193.333 | 52.04164 |
| SR | 11.5 | 13 | 11.25 | 11.91666 | 0.946484 |
| SO4 | 7055 | 7080 | 7063 | 7066 | 12.76714 |
| TL | < 0.01 | < 0.01 | < 0.01 | 0.01 | 0 |
| SN | < 0.02 | < 0.02 | < 0.02 | 0.02 | 0 |
| TDS | 15920 | 16226 | 16714 | 16286.66 | 400.4614 |
| U | 0.043 | 0.044 | 0.041 | 0.042666 | 0.001527 |
| V | 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| ZN | 0.2 | 0.2 | 0.2 | 0.2 | 0 |

9/14/90

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR ALLUVIUM ("1")
FIRST PORE VOLUME

Sample # 179-4

L.M. COONS PE. PHG
SEP '90

| | 656 | 657 | 658 | MEAN | STD |
|---|---|---|---|---|---|
| AL | < 0.5 | < 0.5 | < 0.5 | 0.5 | 0 |
| SB | 0.015 | < 0.001 | < 0.001 | 0.005666 | 0.008082 |
| AS | 0.004 | 0.006 | 0.005 | 0.005 | 0.001 |
| BA | 0.1 | 0.1 | < 0.1 | 0.1 | 0 |
| BE | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| B | 3.8 | 3.75 | 5.15 | 4.233333 | 0.794250 |
| BR | 7 | 0.22 | 9.2 | 5.473333 | 4.680612 |
| CD | 0.0008 | 0.001 | 0.0006 | 0.0008 | 0.0002 |
| CA | 465 | 520 | 525 | 503.3333 | 33.29164 |
| CL | 2400 | 3700 | 3100 | 3066.666 | 650.6407 |
| CR | < 0.1 | 0.1 | < 0.1 | 0.1 | 0 |
| CO | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| CU | 0.2 | < 0.1 | 0.2 | 0.166666 | 0.057735 |
| F | 2.5 | 2.6 | 2.5 | 2.533333 | 0.057735 |
| FE | < 0.2 | < 0.2 | < 0.2 | 0.2 | 0 |
| PB | < 0.001 | < 0.001 | < 0.001 | 0.001 | 0 |
| MG | 675 | 780 | 565 | 673.3333 | 107.5096 |
| [illegible] | < 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| HG | 0.0001 | 0.0001 | 0.0002 | 0.000133 | 0.000057 |
| MO | 1.7 | 1.2 | 2.1 | 1.666666 | 0.450924 |
| NI | 1.1 | 1.1 | 1.2 | 1.133333 | 0.057735 |
| NO3 | 492.8 | 641.5 | 617.8 | 584.0333 | 79.89407 |
| PO4 | 0.1 | 0.1 | 0.1 | 0.1 | 0 |
| K | 35 | 20 | 20 | 25 | 8.660254 |
| SE | 1.6 | 1.8 | 0.9 | 1.433333 | 0.472581 |
| SIO | 22 | 30 | 28.5 | 26.83333 | 4.252450 |
| AG | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| NA | 5670 | 6365 | 5010 | 5681.666 | 677.5753 |
| SR | 10.2 | 10.5 | 10.25 | 10.31666 | 0.160727 |
| SO4 | 10496 | 12570 | 11632 | 11566 | 1038.574 |
| TL | < 0.01 | < 0.01 | < 0.01 | 0.01 | 0 |
| SN | < 0.02 | < 0.02 | < 0.02 | 0.02 | 0 |
| TDS | 19298 | 24470 | 21698 | 21822 | 2588.228 |
| U | 0.076 | 0.152 | 0.096 | 0.108 | 0.039395 |
| V | 0.1 | 0.1 | 0.1 | 0.1 | 0 |
| ZN | 0.1 | 0.2 | 0.1 | 0.133333 | 0.057735 |
| PH | 7.23 | 8.18 | 8.20 | 7.87 | — |
| Eh | | | | 0.181 | |
| Cond | | | | | |
| AIK | | | | | |

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9/10/90

D-4

# Hazardous constituents detected in the pore water of the Grand Junction tailings.

Tailings Pore Water Quality Statistics
Lysimeters 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/07/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 99% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 11 | 7.0000 | 679.0000 | 175.0000 | 173.4411 | 3.6401 | NA | 0.0 | 59.0920 | 509.0678 | LOGNORMAL | 7,8 |
| ALUMINUM | | | MG/L | | | | | | | | |
| 14 | 0.0500 | 78.9667 | 0.1033 | NA | NA | NA | 25.0 | 0.0500 | 5.7000 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 13 | 27.0000 | 892.3333 | 305.5000 | 243.9303 | 2.8709 | NA | 0.0 | 111.3508 | 534.3649 | LOGNORMAL | 7,8 |
| ANTIMONY | | | MG/L | | | | | | | | |
| 14 | 0.0015 | 0.0173 | 0.0062 | NA | NA | NA | 46.4 | 0.0015 | 0.0095 | NONPARAMETRIC | 2 |
| ARSENIC | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 1.3125 | 0.1067 | 0.0918 | 5.4562 | NA | 3.6 | 0.0276 | 0.3052 | LOGNORMAL | 7,8 |
| BARIUM | | | MG/L | | | | | | | | |
| 14 | 0.0100 | 0.0733 | 0.0342 | NA | NA | NA | 32.1 | 0.0233 | 0.0500 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 14 | 0.0025 | 0.1730 | 0.0031 | NA | NA | NA | 50.0 | 0.0025 | 0.0125 | NONPARAMETRIC | 2 |
| BORON | | | MG/L | | | | | | | | |
| 13 | 0.2600 | 2.0400 | 0.4600 | 0.6234 | 1.7047 | NA | 0.0 | 0.4193 | 0.9269 | LOGNORMAL | 7,8 |
| CADMIUM | | | MG/L | | | | | | | | |
| 14 | 0.0005 | 0.2873 | 0.0118 | 0.0111 | 12.0844 | NA | 14.3 | 0.0019 | 0.0647 | LOGNORMAL | 7,8 |
| CALCIUM | | | MG/L | | | | | | | | |
| 14 | 445.5000 | 1005.0000 | 523.5000 | 547.0648 | 1.2475 | NA | 0.0 | 467.7507 | 639.8279 | LOGNORMAL | 7,8 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

L.M. COONS
SEP 93

Tailings Pore Water Quality S. tics
Lysimeters 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/07/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| CHLORIDE | | | MG/L | | | | | | | | |
| 12 | 296.7500 | 1830.0000 | 1044.7500 | 925.9731 | 1.6570 | NA | 0.0 | 623.0485 | 1376.1789 | LOGNORMAL | 7,8 |
| CHROMIUM | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.0525 | 0.0050 | NA | NA | NA | 82.1 | 0.0050 | 0.0367 | NONPARAMETRIC | 2 |
| COBALT | | | MG/L | | | | | | | | |
| 14 | 0.0250 | 0.6300 | 0.0900 | NA | NA | NA | 32.1 | 0.0250 | 0.3800 | NONPARAMETRIC | 2 |
| COPPER | | | MG/L | | | | | | | | |
| 14 | 0.0100 | 3.0333 | 0.0492 | NA | NA | NA | 17.9 | 0.0100 | 2.6050 | NONPARAMETRIC | 2 |
| CYANIDE | | | MG/L | | | | | | | | |
| 14 | 0.0400 | 0.1600 | 0.0800 | 0.0710 | 1.6920 | NA | 4.8 | 0.0489 | 0.1030 | LOGNORMAL | 7,8 |
| FLUORIDE | | | MG/L | | | | | | | | |
| 14 | 0.7000 | 15.2800 | 4.7000 | 4.4638 | 2.6410 | NA | 0.0 | 2.2438 | 8.8801 | LOGNORMAL | 7,8 |
| GROSS ALPHA | | | PCI/L | | | | | | | | |
| 9 | 113.0000 | 8020.0000 | 558.0000 | 794.7962 | 4.9612 | NA | 0.0 | 169.3478 | 3730.1988 | LOGNORMAL | 7,8 |
| GROSS BETA | | | PCI/L | | | | | | | | |
| 9 | 109.0000 | 2675.0000 | 666.0000 | 585.5358 | 3.4625 | NA | 0.0 | 176.5463 | 1941.9950 | LOGNORMAL | 7,8 |
| IRON | | | MG/L | | | | | | | | |
| 14 | 0.0150 | 213.5000 | 8.3000 | 4.4329 | 20.7171 | NA | 14.3 | 0.5181 | 37.9285 | LOGNORMAL | 7,8 |
| LEAD | | | MG/L | | | | | | | | |
| 14 | 0.0040 | 0.0670 | 0.0050 | NA | NA | NA | 53.6 | 0.0050 | 0.0453 | NONPARAMETRIC | 2 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

,17,25,33,41,49,57,65,73,81,89,97,A5,B3,C1,C9,D7.

L.M. COONS PE, PHg
SEP '90

59

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR ALLUVIUM ((1")+10% PEAT
FIRST PORE VOLUME

Sample : 10% Peat in sample 179-4

| | 665 | 666 | 667 | MEAN | STD |
|---|---|---|---|---|---|
| AL | < 0.5 | < 0.5 | 0.6 | 0.533333 | 0.057735 |
| SB | < 0.001 | 0.001 | < 0.001 | 0.001 | 0 |
| AS | 0.003 | < 0.005 | 0.01 | 0.006 | 0.003605 |
| BA | 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| BE | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| B | 3.3 | 3 | 5.3 | 3.866666 | 1.250333 |
| BR | 0.96 | 0.57 | 4.7 | 2.076666 | 2.280226 |
| CD | 0.0012 | 0.0012 | 0.0011 | 0.001166 | 0.000057 |
| CA | 600 | 650 | 700 | 650 | 50 |
| CL | 1800 | 1300 | 2800 | 1966.666 | 763.7626 |
| CR | 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| CO | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| CU | 0.2 | < 0.1 | < 0.1 | 0.133333 | 0.057735 |
| F | 0.5 | 0.5 | 0.4 | 0.466666 | 0.057735 |
| FE | < 0.001 | 0.2 | 0.2 | 0.133666 | 0.114892 |
| | < 0.001 | < 0.001 | 0.001 | 0.001 | 0 |
| [illegible] | 405 | 410 | 700 | 505 | 168.8934 |
| MN | 0.5 | 0.6 | 0.7 | 0.6 | 0.1 |
| HG | <0.0001 | <0.0001 | 0.0001 | 0.0001 | 0 |
| MO | < 0.5 | 0.9 | < 0.5 | 0.633333 | 0.230940 |
| NI | 1.4 | 1.6 | 1.6 | 1.533333 | 0.115470 |
| NO3 | 609.8 | 407.9 | 986.9 | 668.2 | 293.8846 |
| PO4 | 0.2 | 0.2 | 0.3 | 0.233333 | 0.057735 |
| K | 15 | 15 | 20 | 16.66666 | 2.886751 |
| SE | 0.4 | 0.4 | 1.3 | 0.7 | 0.519615 |
| SIO | 36.5 | 34 | 37.5 | 36 | 1.802775 |
| AG | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| NA | 3075 | 2600 | 4400 | 3358.333 | 932.8495 |
| SR | 6.8 | 7.05 | 9.25 | 7.7 | 1.348146 |
| SO4 | 4075 | 5038 | 7277 | 6130 | 1120.512 |
| TL | < 0.01 | < 0.01 | < 0.01 | 0.01 | 0 |
| SN | < 0.02 | < 0.02 | < 0.02 | 0.02 | 0 |
| TDS | 12766 | 10254 | 16642 | 13220.66 | 3218.179 |
| U | 0.076 | 0.072 | 0.135 | 0.094333 | 0.035275 |
| V | < 0.1 | < 0.1 | 0.1 | 0.1 | 0 |
| ZN | 0.2 | 0.3 | 0.3 | 0.266666 | 0.057735 |

9/12/90

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR PEAT
FIRST PORE VOLUME

Peat

L.M. COCKS PE. PH2
SEP '90

| | 662 | 663 | 664 | MEAN | STD |
|---|---|---|---|---|---|
| AL | < 0.5 | 0.7 | < 0.5 | 0.566666 | 0.115470 |
| SB | < 0.001 | 0.001 | < 0.001 | 0.001 | 0 |
| AS | 0.011 | 0.016 | 0.011 | 0.012666 | 0.002886 |
| BA | 0.1 | 0.1 | 0.1 | 0.1 | 0 |
| BE | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| B | < 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| BR | 0.28 | 0.08 | 0.28 | 0.213333 | 0.115470 |
| CD | 0.0013 | 0.0011 | 0.0013 | 0.001233 | 0.000115 |
| CA | 1600 | 1600 | 1600 | 1600 | 0 |
| CL | 1400 | 1400 | 1400 | 1400 | 0 |
| CR | 0.1 | < 0.1 | 0.1 | 0.1 | 0 |
| CO | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| CU | < 0.1 | < 0.1 | < 0.1 | 0.1 | 0 |
| F | 0.2 | 0.2 | 0.2 | 0.2 | 0 |
| FE | 0.4 | 0.5 | 0.4 | 0.433333 | 0.057735 |
| PB | < 0.001 | < 0.001 | < 0.001 | 0.001 | 0 |
| MG | 490 | 440 | 490 | 473.3333 | 28.86751 |
| [illegible] | 2.9 | 3 | 2.9 | 2.933333 | 0.057735 |
| HG | 0.0001 | 0.0002 | 0.0001 | 0.000133 | 0.000057 |
| MO | < 0.5 | < 0.5 | < 0.5 | 0.5 | 0 |
| NI | 0.8 | 1.1 | 0.8 | 0.9 | 0.173205 |
| NO3 | 1935.4 | 1934.1 | 1935.4 | 1934.966 | 0.750555 |
| PO4 | 1 | 0.9 | 1 | 0.966666 | 0.057735 |
| K | 25 | 30 | 25 | 26.66666 | 2.886751 |
| SE | 0.03 | 0.03 | 0.03 | 0.03 | 0 |
| SIO | 56.5 | 54.5 | 56.5 | 55.83333 | 1.154700 |
| AG | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0 |
| NA | 460 | 455 | 460 | 458.3333 | 2.886751 |
| SR | 9.7 | 8.6 | 9.7 | 9.333333 | 0.635085 |
| SO4 | 2824 | 2988 | 2824 | 2878.666 | 94.68544 |
| TL | < 0.01 | < 0.01 | < 0.01 | 0.01 | 0 |
| SN | < 0.02 | < 0.02 | < 0.02 | 0.02 | 0 |
| TDS | 8778 | 8710 | 8778 | 8755.333 | 39.25981 |
| U | 0.007 | < 0.003 | 0.007 | 0.005666 | 0.002309 |
| V | 0.1 | < 0.1 | 0.1 | 0.1 | 0 |
| ZN | 0.3 | 0.2 | 0.3 | 0.266666 | 0.057735 |

9/12/90

Tailings Pore Water Quality Statistics
Lysimeters 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/07/90

| PARAMETER NAME | # OF SAMP | MINIMUM | MAXIMUM | UNITS MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAGNESIUM | | | | MG/L | | | | | | | | |
| | 14 | 158.0000 | 512.5000 | 246.5000 | 265.8329 | 1.4847 | NA | 0.0 | 200.9294 | 351.7813 | LOGNORMAL | 7,8 |
| MANGANESE | | | | MG/L | | | | | | | | |
| | 14 | 1.9300 | 8.3333 | 4.6975 | 4.6087 | 1.6435 | NA | 0.0 | 3.2416 | 6.5524 | LOGNORMAL | 7,8 |
| MERCURY | | | | MG/L | | | | | | | | |
| | 9 | 0.0001 | 0.0003 | 0.0001 | NA | NA | NA | 85.7 | 0.0001 | 0.0003 | NONPARAMETRIC | 2 |
| MOLYBDENUM | | | | MG/L | | | | | | | | |
| | 14 | 0.0617 | 4.3500 | 0.2462 | NA | NA | NA | 21.4 | 0.0958 | 0.8567 | NONPARAMETRIC | 2 |
| NICKEL | | | | MG/L | | | | | | | | |
| | 14 | 0.0200 | 3.7133 | 0.5400 | 0.3420 | 5.2409 | NA | 7.1 | 0.1058 | 1.185[illegible] | LOGNORMAL | 7,8 |
| NITRATE | | | | MG/L | | | | | | | | |
| | 12 | 0.3500 | 3465.0000 | 1.1333 | NA | NA | NA | 42.1 | 0.4000 | 1420.0000 | NONPARAMETRIC | 2 |
| PHOSPHATE | | | | MG/L | | | | | | | | |
| | 13 | 0.2000 | 4.0000 | 0.9000 | 0.8700 | 2.7700 | NA | 5.0 | 0.4078 | 1.8557 | LOGNORMAL | 7,8 |
| POTASSIUM | | | | MG/L | | | | | | | | |
| | 14 | 21.0000 | 233.5000 | 67.5000 | 70.7768 | 1.9421 | NA | 0.0 | 44.2308 | 113.2551 | LOGNORMAL | 7,8 |
| RADIUM-226 | | | | PCI/L | | | | | | | | |
| | 10 | 0.0000 | 668.9000 | 18.9667 | NA | NA | NA | 0.0 | 1.0565 | 413.0500 | NONPARAMETRIC | 9 |
| RADIUM-228 | | | | PCI/L | | | | | | | | |
| | 10 | 0.0000 | 3.8000 | 0.5500 | NA | NA | NA | 30.0 | 0.0000 | 2.9000 | NONPARAMETRIC | 2 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametric distribution was used because the data failed the normal distribution test and includes values ≤0.

L.M. COOLIS P.E. PHB
SEP '90

Tailings Pore Water Qual  tistics
Lysimeters 550-556, 600-6[illegible], 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/07/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | MG/L | 14 | 0.0025 | 0.8700 | 0.0732 | NA | NA | NA | 25.0 | 0.0025 | 0.4600 | NONPARAMETRIC | 2 |
| SILICA - SIO2 | MG/L | 13 | 17.1000 | 83.0000 | 39.7500 | 35.6165 | 1.6407 | NA | 0.0 | 24.6466 | 51.4491 | LOGNORMAL | 7,8 |
| SILVER | MG/L | 14 | 0.0026 | 0.0208 | 0.0050 | NA | NA | NA | 71.4 | 0.0035 | 0.0189 | NONPARAMETRIC | 2 |
| SODIUM | MG/L | 14 | 390.5000 | 1205.0000 | 775.0000 | 740.6519 | 1.3977 | NA | 0.0 | 584.2911 | 938.8560 | LOGNORMAL | 7,8 |
| SPECIFIC CONDUCTANCE | UMHO/CM | 15 | 6200.0000 | 15000.0000 | 9180.0000 | 10147.0110 | 1.3377 | NA | 0.0 | 8331.5067 | 12358.1286 | LOGNORMAL | 7,8 |
| STRONTIUM | MG/L | 14 | 3.9133 | 5.9200 | 5.4325 | 5.0564 | 1.1635 | NA | 0.0 | 4.5421 | 5.6289 | LOGNORMAL | 7,8 |
| SULFATE | MG/L | 12 | 2198.5000 | 4487.0000 | 3327.5000 | 3378.3908 | 1.2494 | NA | 0.0 | 2836.7667 | 4023.4271 | LOGNORMAL | 7,8 |
| SULFIDE | MG/L | 14 | 0.0300 | 60.0000 | 0.0500 | NA | NA | NA | 82.4 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| TEMPERATURE | C - DEGREE | 15 | 6.3000 | 16.7000 | 12.5000 | 12.2622 | 1.2539 | NA | 0.0 | 10.5192 | 14.2939 | LOGNORMAL | 7,8 |
| THALLIUM | MG/L | 14 | 0.0500 | 0.0500 | 0.0500 | NA | NA | NA | 100.0 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

SEP 90

0 5 1 1 0 / 0

Tailings Pore Water Quality Statistics
Lysimeters 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
06/17/89 TO 01/15/90
REPORT DATE: 07/07/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| THORIUM-230 | | | PCI/L | | | | | | | | |
| 5 | 3.5900 | 29.6000 | 18.8800 | 12.9673 | 2.5996 | NA | 0.0 | 2.6157 | 64.2843 | LOGNORMAL | 7,8 |
| TIN | | | MG/L | | | | | | | | |
| 8 | 0.0025 | 0.0170 | 0.0025 | NA | NA | NA | 75.0 | 0.0025 | 0.0170 | NONPARAMETRIC | 2 |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 13 | 4563.0000 | 10345.0000 | 6457.0000 | 6609.3040 | 1.2970 | NA | 0.0 | 5447.3447 | 8019.1178 | LOGNORMAL | 7,8 |
| TOTAL KJELDAHL NITROGEN | | | MG/L | | | | | | | | |
| 13 | 0.5000 | 731.0000 | 223.0000 | 103.2699 | 9.6318 | NA | 7.7 | 19.1652 | 556.4608 | LOGNORMAL | 7,8 |
| URANIUM | | | MG/L | | | | | | | | |
| 14 | 0.0750 | 29.7000 | 0.9850 | 0.7777 | 5.3430 | NA | 0.0 | 0.2373 | 2.5484 | LOGNORMAL | 7,8 |
| VANADIUM | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 27.6333 | 1.3058 | 0.6522 | 14.0823 | NA | 7.1 | 0.1002 | 4.2453 | LOGNORMAL | 7,8 |
| ZINC | | | MG/L | | | | | | | | |
| 14 | 0.0025 | 7.0533 | 0.2798 | 0.2544 | 15.8659 | NA | 7.1 | 0.0359 | 1.8019 | LOGNORMAL | 7,8 |

Note the data at each location was averaged before the statistical calculations were performed.
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

INPUT DATA FILENAME: J:\DART\GRJ01\GM010005.DAT

L.M. COOK'S P.C.
SEP '90

L.M. COUN

ATTACHMENT E

Groundwater quality of the Mancos Shale and the Dakota Sandstone.

Table Background water quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GAJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 90% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 7 | 260.0000 | 1219.0000 | 377.0000 | 454.6454 | 1.8947 | NA | 0.0 | 212.8025 | 971.3346 | LOGNORMAL | 7,8 |
| ALUMINUM | | | MG/L | | | | | | | | |
| 7 | 0.0500 | 0.4300 | 0.1750 | NA | NA | NA | 45.0 | 0.0500 | 0.4300 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 7 | 0.0500 | 4.5000 | 0.5000 | NA | NA | NA | 55.0 | 0.0500 | 4.5000 | NONPARAMETRIC | 2 |
| ANTIMONY | | | MG/L | | | | | | | | |
| 6 | 0.0015 | 0.0610 | 0.0072 | NA | NA | NA | 36.4 | 0.0015 | 0.0610 | NONPARAMETRIC | 2,6 |
| ARSENIC | | | MG/L | | | | | | | | |
| 7 | 0.0044 | 0.0085 | 0.0050 | NA | NA | NA | 80.0 | 0.0044 | 0.0085 | NONPARAMETRIC | 2 |
| BARIUM | | | MG/L | | | | | | | | |
| 7 | 0.0200 | 0.0600 | 0.0400 | NA | NA | NA | 52.9 | 0.0200 | 0.0600 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 6 | 0.0037 | 0.0050 | 0.0037 | NA | NA | NA | 100.0 | 0.0037 | 0.0050 | NONPARAMETRIC | 2,6 |
| BORON | | | MG/L | | | | | | | | |
| 4 | 0.0650 | 1.7200 | 0.7900 | NA | NA | NA | 33.3 | 0.0650 | 1.7200 | NONPARAMETRIC | 2,4 |
| BROMIDE | | | MG/L | | | | | | | | |
| 3 | 1.0000 | 5.5000 | 1.2000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) Data from a minimum of 4 locations must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
4) The stat. range is the 87.5% confidence interval due to a sample size of 4. The maximum is the 93.8% one sided confidence int.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

L.M. COONS PE. PM
SEP '90

Table 3.36 Background water quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GAJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 90% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CADMIUM | MG/L | 7 | 0.0005 | 0.0050 | 0.0018 | NA | NA | NA | 52.9 | 0.0005 | 0.0050 | NONPARAMETRIC | 2 |
| CALCIUM | MG/L | 7 | 11.5000 | 462.0000 | 204.2000 | 185.5234 | 3.9872 | NA | 0.0 | 28.9050 | 532.4673 | LOGNORMAL | 7,8 |
| CATION/ANION BALANCE | % | 3 | -2.7900 | 0.0000 | -1.5000 | NA | NA | NA | 66.7 | NA | NA | UNKNOWN | 1 |
| CHLORIDE | MG/L | 7 | 29.4000 | 2400.0000 | 230.0000 | 313.3838 | 5.4014 | NA | 0.0 | 42.2576 | 2324.6672 | LOGNORMAL | 7,8 |
| CHROMIUM | MG/L | 7 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 85.0 | 0.0050 | 0.0100 | NONPARAMETRIC | 2 |
| COBALT | MG/L | 6 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2,6 |
| COPPER | MG/L | 7 | 0.0100 | 0.0300 | 0.0150 | NA | NA | NA | 76.5 | 0.0100 | 0.0300 | NONPARAMETRIC | 2 |
| CYANIDE | MG/L | 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| FLUORIDE | MG/L | 7 | 0.1900 | 1.6000 | 0.4325 | 0.5457 | 2.1611 | NA | 0.0 | 0.2185 | 1.3630 | LOGNORMAL | 7,8 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) Data from a minimum of 4 locations must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

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SEP '90
L.M. COONS

Table 3.36 Background water quality in the Hanson Shale at the Cheney disposal site, Colorado
SITE: GRJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 90% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GROSS ALPHA | PCI/L | 7 | 6.8000 | 73.5000 | 18.0000 | 20.3795 | 2.5760 | NA | 5.9 | 6.6225 | 62.7143 | LOGNORMAL | 7,8 |
| GROSS BETA | PCI/L | 7 | 9.8500 | 69.0000 | 18.5500 | 21.6624 | 1.9410 | NA | 5.9 | 9.8527 | 47.6276 | LOGNORMAL | 7,8 |
| IRON | MG/L | 7 | 0.0500 | 0.5100 | 0.1450 | 0.1654 | 2.0809 | NA | 5.0 | 0.0693 | 0.3950 | LOGNORMAL | 7,8 |
| LEAD | MG/L | 6 | 0.0050 | 0.0200 | 0.0088 | NA | NA | NA | 69.2 | 0.0050 | 0.0200 | NONPARAMETRIC | 2,6 |
| MAGNESIUM | MG/L | 7 | 12.6500 | 260.0000 | 91.7667 | 61.4801 | 2.9755 | NA | 0.0 | 16.8532 | 224.5452 | LOGNORMAL | 7,8 |
| MANGANESE | MG/L | 7 | 0.0250 | 0.6900 | 0.2210 | 0.1594 | 3.0795 | NA | 5.0 | 0.0419 | 0.6064 | LOGNORMAL | 7,8 |
| MERCURY | MG/L | 6 | 0.0001 | 0.0002 | 0.0001 | NA | NA | NA | 91.7 | 0.0001 | 0.0002 | NONPARAMETRIC | 2,6 |
| MOLYBDENUM | MG/L | 6 | 0.0125 | 0.1150 | 0.0675 | NA | NA | NA | 31.3 | 0.0125 | 0.1150 | NONPARAMETRIC | 2,6 |
| NICKEL | MG/L | 7 | 0.0200 | 0.0280 | 0.0200 | NA | NA | NA | 94.7 | 0.0200 | 0.0280 | NONPARAMETRIC | 2 |
| NITRATE | MG/L | 7 | 0.5000 | 3.0000 | 1.7200 | NA | NA | NA | 60.0 | 0.5000 | 3.0000 | NONPARAMETRIC | 2 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

L.M. COONS PE. PHS
SEP '90

Table 3.36 Backgro[illegible]ter quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GRJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 95% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| PHOSPHATE | | | MG/L | | | | | | | | |
| 4 | 0.0750 | 0.3100 | 0.1775 | NA | NA | NA | 33.3 | 0.0750 | 0.3100 | NONPARAMETRIC | 2,4 |
| POTASSIUM | | | MG/L | | | | | | | | |
| 7 | 2.7300 | 19.0000 | 5.9500 | 5.7098 | 2.0295 | NA | 0.0 | 2.4430 | 13.2344 | LOGNORMAL | 7,8 |
| RADIUM-226 | | | PCI/L | | | | | | | | |
| 7 | 0.0750 | 1.3500 | 0.3000 | NA | NA | NA | 31.3 | 0.0750 | 1.3500 | NONPARAMETRIC | 2 |
| RADIUM-228 | | | PCI/L | | | | | | | | |
| 7 | 0.0500 | 1.0000 | 0.4500 | NA | NA | NA | 35.3 | 0.0500 | 1.0000 | NONPARAMETRIC | 2 |
| SELENIUM | | | MG/L | | | | | | | | |
| 7 | 0.0030 | 0.1095 | 0.0155 | NA | NA | NA | 35.0 | 0.0030 | 0.1095 | NONPARAMETRIC | 2 |
| SILICA - SIO2 | | | MG/L | | | | | | | | |
| 5 | 8.6000 | 42.0000 | 10.4500 | 16.9153 | 2.2525 | NA | 0.0 | 4.3383 | 65.9543 | LOGNORMAL | 7,8 |
| SILVER | | | MG/L | | | | | | | | |
| 4 | 0.0050 | 0.0075 | 0.0050 | NA | NA | NA | 92.3 | 0.0050 | 0.0075 | NONPARAMETRIC | 2,4 |
| SODIUM | | | MG/L | | | | | | | | |
| 7 | 80.6000 | 2445.0000 | 1125.0000 | 502.3447 | 4.0092 | NA | 0.0 | 94.2784 | 2676.6506 | LOGNORMAL | 7,8 |
| SPECIFIC CONDUCTANCE | | | UMHO/CM | | | | | | | | |
| 7 | 664.6667 | 6500.0000 | 1873.0000 | 1808.9055 | 2.4343 | NA | 0.0 | 628.0524 | 5209.9774 | LOGNORMAL | 7,8 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
4) The stat. range is the 87.5% confidence interval due to a sample size of 4. The maximum is the 93.8% one sided confidence int.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

SEP '90
L.M. Co[illegible]

Table 3.36 Background water quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GRJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| STRONTIUM | | | MG/L | | | | | | | | |
| 7 | 1.2450 | 9.0000 | 2.6700 | 3.3706 | 2.0819 | NA | 0.0 | 1.4185 | 8.0643 | LOGNORMAL | 7,8 |
| SULFATE | | | MG/L | | | | | | | | |
| 7 | 344.6000 | 3690.0000 | 875.2000 | 920.8585 | 2.1770 | NA | 0.0 | 365.4535 | 2320.3509 | LOGNORMAL | 7,8 |
| SULFIDE | | | MG/L | | | | | | | | |
| 5 | 0.0500 | 16.5000 | 1.0250 | NA | NA | NA | 33.3 | 0.0500 | 16.5000 | NONPARAMETRIC | 2,5 |
| TEMPERATURE | | | C - DEGREE | | | | | | | | |
| 7 | 12.6500 | 39.7600 | 14.0000 | 16.2430 | 1.4897 | NA | 0.0 | 10.1146 | 26.0795 | LOGNORMAL | 7,8 |
| THALLIUM | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.0525 | 0.0275 | NA | NA | NA | 72.7 | 0.0050 | 0.0525 | NONPARAMETRIC | 2,6 |
| THORIUM-230 | | | PCI/L | | | | | | | | |
| 6 | 0.0000 | 0.6000 | 0.0750 | NA | NA | NA | 44.4 | 0.0000 | 0.6000 | NONPARAMETRIC | 2,6 |
| TIN | | | MG/L | | | | | | | | |
| 6 | 0.0025 | 0.1530 | 0.0265 | NA | NA | NA | 42.9 | 0.0025 | 0.1530 | NONPARAMETRIC | 2,6 |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 7 | 873.4000 | 7010.0000 | 4195.0000 | 2909.9871 | 2.2242 | NA | 0.0 | 1125.8183 | 7521.6620 | LOGNORMAL | 7,8 |
| TOTAL KJELDAHL NITROGEN | | | MG/L | | | | | | | | |
| 2 | 3.0000 | 4.0000 | 3.5000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) Data from a minimum of 4 locations must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
5) The stat. range is the 93.8% confidence interval due to a sample size of 5. The maximum is the 96.9% one sided confidence int.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

L.M. COONS PE. PHB
SEP '90

Table 3.36 Backgro[illegible]ter quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GRJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | 95% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| TOTAL ORGANIC CARBON | | | MG/L | | | | | | | | |
| 7 | 20.0000 | 104.0000 | 63.0000 | 54.9848 | 2.0427 | NA | 0.0 | 23.5362 | 128.4546 | LOGNORMAL | 7,8 |
| URANIUM | | | MG/L | | | | | | | | |
| 7 | 0.0027 | 0.0110 | 0.0096 | 0.0065 | 1.0671 | NA | 10.0 | 0.0051 | 0.0136 | LOGNORMAL | 7,8 |
| VANADIUM | | | MG/L | | | | | | | | |
| 7 | 0.0050 | 0.1300 | 0.0750 | NA | NA | NA | 35.0 | 0.0050 | 0.1300 | NONPARAMETRIC | 2 |
| ZINC | | | MG/L | | | | | | | | |
| 7 | 0.0067 | 0.0250 | 0.0112 | NA | NA | NA | 30.0 | 0.0067 | 0.0250 | NONPARAMETRIC | 2 |

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

INPUT DATA FILENAME: J:\DART\GRJ03\GW10919.DAT

L.M. COUNS[illegible]
SEP 90

Table Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 90% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALKALINITY | MG/L CACO3 | 5 | 5667.0000 | 9139.0000 | 7861.0000 | 7439.2000 | 1329.8636 | 0.1788 | 0.0 | 5210.7352 | 9667.6648 | NORMAL | |
| ALUMINUM | MG/L | 6 | 0.0500 | 0.0500 | 0.0500 | NA | NA | NA | 100.0 | 0.0500 | 0.0500 | NONPARAMETRIC | 2,6 |
| AMMONIUM | MG/L | 6 | 5.2000 | 8.0000 | 6.0500 | 6.2667 | 1.0690 | 0.1706 | 0.0 | 4.7982 | 7.7352 | NORMAL | |
| ANTIMONY | MG/L | 3 | 0.0015 | 0.0015 | 0.0015 | NA | NA | NA | 100.0 | NA | NA | UNKNOWN | 1 |
| ARSENIC | MG/L | 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| BARIUM | MG/L | 6 | 4.4400 | 38.0000 | 33.3000 | 27.2567 | 13.1413 | 0.4821 | 0.0 | 9.2037 | 45.3096 | NORMAL | |
| BERYLLIUM | MG/L | 3 | 0.0025 | 0.0025 | 0.0025 | NA | NA | NA | 100.0 | NA | NA | UNKNOWN | 1 |
| BORON | MG/L | 6 | 1.5000 | 3.1300 | 2.0450 | 2.2633 | 0.6217 | 0.2747 | 0.0 | 1.4095 | 3.1174 | NORMAL | |
| CADMIUM | MG/L | 6 | 0.0005 | 0.0005 | 0.0005 | NA | NA | NA | 100.0 | 0.0005 | 0.0005 | NONPARAMETRIC | 2,6 |
| CALCIUM | MG/L | 6 | 14.5000 | 42.0000 | 33.8000 | 31.6833 | 9.7016 | 0.3062 | 0.0 | 18.3557 | 45.0110 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Table 3.39 Dakota Sands )ter quality statistics at the
Cheney disposal si. and Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| CHLORIDE | | | MG/L | | | | | | | | |
| 6 | 3040.0000 | 4850.0000 | 4310.0000 | 4085.0000 | 731.7835 | 0.1791 | 0.0 | 3079.8183 | 5090.1817 | NORMAL | |
| CHROMIUM | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| COBALT | | | MG/L | | | | | | | | |
| 6 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2,6 |
| COPPER | | | MG/L | | | | | | | | |
| 6 | 0.0100 | 0.0200 | 0.0100 | NA | NA | NA | 66.7 | 0.0100 | 0.0200 | NONPARAMETRIC | 2,6 |
| CYANIDE | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| FLUORIDE | | | MG/L | | | | | | | | |
| 6 | 1.2000 | 2.2000 | 1.4000 | 1.4667 | 0.3724 | 0.2234 | 0.0 | 1.1551 | 2.1782 | NORMAL | |
| GROSS ALPHA | | | PCI/L | | | | | | | | |
| 6 | 0.0000 | 90.0000 | 37.5000 | NA | NA | NA | 33.3 | 0.0000 | 90.0000 | NONPARAMETRIC | 2,6 |
| GROSS BETA | | | PCI/L | | | | | | | | |
| 6 | 0.0000 | 160.0000 | 102.5000 | NA | NA | NA | 16.7 | 0.0000 | 160.0000 | NONPARAMETRIC | 2,6 |
| IRON | | | MG/L | | | | | | | | |
| 6 | 0.2500 | 0.8000 | 0.4850 | 0.5067 | 0.2106 | 0.4156 | 0.0 | 0.2174 | 0.7960 | NORMAL | |
| LEAD | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 83.3 | 0.0050 | 0.0100 | NONPARAMETRIC | 2,6 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 90% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| MAGNESIUM | | | MG/L | | | | | | | | |
| 6 | 13.7000 | 42.0000 | 22.5000 | 26.7167 | 10.7682 | 0.4031 | 0.0 | 11.9238 | 41.5095 | NORMAL | |
| MANGANESE | | | MG/L | | | | | | | | |
| 6 | 0.0200 | 0.3900 | 0.1100 | 0.0809 | 3.5524 | NA | 0.0 | 0.0142 | 0.4615 | LOGNORMAL | 7,8 |
| MERCURY | | | MG/L | | | | | | | | |
| 6 | 0.0001 | 0.0910 | 0.0001 | NA | NA | NA | 83.3 | 0.0001 | 0.0910 | NONPARAMETRIC | 2,6 |
| MOLYBDENUM | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.2100 | 0.0500 | NA | NA | NA | 33.3 | 0.0050 | 0.2100 | NONPARAMETRIC | 2,6 |
| NICKEL | | | MG/L | | | | | | | | |
| 6 | 0.0200 | 0.0200 | 0.0200 | NA | NA | NA | 100.0 | 0.0200 | 0.0200 | NONPARAMETRIC | 2,6 |
| NITRATE | | | MG/L | | | | | | | | |
| 6 | 0.5000 | 10.0000 | 1.7500 | NA | NA | NA | 50.0 | 0.5000 | 10.0000 | NONPARAMETRIC | 2,6 |
| PHOSPHATE | | | MG/L | | | | | | | | |
| 6 | 0.1200 | 11.4000 | 2.6000 | 1.4390 | 5.4103 | NA | 0.0 | 0.1415 | 14.6324 | LOGNORMAL | 7,8 |
| POTASSIUM | | | MG/L | | | | | | | | |
| 6 | 14.0000 | 111.0000 | 71.6500 | 67.2167 | 39.0846 | 0.5815 | 0.0 | 13.5212 | 120.9121 | NORMAL | |
| RADIUM-226 | | | PCI/L | | | | | | | | |
| 6 | 1.5000 | 32.0000 | 2.8500 | 4.7334 | 3.6747 | NA | 0.0 | 0.7928 | 28.2906 | LOGNORMAL | 7,8 |
| RADIUM-228 | | | PCI/L | | | | | | | | |
| 6 | 3.4000 | 48.0000 | 23.5000 | 25.0667 | 15.7915 | 0.6300 | 0.0 | 3.3730 | 46.7603 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

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Table 3.39 Dakota [illegible]stone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 90% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | MG/L | 6 | 0.0025 | 0.0050 | 0.0025 | NA | NA | NA | 83.3 | 0.0025 | 0.0050 | NONPARAMETRIC | 2,6 |
| SILICA - SIO2 | MG/L | 6 | 0.0000 | 44.0000 | 18.3500 | 21.2333 | 13.1767 | 0.6206 | 0.0 | 3.1317 | 39.3350 | NORMAL | |
| SILVER | MG/L | 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| SODIUM | MG/L | 6 | 4210.0000 | 7020.0000 | 5950.0000 | 5756.6667 | 1012.9692 | 0.1760 | 0.0 | 4365.0047 | 7148.2387 | NORMAL | |
| SPECIFIC CONDUCTANCE | UMHO/CM | 2 | 15.5000 | 21000.0000 | 10507.7950 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| STRONTIUM | MG/L | 6 | 3.5900 | 9.0500 | 7.7200 | 7.1850 | 2.0867 | 0.2904 | 0.0 | 4.3184 | 10.0516 | NORMAL | |
| SULFATE | MG/L | 6 | 6.2000 | 175.0000 | 54.3000 | 67.0167 | 61.0021 | 0.9222 | 0.0 | -17.0043 | 151.9176 | NORMAL | |
| SULFIDE | MG/L | 6 | 0.0500 | 10.0000 | 0.1700 | NA | NA | NA | 50.0 | 0.0500 | 10.0000 | NONPARAMETRIC | 2,6 |
| TEMPERATURE | C - DEGREE | 5 | 16.9000 | 22.1000 | 19.0000 | 19.4200 | 1.0939 | 0.0975 | 0.0 | 16.2463 | 22.5937 | NORMAL | |
| THALLIUM | MG/L | 3 | 0.0500 | 0.1000 | 0.0500 | NA | NA | NA | 66.7 | NA | NA | UNKNOWN | 1 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | MG/L | 6 | 10500.0000 | 18300.0000 | 15355.0000 | 14518.3333 | 2780.8662 | 0.1915 | 0.0 | 10698.1833 | 18338.5434 | NORMAL | |
| TOTAL KJELDAHL NITROGEN | MG/L | 3 | 0.5000 | 5.0000 | 0.5000 | NA | NA | NA | 66.7 | NA | NA | UNKNOWN | 1 |
| URANIUM | MG/L | 6 | 0.0004 | 0.0032 | 0.0015 | NA | NA | NA | 50.0 | 0.0004 | 0.0052 | NONPARAMETRIC | 2,6 |
| VANADIUM | MG/L | 6 | 0.0050 | 0.0300 | 0.0050 | NA | NA | NA | 83.3 | 0.0050 | 0.0300 | NONPARAMETRIC | 2,6 |
| ZINC | MG/L | 6 | 0.0025 | 4.0600 | 0.6995 | NA | NA | NA | 33.3 | 0.0025 | 4.0600 | NONPARAMETRIC | 2,6 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

INPUT DATA FILENAME: J:\DART\GRJ03\GW10020.DAT

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SEP '90
L.M. COOKS PE.

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ03-07-90-13-06(0)-00 But reported as GRJ03-07-90-13-06(3)-00 in the RAP. DISCIPLINE Hydrology NO. OF SHEETS 22

PROJECT:

UMTRA

SITE: GRJ03 : Cheney disposal site for the GRJ tailings, Grand Junction, Colorado

FEATURE: Aquifer Hydraulic and Geochemical Properties: Geochemical Modeling: Speciation and Saturation Indices of Groundwater in the Mancos Shale

SOURCES OF DATA:

1. Groundwater Quality data from selected Mancos shale groundwater wells - presented in this calculation
2. Geochemical computer code - PHREEQE (referenced below) was used

SOURCES OF FORMULAE & REFERENCES:

Parkhurst, D.L., Thorstenson, D.C., and Plummer, L.N., 1980. "PHREEQE - A Computer Program for Geochemical Calculations," U.S.G.S. Water Resources Investigations, 80-96, Washington D.C., 210 p.

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | [illegible] | 9/12/90 | [illegible] | 9/20/90 | KB | 9/21/90 |
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DETERMINATION OF DISSOLVED SPECIES AND MINERALS SATURATION INDICES OF THE HAZARDOUS CONSTITUENTS IN GROUNDWATER OF THE MANCOS SHALE UNDERLYING THE PROPOSED DISPOSAL CELL AT THE CHENEY SITE, GRAND JUNCTION, COLORADO

CALCULATION NUMBER: GRJ03-07-90-14-14(01)-00 ( WAS REPORTED AS GRJ03-07-90-13-06(02)-00 IN THE LATEST GRAND JUNCTION RAP).

## A. Purpose

The batch and column test data presented in Calculation GRJ03-07-90-31-06(01))-00 demonstrate that the hazardous constiutents present in the Grand Junction tailings pore water will be attenuated by the Quaternary alluvium and Mancos Shale underlying the disposal cell at the proposed Cheney site. The purpose of this calculation is to determine if the geochemical condition of the groundwater where it is present in the Mancos Shale underneath the Cheney site, is also conducive to attenuation of the hazardous constituents by chemical precipitation.

## B. Overview of Method

The numerical computer code PHREEQE was used to determine a) the dissolved species of the hazardous constiutents in the groundwater of the Mancos Shale and, b) the saturation indices of several minerals that contain these hazardous constituents. The dissolved species indicate which species of a chemical element is stable in the solution. Saturation index on the other hand, is a measure of solubility of a mineral, that is, whether a mineral precipitates or dissolves in a solution of known chemical composition and condition. The computational details used by PHREEQE are provided in Parkhurst and others(1980).

The input parameters for this computation consisted of the following types:

a) On-site measured parameters of the Mancos Shale groundwater geochemical condition. These parameters are: oxidation-reduction potential, pH, alkalinity, electrical conductance and temperature. The measurements were made following the procedures described in the UMTRA Project Standard Operating Procedure No. 16.1.13. The data are provided in Attachment A.

b) Concentrations of several dissolved constituents including the hazardous constituents that are present in the groundwater. The chemical analysis of groundwater in wells 981 and 982 are provided in Attachment B.

The input parameters used in the computation for the groundwater from wells 981 and 982 are summarized in Attachments C and D

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respectively.

The values of the saturation indices and the dissolved species of the hazardous constituents are read off directly from the computer print outs presented in Attachments C and D.

C. Assumptions

1. The calculation represents thermodynamic equilibrium reactions with no consideration for time dependence of these reactions (kinetic effects). This is a reasonable assumption as the reactions involving the constituents of interest are probably instantaneous.

2. The thermodynamic data base adequately represents the minerals and the dissolved species that are present in the Mancos groundwater. The data base is not adequate in that a) the number of minerals and dissolved species for the elements for which data is present are limited, and b) for a number of elements (for example, bismuth, copper, cobalt and chromium) no data is in the data base.

D. Material properties

Not applicable.

E. Data Sources

Thermodynamic data, chemical equations, procedures for calculation of the dissolved species and saturation indices for minerals containing hazardous constituents are in PHREEQE data base of the UMTRA Project file maintained at the DOE's Albuquerque office. The groundwater data used in the calculation are in Attachments A and B of this calculation.

F. Solution

The details of calculations performed is voluminous and are not attached. However, they can be exactly reproduced using PHREEQE and the chemical input parameters shown in Attachments C and D, with the input oxidation-reduction potential held constant and the density of the solution being 1 gram per milliliter.

The dissolved species and the saturation indices of minerals for the groundwater in wells 981 and 982 are shown in Attachments C and D respectively. The dominant dissolved species and the minerals containing selected chemical elements including the hazardous constituents of interest are highlighted in these Attachments.

G. Conclusions and Recommendations

1. The data presented in Attachments C and D strongly support the field observations (Attachment A) that the groundwater in the

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Mancos Shale underneath the proposed disposal cell is in a highly reducing geochemical condition. Methane gas was produced during drilling of wells into the Mancos Shale; the modeling data show that the groundwater is supersaturated with respect to methane (well 982) and pyrite, and the chemically reduced ~~dissolved~~ species of various elements including those of sulfur, iron, arsenic, ~~cadmium~~, molybdenum, selenium and uranium are predicted to be dominant in the Mancos groundwater. This highly reducing geochemical condition coupled with the alkaline pH condition will insolubilize the hazardous constituents present in the Grand Junction tailings pore leachate.

2. The saturation indices of the hazardous constituents presented in Attachments C and D show that the Mancos groundwater is supersaturated with respect to coffinite (USiO4), sphalerite (ZnS), greenockite (CdS), galena (PbS), ferroselite (FeSe2), native selenium (Se) and molybdenite (MoS). Therefore, these hazardous constituents are predicted to precipitate in these mineral forms as the tailings leachate mixes with the Mancos groundwater. The concentration of other hazardous constituents in the Mancos groundwater was below their detection limits.

H. Results

The dissolved species and minerals-saturation indices of the various constituents of interest, including the hazardous constituents, are highlighted in Attachments C and D. Also see the conclusions above.

I. References

See the cover sheet of this calculation.

J. Attachments

Attachment A: On-site measured parameters of groundwater condition in the Mancos Shale at the Cheney site.

Attachment B: Chemical analysis of groundwater in Wells 981 and 982 in the Mancos Shale at the Cheney site.

Attachment C: PHREEQE (model) predicted dissolved species and minerals-saturation indices of various constituents present in the Mancos groundwater, Well 981.

Attachment D: PHREEQE model predicted dissolved species and minerals-saturation indices on various constituents present in the Mancos groundwater, Well 982.

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Attachment A: On-site measured parameters of groundwater condition in the Mancos Shale at the Cheney site.

| FOUNDATION | WELL NUMBER | Eh(mV) | pH | TDS* (mg/l) | ALKALINITY (mg/l as CaCO3) | TEMP (C) |
|---|---|---|---|---|---|---|
| ALLUVIUM | 808 | 206 | 7.48 | 1170 | 327 | 14 |
| ALLUVIUM | 811S | 227 | 7.36 | 664 | 286 | 12 |
| ALLUVIUM | 820 | 24 | 7.49 | 1630 | | 14 |
| ALLUVIUM | 828 | -20 | 7.51 | 620 | 474 | 14 |
| ALLUVIUM | 8292 | 208 | 7.23 | 680 | 401 | 13 |
| ALLUVIUM | 904 | 111 | 7.31 | 966 | 422 | 13 |
| ALLUVIUM | 965 | 221 | 7.09 | 798 | 290 | 15 |
| ALLUVIUM | 966 | 247 | 7.31 | 812 | 349 | 13 |
| ALLUVIUM | 967 | 255 | 7.40 | 760 | 259 | 12 |
| MANCOS SHALE | 811D | 57 | 7.14 | 4320 | 457 | 10 |
| MANCOS SHALE | 981 | -252 | 8.38 | 4220 | 1148 | 12 |
| MANCOS SHALE | 982 | -355 | 7.22 | 6210 | 1002 | 14 |
| DAKOTA SANDSTO | 977 | -12.5 | 7.21 | 12100 | 6630 | 19 |
| DAKOTA SANDSTO | 978 | | 7.43 | 15410 | 7861 | 19 |
| DAKOTA SANDSTO | 971 | | 7.80 | 15300 | 7899 | 17 |

*= LABORATORY MEASUREMENTS MADE ON SAMPLE COLLECTED
ALL OTHER MEASUREMENTS MADE IN FIELD FROM 11/89-2/90

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Attachment B: Chemical analysis of groundwater in Wells 981 and 982 in the Mancos Shale at the Cheney site.

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WATER QUALITY ANALYTICAL RESULTS

SITE ID: BRJ03
SAMPLE DATE: 11/18/89

LOCATION ID: 981
ANALYTICAL LAB CODE: BAR

SAMPLE ID: 0.

LAB SAMPLE CONTROL ID: 1554-14
ANALYSIS CHECKED BY: [illegible]

DATE RECEIVED: 11-20-89
DATE CHECKED: 12-22-89

COMMENTS: Total Report DR #035, Lot 2
ASD-34-6764-[illegible]5-88-[illegible]

| PARAMETER | V I | PARAMETER VALUE | VALUE UNCERTAINTY | DETECTION LIMIT | UNITS OF MEASURE | COMMENTS |
|---|---|---|---|---|---|---|
| AG | < | .01 | | 0.01 | MG/L | |
| AL | < | .1 | | 0.1 | MG/L | |
| AS | | .012 | | 0.01 | MG/L | |
| BA | < | .1 | | 0.1 | MG/L | |
| BE | < | .01 | | 0.01 | MG/L | |
| BR | | 6.9 | | 0.1 | MG/L | |
| CA | | 9.82 | | 0.01 | MG/L | |
| CD | | .003 | | 0.001 | MG/L | |
| CL | | 1610. | | 1.0 | MG/L | |
| CN | < | .01 | | 0.01 | MG/L | |
| CO | < | .05 | | 0.05 | MG/L | |
| CR | < | .01 | | 0.01 | MG/L | |
| CU | < | .02 | | 0.02 | MG/L | |
| F | | 1.5 | | 0.1 | MG/L | |
| FE | | .23 | | 0.03 | MG/L | |
| GA | | 140. | 50. | 1.0 | PCI/L | |
| GB | | 55. | 22. | 0.5 | PCI/L | |
| | < | .0002 | | 0.0002 | MG/L | |
| | | 6.8 | | 0.01 | MG/L | |
| MG | | 11.0 | | 0.001 | MG/L | |
| MN | | .04 | | 0.01 | MG/L | |
| MO | | .21 | | 0.01 | MG/L | |
| NA | | 1540. | | 0.002 | MG/L | |
| NH4 | | 3.2 | | 0.1 | MG/L | |
| NI | < | .04 | | 0.04 | MG/L | |
| NO3 | < | .1 | | 1.0 | MG/L | |
| PB | | .02 | | 0.01 | MG/L | |
| REL | | 0.0 | 0.1 | 1.0 | PCI/L | |
| RAB | | 0.1 | 1.6 | 1.0 | PCI/L | |
| S | | 14. | | 0.1 | MG/L | |
| SB | | .011 | | 0.003 | MG/L | |
| SE | | .009 | | 0.005 | MG/L | |
| SIO | | 11. | | 2.0 | MG/L | |
| SN | | .101 | | 0.005 | MG/L | |
| SO4 | | 426. | | 0.1 | MG/L | |
| SR | | 1.79 | | 0.1 | MG/L | |
| TDS | | 4170. | | 10.0 | MG/L | |
| TL | < | .01 | | 0.01 | MG/L | |
| TOC | | 69. | | 1.0 | MG/L | |
| U | | 0.0084 | | 0.003 | MG/L | |
| V | < | .01 | | 0.01 | MG/L | |
| ZN | | .011 | | 0.005 | MG/L | |

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# WATER QUALITY ANALYTICAL RESULTS

SITE ID: GRJ03
SAMPLE DATE: 11/18/89

LOCATION ID: 982
ANALYTICAL LAB CODE: BAR

SAMPLE ID: 0:

LAB SAMPLE CONTROL ID: 1556-15
ANALYSIS CHECKED BY: [illegible]

DATE RECEIVED: 11-[illegible]
DATE CHECKED: 12-[illegible]

COMMENTS: Total Report DO# 035, lot 2
ASD-34-6704-5-88

| PARAMETER | V I | PARAMETER VALUE | VALUE UNCERTAINTY | DETECTION LIMIT | UNITS OF MEASURE | COMMENTS |
|---|---|---|---|---|---|---|
| AG | < | .01 | | 0.01 | MG/L | |
| AL | < | .1 | | 0.1 | MG/L | |
| AS | < | .01 | | 0.01 | MG/L | |
| BA | < | .1 | | 0.1 | MG/L | |
| BE | < | .01 | | 0.01 | MG/L | |
| BR | | 3.7 | | 0.1 | MG/L | |
| CA | | 19.5 | | 0.01 | MG/L | |
| CD | | .004 | | 0.001 | MG/L | |
| CL | | 2320. | | 1.0 | MG/L | |
| CN | < | .01 | | 0.01 | MG/L | |
| CO | < | .05 | | 0.05 | MG/L | |
| CR | < | .01 | | 0.01 | MG/L | |
| CU | < | .02 | | 0.02 | MG/L | |
| F | | 1.4 | | 0.1 | MG/L | |
| FE | | .07 | | 0.03 | MG/L | |
| GA | | 38. | 49. | 1.0 | PCI/L | |
| GR | | 36. | 24. | 0.5 | PCI/L | |
| HG | | .0002 | | 0.0002 | MG/L | |
| K | | 7.9 | | 0.01 | MG/L | |
| MG | | 17.2 | | 0.001 | MG/L | |
| MN | | .10 | | 0.01 | MG/L | |
| MO | | .02 | | 0.01 | MG/L | |
| NA | | 2300. | | 0.002 | MG/L | |
| NH4 | | 5.0 | | 0.1 | MG/L | |
| NI | < | .04 | | 0.04 | MG/L | |
| NO3 | < | .1 | | 1.0 | MG/L | |
| PB | | .03 | | 0.01 | MG/L | |
| RGL | | 0.5 | 0.3 | 1.0 | PCI/L | |
| RAB | | 1.9 | 1.1 | 1.0 | PCI/L | |
| S | < | 4. | | 0.1 | MG/L | |
| SB | | .041 | | 0.003 | MG/L | |
| SE | | .014 | | 0.005 | MG/L | |
| SIO | | 8. | | 2.0 | MG/L | |
| SN | | .153 | | 0.005 | MG/L | |
| SO4 | | 1040. | | 0.1 | MG/L | |
| SR | | 4.50 | | 0.1 | MG/L | |
| TOL | | 0.0 | 0.3 | 1.0 | PCI/L | |
| TDS | | 6440. | | 10.0 | MG/L | |
| TL | | .041 | | 0.01 | MG/L | |
| TOC | | 23. | | 1.0 | MG/L | |
| U | | 0.0038 | | 0.003 | MG/L | |
| | < | .01 | | 0.01 | MG/L | |
| ZN | | .020 | | 0.005 | MG/L | |

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**Attachment C: PHREEQE (model) predicted dissolved species and minerals-saturation indices of various constituents present in the Mancos groundwater, Well 981.**

```
ENTS
IES
MIN
        ed and minerals saturation indices in mancos groundwater, Cheney si
...JD      0          .00000
ENTS
      10          50.
       0          D.
TION 1
os Shale, GRJ Cheney Site, well 0981
D 2     8.36     -4.45     12.0     1.00
  2.268D-02  11  9.820D+00  12  3.000D-03  13  1.610D+03  16  1.500D+00
  2.300D-01  19  6.800D+00  21  1.100D+01  22  4.000D-02  35  3.507D-01
  1.540D+03  23  1.103D+01  27  2.000D-02  29  4.680D+01  37  1.456D-02
  1.760D+01  31  1.790D+00  32  9.492D-03  34  1.100D-02  10  1.148D+02
TION NUMBER 1          Mancos Shale, GRJ Cheney Site, well 0981
```

pH

Pe = 16.92Eh

Temperature, °C

Density of solution (water), g/cc

Pe to Eh Conversion

$$Pe = \frac{F}{2.3RT} Eh$$

F = Faraday Const = 23.06 kcal/volt-gram

R = "Gas Constant" = 0.001987 kcal/deg

T = 298.15°K

INPUT PARAMETERS FOR GROUNDWATER FROM WELL #981

Input values are in correspondence. 9/20/90

TOTAL MOLALITIES OF ELEMENTS

| ELEMENT | MOLALITY | LOG MOLALITY |
|---|---|---|
| AS | 1.603229D-07 | -6.795D |
| TOT ALK | 2.301715D-03 | -2.6379 |
| CA | 2.458389D-04 | -3.6093 |
| CD | 2.678063D-08 | -7.5722 |
| CL | 4.556566D-02 | -1.3414 |
| F | 7.922113D-05 | -4.1012 |
| FE | 4.132328D-06 | -5.3638 |
| K | 1.744925D-04 | -3.7562 |
| MG | 4.539622D-04 | -3.343D |
| MN | 7.305568D-07 | -6.1363 |
| N | 1.784910D-04 | -3.7464 |
| NA | 6.721286D-02 | -1.1725 |
| PB | 9.685636D-08 | -7.0139 |
| S | 4.886356D-04 | -3.3105 |
| SI | 1.837325D-04 | -3.7358 |
| SR | 2.049624D-05 | -4.6853 |
| U | 3.527066D-08 | -7.4526 |
| ZN | 1.688425D-07 | -6.7725 |
| MO | 2.200149D-06 | -5.6575 |
| SE | 1.143219D-07 | -6.9419 |

----DESCRIPTION OF SOLUTION----

| | |
|---|---|
| PH = | 8.3800 |
| PE = | -4.4540 |
| ACTIVITY H2O = | .9962 |
| IONIC STRENGTH = | .0600 |
| TEMPERATURE = | 12.0000 |
| ELECTRICAL BALANCE = | 2.0087D-02 |
| THOR = | -2.8445D+04 |
| TOTAL ALKALINITY = | 2.3017D-03 |
| ITERATIONS = | 22 |

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DISTRIBUTION OF SPECIES

# DISSOLVED SPECIES

| I | SPECIES | Z | MOLALITY | LOG MOLALITY | ACTIVITY | LOG ACTIVITY | GAMMA | LOG GAMMA |
|---|---|---|---|---|---|---|---|---|
| 1 | H+ | 1.0 | 5.12192D-09 | -8.2906 | 4.16869D-09 | -8.3800 | 8.13894D-01 | -.0894 |
| 2 | E- | -1.0 | 2.84446D-04 | 4.4540 | 2.84446D-04 | 4.4540 | 1.00000D+00 | .0000 |
| 3 | H2O | .0 | 9.98015D-01 | -.0009 | 9.98015D-01 | -.0009 | 1.00000D+00 | .0000 |
| 6 | H3AS04 | .0 | 3.67369D-20 | -19.4349 | 3.72479D-20 | -19.4289 | 1.01391D+00 | .0060 |
| 10 | CO3 2- | -2.0 | 3.29927D-05 | -4.4816 | 1.44773D-05 | -4.8393 | 4.38804D-01 | -.3577 |
| 11 | CA 2+ | 2.0 | 2.38583D-04 | -3.6224 | 1.13850D-04 | -3.9437 | 4.77194D-01 | -.3213 |
| 12 | CD 2+ | 2.0 | 2.26779D-10 | -9.6406 | 1.00389D-10 | -9.9983 | 4.38804D-01 | -.3577 |
| 13 | CL- | -1.0 | 4.55658D-02 | -1.3414 | 3.63673D-02 | -1.4393 | 7.98127D-01 | -.0979 |
| 16 | F- | -1.0 | 7.78361D-05 | -4.1088 | 6.33503D-05 | -4.1983 | 8.13894D-01 | -.0894 |
| 17 | FE 2+ | 2.0 | 4.02945D-06 | -5.3948 | 1.76814D-06 | -5.7525 | 4.38804D-01 | -.3577 |
| 19 | K+ | 1.0 | 1.74323D-04 | -3.7586 | 1.39132D-04 | -3.8566 | 7.98127D-01 | -.0979 |
| 21 | MG 2+ | 2.0 | 4.39683D-04 | -3.3569 | 2.15105D-04 | -3.6674 | 4.89227D-01 | -.3105 |
| 22 | MN 2+ | 2.0 | 6.60430D-07 | -6.1802 | 2.89799D-07 | -6.5379 | 4.38804D-01 | -.3577 |
| 23 | NO3 - | -1.0 | 0.00000D+00 | -80.9115 | 0.00000D+00 | -81.0010 | 8.13894D-01 | -.0894 |
| 24 | NA+ | 1.0 | 6.71087D-02 | -1.1732 | 5.47571D-02 | -1.2616 | 8.15946D-01 | -.0883 |
| 27 | PB 2+ | 2.0 | 7.57188D-10 | -9.1039 | 3.45421D-10 | -9.4617 | 4.38804D-01 | -.3577 |
| 29 | SO4 2- | -2.0 | 4.23085D-04 | -3.3736 | 1.78927D-04 | -3.7473 | 4.22910D-01 | -.3738 |
| 30 | H4SiO4 | .0 | 1.80605D-04 | -3.7433 | 1.83117D-04 | -3.7373 | 1.01391D+00 | .0060 |
| 31 | SR 2+ | 2.0 | 2.04982D-05 | -4.6883 | 8.99468D-06 | -5.0463 | 4.38804D-01 | -.3577 |
| 32 | UO2 2+ | 2.0 | 1.60383D-21 | -20.7948 | 7.03766D-22 | -21.1526 | 4.38804D-01 | -.3577 |
| 34 | ZN 2- | 2.0 | 4.82668D-08 | -7.3164 | 2.11793D-08 | -7.6741 | 4.38804D-01 | -.3577 |
| 35 | MOO4 2- | -2.0 | 2.19631D-06 | -5.6584 | 9.63816D-07 | -6.0161 | 4.38804D-01 | -.3577 |
| 51 | H3BO3 | .0 | 1.44856D-07 | -6.8391 | 1.46871D-07 | -6.8331 | 1.01391D+00 | .0060 |
| 53 | FE 3+ | 3.0 | 1.72707D-23 | -22.7677 | 2.67522D-24 | -23.5726 | 1.56714D-01 | -.8049 |
| 55 | NH4 + | 1.0 | 1.76081D-04 | -3.7494 | 1.44939D-04 | -3.8388 | 8.13894D-01 | -.0894 |
| 57 | HS- | -1.0 | 1.68728D-08 | -7.7728 | 1.37324D-08 | -7.8623 | 8.13894D-01 | -.0894 |
| 58 | SO3 2- | -2.0 | 1.60788D-15 | -14.7938 | 7.05414D-16 | -15.1516 | 4.38804D-01 | -.3577 |
| 61 | UO2 + | 1.0 | 1.93256D-14 | -13.7139 | 1.57293D-14 | -13.8033 | 8.13894D-01 | -.0894 |
| 65 | O-- | -1.0 | 1.05837D-06 | -5.9754 | 8.61399D-07 | -6.0648 | 8.13894D-01 | -.0894 |
| 66 | H3SiO4 - | -1.0 | 3.12691D-06 | -5.5049 | 2.54497D-06 | -5.5943 | 8.13894D-01 | -.0894 |
| 67 | H2SiO4-- | -2.0 | 5.39279D-10 | -9.2682 | 2.36635D-10 | -9.6259 | 4.38804D-01 | -.3577 |
| 75 | NH4SO4 - | -1.0 | 4.10474D-07 | -6.3867 | 3.34052D-07 | -6.4761 | 8.13894D-01 | -.0894 |
| 76 | MSO4 + | 1.0 | 3.19444D-05 | -7.4956 | 2.59993D-05 | -7.5850 | 8.13894D-01 | -.0894 |
| 77 | MGF + | 1.0 | 7.77052D-07 | -6.1124 | 6.26368D-07 | -6.2018 | 8.13894D-01 | -.0894 |
| 78 | MGCO3 AQ | .0 | 2.40288D-06 | -5.6196 | 2.43420D-06 | -5.6136 | 1.01391D+00 | .0060 |
| 79 | MGHCO3 + | 1.0 | 5.23330D-06 | -5.2981 | 4.09657D-06 | -5.3876 | 8.13894D-01 | -.0894 |
| 80 | MGSO4 AQ | .0 | 6.06147D-06 | -5.2174 | 6.14578D-06 | -5.2114 | 1.01391D+00 | .0060 |
| 84 | CAOH + | 1.0 | 2.76169D-09 | -8.5588 | 2.24789D-09 | -8.6482 | 8.13894D-01 | -.0894 |
| 85 | CAHCO3 + | 1.0 | 1.71061D-06 | -5.7669 | 1.39225D-06 | -5.8563 | 8.13894D-01 | -.0894 |
| 86 | CACO3 AQ | .0 | 1.82999D-06 | -5.7376 | 1.85545D-06 | -5.7316 | 1.01391D+00 | .0060 |
| 87 | CASO4 AQ | .0 | 3.65501D-06 | -5.4371 | 3.70586D-06 | -5.4311 | 1.01391D+00 | .0060 |
| 91 | CAF + | 1.0 | 5.76239D-08 | -7.2394 | 4.65997D-08 | -7.3288 | 8.13894D-01 | -.0894 |
| 92 | NACO3 - | -1.0 | 9.09461D-06 | -5.0412 | 7.40221D-06 | -5.1306 | 8.13894D-01 | -.0894 |
| 93 | NAHCO3 A | .0 | 3.91858D-05 | -4.4069 | 3.97309D-05 | -4.4009 | 1.01391D+00 | .0060 |
| 94 | NASO4 - | -1.0 | 5.53506D-05 | -4.2569 | 4.50495D-05 | -4.3463 | 8.13894D-01 | -.0894 |
| 96 | NAF AQ | .0 | 5.54866D-07 | -6.2558 | 5.62586D-07 | -6.2498 | 1.01391D+00 | .0060 |
| 97 | KSO4 - | -1.0 | 1.69571D-07 | -6.7706 | 1.38013D-07 | -6.8601 | 8.13894D-01 | -.0894 |
| 109 | FEOH + | 1.0 | 5.95706D-08 | -7.2250 | 4.84842D-08 | -7.3144 | 8.13894D-01 | -.0894 |
| 110 | FEOH3 -1 | -1.0 | 2.67645D-13 | -12.5381 | 2.35741D-13 | -12.6276 | 8.13894D-01 | -.0894 |
| 111 | FESO4 AQ | .0 | 4.32773D-08 | -7.3637 | 4.38793D-08 | -7.3577 | 1.01391D+00 | .0060 |
| 113 | FEOH2 AQ | .0 | 2.95725D-11 | -10.5247 | 3.02551D-11 | -10.5187 | 1.01391D+00 | .0060 |
| 115 | FE(HS)2 | .0 | 2.93096D-13 | -12.5330 | 2.97173D-13 | -12.5270 | 1.01391D+00 | .0060 |
| 116 | FE(HS)3 | -1.0 | 5.09544D-19 | -18.2926 | 4.14714D-19 | -18.3823 | 8.13894D-01 | -.0894 |
| 117 | FEOH 2+ | 2.0 | 4.23366D-15 | -17.3733 | 1.85783D-18 | -17.7310 | 4.38804D-01 | -.3577 |
| 119 | FESO4 + | 1.0 | 3.62086D-24 | -23.4412 | 2.94499D-24 | -23.5306 | 8.13894D-01 | -.0894 |
| 120 | FECL 2+ | 2.0 | 4.35163D-24 | -23.3613 | 1.90960D-24 | -23.7191 | 4.38804D-01 | -.3577 |
| 121 | FECL2 + | 1.0 | 5.66426D-25 | -24.2318 | 4.77265D-25 | -24.3212 | 8.13894D-01 | -.0894 |
| 122 | FECL3 AQ | .0 | 1.71196D-27 | -26.7665 | 1.73577D-27 | -26.7605 | 1.01391D+00 | .0060 |
| 123 | FECL4 - | -1.0 | 1.09734D-17 | -17.9597 | 8.93116D-18 | -17.9491 | 8.13894D-01 | -.0894 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 125 | FEOH | 1.0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 127 | FEF 2+ | 2.0 | 4.961910-22 | -21.3044 | 2.177310-22 | -21.6621 | 4.366040-01 | -.3577 |
| 128 | FEF2 + | 1.0 | 5.752990-22 | -21.2401 | 4.662320-22 | -21.3295 | 8.136940-01 | -.0894 |
| 129 | FEF3 AQ | .0 | 4.427870-23 | -22.3538 | 4.489440-23 | -22.3478 | 1.013910+00 | .0060 |
| 130 | FE(SO4)2 | -1.0 | 1.942810-26 | -25.7116 | 1.581240-26 | -25.8010 | 8.136940-01 | -.0894 |
| 134 | BROH + | 1.0 | 5.756970-11 | -10.2395 | 4.685560-11 | -10.3292 | 8.136940-01 | -.0894 |
| | MNCL + | 1.0 | 5.238910-08 | -7.2808 | 4.263910-08 | -7.3702 | 8.136940-01 | -.0894 |
| | MNCL2 AQ | .0 | 4.154510-10 | -9.3815 | 4.212330-10 | -9.3765 | 1.013910+00 | .0060 |
| 138 | MNCL3 - | -1.0 | 8.485220-12 | -11.0713 | 6.906360-12 | -11.1605 | 8.136940-01 | -.0894 |
| 139 | MNOH + | 1.0 | 7.236260-10 | -9.1405 | 5.859550-10 | -9.2299 | 8.136940-01 | -.0894 |
| 140 | MN(OH)3 | -1.0 | 7.743560-17 | -16.1111 | 6.302450-17 | -16.2005 | 8.136940-01 | -.0894 |
| 141 | MNF + | 1.0 | 1.596900-10 | -9.7967 | 1.299710-10 | -9.8862 | 8.136940-01 | -.0894 |
| 142 | MNSO4 AQ | .0 | 7.875200-09 | -8.1037 | 7.984750-09 | -8.0977 | 1.013910+00 | .0060 |
| 144 | MNHCO3 + | 1.0 | 8.554970-09 | -8.0678 | 6.962840-09 | -8.1572 | 8.136940-01 | -.0894 |
| 162 | ZNCL + | 1.0 | 1.398770-09 | -8.8543 | 1.138450-09 | -8.9437 | 8.136940-01 | -.0894 |
| 163 | ZNCL2 AQ | .0 | 4.048570-11 | -10.3927 | 4.104880-11 | -10.3867 | 1.013910+00 | .0060 |
| 164 | ZNCL3 - | -1.0 | 1.676810-12 | -11.7720 | 1.543800-12 | -11.8114 | 8.136940-01 | -.0894 |
| 165 | ZNCL4 2- | -2.0 | 5.744470-14 | -13.2407 | 2.520780-14 | -13.5985 | 4.366040-01 | -.3577 |
| 166 | ZNF + | 1.0 | 1.962960-11 | -10.7071 | 1.597640-11 | -10.7965 | 8.136940-01 | -.0894 |
| 167 | ZNOH + | 1.0 | 2.326730-09 | -8.6333 | 1.893710-09 | -8.7227 | 8.136940-01 | -.0894 |
| 168 | ZN(OH)2 | .0 | 3.048690-09 | -8.5159 | 3.091300-09 | -8.5099 | 1.013910+00 | .0060 |
| 169 | ZN(OH)3 | -1.0 | 1.495120-12 | -11.8253 | 1.216870-12 | -11.9148 | 8.136940-01 | -.0894 |
| 170 | ZN(OH)4 | -2.0 | 3.474740-17 | -16.4591 | 1.524730-17 | -16.8168 | 4.366040-01 | -.3577 |
| 171 | ZNOHCL A | .0 | 6.022280-09 | -8.2202 | 6.106050-09 | -8.2142 | 1.013910+00 | .0060 |
| 172 | ZN(HS)2 | .0 | 3.430920-09 | -8.4646 | 3.478650-09 | -8.4586 | 1.013910+00 | .0060 |
| 173 | ZN(HS)3 | -1.0 | 8.483650-16 | -15.0714 | 6.924780-16 | -15.1605 | 8.136940-01 | -.0894 |
| 174 | ZNSO4 AQ | .0 | 7.891200-10 | -9.1029 | 8.000970-10 | -9.0969 | 1.013910+00 | .0060 |
| 175 | ZN(SO4)2 | -2.0 | 2.944370-12 | -11.5310 | 1.292300-12 | -11.8857 | 4.366040-01 | -.3577 |
| 180 | ZNHCO3 + | 1.0 | 1.977120-19 | -18.7040 | 1.609160-19 | -18.7934 | 8.136940-01 | -.0894 |
| 181 | ZNCO3 AQ | .0 | 6.033940-08 | -7.2194 | 6.117880-08 | -7.2134 | 1.013910+00 | .0060 |
| 182 | ZN(CO3)2 | -2.0 | 4.315380-08 | -7.3650 | 1.693800-08 | -7.7227 | 4.366040-01 | -.3577 |
| [illegible] | CDCL + | 1.0 | 4.193690-10 | -9.3679 | 3.331830-10 | -9.4773 | 8.136940-01 | -.0894 |
| | CDCL2 AQ | .0 | 4.738860-11 | -10.3243 | 4.804750-11 | -10.3183 | 1.013910+00 | .0060 |
| 185 | CDCL3 - | -1.0 | 1.101360-12 | -11.9561 | 8.963930-13 | -12.0475 | 8.136940-01 | -.0894 |
| 186 | CDF + | 1.0 | 9.837110-14 | -13.0071 | 6.006360-14 | -13.0966 | 8.136940-01 | -.0894 |
| 187 | CDF2 AQ | .0 | 1.256560-17 | -16.9008 | 1.274040-17 | -16.8945 | 1.013910+00 | .0060 |
| 188 | CD(CO3)3 | -4.0 | 1.363550-17 | -16.8653 | 5.055360-19 | -18.2962 | 3.707510-02 | -1.4309 |
| 189 | CDOH + | 1.0 | 8.964190-13 | -12.0475 | 7.295900-13 | -12.1369 | 8.136940-01 | -.0894 |
| 190 | CD(OH)2 | .0 | 2.534900-14 | -13.5960 | 2.570160-14 | -13.5900 | 1.013910+00 | .0060 |
| 191 | CD(OH)3 | -1.0 | 8.482640-19 | -18.0715 | 6.903970-19 | -18.1609 | 8.136940-01 | -.0894 |
| 192 | CD(OH)4 | -2.0 | 3.357110-24 | -23.4740 | 1.473110-24 | -23.8316 | 4.366040-01 | -.3577 |
| 193 | CDZOH +3 | 3.0 | 2.711460-21 | -20.5668 | 4.249250-22 | -21.3717 | 1.567140-01 | -.8049 |
| 194 | CDOHCL A | .0 | 2.432260-11 | -10.6140 | 2.466090-11 | -10.6080 | 1.013910+00 | .0060 |
| 196 | CDSO4 AQ | .0 | 4.781910-12 | -11.3277 | 4.767310-12 | -11.3217 | 1.013910+00 | .0060 |
| 197 | CDHS + | 1.0 | 2.505350-08 | -7.6011 | 2.039090-08 | -7.6906 | 8.136940-01 | -.0894 |
| 198 | CD(HS)2 | .0 | 6.326760-10 | -9.1988 | 6.414770-10 | -9.1928 | 1.013910+00 | .0060 |
| 199 | CD(HS)3 | -1.0 | 1.638160-15 | -14.7856 | 1.333290-15 | -14.8751 | 8.136940-01 | -.0894 |
| 200 | CD(HS)4 | -2.0 | 6.462510-21 | -20.1896 | 2.835770-21 | -20.5473 | 4.366040-01 | -.3577 |
| 205 | CDHCO3 + | 1.0 | 1.869850-11 | -10.7282 | 1.521860-11 | -10.8176 | 8.136940-01 | -.0894 |
| 206 | CDCO3 AQ | .0 | 3.592330-10 | -9.4446 | 3.642300-10 | -9.4386 | 1.013910+00 | .0060 |
| 207 | CD(SO4)2 | -2.0 | 2.316150-14 | -13.6352 | 1.016340-14 | -13.9930 | 4.366040-01 | -.3577 |
| 208 | FBCL + | 1.0 | 4.386640-10 | -9.3579 | 3.570260-10 | -9.4473 | 8.136940-01 | -.0894 |
| 209 | FBCL2 AQ | .0 | 2.616270-11 | -10.5823 | 2.652660-11 | -10.5763 | 1.013910+00 | .0060 |
| 210 | FBCL3 - | -1.0 | 8.637790-13 | -12.0636 | 7.030240-13 | -12.1530 | 8.136940-01 | -.0894 |
| 211 | FBCL4 2- | -2.0 | 2.517460-14 | -13.5990 | 1.104680-14 | -13.9568 | 4.366040-01 | -.3577 |
| 212 | FB(CO3)2 | -2.0 | 7.202040-09 | -8.1425 | 3.160260-09 | -8.5003 | 4.366040-01 | -.3577 |
| 213 | FBF + | 1.0 | 4.751120-13 | -12.3205 | 3.691330-13 | -12.4099 | 8.136940-01 | -.0894 |
| 214 | FBFZ AQ | .0 | 4.964170-16 | -15.3042 | 5.033230-16 | -15.2982 | 1.013910+00 | .0060 |
| [illegible] | FBF3 - | -1.0 | 2.836100-19 | -18.5470 | 2.309910-19 | -18.6364 | 8.136940-01 | -.0894 |
| 216 | FBF4 2- | -2.0 | 1.576150-23 | -22.7969 | 7.003960-24 | -23.1547 | 4.366040-01 | -.3577 |
| 217 | FBOH + | 1.0 | 1.761150-09 | -8.7031 | 1.612450-09 | -8.7925 | 8.136940-01 | -.0894 |
| 218 | FB(OH)2 | .0 | 1.481230-10 | -9.8294 | 1.501840-10 | -9.8234 | 1.013910+00 | .0060 |
| 219 | FB(OH)3 | -1.0 | 5.072160-13 | -12.2945 | 4.128200-13 | -12.3842 | 8.136940-01 | -.0894 |
| 220 | FBZOH +3 | 3.0 | 7.956560-17 | -16.0993 | 1.246910-17 | -16.9042 | 1.567140-01 | -.8049 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 224 | PB(HS)3 | -1.0 | 4.083390-17 | -16.3890 | 3.32344D-17 | -16.4764 | 8.13894D-01 | -.0894 |
| 225 | PB3(OH)4 | 2.0 | 5.274320-20 | -19.2762 | 2.32317D-20 | -19.6339 | 4.36804D-01 | -.3577 |
| 230 | PBCO3 AQ | .0 | 8.571170-08 | -7.0670 | 8.690350-08 | -7.0610 | 1.01391D+00 | .0060 |
| 231 | PB(OH)4 | -2.0 | 5.171610-16 | -15.2864 | 2.269320-16 | -15.6441 | 4.36804D-01 | -.3577 |
| 232 | PB(SO4)2 | -2.0 | 7.437550-14 | -13.1266 | 3.263630-14 | -13.4863 | 4.36804D-01 | -.3577 |
| 233 | PBHCO3 + | 1.0 | 4.059470-10 | -9.3915 | 3.303950-10 | -9.4810 | 8.13894D-01 | -.0894 |
| 265 | HZASO3 - | -1.0 | 1.545630-08 | -7.8106 | 1.258140-08 | -7.9003 | 8.13894D-01 | -.0894 |
| 266 | HASO3 2- | -2.0 | 3.021320-12 | -11.5195 | 1.325770-12 | -11.8775 | 4.36804D-01 | -.3577 |
| 267 | ASO3 -3 | -3.0 | 4.910890-17 | -16.3058 | 7.696270-18 | -17.1137 | 1.56714D-01 | -.8049 |
| 268 | H4ASO3 + | 1.0 | 3.727080-16 | -15.4286 | 3.033450-16 | -15.5181 | 8.13894D-01 | -.0894 |
| 269 | HZASO4 - | -1.0 | 7.145060-14 | -13.1460 | 5.815330-14 | -13.2354 | 8.13894D-01 | -.0894 |
| 270 | HASO4 2- | -2.0 | 5.230870-12 | -11.2614 | 2.295330-12 | -11.6392 | 4.36804D-01 | -.3577 |
| 271 | ASO4 -3 | -3.0 | 6.373460-15 | -14.1956 | 9.968160-16 | -15.0005 | 1.56714D-01 | -.8049 |
| 272 | HCO3 - | -1.0 | 2.158660-03 | -2.6658 | 1.756730-03 | -2.7552 | 8.13894D-01 | -.0894 |
| 273 | HZCO3 AQ | .0 | 2.006550-05 | -4.6976 | 2.034460-05 | -4.6916 | 1.01391D+00 | .0060 |
| 274 | HSO4 - | -1.0 | 6.250820-11 | -10.2041 | 5.087500-11 | -10.2935 | 8.13894D-01 | -.0894 |
| 275 | HF AQ | .0 | 2.945310-10 | -9.5309 | 2.986280-10 | -9.5249 | 1.01391D+00 | .0060 |
| 276 | HF2 - | -1.0 | 8.126220-14 | -13.0901 | 6.613860-14 | -13.1795 | 8.13894D-01 | -.0894 |
| 277 | HZF2 AQ | .0 | 4.031790-19 | -18.3945 | 4.087860-19 | -18.3885 | 1.01391D+00 | .0060 |
| 281 | HZS AQ | .0 | 8.372360-10 | -9.0772 | 8.488640-10 | -9.0712 | 1.01391D+00 | .0060 |
| 282 | S 2- | -2.0 | 3.573940-13 | -12.4449 | 1.565260-13 | -12.8046 | 4.36804D-01 | -.3577 |
| 283 | UOH +3 | 3.0 | 5.496190-28 | -27.2598 | 6.616450-29 | -28.0647 | 1.56714D-01 | -.8049 |
| 284 | U(OH)2 + | 2.0 | 7.197800-22 | -21.1426 | 3.158420-22 | -21.5005 | 4.36804D-01 | -.3577 |
| 285 | U(OH)3 + | 1.0 | 1.376580-16 | -15.8612 | 1.120390-16 | -15.9506 | 8.13894D-01 | -.0894 |
| 286 | U(OH)4 A | .0 | 6.149400-12 | -11.2112 | 6.234940-12 | -11.2052 | 1.01391D+00 | .0060 |
| 287 | U(OH)5 - | -1.0 | 3.526440-08 | -7.4527 | 2.870150-08 | -7.5421 | 8.13894D-01 | -.0894 |
| 289 | UF2 2+ | 2.0 | 6.043520-30 | -29.2187 | 2.651920-30 | -29.5764 | 4.36804D-01 | -.3577 |
| 290 | UF3 +1 | 1.0 | 9.427820-30 | -29.0256 | 7.673240-30 | -29.1150 | 8.13894D-01 | -.0894 |
| 291 | UF4 AQ | .0 | 1.954050-29 | -28.7091 | 1.981240-29 | -28.7031 | 1.01391D+00 | .0060 |
| 301 | UO2OH +1 | 1.0 | 7.666760-19 | -18.1154 | 6.240090-19 | -18.2048 | 8.13894D-01 | -.0894 |
| 304 | UO2CO3 A | .0 | 1.216530-16 | -15.9149 | 1.233450-16 | -15.9089 | 1.01391D+00 | .0060 |
| 305 | UO2(CO3)2 | -2.0 | 2.535550-14 | -13.5959 | 1.112610-14 | -13.9537 | 4.36804D-01 | -.3577 |
| 306 | UO2(CO3)3 | -4.0 | 2.740330-13 | -12.5622 | 1.015980-14 | -13.9931 | 3.70751D-02 | -1.4309 |
| 307 | UO2F +1 | 1.0 | 7.221820-21 | -20.1414 | 5.677790-21 | -20.2308 | 8.13894D-01 | -.0894 |
| 308 | UO2F2 AQ | .0 | 2.453140-21 | -20.6050 | 2.517680-21 | -20.5990 | 1.01391D+00 | .0060 |
| 309 | UO2F3 -1 | -1.0 | 5.426380-23 | -22.2655 | 4.416500-23 | -22.3549 | 8.13894D-01 | -.0894 |
| 310 | UO2F4 2- | -2.0 | 1.137390-25 | -24.9441 | 4.990930-26 | -25.3016 | 4.36804D-01 | -.3577 |
| 311 | UO2CL +1 | 1.0 | 4.746460-23 | -22.3236 | 3.863120-23 | -22.4131 | 8.13894D-01 | -.0894 |
| 312 | UO2SO4 A | .0 | 4.707160-23 | -22.3272 | 4.772640-23 | -22.3212 | 1.01391D+00 | .0060 |
| 313 | UO2(SO4)2 | -2.0 | 5.478190-25 | -24.2614 | 2.403850-25 | -24.6191 | 4.36804D-01 | -.3577 |
| 319 | UO2-3510 | 1.0 | 1.512130-19 | -18.8204 | 1.230720-19 | -18.9098 | 8.13894D-01 | -.0894 |
| 353 | HSO3- | -1.0 | 5.433810-17 | -16.2649 | 4.422540-17 | -16.3543 | 8.13894D-01 | -.0894 |
| 354 | HZSO3 AQ | .0 | 6.953620-24 | -23.1578 | 7.050340-24 | -23.1518 | 1.01391D+00 | .0060 |
| 367 | SE2-2 | -2.0 | 5.744550-08 | -7.2429 | 2.508240-08 | -7.6006 | 4.36804D-01 | -.3577 |
| 368 | SE-2 | -2.0 | 7.249430-22 | -21.1397 | 3.181080-22 | -21.4974 | 4.36804D-01 | -.3577 |
| 369 | HSE- | -1.0 | 3.599870-15 | -14.4437 | 2.929910-15 | -14.5331 | 8.13894D-01 | -.0894 |
| 370 | HZSE | .0 | 7.313460-20 | -19.1359 | 7.415190-20 | -19.1299 | 1.01391D+00 | .0060 |
| 371 | SEO3-2 | -2.0 | 2.585530-30 | -29.5875 | 1.134540-30 | -29.9452 | 4.36804D-01 | -.3577 |
| 372 | MOO2+ | 1.0 | 4.143210-09 | -8.3827 | 3.372130-09 | -8.4721 | 8.13894D-01 | -.0894 |
| 373 | HMOO4- | -1.0 | 9.480510-29 | -28.0267 | 7.654270-29 | -28.1161 | 8.13894D-01 | -.0894 |

--- LOOK MIN IAP ---

SATURATION INDICES

| PHASE | LOG IAP | LOG KT | LOG IAP/KT |
|---|---|---|---|
| URANINIT | -12.2446 | -14.4480 | 2.2034 |
| UO2 (AM | -12.2446 | -8.5540 | -3.6906 |
| U409 (C) | -41.1271 | -41.4693 | .3422 |
| U308 (C) | -21.0314 | -6.1146 | -14.9168 |
| US104 (C | -15.9831 | -17.5043 | 1.5242 |
| UF4 (C) | -62.5559 | -28.3389 | -34.2169 |
| UF4.2.5H | -62.5550 | -37.9206 | -24.6372 |
| UO3 (C) | -4.3934 | 8.3656 | -12.7590 |

→ see Attachment D

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| | | | |
|---|---|---|---|
| SCHOEPIT | -4.3952 | 5.8027 | -10.1978 |
| RUTHERFO | -25.9919 | -14.4461 | -11.5458 |
| URANOPHA | -3.4434 | 17.4900 | -20.9334 |
| ANHYDRIT | -7.6910 | -4.5140 | -3.1770 |
| ARAGONIT | -8.7830 | -8.2261 | -.5569 |
| ARTINITE | 4.5817 | 10.5604 | -5.9787 |
| BRUCITE | 13.0939 | 17.6535 | -4.5625 |
| CALCITE | -8.7830 | -8.4123 | -.3707 |
| CELESTIT | -8.7933 | -6.4543 | -2.3390 |
| CHALCEDO | -3.7355 | -3.6740 | -.0615 |
| CHRYSOTI | 31.8025 | 33.9440 | -2.1414 |
| CLINOENS | 9.3562 | 12.0086 | -2.6524 |
| CRISTOBA | -3.7355 | -3.7738 | .0382 |
| DIOPSIDE | 18.4362 | 20.9687 | -2.5325 |
| DOLOMITE | -17.2896 | -16.7230 | -.5667 |
| EPSOMITE | -7.4207 | -2.2342 | -5.1865 |
| SEPIOLIT | 14.9739 | 18.7800 | -3.8061 |
| FERRIHYD | 14.9309 | 18.2542 | -3.3232 |
| FE3(OH)8 | 40.6676 | 46.9583 | -6.0907 |
| FEOH)2.7 | 11.9854 | 10.3242 | 1.6612 |
| FES PPT | -40.9044 | -39.5696 | -1.3147 |
| FE2(SO4) | -31.6549 | 32.2838 | -63.9388 |
| FLUORITE | -12.3402 | -11.1174 | -1.2228 |
| FORSTERI | 22.4487 | 29.9210 | -7.4730 |
| GOETHITE | 14.9316 | 14.3480 | .5836 |
| GREENALI | 25.5471 | 20.8100 | 4.7371 |
| GREIGITE | -166.7729 | -160.9802 | -5.7926 |
| GYPSUM | -7.6927 | -4.8587 | -2.8340 |
| HALITE | -2.7036 | 1.5493 | -4.2501 |
| HEMATITE | 29.8644 | 23.7592 | 6.1053 |
| HUNTITE | -34.3030 | -29.1092 | -5.1938 |
| HYDRMAGN | -20.9392 | -7.0254 | -13.9138 |
| JAROSITE | 3.7799 | 29.8453 | -26.0655 |
| MACKINAW | -40.9044 | -40.3196 | -.5847 |
| MAGADIIT | -19.0347 | -14.3000 | -4.7347 |
| MAGHEMIT | 29.8644 | 33.1183 | -3.2539 |
| MAGNESIT | -8.5067 | -7.8238 | -.6828 |
| MAGNETIT | 40.8711 | 32.1545 | 8.7166 |
| MELANTER | -9.5056 | -2.5656 | -6.9403 |
| MIRABILI | -6.2791 | -1.7446 | -4.5345 |
| NATRON | -7.3711 | -1.8360 | -5.5351 |
| NESQUEHO | -8.5093 | -5.4265 | -3.0827 |
| PYRITE | -64.9642 | -70.1968 | 5.2326 |
| QUARTZ | -3.7355 | -4.2178 | .4823 |
| SIDERITE | -10.5918 | -10.3719 | -.2199 |
| SIO2(A,G | -3.7355 | -2.8330 | -.9025 |
| SIO2(A,P | -3.7355 | -2.8330 | -.9025 |
| SRF2 | -13.4425 | -8.5818 | -4.8607 |
| STRONTIA | -9.8853 | -9.2269 | -.6584 |
| TALC | 24.3323 | 24.2299 | .1024 |
| THENARDI | -6.2704 | -.1610 | -6.1095 |
| THERMONA | -7.3633 | .2236 | -7.5869 |
| TREMOLIT | 61.2047 | 59.7783 | 1.4264 |
| PYROLUSI | 18.0724 | 43.2059 | -25.1335 |
| BIRNESSI | 18.0724 | 44.4608 | -26.3884 |
| NSUTITE | 18.0724 | 43.8705 | -25.7984 |
| BIXBYITE | 28.2936 | 52.6308 | -24.3372 |
| HAUSMANN | 38.5148 | 64.2179 | -25.7031 |
| PYROCROI | 10.2204 | 15.8449 | -5.6245 |
| MANGANIT | 14.1464 | 26.1308 | -11.9844 |
| RHODOCHR | -11.3772 | -10.3405 | -1.0367 |
| MNCL2, 4 | -9.4199 | 2.1292 | -11.5492 |
| MNS GREE | -41.6598 | -31.6761 | -10.0136 |
| MNCO3 | -10.2852 | 3.1873 | -13.4725 |

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|---|---|---|---|
| ZNCO3, 1 | -12.5143 | -10.2600 | -2.2543 |
| ZNF2 | -16.0706 | -1.0829 | -14.9877 |
| ZN(OH)2 | 9.0842 | 11.5000 | -2.4158 |
| ZN2(OH)3 | 8.3499 | 15.2000 | -6.8501 |
| ZN5(OH)8 | 25.7841 | 38.5000 | -12.7159 |
| ZN7(OH)2 | -2.3372 | 7.5000 | -9.8372 |
| ZN4(OH)6 | 15.8311 | 28.4000 | -12.5689 |
| ZNNO3)2, | -169.6812 | 3.2559 | -172.9371 |
| ZNO(ACT) | 9.0850 | 11.3100 | -2.2250 |
| ZINCITE | 9.0850 | 11.8705 | -2.7854 |
| ZN3O(SO4 | -13.7578 | 21.0918 | -34.8495 |
| ZNS (A) | -42.8260 | -44.8423 | 2.0163 |
| SPHALERI | -42.8260 | -47.5653 | 4.7393 |
| WURTZITE | -42.8260 | -45.5187 | 2.6927 |
| ZNSIO3 | 5.3495 | 3.5405 | 1.8090 |
| WILLEMIT | 14.4346 | 16.4451 | -2.0105 |
| ZINCOSIT | -11.4214 | 3.6516 | -15.0730 |
| ZNSO4, 1 | -11.4223 | -.2145 | -11.2078 |
| BIANCHIT | -11.4266 | -1.7547 | -9.6719 |
| GOSLARIT | -11.4275 | -2.0703 | -9.3572 |
| CD METAL | -1.0903 | 14.0915 | -15.1818 |
| GAMMA CD | -1.0903 | 14.1962 | -15.2865 |
| OTAVITE | -14.6376 | -13.7206 | -1.1170 |
| CDCL2 | -12.8769 | -.5306 | -12.3463 |
| CDCL2, 1 | -12.8778 | -1.6492 | -11.2286 |
| CDCL2,2. | -12.8790 | -1.9971 | -10.8819 |
| CDF2 | -16.3945 | -2.6552 | -15.7396 |
| CD(OH)2 | 6.7600 | 13.6500 | -6.8900 |
| CDOHCL | -3.0585 | 3.7676 | -6.8261 |
| CD3(OH)4 | -.2257 | 22.5600 | -22.7857 |
| CD3OH2(S | -20.7313 | 6.7100 | -27.4413 |
| CD4(OH)6 | 6.5342 | 28.4000 | -21.8658 |
| MONTEPON | 6.7608 | 15.9474 | -9.1865 |
| CDSIO3 | 3.0253 | 9.6157 | -6.5904 |
| CDSO4 | -13.7456 | .3925 | -14.1382 |
| CDSO4, 1 | -13.7465 | -1.4087 | -12.3378 |
| CDSO4,2. | -13.7479 | -1.7263 | -12.0216 |
| GREENOCK | -45.1502 | -52.1463 | 6.9961 |
| PB METAL | -.5537 | 4.2566 | -4.8103 |
| COTUNNIT | -12.3402 | -4.9571 | -7.3831 |
| MATLOCKI | -15.0992 | -9.6957 | -5.4035 |
| PHOSGENI | -26.6412 | -19.8100 | -6.8312 |
| CERRUSIT | -14.3010 | -13.2924 | -1.0086 |
| PBF2 | -17.8582 | -7.4166 | -10.4415 |
| MASSICOT | 7.2975 | 13.4707 | -6.1732 |
| LITHARGE | 7.2975 | 13.2673 | -5.9699 |
| PBO, .3H | 7.2972 | 12.9800 | -5.6828 |
| PB2OCO3 | -7.0035 | -.1171 | -6.8864 |
| LARNAKIT | -5.9115 | -.0648 | -5.8467 |
| PB3O2SO4 | 1.3860 | 11.0934 | -9.7074 |
| PB4O3SO4 | 8.6835 | 23.2719 | -14.5884 |
| PB3O2CO3 | .2940 | 11.9032 | -11.6092 |
| PBSIO3 | 3.5619 | 7.6294 | -4.0675 |
| PB2SIO4 | 10.8594 | 20.6268 | -9.7694 |
| ANGLESIT | -13.2090 | -7.8618 | -5.3471 |
| GALENA | -44.6135 | -51.4479 | 6.8344 |
| PLATTNER | 15.1456 | 51.6635 | -36.5149 |
| PB2O3 | 22.4461 | 61.0400 | -38.5939 |
| MINIUM | 29.7436 | 77.1235 | -47.3802 |
| PB(OH)2 | 7.2966 | 8.6175 | -1.3209 |
| LAURIONI | -2.5218 | .6200 | -3.1418 |
| PB2(OH)3 | 4.7748 | 8.7900 | -4.0152 |
| HYDCERRU | -21.3053 | -17.4800 | -3.8453 |

see Attachment D

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| | | | |
|---|---|---|---|
| PB4(OH)6 | 8.6809 | 21.1000 | -12.4191 |
| ARSENOLI | -109.1150 | -85.0707 | -24.0442 |
| CLAUDETI | -109.1150 | -85.2960 | -23.8190 |
| ORIPMENT | -210.2905 | -211.6446 | 1.3541 |
| REALGAR | -83.1153 | -76.8833 | -6.2320 |
| AS2O5 | -38.8552 | 6.8808 | -45.7360 |
| SULFUR | -44.0599 | -37.6393 | -6.4206 |
| CA3(ASO4 | -.4122 | 22.3000 | -22.7122 |
| FEASO4.2 | -4.4971 | 13.7642 | -18.2613 |
| MN3ASO42 | -8.1984 | 12.8000 | -20.6984 |
| PB3(ASO4 | -16.9627 | 5.8000 | -22.7627 |
| ZN3ASO42 | -11.6022 | 13.6500 | -25.2522 |
| LIME | 12.8155 | 34.3458 | -21.5303 |
| PORTLAND | 12.8146 | 23.6955 | -10.8809 |
| WUSTITE | 10.8394 | 12.5204 | -1.6810 |
| PERICLAS | 13.0918 | 22.7173 | -9.6255 |
| MAG-FERR | 42.9562 | 45.7251 | -2.7689 |
| WOLLASTO | 9.0799 | 13.6516 | -4.5717 |
| P-WOLLST | 9.0799 | 14.5541 | -5.4741 |
| CA-OLIVI | 21.8954 | 39.4775 | -17.5821 |
| LARNITE | 21.8954 | 41.0527 | -19.1573 |
| CA3SIO5 | 34.7109 | 77.4231 | -42.7122 |
| MONTICEL | 22.1717 | 31.9214 | -9.7497 |
| AKERMINI | 31.2816 | 50.0243 | -18.7427 |
| MERWINIT | 44.0671 | 72.1192 | -28.0520 |
| LEPIDOCR | 14.9318 | 14.7342 | .1976 |
| FE(OH)3S | 14.9309 | 16.0342 | -1.1032 |
| NAZSO3 | -14.1216 | 5.0489 | -19.1705 |
| KZSO3 | -19.3118 | 8.2828 | -27.5946 |
| CASO3.2H | -15.5439 | -3.5819 | -11.9619 |
| CASO3.5H | -15.5426 | -3.1266 | -12.4159 |
| MGSO3 | -15.2658 | 7.1152 | -22.3810 |
| CH4(GAS) | -53.0047 | -43.1184 | -9.8864 |
| CO2(GAS) | -21.5984 | -18.1777 | -3.4207 |
| O2(GAS) | 15.7023 | 87.6856 | -71.9833 |
| CAMOO4 | -9.9596 | -7.7434 | -2.2164 |
| NAT. SE | 62.5854 | -63.7019 | 126.2873 |
| FERROSEL | -122.0110 | -130.7170 | 8.7060 |

see Attachment D

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**Attachment D: PHREEQE model predicted dissolved species and minerals-saturation indices on various constituents present in the Mancos groundwater, Well 982.**

```
gr jD3 Cheney, Mancos water combination, well 982
00000120000 0 0          .00000
ELEMENTS
C          10          50.
           0           0.
SOLUTION 2
gr jD3 Mancos Shale, well #982 at Cheney
16 10 2      7.27      -6.23      14.0      1.00
   9  3.7000+00  10  1.0020+03  11  1.9500+01  12  4.0000-03  13  2.3200+03
  17  7.0000-02  19  7.9000+00  21  1.7200+01  22  1.0000-01  24  2.3000+03
  27  3.0000-02  29  1.0400+03  30  1.1800+01  31  4.5000+00  32  4.3000-03
  34  2.0000-02  35  3.3400-02  37  2.3000-02
SOLUTION NUMBER 2          gr jD3 Mancos Shale, well #982 at Cheney
```

pH

Pe

temperature in °C

density of solution, g/c.c

TOTAL MOLALITIES OF ELEMENTS

continue

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| | | |
|---|---|---|
| BR | 4.661917D-05 | -4.3314 |
| TOT ALK | 2.015774D-02 | -1.6956 |
| CA | 4.696219D-04 | -3.3285 |
| CD | 3.562639D-08 | -7.4456 |
| CL | 6.568193D-02 | -1.1812 |
| FE | 1.261913D-06 | -5.8990 |
| K | 2.034040D-04 | -3.6916 |
| MG | 7.122608D-04 | -3.1474 |
| MN | 1.832561D-06 | -5.7369 |
| NA | 1.007219D-01 | -.9969 |
| PB | 1.457753D-07 | -6.8363 |
| S | 1.089971D-02 | -1.9626 |
| SI | 1.236004D-04 | -3.9080 |
| SR | 5.170595D-05 | -4.2665 |
| U | 1.603213D-08 | -7.7950 |
| ZN | 3.060232D-07 | -6.5114 |
| MO | 2.102457D-07 | -6.6773 |
| SE | 1.809523D-07 | -6.7424 |

FOR GROUNDWATER IN WELL #982

----DESCRIPTION OF SOLUTION----

| | |
|---|---|
| PH = | 7.2700 |
| PE = | -6.2308 |
| ACTIVITY H2O = | .9967 |
| IONIC STRENGTH = | .0956 |
| TEMPERATURE = | 14.0000 |
| ELECTRICAL BALANCE = | 1.7353D-02 |
| THOR = | -1.0000D+05 |
| TOTAL ALKALINITY = | 2.0152D-02 |
| ITERATIONS = | 15 |
| TOTAL CARBON = | 1.4613D-02 |

DISTRIBUTION OF SPECIES : DISSOLVED SPECIES :

| I | SPECIES | Z | MOLALITY | LOG MOLALITY | ACTIVITY | LOG ACTIVITY | GAMMA | LOG GAMMA |
|---|---|---|---|---|---|---|---|---|
| 1 | H+ | 1.0 | 6.825250-08 | -7.1659 | 5.370320-08 | -7.2700 | 7.868310-01 | -.1041 |
| 2 | E- | -1.0 | 1.701370+06 | 6.2308 | 1.701370+06 | 6.2308 | 1.000000+00 | .0000 |
| 3 | H2O | .0 | 9.967130-01 | -.0014 | 9.967130-01 | -.0014 | 1.000000+00 | .0000 |
| 9 | BR- | -1.0 | 4.661920-05 | -4.3314 | 3.668140-05 | -4.4356 | 7.868310-01 | -.1041 |
| 10 | CO3 2- | -2.0 | 1.770360-05 | -4.7519 | 6.785660-06 | -5.1684 | 3.832690-01 | -.4165 |
| 11 | CA 2+ | 2.0 | 4.693760-04 | -3.3285 | 1.999800-04 | -3.6990 | 4.260550-01 | -.3705 |
| 12 | CD 2+ | 2.0 | 2.422900-20 | -19.6157 | 9.266730-21 | -20.0321 | 3.832690-01 | -.4165 |
| 13 | CL- | -1.0 | 6.568180-02 | -1.1812 | 5.025210-02 | -1.2988 | 7.627620-01 | -.1176 |
| 17 | FE 2+ | 2.0 | 7.407580-11 | -10.1303 | 2.839250-11 | -10.5468 | 3.832890-01 | -.4165 |
| 19 | K+ | 1.0 | 2.034040-04 | -3.6916 | 1.551490-04 | -3.8093 | 7.627620-01 | -.1176 |
| 21 | MG 2+ | 2.0 | 6.693760-04 | -3.1743 | 2.952990-04 | -3.5297 | 4.411550-01 | -.3554 |
| 22 | MN 2+ | 2.0 | 1.565130-06 | -5.8055 | 5.996960-07 | -6.2219 | 3.832690-01 | -.4165 |
| 24 | NA+ | 1.0 | 1.007260-01 | -.9964 | 7.912590-02 | -1.1017 | 7.862980-01 | -.1033 |
| 27 | PB 2+ | 2.0 | 6.169940-18 | -17.2097 | 2.364870-18 | -17.6262 | 3.832690-01 | -.4165 |
| 29 | SO4 2- | -2.0 | 2.576620-22 | -21.5889 | 9.232560-23 | -22.0347 | 3.583200-01 | -.4457 |
| 30 | H4SIO4 | .0 | 1.234060-04 | -3.9087 | 1.261510-04 | -3.8991 | 1.022250+00 | .0096 |
| 31 | SR 2+ | 2.0 | 5.170590-05 | -4.2665 | 1.981630-05 | -4.7029 | 3.832690-01 | -.4165 |
| 32 | UO2 2+ | 2.0 | 3.167070-24 | -23.4993 | 1.213900-24 | -23.9158 | 3.832690-01 | -.4165 |
| 34 | ZN 2+ | 2.0 | 2.865610-17 | -16.5398 | 1.106320-17 | -16.9562 | 3.832690-01 | -.4165 |
| 35 | MOO4 2- | -2.0 | 6.720920-11 | -10.1726 | 2.576060-11 | -10.5890 | 3.832690-01 | -.4165 |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 61 | OH2 + | 1.0 | 1.78543D-13 | -12.7532 | 1.55328D-13 | -12.8074 | [illegible] | [illegible] | |
| 65 | OH- | -1.0 | 9.99974D-06 | -7.0000 | 7.86611D-08 | -7.1041 | 7.86831D-01 | -.1041 | |
| 66 | H3SIO4 - | -1.0 | 1.94294D-07 | -6.7115 | 1.52676D-07 | -6.8157 | 7.86831D-01 | -.1041 | |
| 67 | H2SIO4-- | -2.0 | 3.78991D-12 | -11.4214 | 1.45263D-12 | -11.8378 | 3.83289D-01 | -.4165 | |
| 76 | MGOH + | 1.0 | 4.24261D-09 | -8.3724 | 3.33822D-09 | -8.4765 | 7.86831D-01 | -.1041 | |
| 78 | MGCO3 AQ | .0 | 1.58000D-06 | -5.8013 | 1.61515D-06 | -5.7918 | 1.02225D+00 | .0096 | |
| 79 | MGHCO3 + | 1.0 | 4.12990D-05 | -4.3841 | 3.24954D-05 | -4.4882 | 7.86831D-01 | -.1041 | |
| 80 | MGSO4 AQ | .0 | 4.33263D-24 | -23.3633 | 4.42898D-24 | -23.3537 | 1.02225D+00 | .0096 | |
| 84 | CAOH + | 1.0 | 4.65119D-10 | -9.3324 | 3.65970D-10 | -9.4366 | 7.86831D-01 | -.1041 | |
| 85 | CAHCO3 + | 1.0 | 1.89096D-05 | -4.7233 | 1.48787D-05 | -4.8274 | 7.86831D-01 | -.1041 | |
| 86 | CACO3 AQ | .0 | 1.53571D-06 | -5.8137 | 1.56987D-06 | -5.8041 | 1.02225D+00 | .0096 | |
| 87 | CASO4 AQ | .0 | 3.34563D-24 | -23.4755 | 3.42006D-24 | -23.4660 | 1.02225D+00 | .0096 | |
| 92 | NACO3 - | -1.0 | 7.10930D-06 | -5.1482 | 5.59382D-06 | -5.2523 | 7.86831D-01 | -.1041 | |
| 93 | NAHCO3 A | .0 | 3.39121D-04 | -3.4696 | 3.46665D-04 | -3.4601 | 1.02225D+00 | .0096 | |
| 94 | NASO4 - | -1.0 | 4.32825D-23 | -22.3637 | 3.40560D-23 | -22.4678 | 7.86831D-01 | -.1041 | |
| 97 | KSO4 - | -1.0 | 1.04823D-25 | -24.9795 | 8.24784D-26 | -25.0837 | 7.86831D-01 | -.1041 | |
| 109 | FEOH + | 1.0 | 9.02177D-14 | -13.0447 | 7.09861D-14 | -13.1488 | 7.86831D-01 | -.1041 | |
| 110 | FEOH3 -1 | -1.0 | 3.25291D-21 | -20.4877 | 2.55949D-21 | -20.5918 | 7.86831D-01 | -.1041 | |
| 113 | FEOH2 AQ | .0 | 4.06204D-18 | -17.3913 | 4.15241D-18 | -17.3817 | 1.02225D+00 | .0096 | |
| 115 | FE(HS)2 | .0 | 7.34059D-07 | -6.1343 | 7.50390D-07 | -6.1247 | 1.02225D+00 | .0096 | |
| 116 | FE(HS)3 | -1.0 | 5.27780D-07 | -6.2775 | 4.15274D-07 | -6.3817 | 7.86831D-01 | -.1041 | |
| 117 | FEOH 2+ | 2.0 | 1.29624D-25 | -24.8873 | 4.96835D-26 | -25.3038 | 3.83289D-01 | -.4165 | |
| 120 | FECL 2+ | 2.0 | 2.23880D-30 | -29.6500 | 8.58109D-31 | -30.0665 | 3.83289D-01 | -.4165 | |
| 123 | FEOH2 + | 1.0 | 2.54899D-22 | -21.5936 | 2.00562D-22 | -21.6978 | 7.86831D-01 | -.1041 | |
| 124 | FEOH3 AQ | .0 | 2.22678D-23 | -22.6523 | 2.27632D-23 | -22.6428 | 1.02225D+00 | .0096 | |
| 125 | FEOH4 - | -1.0 | 3.76264D-24 | -23.4245 | 2.96356D-24 | -23.5286 | 7.86831D-01 | -.1041 | |
| 134 | SROH + | 1.0 | 1.21853D-11 | -10.9152 | 9.56418D-12 | -11.0194 | 7.86831D-01 | -.1041 | |
| 136 | MNCL + | 1.0 | 1.55086D-07 | -6.8097 | 1.21964D-07 | -6.9138 | 7.86831D-01 | -.1041 | |
| 137 | MNCL2 AQ | .0 | 1.62868D-09 | -8.7882 | 1.66489D-09 | -8.7786 | 1.02225D+00 | .0096 | |
| 138 | MNCL3 - | -1.0 | 4.79355D-11 | -10.3193 | 3.77172D-11 | -10.4235 | 7.86831D-01 | -.1041 | |
| 139 | MNO- + | 1.0 | 1.43374D-10 | -9.8435 | 1.12811D-10 | -9.9476 | 7.86831D-01 | -.1041 | |
| 140 | MN(OH)3 | -1.0 | 7.72513D-20 | -19.1121 | 6.07838D-20 | -19.2162 | 7.86831D-01 | -.1041 | |
| 142 | MNSO4 AQ | .0 | 8.56567D-27 | -26.0671 | 8.75730D-27 | -26.0575 | 1.02225D+00 | .0096 | |
| 144 | MNHCO3 + | 1.0 | 1.10606D-07 | -6.9562 | 8.70299D-08 | -7.0603 | 7.86831D-01 | -.1041 | |
| 162 | ZNCL + | 1.0 | 1.14897D-18 | -17.9397 | 9.04049D-19 | -18.0438 | 7.86831D-01 | -.1041 | |
| 163 | ZNCL2 AQ | .0 | 4.44483D-20 | -19.3521 | 4.54371D-20 | -19.3426 | 1.02225D+00 | .0096 | |
| 164 | ZNCL3 - | -1.0 | 3.04033D-21 | -20.5171 | 2.39223D-21 | -20.6212 | 7.86831D-01 | -.1041 | |
| 165 | ZNCL4 2- | -2.0 | 1.43259D-22 | -21.8439 | 5.49096D-23 | -22.2604 | 3.83289D-01 | -.4165 | |
| 167 | ZNOH + | 1.0 | 1.14878D-19 | -18.9398 | 9.03897D-20 | -19.0439 | 7.86831D-01 | -.1041 | |
| 168 | ZN(OH)2 | .0 | 1.22554D-20 | -19.9117 | 1.25281D-20 | -19.9021 | 1.02225D+00 | .0096 | |
| 169 | ZN(OH)3 | -1.0 | 5.39401D-25 | -24.2681 | 4.24418D-25 | -24.3722 | 7.86831D-01 | -.1041 | |
| 170 | ZN(OH)4 | -2.0 | 1.28364D-30 | -29.8915 | 4.92084D-31 | -30.3080 | 3.83289D-01 | -.4165 | |
| 171 | ZNOHCL A | .0 | 3.34144D-19 | -18.4761 | 3.41577D-19 | -18.4665 | 1.02225D+00 | .0096 | |
| 172 | ZN(HS)2 | .0 | 2.79446D-07 | -6.5537 | 2.85663D-07 | -6.5441 | 1.02225D+00 | .0096 | |
| 173 | ZN(HS)3 | -1.0 | 2.65772D-08 | -7.5440 | 2.24854D-08 | -7.6481 | 7.86831D-01 | -.1041 | |
| 176 | ZNBR + | 1.0 | 1.35622D-22 | -21.8677 | 1.06711D-22 | -21.9718 | 7.86831D-01 | -.1041 | |
| 177 | ZNBR2 AQ | .0 | 1.52441D-27 | -26.8169 | 1.55832D-27 | -26.8073 | 1.02225D+00 | .0096 | |
| 180 | ZNHCO3 + | 1.0 | 6.44873D-28 | -27.1905 | 5.07406D-28 | -27.2946 | 7.86831D-01 | -.1041 | |
| 181 | ZNCO3 AQ | .0 | 1.46487D-17 | -16.8342 | 1.49746D-17 | -16.8246 | 1.02225D+00 | .0096 | |
| 182 | ZN(CO3)2 | -2.0 | 5.66789D-18 | -17.2466 | 2.17244D-18 | -17.6631 | 3.83289D-01 | -.4165 | |
| 183 | CDCL + | 1.0 | 5.45217D-20 | -19.2634 | 4.28994D-20 | -19.3675 | 7.86831D-01 | -.1041 | |
| 184 | CDCL2 AQ | .0 | 8.42945D-21 | -20.0742 | 8.61697D-21 | -20.0646 | 1.02225D+00 | .0096 | |
| 185 | CDCL3 - | -1.0 | 2.91703D-22 | -21.5351 | 2.29521D-22 | -21.6392 | 7.86831D-01 | -.1041 | |
| 188 | CD(CO3)3 | -4.0 | 2.23117D-28 | -27.6515 | 4.81546D-30 | -29.3174 | 2.15827D-02 | -1.6659 | |
| 189 | CDOH + | 1.0 | 7.81145D-24 | -23.1073 | 6.14629D-24 | -23.2114 | 7.86831D-01 | -.1041 | |
| 190 | CD(OH)2 | .0 | 1.39781D-26 | -25.8546 | 1.42890D-26 | -25.8450 | 1.02225D+00 | .0096 | |
| 194 | CDOHCL A | .0 | 2.52204D-22 | -21.5982 | 2.57815D-22 | -21.5887 | 1.02225D+00 | .0096 | |
| 197 | CDHS + | 1.0 | 9.50663D-13 | -12.0220 | 7.48011D-13 | -12.1261 | 7.86831D-01 | -.1041 | |
| 198 | CD(HS)2 | .0 | 9.12836D-09 | -8.0396 | 9.33144D-09 | -8.0301 | 1.02225D+00 | .0096 | |
| 199 | CD(HS)3 | -1.0 | 9.77503D-09 | -8.0099 | 7.69130D-09 | -8.1140 | 7.86831D-01 | -.1041 | |
| 200 | CD(HS)4 | -2.0 | 1.69240D-08 | -7.7715 | 6.46680D-09 | -8.1880 | 3.83289D-01 | -.4165 | |
| 201 | CDBR + | 1.0 | 6.74793D-23 | -22.1708 | 5.30946D-23 | -22.2749 | 7.86831D-01 | -.1041 | |
| 202 | CDBR2 AQ | .0 | 9.68722D-27 | -26.0136 | 9.90273D-27 | -26.0042 | 1.02225D+00 | .0096 | |

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|---|---|---|---|---|---|---|---|---|---|
| 206 | CUCO3 AQ | .0 | 1.544890-20 | -19.8111 | 1.577260-20 | -19.8015 | 1.022250+00 | .0096 | |
| 208 | PBCL + | 1.0 | 4.530010-18 | -17.3439 | 3.564350-18 | -17.4480 | 7.668310-01 | -.1041 | |
| 209 | PBCL2 AQ | .0 | 3.437450-19 | -18.4638 | 3.513920-19 | -18.4542 | 1.022250+00 | .0096 | |
| 210 | PBCL3 - | -1.0 | 1.657520-20 | -19.7805 | 1.304190-20 | -19.8847 | 7.668310-01 | -.1041 | |
| 211 | PBCL4 2- | -2.0 | 7.512480-22 | -21.1242 | 2.679450-22 | -21.5407 | 3.832690-01 | -.4165 | |
| 212 | PB(CO3)2 | -2.0 | 1.240120-17 | -16.9065 | 4.753260-18 | -17.3230 | 3.832690-01 | -.4165 | |
| 217 | PBOH + | 1.0 | 1.057670-18 | -17.9635 | 8.556110-19 | -18.0676 | 7.668310-01 | -.1041 | |
| 218 | PB(OH)2 | .0 | 6.044930-21 | -20.2186 | 6.179410-21 | -20.2091 | 1.022250+00 | .0096 | |
| 219 | PB(OH)3 | -1.0 | 1.673540-24 | -23.7764 | 1.316800-24 | -23.8805 | 7.668310-01 | -.1041 | |
| 223 | PB(HS)2 | .0 | 1.277420-07 | -6.8937 | 1.305840-07 | -6.8841 | 1.022250+00 | .0096 | |
| 224 | PB(HS)3 | -1.0 | 1.803260-08 | -7.7439 | 1.418860-08 | -7.8481 | 7.668310-01 | -.1041 | |
| 226 | PBBR + | 1.0 | 5.368990-21 | -20.2685 | 4.240230-21 | -20.3726 | 7.668310-01 | -.1041 | |
| 227 | PBBR2 AQ | .0 | 8.573220-26 | -25.0669 | 8.763950-26 | -25.0573 | 1.022250+00 | .0096 | |
| 230 | PBCO3 AQ | .0 | 2.727990-16 | -15.5642 | 2.766680-16 | -15.5546 | 1.022250+00 | .0096 | |
| 231 | PB(OH)4 | -2.0 | 1.464070-26 | -27.8344 | 5.611600-29 | -28.2509 | 3.832690-01 | -.4165 | |
| 233 | PBHCO3 + | 1.0 | 1.735870-17 | -16.7605 | 1.365840-17 | -16.8646 | 7.668310-01 | -.1041 | |
| 272 | HCO3 - | -1.0 | 1.277820-02 | -1.8935 | 1.005430-02 | -1.9976 | 7.668310-01 | -.1041 | |
| 273 | H2CO3 AQ | .0 | 1.408940-03 | -2.8511 | 1.440280-03 | -2.8416 | 1.022250+00 | .0096 | |
| 274 | HSO4 - | -1.0 | 4.532540-26 | -27.3437 | 3.566350-26 | -27.4478 | 7.668310-01 | -.1041 | |
| 281 | H2S AQ | .0 | 3.974650-03 | -2.4007 | 4.063110-03 | -2.3911 | 1.022250+00 | .0096 | |
| 282 | S 2- | -2.0 | 1.461430-08 | -7.8352 | 5.601490-09 | -8.2517 | 3.832690-01 | -.4165 | |
| 283 | UOH +3 | 3.0 | 7.448490-24 | -23.1279 | 8.610000-25 | -24.0650 | 1.155940-01 | -.9371 | |
| 284 | U(OH)2 + | 2.0 | 6.873190-19 | -18.1626 | 2.634420-19 | -18.5793 | 3.832690-01 | -.4165 | |
| 285 | U(OH)3 + | 1.0 | 9.780720-15 | -14.0096 | 7.695770-15 | -14.1137 | 7.668310-01 | -.1041 | |
| 286 | U(OH)4 A | .0 | 3.333360-11 | -10.4771 | 3.427510-11 | -10.4676 | 1.022250+00 | .0096 | |
| 287 | U(OH)5 - | -1.0 | 1.599880-08 | -7.7959 | 1.258830-08 | -7.9000 | 7.668310-01 | -.1041 | |
| 294 | UCL +3 | 3.0 | 2.231980-30 | -29.6513 | 2.580010-31 | -30.5884 | 1.155940-01 | -.9371 | |
| 301 | UO2CL +1 | 1.0 | 1.202340-22 | -21.9200 | 9.460420-23 | -22.0241 | 7.668310-01 | -.1041 | |
| 304 | UO2CO3 A | .0 | 9.756580-20 | -19.0107 | 9.973630-20 | -19.0011 | 1.022250+00 | .0096 | |
| 305 | UO2(CO3)2 | -2.0 | 1.149680-17 | -16.9394 | 4.406600-18 | -17.3559 | 3.832690-01 | -.4165 | |
| 306 | UO2(CO3)3 | -4.0 | 7.505460-17 | -16.1246 | 1.619880-18 | -17.7935 | 2.158270-02 | -1.6659 | |
| 311 | UO2CL +1 | 1.0 | 1.188260-25 | -24.9252 | 9.347990-26 | -25.0293 | 7.668310-01 | -.1041 | |
| 319 | UO2HSO4 | 1.0 | 1.442760-23 | -22.8408 | 1.135210-23 | -22.9449 | 7.668310-01 | -.1041 | |
| 353 | HSO3- | -1.0 | 2.177490-28 | -27.6620 | 1.713320-28 | -27.7662 | 7.668310-01 | -.1041 | |
| 367 | SE2-2 | -2.0 | 8.727460-15 | -14.0591 | 3.348140-15 | -14.4756 | 3.832690-01 | -.4165 | |
| 368 | SE-2 | -2.0 | 3.635280-15 | -14.4431 | 1.381790-15 | -14.8596 | 3.832690-01 | -.4165 | |
| 369 | HSE- | -1.0 | 1.839140-07 | -6.7425 | 1.423430-07 | -6.8467 | 7.668310-01 | -.1041 | |
| 370 | H2SE | .0 | 4.884800-11 | -10.3387 | 4.656800-11 | -10.3291 | 1.022250+00 | .0096 | |
| 5 372 | MOO2+ | 1.0 | 1.899710-07 | -6.7213 | 1.494910-07 | -6.8254 | 7.668310-01 | -.1041 | |
| 6 373 | HMOO4- | -1.0 | 2.018710-08 | -7.6949 | 1.588390-08 | -7.7990 | 7.668310-01 | -.1041 | |

---- LOOK MIN IAP ----

SATURATION INDICES

| PHASE | LOG IAP | LOG KT | LOG IAP/KT |
|---|---|---|---|
| URANINIT | -11.4542 | -14.3636 | 2.9094 |
| UO2 (AM | -11.4542 | -8.5102 | -2.9440 |
| U4O9 (C) | -43.7399 | -41.2746 | -2.4653 |
| U3O8 (C) | -30.2087 | -6.1826 | -24.0261 |
| USiO4 (C | -15.3505 | -17.3982 | 2.0477 |
| UO3 (C) | -9.3772 | 8.2625 | -17.6397 |
| GUMMITE | -9.3772 | 11.0461 | -20.4233 |
| B-UO2(OH | -9.3787 | 5.9255 | -15.3042 |
| SCHOEPIT | -9.3801 | 5.7383 | -15.1184 |
| RUTHERFO | -29.0842 | -14.4461 | -14.6381 |
| URANOPHA | -15.7089 | 17.4900 | -33.1989 |
| ANHYDRIT | -25.7337 | -4.5341 | -21.1995 |
| ARAGONIT | -8.8674 | -8.2419 | -.6256 |
| ARTINITE | 2.3050 | 10.4070 | -8.1020 |
| BRUCITE | 11.0074 | 17.5155 | -6.5081 |
| CALCITE | -8.8674 | -8.4193 | -.4482 |
| CELESTIT | -26.7376 | -6.4568 | -20.2808 |
| CHALCEDO | -3.8962 | -3.6494 | -.2468 |

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| | | | |
|---|---|---|---|
| DIOPSIDE | 14.0559 | 20.7964 | -6.7405 |
| DOLOMITE | -17.5656 | -16.7672 | -.7983 |
| EPSOMITE | -25.5744 | -2.2192 | -23.3552 |
| SEPIOLIT | 10.3239 | 16.7800 | -6.4561 |
| FERRIHYD | 5.0281 | 18.2008 | -13.1727 |
| FE3(OH)8 | 14.0466 | 46.8516 | -32.8050 |
| FEOH)2.7 | 2.4579 | 10.2708 | -7.8129 |
| FES PPT | -40.8894 | -39.2686 | -1.6208 |
| FE2(SO4) | -99.6592 | 31.8615 | -131.5207 |
| FORSTERI | 18.1214 | 29.6621 | -11.5406 |
| GOETHITE | 5.0295 | 14.2173 | -9.1878 |
| GREENALI | 4.1600 | 20.8100 | -16.6300 |
| GREIGITE | -165.4722 | -159.8029 | -5.6694 |
| GYPSUM | -25.7366 | -4.8573 | -20.8793 |
| HALITE | -2.4005 | 1.5542 | -3.9547 |
| HEMATITE | 10.0605 | 23.4876 | -13.4272 |
| HUNTITE | -34.9619 | -29.2467 | -5.7151 |
| HYDRMAGN | -23.7909 | -7.3041 | -16.4868 |
| JAROSITE | -58.0622 | 29.3908 | -87.4530 |
| MACKINAW | -40.8894 | -39.9986 | -.8908 |
| MAGADIIT | -21.1126 | -14.3000 | -6.8126 |
| MAGHEMIT | 10.0605 | 33.0116 | -22.9510 |
| MAGNESIT | -8.6981 | -7.8568 | -.8414 |
| MAGNETIT | 14.0523 | 31.7784 | -17.7261 |
| MELANTER | -32.5915 | -2.5503 | -30.0412 |
| MIRABILI | -24.2523 | -1.6432 | -22.6091 |
| NATRON | -7.3861 | -1.7519 | -5.6341 |
| NESQUEHO | -8.7024 | -5.4574 | -3.2450 |
| PYRITE | -83.6935 | -89.4945 | 5.8010 |
| QUARTZ | -3.8762 | -4.1646 | .2884 |
| SIDERITE | -15.7152 | -10.4003 | -5.3149 |
| SIO2(A,G | -3.8762 | -2.8141 | -1.0622 |
| SIO2(A,P | -3.8762 | -2.8141 | -1.0622 |
| STRONTIA | -9.8713 | -9.2306 | -.6407 |
| TALC | 17.4431 | 24.0430 | -6.6029 |
| THENARDI | -24.2350 | -.1640 | -24.0740 |
| THERMONA | -7.3732 | .2086 | -7.5818 |
| TREMOLIT | 45.5519 | 59.2626 | -13.7107 |
| PYROLUSI | 10.3936 | 42.9126 | -32.5190 |
| BIRNESSI | 10.3936 | 44.3233 | -33.9297 |
| NSUTITE | 10.3936 | 43.7333 | -33.3397 |
| BIXBYITE | 16.7103 | 52.2745 | -33.5642 |
| HAUSMANN | 27.0269 | 63.7902 | -36.7633 |
| PYROCROI | 8.3152 | 15.7243 | -7.4091 |
| MANGANIT | 9.3544 | 25.9933 | -16.6389 |
| RHODOCHR | -11.3903 | -10.3516 | -1.0387 |
| MNCL2, 4 | -8.8253 | 2.2220 | -11.0473 |
| MNS GREE | -36.5645 | -31.3860 | -5.1784 |
| MNSO4 | -28.2566 | 3.1046 | -31.3612 |
| MN2(SO4) | -91.0095 | 47.8433 | -138.8528 |
| ZN METAL | -4.4946 | 26.7927 | -31.2873 |
| ZNCL2 | -19.5539 | 7.5208 | -27.0747 |
| SMITHSON | -22.1246 | -9.8776 | -12.2471 |
| ZNCO3, 1 | -22.1261 | -10.2600 | -11.8661 |
| ZN(OH)2 | -2.4191 | 11.5000 | -13.9191 |
| ZN2(OH)3 | -13.4056 | 15.2000 | -28.6056 |
| ZN5(OH)8 | -29.2303 | 38.5000 | -67.7303 |
| ZN2(OH)2 | -41.4100 | 7.5000 | -48.9100 |
| ZN4(OH)6 | -46.2482 | 28.4000 | -74.6482 |
| ZNO(ACTI | -2.4177 | 11.3100 | -13.7277 |
| ZINCITE | -2.4177 | 11.7538 | -14.1714 |
| ZN3O(SO4 | -80.3995 | 20.7608 | -101.1603 |
| ZNS (A) | -47.2958 | -44.5016 | -2.7971 |
| SPHALERI | -47.2958 | -47.2002 | -.0955 |

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| | | | |
|---|---|---|---|
| WILLEMIT | -8.7316 | 16.2670 | -24.9985 |
| ZINCOSIT | -38.9909 | 3.5491 | -42.5400 |
| ZNSO4, 1 | -38.9923 | -.2713 | -38.7211 |
| BIANCHIT | -38.9995 | -1.7555 | -37.2440 |
| GOSLARIT | -39.0009 | -2.0527 | -36.9483 |
| ZNBR2, 2 | -25.8302 | 5.4209 | -31.2511 |
| CD METAL | -7.5705 | 13.9954 | -21.5659 |
| GAMMA CD | -7.5705 | 14.0993 | -21.6699 |
| OTAVITE | -25.2885 | -13.7237 | -11.4768 |
| CDCL2 | -22.6298 | -.5545 | -22.0753 |
| CDCL2, 1 | -22.6313 | -1.6589 | -20.9724 |
| CDCL2,2. | -22.6334 | -1.9880 | -20.6454 |
| CD(OH)2 | -5.4950 | 13.6500 | -19.1450 |
| CDOHCL | -14.0674 | 3.7281 | -17.7905 |
| CD3(OH)4 | -53.0568 | 22.5600 | -75.6168 |
| CD3OH2(S | -89.6286 | 6.7100 | -96.3386 |
| CD4(OH)6 | -58.5518 | 28.4000 | -86.9518 |
| MONTEPON | -5.4936 | 15.8152 | -21.3088 |
| CDSIO3 | -9.3898 | 9.5269 | -18.9168 |
| CDSO4 | -42.0665 | .3139 | -42.3807 |
| CDSO4, 1 | -42.0682 | -1.4489 | -40.6194 |
| CDSO4,2. | -42.0706 | -1.7493 | -40.3214 |
| GREENOCK | -50.3747 | -51.7380 | 1.3633 |
| CDBR2, 4 | -28.9090 | -2.6230 | -26.2860 |
| PB METAL | -5.1646 | 4.2588 | -9.4234 |
| COTUNNIT | -20.2239 | -4.9272 | -15.2966 |
| PHOSGENI | -43.0185 | -19.8100 | -23.2085 |
| CERRUSIT | -22.7946 | -13.2665 | -9.5281 |
| MASSICOT | -3.0876 | 13.3511 | -16.4388 |
| LITHARGE | -3.0876 | 13.1799 | -16.2675 |
| PBO, .3H | -3.0881 | 12.9800 | -16.0681 |
| PB2OCO3 | -25.8822 | -.1782 | -25.7040 |
| LARNAKIT | -42.7455 | -.0992 | -42.6493 |
| PB3O2SO4 | -45.8361 | 10.9826 | -56.8187 |
| PB4O3SO4 | -48.9237 | 23.0547 | -72.0084 |
| PB3O2CO3 | -28.9698 | 11.7621 | -40.7319 |
| PBSIO3 | -6.9839 | 7.5800 | -14.5639 |
| PB2SIO4 | -10.0715 | 20.4900 | -30.5615 |
| ANGLESIT | -39.6609 | -7.8504 | -31.8105 |
| GALENA | -47.9658 | -51.0233 | 3.0546 |
| PLATTNER | -1.0107 | 51.2859 | -52.2966 |
| PB2O3 | -4.0983 | 61.0400 | -65.1383 |
| MINIUM | -7.1859 | 76.5753 | -83.7612 |
| PB(OH)2 | -3.0891 | 8.5428 | -11.6319 |
| LAURIONI | -11.6565 | .6200 | -12.2765 |
| PB2(OH)3 | -14.7455 | 8.7900 | -23.5355 |
| HYDCERRU | -48.6763 | -17.4600 | -31.2163 |
| PB2O(OH) | -6.1767 | 26.2000 | -32.3767 |
| PBBR2 | -26.4973 | -5.4074 | -21.0899 |
| PB4(OH)6 | -48.9280 | 21.1000 | -70.0280 |
| SULFUR | -42.8042 | -37.3407 | -5.4635 |
| LIME | 10.8396 | 34.0989 | -23.2593 |
| PORTLAND | 10.8381 | 23.5317 | -12.6936 |
| WUSTITE | 3.8903 | 12.3877 | -8.4974 |
| FERICLAS | 11.0088 | 22.5245 | -11.5156 |
| MAG-FERR | 21.0693 | 45.2627 | -24.1933 |
| WOLLASTO | 6.9433 | 13.5475 | -6.6042 |
| P-WOLLST | 6.9433 | 14.4416 | -7.4983 |
| CA-OLIVI | 17.7829 | 39.1856 | -21.4027 |
| LARNITE | 17.7829 | 40.7472 | -22.9643 |
| CASSIOS | 28.6224 | 76.8555 | -48.2331 |
| MONTICEL | 17.9521 | 31.6576 | -13.7055 |
| AKERMINI | 24.8954 | 49.6163 | -24.7208 |
| [illegible] | [illegible] | [illegible] | [illegible] |

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| | | | |
|---|---|---|---|
| NAZSO3 | -26.3150 | 5.0331 | -31.3481 |
| KZSO3 | -31.7302 | 8.2712 | -40.0014 |
| CASO3.2H | -27.8135 | -3.5656 | -24.2479 |
| CASO3.5H | -27.8114 | -3.1288 | -24.6826 |
| MGSO3 | -27.6414 | 7.0169 | -34.6563 |
| CH4(GAS) | -28.0177 | -42.7928 | 14.7752 |
| CO2(GAS) | -19.7070 | -18.1749 | -1.5321 |
| O2(GAS) | 4.1539 | 66.9563 | -62.8023 |
| CAMOO4 | -14.2881 | -7.7397 | -6.5484 |
| NAT. SE | 59.1517 | -63.2575 | 122.4092 |
| FERROSEL | -116.3714 | -129.8086 | 13.4372 |
| MOLYBDEN | -116.9665 | -130.8200 | 13.8532 |
| MOLYBDIT | -25.1276 | -11.7900 | -13.3376 |
| ILSEMANN | -77.4598 | -77.5900 | .1302 |

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JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-01-91-15-02-00 DISCIPLINE Hydro NO. OF SHEETS 20

PROJECT: UMTRA Site Characterization

SITE: GRAND JUNCTION (Cheney Reservoir)

FEATURE: Concentration Limits

SOURCES OF DATA:

Groundwater data is obtained from UMTRA DART (data base)

SOURCES OF FORMULAE & REFERENCES:

Technical Approach Document (Dec, 1989)

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | SPeinert | 1/30/91 | CPrince | 2/1/91 | KB | 2/4/91 |
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## Purpose of Calculation

The purpose of this calculation is to determine proposed concentration limits for hazardous constituents and elements of hazardous constituent compounds in groundwater at the Cheney disposal site in Grand Junction, Colorado.

## Overview of Method

For those hazardous constituents that have an EPA MCL (arsenic, barium, cadmium, chromium, lead, mercury, molybdenum, nitrate, selenium, silver, uranium, and the activities of radium-226/228 and net gross alpha) background concentrations (listed in table 3.38) are compared to the groundwater standards. If concentrations are less than the standard, then the proposed concentration limit (PCL) will be the same as the EPA MCL. When background concentrations exceed the groundwater standards, the statistical maximum of background is used as a replacement to the EPA MCL. There are certain hazardous constituents and elements in hazardous constituent compounds that do not have any predetermined concentration limits. For these constituents, the PCL will be based on the statistical maximum of background concentrations. In the case where the hazardous constituent was not detected in groundwater, the laboratory detection limit will be used as the PCL. The observed maximum for Net Gross Alpha was chosen to represent the statistical maximum.

## Assumptions

The assumption being made in this calculation is that the background monitor wells and number of samples are an accurate indication of background groundwater quality.

## Data Source

DOE sampling results from UMTRA Data Analysis and Retrieval System (DART). See tables 3.38 and 3.39.

## Attachments

1) List of EPA hazardous constituents and their concentration limits. (Those underlined in blue are the constituent whose PCL is the same as the EPA MCL.

2) Table 3.38 is a list of water quality data for the background monitor wells. (Beside each hazardous constituent is a comment on how its PCL was determined.)

3) Table 3.39 is a list of water quality statistics for background monitor wells. For those hazardous constituents that do not have a concentration limit, the statistical maximum is chosen as the PCL.

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Elements contained in hazardous constituent compounds

| | | |
|---|---|---|
| Aluminum (Aluminum phosphide) | 0.1 | <MDL |
| Cyanide (Soluble salts and complexes) | 0.01 | <MDL |
| Fluoride (Carbon oxyfluoride) | 2.2 | BG |
| Strontium (Strontium sulfide) | 10.1 | BG |
| Sulfide (Strontium sulfide, carbon disulfide) | 10.0 | BG |

* MCL- Maximum concentration limit as defined by the EPA. (Secondary drinking water standards are being used for copper and zinc).

<MDL- Concentrations in background groundwater were less than detection. For these constituents, the concentration limit is the same as the laboratory detection limit.

BG- Concentration limit is based on the statistical maximum concentration of background water quality.

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 4

BY _____ CHKD. _____ JOB NO. _____

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List of Hazardous Constituents and their concentration limits

Constituents underlined in blue are those which use the EPA MCL.

## MAXIMUM CONCENTRATION OF CONSTITUENTS for GROUNDWATER PROTECTION
(Summarized from DRAFT FINAL EPA Groundwater Standards (of 1/90)) 2/1/
(40 CFR 192.02)

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### Table 1 - CONCENTRATION LIMITS
(Concentrations of these constituents shall not exceed the following limits or background, whichever is higher)

| | | |
|---|---|---|
| Arsenic (As) | 0.05 mg/l | |
| Barium (Ba) | 1.0 | |
| Cadmium (Cd) | .01 | |
| Chromium (Cr) | .05 | |
| Lead (Pb) | .05 | |
| Mercury (Hg) | .002 | |
| Molybdenum (Mo) | .1 | |
| Nitrate (as N) | 10.0 | (= 44.0 mg/l $NO^3$) |
| Selenium (Se) | .01 | |
| Silver (Ag) | .05 | |

| | | | |
|---|---|---|---|
| Benzene (Cyclohexatriene) | 0.005 mg/l | Methoxychlor | 0.1 mg/l |
| Carbon tetrachloride | .005 | Methyl chloroform | .20 |
| p-Dichlorobenzene(Benzene,1,4-di-) | .075 | Toxaphene | .005 |
| 1,1-Dichloroethylene(Ethene,1,1-di-) | .007 | 2,4-D | .1 |
| Endrin | .0002 | 2,4,5-TP | .01 |
| Ethylene dichloride | .005 | Trichloroethylene | .005 |
| Lindane | .004 | Vinyl chloride | .002 |

| | | | |
|---|---|---|---|
| Combined Radium (Ra-226 & 228) | 5 | pCi/l | |
| Combined Uranium (U-234 & 238) | 30 | " | (= 0.044 mg/l) |
| Gross Alpha (excluding Rn & U) | 15 | " | |

### Appendix I - LISTED CONSTITUENTS
(Partial list: only inorganics w/o MCLs)

| | |
|---|---|
| Antimony and compounds, | N.O.S. |
| Aluminum phosphide | # |
| Beryllium and compounds, | N.O.S. |
| Calcium chromate | # |
| Carbon Disulfide | |
| Carbon oxyfluoride | # |
| Cyanides (soluble salts and complexes), | N.O.S. |
| Nickel and compounds, | N.O.S. |
| Strontium sulfide | # |
| Thallium and compounds, | N.O.S. |
| Vanadic acid, ammonium salt | # |
| Vanadium pentoxide | # |
| Zinc phosphide | # |

N.O.S. - Not Otherwise Specified; Signifies all members of this general class, including those not specifically named in Append.I

# - ADDED when this Appendix replaced Appendix IX, 40 CFR 264

Note - Cobalt, Copper, Sulphide, Tin, Vanadium, and Zinc were DELETED when this Appendix replaced Appendix IX

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 6

BY _____ CHKD. _____ JOB NO. _____

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Table 3.38

Background water quality data

(BACKGROUND WATER QUALITY)

Table 3.38 Dakota Sandstone water quality by parameter at the [illegible] disposal site, Grand Junction, Colorado
SITE: GRJCS CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | DETECTION LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| ALKALINITY | 0971 | 02/19/90 | 0001 | KD | D | MG/L CACO3 | | 7899. | - | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 9139. | - | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 6630. | - | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 5667. | - | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 7861. | - | - |
| ALUMINUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.05 | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .1 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.05 | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .1 | [illegible] | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.05 | 0.1 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .1 | 0.1 | - |
| AMMONIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 6.1 | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 8. | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 5.3 | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 6. | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 5.2 | 0.1 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 7. | 0.1 | - |
| ANTIMONY | 0971 | 06/28/90 | F014 | KD | D | MG/L | < | .003 | 0.003 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .003 | 0.003 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .003 | 0.003 | - |
| ARSENIC | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.03 | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.03 | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.03 | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| BARIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 4.44 | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 18.5 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 38. | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 34.1 | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 36. | 0.1 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 32.5 | 0.1 | - |
| BERYLLIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.005 | 0.005 | - |

< MDL 0.1 mg/l

< MDL 0.003 mg/l

CL = 0.05 mg/l

see table 3.39

< MDL 0.005 mg/l

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
03/01/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | DETECTION LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| BERYLLIUM | 0977 | 02/02/90 | 0001 | KD | D | MG/L | < | 0.005 | 0.005 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.005 | 0.005 | - |
| BORON | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 1.96 | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 2.1 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 1.99 | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 1.5 | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 3.13 | 0.1 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 2.9 | 0.1 | - |
| CADMIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.001 | 0.001 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .001 | 0.001 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.01 | 0.001 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .001 | 0.001 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.001 | 0.001 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .001 | 0.001 | - |
| CALCIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 32. | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 38.0 | 0.01 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 28. | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 14.5 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 42. | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 35.6 | 0.01 | - |
| CHLORIDE | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 4640. | 1.0 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 4490. | 1.0 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 3360. | 1.0 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 3040. | 1.0 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 4130. | 1.0 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 4850. | 1.0 | - |
| CHROMIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.01 | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.01 | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.01 | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| COBALT | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.03 | 0.05 | - |

<MDL 0.005 mg/l

MCL = 0.01

MCL = 0.05

<MDL 0.05 mg/l

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | DETECTION LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| COBALT | 0971 | 06/28/90 | F014 | KD | D | MG/L | < | .05 | 0.05 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.03 | 0.05 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .05 | 0.05 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.03 | 0.05 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .05 | 0.05 | - |
| COPPER | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 0.02 | 0.02 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .02 | 0.02 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.01 | 0.02 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .02 | 0.02 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 0.01 | 0.02 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .02 | 0.02 | - |
| CYANIDE | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.02 | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.02 | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.02 | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| FLUORIDE | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 1.6 | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 1.6 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 2.0 | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 2.2 | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 1.2 | 0.1 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 1.4 | 0.1 | - |
| GROSS ALPHA | 0971 | 02/19/90 | 0001 | KD | D | PCI/L | | 86. | 1.0 | 94. |
| | 0971 | 06/28/90 | F014 | KD | D | | | 0. | 1.0 | 120. |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 98. | 1.0 | 71. |
| | 0977 | 06/28/90 | F014 | KD | D | | | 75. | 1.0 | 72. |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 0.0 | 1.0 | 76. |
| | 0978 | 06/29/90 | F014 | KD | D | | | 0. | 1.0 | 140. |
| GROSS BETA | 0971 | 02/19/90 | 0001 | KD | D | PCI/L | | 146. | 0.5 | 79. |
| | 0971 | 06/28/90 | F014 | KD | D | | | 100. | 0.5 | 100. |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 105. | 0.5 | 48. |
| | 0977 | 06/28/90 | F014 | KD | D | | | 160. | 0.5 | 60. |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 0.0 | 0.5 | 68. |

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

<MDL 0.05 mg/l

secondary MCL = 1.0 mg/l

<MDL 0.01 mg/l

See table 3.39

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESEARCH
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | DETECTION LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| GROSS BETA | 0978 | 06/29/90 | F014 | KD | D | PCI/L | | 77. | 0.5 | 95. |
| IRON | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 0.50 | 0.03 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | .51 | 0.03 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 0.42 | 0.03 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | .25 | 0.03 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 0.89 | 0.03 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | .47 | 0.03 | - |
| LEAD | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.01 | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 0.01 | 0.01 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.05 | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.01 | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| MAGNESIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 42. | 0.001 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 37.6 | 0.001 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 23. | 0.001 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 13.7 | 0.001 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 22. | 0.001 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 22.0 | 0.001 | - |
| MANGANESE | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 0.02 | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | .03 | 0.01 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 0.21 | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | .03 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 0.39 | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | .19 | 0.01 | - |
| MERCURY | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.0002 | 0.0002 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .0002 | 0.0002 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.0002 | 0.0002 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .0002 | 0.0002 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.0002 | 0.0002 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | .091 | 0.0002 | - |
| MOLYBDENUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.01 | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | .05 | 0.01 | - |

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

CL = 0.05 mg/l

CL = 0.09
x Obs from Background

table 3.39

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | DETECTION LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| MOLYBDENUM | 0977 | 02/02/90 | 0001 | KD | D | MG/L | | 0.21 | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | .07 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.05 | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | .05 | 0.01 | - |
| NET GROSS ALPHA * | 0971 | 02/19/90 | 0001 | KD | D | PCI/L | | 84.97 | - | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | -2.20 | - | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 96.97 | - | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 74.73 | - | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | -1.03 | - | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | -0.27 | - | - |
| NICKEL | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.04 | 0.04 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .04 | 0.04 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.04 | 0.04 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .04 | 0.04 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.04 | 0.04 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .04 | 0.04 | - |
| NITRATE | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.1 | 1.0 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 3. | 1.0 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.1 | 1.0 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 10. | 1.0 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.1 | 1.0 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 4. | 1.0 | - |
| PH | 0971 | 02/19/90 | 0001 | KD | D | SU | | 7.80 | - | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 7.44 | - | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 7.21 | - | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 7.66 | - | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 7.43 | - | - |
| PHOSPHATE | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 3.2 | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 2.6 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 0.12 | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 2.6 | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 0.3 | 0.1 | - |

* NET GROSS ALPHA (GROSS ALPHA - URANIUM) WITH 1 MG URANIUM = 686 PCI

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

: table 3.39

lex Observed Background: 97

<MDL 0.04 mg/l

MCL = 44.0 mg/l

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | DETECTION LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| PHOSPHATE | 0978 | 06/29/90 | F014 | KD | D | MG/L | | 11.4 | 0.1 | - |
| POTASSIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 30. | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 67.3 | 0.01 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 14. | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 111. | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 76. | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 105. | 0.01 | - |
| RADIUM-226 | 0971 | 02/19/90 | 0001 | KD | D | PCI/L | | 3.5 | 1.0 | 0.6 |
| | 0971 | 06/28/90 | F014 | KD | D | | | 1.7 | 1.0 | 0.5 |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 32.0 | 1.0 | 2.2 |
| | 0977 | 06/28/90 | F014 | KD | D | | | 2.2 | 1.0 | 0.5 |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 17.9 | 1.0 | 1.6 |
| | 0978 | 06/29/90 | F014 | KD | D | | | 1.5 | 1.0 | 0.5 |
| RADIUM-228 | 0971 | 02/19/90 | 0001 | KD | D | PCI/L | | 3.4 | 1.0 | 1.9 |
| | 0971 | 06/28/90 | F014 | KD | D | | | 18. | 1.0 | 2. |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 35.6 | 1.0 | 3.3 |
| | 0977 | 06/28/90 | F014 | KD | D | | | 48. | 1.0 | 2. |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 16.4 | 1.0 | 2.6 |
| | 0978 | 06/29/90 | F014 | KD | D | | | 29. | 1.0 | 2. |
| SELENIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.03 | 0.005 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 0.005 | 0.005 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.03 | 0.005 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .005 | 0.005 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.03 | 0.005 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .005 | 0.005 | - |
| SILICA - SIO2 | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 13.7 | 2.0 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 46. | 2.0 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 17.1 | 2.0 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 8. | 2.0 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 19.6 | 2.0 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 23. | 2.0 | - |
| SILVER | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.01 | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

226/228
table 3.39

CL = 0.01 mg/l

MCL = 0.05 mg/l

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | DETECTION LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| SILVER | 0977 | 02/02/90 | 0001 | KD | D | MG/L | < | 0.01 | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.01 | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| SODIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 6100. | 0.002 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 7020. | 0.002 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 5010. | 0.002 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 4210. | 0.002 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 6440. | 0.002 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 5760. | 0.002 | - |
| SPECIFIC CONDUCTANCE | 0971 | 06/28/90 | F014 | KD | D | UMHO/CM | | 21000. | - | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 15.59 | - | - |
| STRONTIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 9.00 | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 7.43 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 3.59 | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 6.03 | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 9.05 | 0.1 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 8.01 | 0.1 | - |
| SULFATE | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 94.2 | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 18.1 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 175. | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 6.2 | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 66.2 | 0.1 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 42.4 | 0.1 | - |
| SULFIDE | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 10. | 0.1 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | < | .1 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 1. | 0.1 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .1 | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 3. | 0.1 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 0.29 | 0.1 | - |
| TEMPERATURE | 0971 | 02/19/90 | 0001 | KD | D | C - DEGREE | | 16.9 | - | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 20.1 | - | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 19.0 | - | - |

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): - LESS THAN DETECTION LIMIT

(14)

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | DETECTION LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | 0977 | 06/28/90 | F014 | KD | D | C - DEGREE | | 22.1 | - | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 19.0 | - | - |
| THALLIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.1 | 0.1 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.1 | 0.1 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 0.1 | 0.1 | - |
| TOTAL DISSOLVED SOLIDS | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 15300. | 10.0 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 18300. | 10.0 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 12100. | 10.0 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 10500. | 10.0 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | | 15410. | 10.0 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 15500. | 10.0 | - |
| TOTAL KJELDAHL NITROGEN | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 1. | 1.0 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 5. | 1.0 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 1. | 1.0 | - |
| URANIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.003 | 0.003 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 0.0032 | 0.003 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.003 | 0.003 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | 0.0004 | 0.003 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.003 | 0.003 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | | 0.0004 | 0.003 | - |
| VANADIUM | 0971 | 02/19/90 | 0001 | KD | D | MG/L | < | 0.01 | 0.01 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | .03 | 0.01 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | < | 0.01 | 0.01 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.01 | 0.01 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .01 | 0.01 | - |
| ZINC | 0971 | 02/19/90 | 0001 | KD | D | MG/L | | 1.36 | 0.005 | - |
| | 0971 | 06/28/90 | F014 | KD | D | | | 1.41 | 0.005 | - |
| | 0977 | 02/02/90 | 0001 | KD | D | | | 4.06 | 0.005 | - |
| | 0977 | 06/28/90 | F014 | KD | D | | | .039 | 0.005 | - |
| | 0978 | 02/12/90 | 0001 | KD | D | | < | 0.005 | 0.005 | - |
| | 0978 | 06/29/90 | F014 | KD | D | | < | .005 | 0.005 | - |

ICL = 0.044 mg/l

radium see table 3.39

ICL = 5.0 mg/l (secondary drinking water standard)

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < = LESS THAN DETECTION LIMIT

DATA FILE NAME: J:\DART\GRJ03\GW010020.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Cay 2/1/91

JM 2/1/91

(15)

Table 3.39

Background water quality statistics

(16)

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 5 | 5667.0000 | 9139.0000 | 7861.0000 | 7439.2000 | 1329.8636 | 0.1788 | 0.0 | 5210.7352 | 9667.6648 | NORMAL | |
| ALUMINUM | | | MG/L | | | | | | | | |
| 6 | 0.0500 | 0.0500 | 0.0500 | NA | NA | NA | 100.0 | 0.0500 | 0.0500 | NONPARAMETRIC | 2,6 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 6 | 5.2000 | 8.0000 | 6.0500 | 6.2667 | 1.0690 | 0.1706 | 0.0 | 4.7982 | 7.7352 | NORMAL | |
| ANTIMONY | | | MG/L | | | | | | | | |
| 3 | 0.0015 | 0.0015 | 0.0015 | NA | NA | NA | 100.0 | NA | NA | UNKNOWN | 1 |
| ARSENIC | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| BARIUM | | | MG/L | | | | | | | | |
| 6 | 4.4400 | 38.0000 | 33.3000 | 27.2567 | 13.1413 | 0.4821 | 0.0 | 9.2037 | 45.3096 | NORMAL | |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 3 | 0.0025 | 0.0025 | 0.0025 | NA | NA | NA | 100.0 | NA | NA | UNKNOWN | 1 |
| BORON | | | MG/L | | | | | | | | |
| 6 | 1.5000 | 3.1300 | 2.0450 | 2.2633 | 0.6217 | 0.2747 | 0.0 | 1.4093 | 3.1174 | NORMAL | |
| CADMIUM | | | MG/L | | | | | | | | |
| 6 | 0.0005 | 0.0005 | 0.0005 | NA | NA | NA | 100.0 | 0.0005 | 0.0005 | NONPARAMETRIC | 2,6 |
| CALCIUM | | | MG/L | | | | | | | | |
| 6 | 14.5000 | 42.0000 | 33.8000 | 31.6833 | 9.7016 | 0.3062 | 0.0 | 18.3557 | 45.0110 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the [illegible]% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

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Barium-
posed conc. limit is
sed on statistical
aximum of background
45.3 mg/l

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| CHLORIDE | | | MG/L | | | | | | | | |
| 6 | 3040.0000 | 4850.0000 | 4310.0000 | 4085.0000 | 731.7035 | 0.1791 | 0.0 | 3079.8183 | 5090.1817 | NORMAL | |
| CHROMIUM | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| COBALT | | | MG/L | | | | | | | | |
| 6 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2,6 |
| COPPER | | | MG/L | | | | | | | | |
| 6 | 0.0100 | 0.0200 | 0.0100 | NA | NA | NA | 66.7 | 0.0100 | 0.0200 | NONPARAMETRIC | 2,6 |
| CYANIDE | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| FLUORIDE | | | MG/L | | | | | | | | |
| 6 | 1.2000 | 2.2000 | 1.6000 | 1.6667 | 0.3724 | 0.2234 | 0.0 | 1.1551 | 2.1782 | NORMAL | |
| GROSS ALPHA | | | PCI/L | | | | | | | | |
| 6 | 0.0000 | 98.0000 | 37.5000 | NA | NA | NA | 33.3 | 0.0000 | 98.0000 | NONPARAMETRIC | 2,6 |
| GROSS BETA | | | PCI/L | | | | | | | | |
| 6 | 0.0000 | 160.0000 | 102.5000 | NA | NA | NA | 16.7 | 0.0000 | 160.0000 | NONPARAMETRIC | 2,6 |
| IRON | | | MG/L | | | | | | | | |
| 6 | 0.2500 | 0.8900 | 0.4850 | 0.5067 | 0.2106 | 0.4156 | 0.0 | 0.2174 | 0.7960 | NORMAL | |
| LEAD | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 83.3 | 0.0050 | 0.0100 | NONPARAMETRIC | 2,6 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

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loride - proposed
e. limit is based
statistical maximum
background concentration
2 mg/l

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| MAGNESIUM | | | MG/L | | | | | | | | |
| 6 | 13.7000 | 42.0000 | 22.5000 | 26.7167 | 10.7682 | 0.4031 | 0.0 | 11.9238 | 41.5095 | NORMAL | |
| MANGANESE | | | MG/L | | | | | | | | |
| 6 | 0.0200 | 0.3900 | 0.1100 | 0.0809 | 3.5524 | NA | 0.0 | 0.0142 | 0.4615 | LOGNORMAL | 7,8 |
| MERCURY | | | MG/L | | | | | | | | |
| 6 | 0.0001 | 0.0910 | 0.0001 | NA | NA | NA | 83.3 | 0.0001 | 0.0910 | NONPARAMETRIC | 2,6 |
| MOLYBDENUM | | | MG/L | | | | | | | | |
| 6 | 0.0050 | 0.2100 | 0.0500 | NA | NA | NA | 33.3 | 0.0050 | 0.2100 | NONPARAMETRIC | 2,6 |
| NICKEL | | | MG/L | | | | | | | | |
| 6 | 0.0200 | 0.0200 | 0.0200 | NA | NA | NA | 100.0 | 0.0200 | 0.0200 | NONPARAMETRIC | 2,6 |
| NITRATE | | | MG/L | | | | | | | | |
| 6 | 0.5000 | 10.0000 | 1.7500 | NA | NA | NA | 50.0 | 0.5000 | 10.0000 | NONPARAMETRIC | 2,6 |
| PHOSPHATE | | | MG/L | | | | | | | | |
| 6 | 0.1200 | 11.4000 | 2.6000 | 1.4390 | 5.4103 | NA | 0.0 | 0.1415 | 14.6324 | LOGNORMAL | 7,8 |
| POTASSIUM | | | MG/L | | | | | | | | |
| 6 | 14.0000 | 111.0000 | 71.6500 | 67.2167 | 39.0866 | 0.5815 | 0.0 | 13.5212 | 120.9121 | NORMAL | |
| RADIUM-226 | | | PCI/L | | | | | | | | |
| 6 | 1.5000 | 32.0000 | 2.8500 | 4.7334 | 3.6747 | NA | 0.0 | 0.7920 | 28.2906 | LOGNORMAL | 7,8 |
| RADIUM-228 | | | PCI/L | | | | | | | | |
| 6 | 3.4000 | 48.0000 | 23.5000 | 25.0667 | 15.7915 | 0.6300 | 0.0 | 3.3730 | 46.7603 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, α = 0.01
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

lybdenum - proposed centration limit is based statistical maximum ntration of background this case it is observed maximum)

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hopsed Concentration mit is based statistical aximum recentration background

= 28.3 + 46.8
= 75

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 99% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | MG/L | 6 | 0.0025 | 0.0050 | 0.0025 | NA | NA | NA | 83.3 | 0.0025 | 0.0050 | NONPARAMETRIC | 2,6 |
| SILICA - SIO2 | MG/L | 6 | 8.0000 | 46.0000 | 18.3500 | 21.2333 | 13.1767 | 0.6206 | 0.0 | 3.1317 | 39.3350 | NORMAL | |
| SILVER | MG/L | 6 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2,6 |
| SODIUM | MG/L | 6 | 4210.0000 | 7020.0000 | 5930.0000 | 5756.6667 | 1012.9692 | 0.1760 | 0.0 | 4365.0947 | 7148.2387 | NORMAL | |
| SPECIFIC CONDUCTANCE | UMHO/CM | 2 | 15.5900 | 21000.0000 | 10507.7950 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| STRONTIUM | MG/L | 6 | 3.5900 | 9.0500 | 7.7200 | 7.1850 | 2.0867 | 0.2904 | 0.0 | 4.3184 | 10.0516 | NORMAL | |
| SULFATE | MG/L | 6 | 6.2000 | 175.0000 | 54.3000 | 67.0167 | 61.8021 | 0.9222 | 0.0 | -17.8843 | 151.9176 | NORMAL | |
| SULFIDE | MG/L | 6 | 0.0500 | 10.0000 | 0.1700 | NA | NA | NA | 50.0 | 0.0500 | 10.0000 | NONPARAMETRIC | 2,6 |
| TEMPERATURE | C - DEGREE | 5 | 16.9000 | 22.1000 | 19.0000 | 19.4200 | 1.8939 | 0.0975 | 0.0 | 16.2463 | 22.5937 | NORMAL | |
| THALLIUM | MG/L | 3 | 0.0500 | 0.1000 | 0.0500 | NA | NA | NA | 66.7 | NA | NA | UNKNOWN | 1 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Strontium - proposed concent. limit is based on statistical maximum of back ground concen. 10.1 mg/l

lfide. posed conc. limit based on statistical imum of background entration 10.0 mg/l

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

| PARAMETER NAME | UNITS | | | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| TOTAL DISSOLVED SOLIDS | MG/L | | | | | | | | | | |
| 6 | 10500.0000 | 18300.0000 | 15355.0000 | 14518.3333 | 2780.8662 | 0.1915 | 0.0 | 10698.1033 | 18338.5634 | NORMAL | |
| TOTAL KJELDAHL NITROGEN | MG/L | | | | | | | | | | |
| 3 | 0.5000 | 5.0000 | 0.5000 | NA | NA | NA | 66.7 | NA | NA | UNKNOWN | 1 |
| URANIUM | MG/L | | | | | | | | | | |
| 6 | 0.0004 | 0.0032 | 0.0015 | NA | NA | NA | 50.0 | 0.0004 | 0.0032 | NONPARAMETRIC | 2,6 |
| VANADIUM | MG/L | | | | | | | | | | |
| 6 | 0.0050 | 0.0300 | 0.0050 | NA | NA | NA | 83.3 | 0.0050 | 0.0300 | NONPARAMETRIC | 2,6 |
| ZINC | MG/L | | | | | | | | | | |
| 6 | 0.0025 | 4.0600 | 0.6995 | NA | NA | NA | 33.3 | 0.0025 | 4.0600 | NONPARAMETRIC | 2,6 |

* Statistical maximum is the 99 percent one sided confidence interval, α = 0.01
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

INPUT DATA FILENAME: J:\DART\GRJ03\GWQ10020.DAT

ed Conc. Limit
btained from Statistic
mum of background
0.03 mg/l

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-08-90-14-11 DISCIPLINE Hydro NO. OF SHEETS ~~92~~ 100

PROJECT:
UMTRA Site Characterization

SITE:
Grand Junction processing site, Colorado

FEATURE:
Statistical evaluation of existing groundwater contamination

SOURCES OF DATA:
DART water quality records

SOURCES OF FORMULAE & REFERENCES:
EPA, 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance."

TAD, 1989

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | B Gallaher | 8/1/90 | S Reinert | 8/13/90 | | |
| | | | | S Reinert | 8/20/90 | [illegible] | 8/20/90 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

JEG-AL-ENG-51 (8/87)

## A. PURPOSE OF CALCULATION:

To assess alluvial groundwater contamination with hazardous constituents at the Grand Junction processing site using only statistical methods. Statistics are applied to those hazardous constituents in which contamination is not readily evident.

## B. METHODS AND PROCEDURES

Water quality data available for monitor wells at the processing site were analyzed using the EPA approach outlined in the TAD. This approach is presented in the attached flowchart. The statistical approach is designed for comparing background water quality to onsite / downgradient water quality for constituents with no MCLs. The statistical comparison method selected depends on whether concentrations in the onsite / downgradient wells exceed statistical maximum background concentrations, and on the percentage of "nondetects" in the sample population.

Comparison is made of the concentrations of hazardous constituents in upgradient and downgradient wells. The list of hazardous constituents in the Grand Junction Tailings was determined previously (Calc Set 4RJ-07-90-15-01).

Not all of the identified hazardous constituents, however, ~~are~~ were statistically analyzed.

were not analyzed because of their insolubility in groundwater geochemical conditions, thus precluding the possibility of contamination.

## C. DATA SOURCES

Groundwater quality records and general statistical descriptions were obtained from DART. To represent recent conditions, only data available from 1987 were used in the analysis. The ~~data~~ wells are grouped according to flow relationships as follows:

| Upgradient | Downgradient | Cross-Gradient |
|---|---|---|
| 588 | 585 | 737 |
| 710 | 586 | 742 |
| 744 | 589 | |
| 745 | 590 | |
| 746 | 733 | |
| | 736 | |
| | 740 | |

DART water quality data tables are presented in Attachment 1.

## D. CALCULATIONS AND ANALYSES

Following EPA protocol (1989), the water quality data were analyzed using one of the background well to compliance well procedures: the test of proportions or the one-way analysis of variance (ANOVA) if more than 50% of the observations

are below the detection limit (XXDL), then the appropriate comparison is a test of proportions. One-way ANOVAs were performed for other constituents (no evidence of seasonality were seen in the data to require useage of an alternate ANOVA approach). The test of proportions is presented in Attachment II and the ANOVA is presented in Attachment III

E. RESULTS

Results of the calculations are summarized in the attached table.

F. CONCLUSIONS.

The statistical analyses show the likelihood that alluvial groundwater downgradient of the processing site is contaminated with uranium and radioactive uranium. KB ~~and gross alpha~~. There are insufficient data, however, to statistically determine which individual well(s), if any, is contaminated, but maximum concentrations appear to be found in the southwest corner of the processing site. This corresponds to the pattern of uranium contamination. Although net gross alpha concentrations exceed the MCLs in downgradient monitor wells, the concentrations are within the range of background and net gross alpha is not a groundwater contaminant

UE

DATE 09 August 1990 SUBJECT

BY BD CHKD. [illegible]

SHEET NO. 4

JOB NO. [illegible]

# Results of Analyses Summary

| Hazardous Constituent | Contamination Indicated? | Reason/Remarks |
|---|---|---|
| 1) Aluminum | No | NS* |
| 2) Antimony | No | Passed Test of Proportions (TOP) |
| 3) Arsenic | No | Passed ANOVA |
| 4) Barium | No | Passed TOP |
| 5) Beryllium | No | Not detected in groundwater |
| 6) Cadmium | No | Passed ANOVA |
| 7) Chromium | No | Passed TOP |
| 8) Cobalt | No | Not detected in ground water |
| 9) Copper | No | Downgradient wells do not exceed secondary |
| 10) Cyanide | No | NS |
| 11) Fluoride | No | NS |
| 12) (Net) Gross alpha | No | Passed ANOVA |
| 13) Lead | No | Passed TOP |
| 14) Mercury | No | Not detected in ground- |
| 15) Molybdenum | Likely | Failed ANOVA |
| 16) Nickel | No | Passed TOP |
| 17) Nitrate | No | Passed TOP |
| 18) Radium-226 & | No | Passed TOP |
| 19) Selenium | No | Passed ANOVA |
| 20) Silver | No | Passed TOP |
| 21) Strontium | No | NS |
| 22) Tin | No | Passed ANOVA |
| 23) Uranium | Yes | Downgradient concs. 5X upgradient |
| 24) Vanadium | No | Passed TOP |
| 25) Sulfide | No | NS |
| 26) Zinc | No | Downgradient Wells do not exceed sec. standards |

*NS = Element of hazardous compound that is not soluble in ground water conditions.

FORM 91-005-1 (4/81)

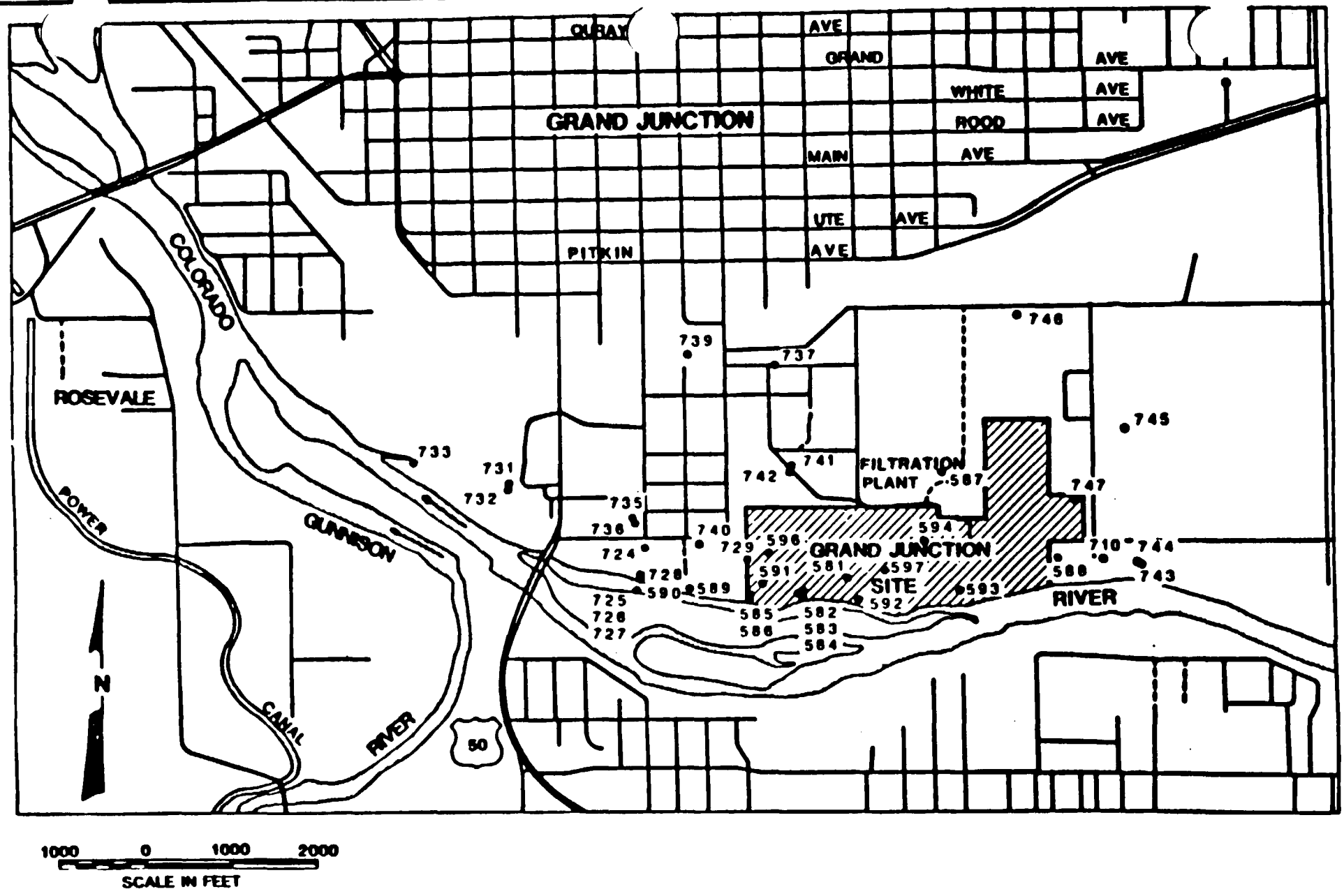


FIGURE F.3.1
MONITORING WELL LOCATIONS NEAR GRAND JUNCTION SITE

# BACKGROUND WELL TO COMPLIANCE WELL COMPARISONS

EPA (1989) protocol.

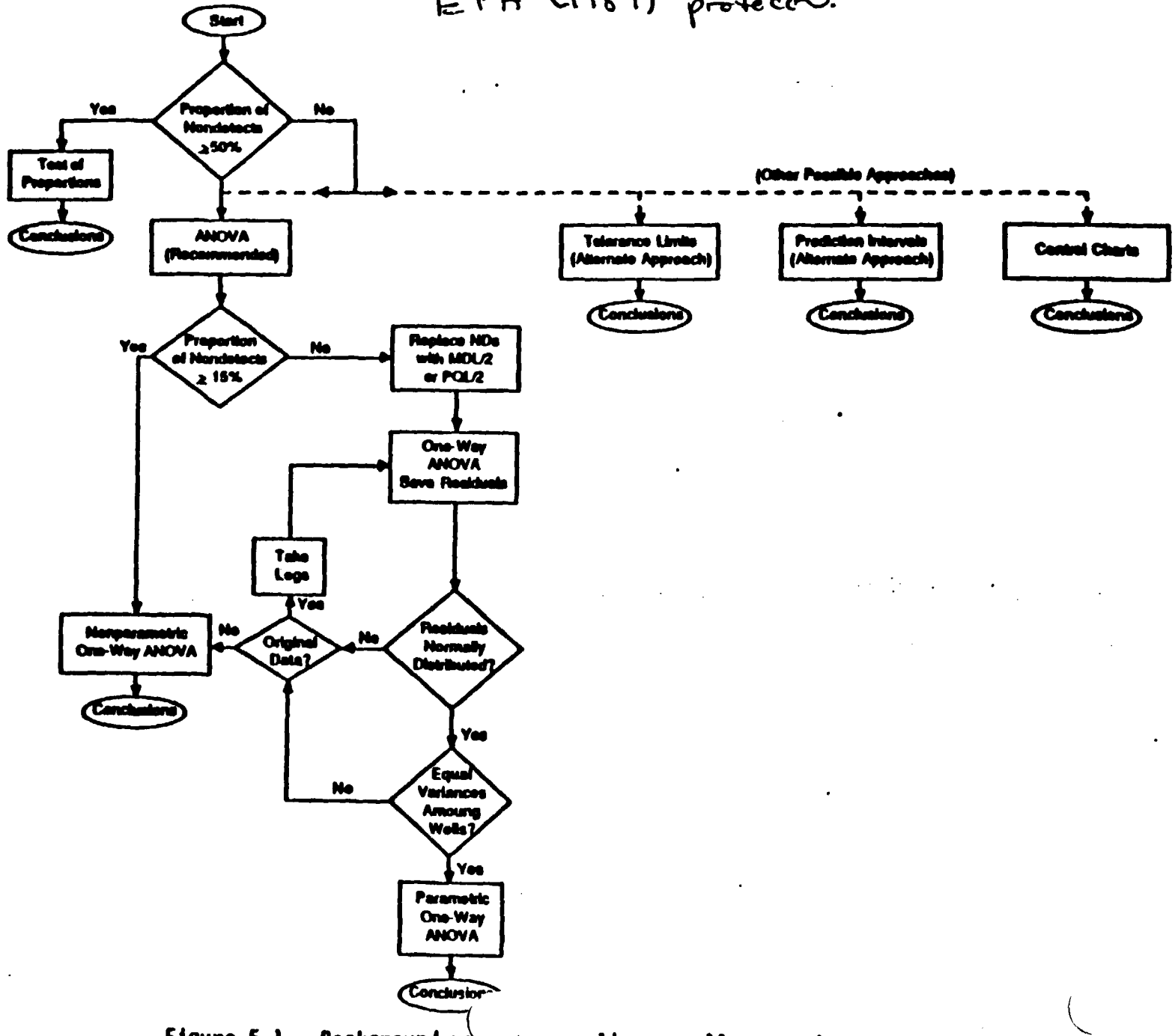


Figure 5-1. Background we. to compliance well comparisons.

8/20/90

JACOBS ENGINEERING

DATE 9 August 1990 SUBJECT

BY BY CHKD. SM 8/20/90

SHEET NO. 7

JOB NO. SM 8/20/90

References:

EPA, 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities". U.S. Environmental Protection Agency, Office of Solid Waste, EPA/530-SW-89-026

UL

DATE _____ SUBJECT

BY BS CHKD. [illegible] 6/20/90

SHEET NO. 8

JOB NO. _____

Attachment 1.

DART Water Quality Records.

FORM 91-005-1 (4/81)

Table , Al...ial water quality by parameter
SITE: C9J01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ALKALINITY | 0581 | 03/07/89 | 0001 | AL | O | MG/L CACO3 | | 539. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 563. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 629. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 229. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 588. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 572. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 488. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 448. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 485. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 467. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 465. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 456. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 651. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 633. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 631. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 632. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 503. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 534. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 591. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 456. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 462. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 420. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 468. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 491. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 411. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 471. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 328. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 20.5 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 306. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 526. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 518. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 532. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 554. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 529. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 419. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 426. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 438. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ALKALINITY | 0746 | 08/03/89 | 0001 | AL | U | MG/L CACO3 | | 442. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 439. | - |
| ALUMINUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.1 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.3 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.38 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.3 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.1 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.3 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.55 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.3 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.72 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.33 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.2 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ALUMINUM | 0746 | 09/17/87 | 0001 | AL | U | MG/L | | 0.38 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.3 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| AMMONIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 170. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 300. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 300. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 9.5 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 1.4 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 160. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 21. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 20.2 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 20.5 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 2.0 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 61. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.4 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.4 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 50. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 31.1 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.3 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 1.7 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 1.3 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 1.0 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.3 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | < | 0.1 | - |

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
U - UPGRADIENT
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C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| AMMONIUM | 0745 | 03/05/89 | 0001 | AL | U | MG/L | | 0.3 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| ANTIMONY | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.003 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.017 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.009 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.012 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.014 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.017 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.016 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.014 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.003 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.013 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.003 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.003 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.009 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.012 | - |

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
U - UPGRADIENT
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C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ANTIMONY | 0746 | 11/02/89 | 0001 | AL | U | MG/L | | 0.004 | - |
| ARSENIC | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.01 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.04 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.015 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.05 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.013 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.015 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.012 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.05 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.01 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.012 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U. | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.016 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.02 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.015 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ARSENIC | 0746 | 09/22/88 | 0001 | AL | U | MG/L | | 0.04 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.016 | - |
| BARIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.1 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.02 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.02 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.03 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.02 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| BARIUM | 0745 | 08/03/89 | 0001 | AL | U | MG/L | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.02 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| BERYLLIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.005 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| BROMIDE | 0590 | 11/02/89 | 0001 | AL | D | MG/L | | .1 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1.0 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1.2 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | .1 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | .2 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | .1 | - |
| CADMIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.001 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.025 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.023 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.001 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.010 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.002 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.016 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.013 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.001 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.014 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.002 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.005 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.018 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.001 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.029 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.005 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.001 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.001 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.006 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | < | 0.005 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CADMIUM | 0745 | 09/22/88 | 0001 | AL | U | MG/L | | 0.013 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.012 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.002 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.005 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.017 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.001 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.039 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.002 | - |
| CALCIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 600. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 560. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 560. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 102. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 540. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 489. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 549. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 540. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 488. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 463. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 427. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 418. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 439. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 434. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 417. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 399. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 510. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 487. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 492. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 473. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 523. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 530. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 497. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 517. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 370. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 570. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 257. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CALCIUM | 0744 | 08/03/89 | 0001 | AL | U | MG/L | | 139. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 93.1 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 378. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 429. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 394. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 372. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 466. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 448. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 483. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 510. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 452. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 451. | - |
| CHLORIDE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 720. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 850. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 870. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 195. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 910. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 1000. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 810. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 851. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 750. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 740. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 640. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 1100. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 1170. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 1150. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 1200. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1200. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 980. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 960. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1000. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 1060. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 1170. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 1200. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 1300. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 890. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CHLORIDE | 0740 | 02/28/89 | 0001 | AL | D | MG/L | | 700. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 920. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 310. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 149. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 160. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 600. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 500. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 430. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 490. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 570. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 695. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 700. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 720. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 730. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 720. | - |
| CHROMIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.14 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.14 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.16 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CHROMIUM | 0737 | 03/04/89 | 0001 | AL | C | MG/L | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.13 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.15 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| COBALT | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.05 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.05 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.05 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.05 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Allu... water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| COBALT | 0740 | 02/28/89 | 0001 | AL | D | MG/L | < | 0.05 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.05 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.05 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.05 | - |
| COPPER | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.02 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.03 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.02 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.03 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.03 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.02 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.04 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.02 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.02 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.02 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.07 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.02 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B
21

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| COPPER | 0742 | 03/03/89 | 0001 | AL | C | MG/L | < | 0.02 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.02 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | < | 0.02 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.02 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.02 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.02 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.02 | - |
| CYANIDE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B3
22

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| CYANIDE | 0744 | 11/02/89 | 0001 | AL | U | MG/L | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| FLUORIDE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 4.4 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 3.4 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 3.7 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.4 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.4 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.4 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.5 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.4 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.4 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.5 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 1.0 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.66 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.7 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.7 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.6 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.7 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.7 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.7 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.7 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 1.08 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 1.0 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 1.3 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.9 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.65 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.8 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.9 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.5 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.5 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.7 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| FLUORIDE | 0745 | 09/17/87 | 0001 | AL | U | MG/L | | 0.76 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.7 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.8 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.6 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.7 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 1.45 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 1.3 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 1.6 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 1.2 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 1.3 | - |
| GROSS ALPHA | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 71. | 33. |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 182. | 58. |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 223. | 50. |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 3. | 6.3 |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 115. | 45. |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 130. | 60. |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 110. | 50. |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 135. | 53. |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 140. | 60. |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 130. | 40. |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 21. | 33. |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 3. | 41. |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 65. | 49. |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0. | 41. |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 160. | 70. |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 49. | 50. |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 60. | 50. |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 110. | 70. |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 58. | 59. |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 15. | 42. |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 100. | 60. |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0. | 46. |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 31. | 62. |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 69. | 51. |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 30. | 36. |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 101. | 52. |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| GROSS ALPHA | 0744 | 03/05/89 | 0001 | AL | U | PCI/L | | 19. | 15. |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 6.7 | 8.5 |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 14. | 8. |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 2. | 35. |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 15. | 34. |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 29. | 24. |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 41. | 26. |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 38. | 28. |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0. | 38. |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 27. | 38. |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0. | 28. |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 58. | 61. |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 56. | 48. |
| GROSS BETA | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 76. | 26. |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 176. | 43. |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 147. | 34. |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 12. | 5. |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 145. | 35. |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 110. | 30. |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 110. | 30. |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 57. | 35. |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 120. | 30. |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 72. | 24. |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 58. | 29. |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 51. | 29. |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 64. | 28. |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 21. | 35. |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 93. | 32. |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 34. | 28. |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 42. | 37. |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 87. | 30. |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 39. | 32. |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 77. | 31. |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 100. | 30. |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 36. | 40. |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 55. | 37. |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| GROSS BETA | 0740 | 09/24/87 | 0001 | AL | D | PCI/L | | 140. | 40. |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 24. | 27. |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 48. | 36. |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 12. | 11. |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 13. | 5. |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 11. | 4. |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 57. | 29. |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 41. | 24. |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0. | 16. |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 19. | 13. |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 23. | 17. |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 64. | 30. |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 65. | 24. |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 40. | 26. |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 32. | 32. |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 110. | 40. |
| IRON | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 14. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 12. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 16. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.35 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 5.7 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 9.75 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.11 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.12 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.12 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 1.56 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.34 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.94 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.97 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 1.10 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.94 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.16 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.11 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvi.. water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| IRON | 0737 | 09/22/88 | 0001 | AL | C | MG/L | | 0.16 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.06 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.19 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.25 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.03 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.04 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.11 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.39 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.82 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.59 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.57 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.01 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.15 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.12 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.12 | - |
| LEAD | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.02 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.02 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.02 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| LEAD | 0737 | 08/07/89 | 0001 | AL | C | MG/L | | 0.02 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| MAGNESIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 259. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 382. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 374. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 39.5 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 332. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 319. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 383. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 390. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 332. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 334. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 310. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 408. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 432. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 432. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 374. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 395. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 462. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 421. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 449. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 485. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 548. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 550. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 565. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 406. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MAGNESIUM | 0740 | 02/28/89 | 0001 | AL | D | MG/L | | 310. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 500. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 147. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 81.0 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 52.1 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 289. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 301. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 256. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 252. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 281. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 458. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 504. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 525. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 478. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 469. | - |
| MANGANESE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 4.90 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 3.62 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 4.16 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.28 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 2.17 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 2.11 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 1.52 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 1.22 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 1.49 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 1.51 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 1.93 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 1.69 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 1.49 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 1.27 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 1.54 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1.50 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.94 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 1.64 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1.88 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 2.21 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 2.02 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MANGANESE | 0737 | 03/04/89 | 0001 | AL | C | MG/L | | 1.80 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 2.08 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 3.50 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 2.46 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 1.78 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 1.07 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.58 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.43 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 1.34 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 1.32 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 1.13 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 1.20 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 1.38 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 1.37 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 1.34 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 1.38 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 1.38 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 1.39 | - |
| MECHANICAL SIEVE TEST 3/8 INCH | 0746 | 08/03/89 | 0001 | AL | U | % PASSING | | 3690. | - |
| MERCURY | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.0002 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.0002 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MERCURY | 0737 | 03/04/89 | 0001 | AL | C | MG/L | < | 0.0002 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.0002 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.0002 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.0002 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.0002 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.0002 | - |
| MOLYBDENUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.10 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.24 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.14 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.04 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.06 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.04 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.04 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.06 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.05 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.04 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.09 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.04 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.07 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.09 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.07 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.03 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.02 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
D - DOWN GRADIENT
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O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| MOLYBDENUM | 0745 | 03/05/89 | 0001 | AL | U | MG/L | | 0.02 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.03 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.05 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.15 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.14 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.15 | - |
| NICKEL | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.04 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.06 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.04 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.11 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.05 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.01 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.12 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.05 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.05 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.13 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.04 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.04 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.04 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.04 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Allu...al water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| NICKEL | 0745 | 09/22/88 | 0001 | AL | U | MG/L | | 0.09 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.12 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.04 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.04 | - |
| NITRATE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 1.0 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 1.0 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 1. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 5.7 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 2.0 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 1. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 1.0 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.4 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | < | 1. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 4.0 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 1.0 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 2.5 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.4 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | < | 1. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 1.0 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 1. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 2.2 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 2.0 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 1.0 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 1.0 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| NITRATE | 0744 | 08/03/89 | 0001 | AL | U | MG/L | | 29. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 1.5 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 3.5 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | < | 1. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 1.0 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 1. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 3.5 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | < | 1. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 1.0 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 1. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.1 | - |
| PH | 0581 | 03/07/89 | 0001 | AL | O | SU | | 7.10 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 7.0 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 7.05 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 7.87 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 7.06 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 7.03 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 6.85 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 6.97 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 7.03 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 6.83 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 7.0 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 6.90 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 7.77 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 7.03 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 7.09 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 7.30 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 7.04 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 6.89 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 6.83 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 7.0 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 7.12 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 7.07 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 7.12 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 6.80 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table  Alluvial water quality by parameter
SITE: GRJ01  GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| PH | 0740 | 02/28/89 | 0001 | AL | D | SU | | 7.11 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 7.02 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 7.18 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 7.16 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 7.27 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 6.90 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 7.08 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 7.02 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 7.03 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 6.85 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 7.0 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 7.03 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 7.20 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 7.18 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 7.10 | - |
| POTASSIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 56. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 68. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 71. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 6.5 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 49. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 66.6 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 23.4 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 15.8 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 25.5 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 25.7 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 19. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 8.82 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 9.1 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 8.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 9.2 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 10.2 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 8.4 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 12.7 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 13.1 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 10.5 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 10.9 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI):  < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| POTASSIUM | 0737 | 03/04/89 | 0001 | AL | C | MG/L | | 10.1 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 11.9 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 26.0 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 16.0 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 6.9 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 6.4 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 7.5 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 5.9 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 5.05 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 5.7 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 4.9 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 5.0 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 6.0 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 8.28 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 9.4 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 8.4 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 10.9 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 10.7 | - |
| RADIUM-226 | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 1.2 | 0.5 |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.8 | 0.4 |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.0 | 0.2 |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.1 | 0.2 |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.1 | 0.1 |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.1 | 0.1 |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.1 | 0.1 |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.2 | 0.2 |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.0 | 0.1 |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.1 | 0.1 |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.0 | 0.1 |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.0 | 0.1 |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.0 | 0.1 |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| RADIUM-226 | 0736 | 11/02/89 | 0001 | AL | D | PCI/L | | 0.0 | 0.1 |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.0 | 0.1 |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.2 | 0.2 |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.1 | 0.2 |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.0 | 0.1 |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.0 | 0.1 |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.0 | 0.2 |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.0 | 0.1 |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.2 | 0.2 |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.1 | 0.1 |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.0 | 0.2 |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.1 | 0.2 |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.1 | 0.2 |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.1 | 0.1 |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.1 | 0.2 |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.0 | 0.1 |
| RADIUM-228 | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 0.5 | 1.3 |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 2.3 | 1.2 |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 2.0 | 1.3 |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.4 | 1.4 |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 2.3 | 1.4 |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.2 | 0.8 |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.0 | 0.7 |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.7 | 1.3 |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 1.0 | 0.9 |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.0 | 1.0 |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.0 | 1.3 |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.4 | 1.6 |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.0 | 0.7 |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.5 | 1.3 |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.2 | 0.9 |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
C - CROSS GRADIENT
D - DOWN GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| RADIUM-228 | 0733 | 11/02/89 | 0001 | AL | D | PCI/L | | 1.0 | 0.9 |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.3 | 1.3 |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.9 | 0.9 |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.7 | 0.9 |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 2.0 | 1.9 |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 1.3 | 1.0 |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 1.5 | 1.3 |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 1.0 | 0.8 |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.5 | 1.0 |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 2.0 | 1.5 |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 1.7 | 1.4 |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.1 | 1.5 |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.7 | 0.8 |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.3 | 1.0 |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.4 | 0.8 |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.3 | 0.9 |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 1.0 | 1.1 |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.0 | 0.9 |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.7 | 0.9 |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 1.0 | 0.9 |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.1 | 0.7 |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 1.2 | 1.2 |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.6 | 0.9 |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.7 | 0.8 |
| SELENIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.025 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.025 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.025 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.028 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.142 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.025 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.036 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.025 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.164 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

3C

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | 0733 | 09/22/88 | 0001 | AL | D | MG/L | | 0.196 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.025 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.039 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.026 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.038 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.159 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.199 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.026 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.127 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.012 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.011 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.067 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.060 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.018 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.030 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.060 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.191 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.05 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.057 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.060 | - |
| SILICA - SIO2 | 0590 | 11/02/89 | 0001 | AL | D | MG/L | | 20. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 17. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 21. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 17. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 17. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 17. | - |
| SILVER | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.01 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SILVER | 0586 | 03/01/89 | 0001 | AL | D | MG/L | < | 0.01 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.01 | - |
| SODIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 805. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 985. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 990. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 144. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 1080. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 1070. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 975. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 950. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 953. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table  Alt. .t water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SODIUM | 0590 | 11/02/89 | 0001 | AL | D | MG/L | | 944. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 736. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 1327. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 1220. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 1220. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 1250. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1200. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 1190. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 1200. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1180. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 1400. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 1220. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 1230. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 1230. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 1240. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 728. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 950. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 309. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 234. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 186. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 668. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 573. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 540. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 404. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 554. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 909. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 871. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 910. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 841. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 843. | - |
| SPECIFIC CONDUCTANCE | 0581 | 03/07/89 | 0001 | AL | O | UMHO/CM | | 4500. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 4600. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 4600. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 800. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 4400. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 2700. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
D - DOWN GRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 0590 | 09/22/88 | 0001 | AL | D | UMHO/CM | | 6000. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 3500. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 3220. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 1700. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 3600. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 7000. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 7500. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 4100. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 3400. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 1000. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 4400. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 1280. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 1050. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 7100. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 7000. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 6000. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 3780. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 7000. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 3400. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 4900. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 1800. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 980. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 75. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 4000. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 3550. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 2950. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 2000. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 405. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 5500. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 4900. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 4300. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 3700. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 900. | - |
| STRONTIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 7.3 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 4.65 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 4.44 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| STRONTIUM | 0588 | 03/06/89 | 0001 | AL | U | MG/L | | 1.04 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 5.3 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 4.49 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 6.2 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 4.93 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 4.9 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 5.36 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 4.89 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 6.95 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 6.5 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 5.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 5.2 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 6.15 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 5.0 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 4.6 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 6.45 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 7.30 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 7.2 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 7.3 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 6.22 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 6.25 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 4.10 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 5.7 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 2.39 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 1.41 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 1.06 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 4.50 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 4.1 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 4.18 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 3.47 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 4.88 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 6.60 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 6.5 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 7.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 5.83 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 6.48 | - |
| SULFATE | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 2940. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
D - DOWN GRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| SULFATE | 0585 | 03/01/89 | 0001 | AL | D | MG/L | | 3950. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 3940. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 179. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 3510. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 3660. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 3420. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 3420. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 3310. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 3140. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 2770. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 3310. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 3130. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 3240. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 3170. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 3230. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 3850. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 3720. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 3960. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 4130. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 3880. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 3920. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 4060. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 3930. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 2520. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 3880. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 1020. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 611. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 385. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 2140. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 2210. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 1990. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 1760. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 2460. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 3450. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 3550. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 3620. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 3690. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 3620. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | 0581 | 03/07/89 | 0001 | AL | O | C - DEGREE | | 14. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 10.0 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 9.5 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 7.5 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 11.5 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 17.5 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 17.0 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 9.0 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 16.5 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 16.0 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 11.0 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 17.0 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 21.0 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 14.5 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 17.5 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 16.0 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 12.0 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 22.5 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 20.0 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 15.5 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 16.5 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 15.0 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 16.5 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 17.0 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 11.0 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 14. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 10. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 20.5 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 20.0 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 14.0 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 14. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 13. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 14.0 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 15.0 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 15.0 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 14. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 15. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TEMPERATURE | 0746 | 08/03/89 | 0001 | AL | U | C - DEGREE | | 16.0 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 14.0 | - |
| THALLIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.1 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.1 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.1 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.1 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| THORIUM-230 | 0581 | 03/07/89 | 0001 | AL | O | PCI/L | | 0.2 | 0.2 |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.2 | 0.3 |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.8 | 0.3 |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 0.2 | 0.2 |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| THORIUM-230 | 0589 | 03/01/89 | 0001 | AL | D | PCI/L | | 0.4 | 0.2 |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.3 | 0.8 |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.6 | 0.5 |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.3 | 0.2 |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.1 | 0.4 |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.3 | 0.4 |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.3 | 0.2 |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.0 | 0.6 |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.1 | 0.3 |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.6 | 0.3 |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.0 | 0.3 |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.0 | 0.3 |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.3 | 0.2 |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.3 | 0.5 |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.0 | 0.3 |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.1 | 0.7 |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.1 | 0.3 |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.3 | 0.2 |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.0 | 0.6 |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 1.2 | 1.0 |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 1.1 | 0.5 |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.4 | 0.3 |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.5 | 0.2 |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.2 | 0.8 |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.0 | 0.3 |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.0 | 0.7 |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.0 | 0.3 |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.1 | 0.2 |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.0 | 0.5 |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.1 | 0.4 |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.2 | 0.8 |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.2 | 0.4 |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.4 | 0.4 |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.6 | 0.9 |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.0 | 0.3 |
| TIN | 0581 | 03/07/89 | 0001 | AL | O | MG/L | < | 0.03 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TIN | 0585 | 03/01/89 | 0001 | AL | D | MG/L | < | 0.03 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.03 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.029 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.020 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.117 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.03 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.024 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 0.116 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.03 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.020 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.120 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.03 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.030 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.03 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.03 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.013 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.010 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.052 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.03 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.029 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.108 | - |
| TOTAL DISSOLVED SOLIDS | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 5380. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 6890. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 6820. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | | 844. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 6680. | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 7090. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 6690. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 6780. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table A...vial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TOTAL DISSOLVED SOLIDS | 0590 | 08/03/89 | 0001 | AL | D | MG/L | | 6180. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 5770. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 5260. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 7790. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 7100. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 7100. | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 6730. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 6970. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 7740. | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 7120. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 7580. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 8670. | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 8050. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 7940. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 8250. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 7850. | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 5390. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 7300. | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 2270. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 1420. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 1050. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 4920. | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 4680. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 4170. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 3790. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 4710. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 7010. | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 6680. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 6720. | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 6820. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 6890. | - |
| TOTAL ORGANIC CARBON | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 18. | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 28. | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 34. | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 1. | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 21. | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
D - DOWN GRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| TOTAL ORGANIC CARBON | 0589 | 08/03/89 | 0001 | AL | D | MG/L | | 146. | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 159. | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 11. | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 95. | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 130. | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 10. | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 180. | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 193. | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 9.0 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 141. | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | | 110. | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 9.0 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 142. | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 87. | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 144.6 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 142. | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 10. | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 115. | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 150.2 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 10. | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 9.0 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 2. | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 62. | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 52. | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 150.2 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 156. | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 5. | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 91. | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 110. | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 130.4 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 138. | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 9.0 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 111. | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 100. | - |
| URANIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.043 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | | 0.29 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table  Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| URANIUM | 0586 | 03/01/89 | 0001 | AL | D | MG/L | | 0.29 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.003 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.18 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.071 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.229 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.19 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.112 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | | 0.125 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | | 0.027 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | | 0.0678 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.0711 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | | 0.08 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | | 0.050 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.0003 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | | 0.129 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.083 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | | 0.095 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.0529 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.0684 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | | 0.064 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | | 0.059 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.213 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | | 0.12 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | | 0.093 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | | 0.021 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | | 0.010 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | | 0.0087 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.0427 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.0397 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | | 0.045 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | | 0.034 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | | 0.035 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.0564 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.0512 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | | 0.059 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | | 0.058 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | | 0.057 | - |
| VANADIUM | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| VANADIUM | 0585 | 03/01/89 | 0001 | AL | D | MG/L | | 0.11 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | | 0.14 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.07 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.01 | - |
| Stat | 0733 | 09/17/87 | 0001 | AL | D | | | 0.09 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.07 | - |
| max | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.01 | - |
| 0.035 | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | | 0.04 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | | 0.13 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.08 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | | 0.15 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.01 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.01 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.07 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.06 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | | 0.09 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.07 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 08/03/89 | 0001 | AL | U | | < | 0.01 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.01 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ZINC | 0581 | 03/07/89 | 0001 | AL | O | MG/L | | 0.016 | - |
| | 0585 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0586 | 03/01/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0588 | 03/06/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0589 | 03/01/89 | 0001 | AL | D | | | 0.019 | - |
| | 0589 | 08/03/89 | 0001 | AL | D | | | 0.006 | - |
| | 0590 | 09/22/88 | 0001 | AL | D | | | 0.027 | - |
| | 0590 | 03/01/89 | 0001 | AL | D | | | 0.006 | - |
| | 0590 | 08/03/89 | 0001 | AL | D | | | 0.009 | - |
| | 0590 | 11/02/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0710 | 03/06/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0733 | 09/17/87 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 09/22/88 | 0001 | AL | D | | | 0.014 | - |
| | 0733 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 08/03/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0733 | 11/02/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0736 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0736 | 08/03/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0736 | 11/02/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0737 | 09/17/87 | 0001 | AL | C | | < | 0.005 | - |
| | 0737 | 09/22/88 | 0001 | AL | C | | | 0.015 | - |
| | 0737 | 03/04/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0737 | 08/07/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0740 | 09/24/87 | 0001 | AL | D | | < | 0.005 | - |
| | 0740 | 02/28/89 | 0001 | AL | D | | < | 0.005 | - |
| | 0742 | 03/03/89 | 0001 | AL | C | | < | 0.005 | - |
| | 0744 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0744 | 08/03/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0744 | 11/02/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0745 | 09/17/87 | 0001 | AL | U | | | 0.362 | - |
| | 0745 | 09/22/88 | 0001 | AL | U | | | 0.021 | - |
| | 0745 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0745 | 08/03/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0745 | 11/02/89 | 0001 | AL | U | | < | 0.005 | - |
| | 0746 | 09/17/87 | 0001 | AL | U | | < | 0.005 | - |
| | 0746 | 09/22/88 | 0001 | AL | U | | | 0.017 | - |
| | 0746 | 03/05/89 | 0001 | AL | U | | < | 0.005 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJC1 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

| PARAMETER NAME | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | UNITS OF MEASURE | PVI | PARAMETER VALUE | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|
| ZINC | 0746 | 08/03/89 | 0001 | AL | U | MG/L | < | 0.005 | - |
| | 0746 | 11/02/89 | 0001 | AL | U | | < | 0.005 | - |

FORMATION OF COMPLETION CODE: FLOW RELATIONSHIP CODE:

PARAMETER VALUE INDICATOR (PVI): < = LESS THAN DETECTION LIMIT DATA FILE NAME: J:\DART\GRJ01\GWQ10015.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 53

BY BJ CHKD. _____ JOB NO. _____

Attachment II.

Test of Proportions Analyses

FORM 91-005 1 (4/81)

Test of Proportions Procedure

BD
SL 8/20/90

be appropriate when the number of detected compounds is quite small relative to the number of compounds analyzed for as might occur in detection monitoring.

**PURPOSE**

The test of proportions determines whether the proportion of compounds detected in the compliance well data differs significantly from the proportion of compounds detected in the background well data. If there is a significant difference, this is statistically significant evidence of contamination.

**PROCEDURE**

- The procedure uses the normal distribution approximation to the binomial distribution. This assumes that the sample size is reasonably large. Generally, if the proportion of detected values is denoted by P, and the sample size is n, then the normal approximation is adequate, provided that nP and n(1-P) both are greater than or equal to 5.

Step 1. Determine X, the number of background well samples in which the compound was detected. Let n be the total number of background well samples analyzed. Compute the proportion of detects:

$$\hat{P}_u = x/n$$

Step 2. Determine Y, the number of compliance well samples in which the compound was detected. Let M be the total number of compliance well samples analyzed. Compute the proportion of detects:

$$\hat{P}_d = y/m$$

Step 3. Compute the standard error of the difference in proportions:

$$S_D = \{[(x+y)/(n+m)][1 - (x+y)/(n+m)][1/n + 1/m]\}^{1/2}$$

and form the statistic:

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

Step 4. Compare the absolute value of Z to the 97.5th percentile from the standard normal distribution, 1.96. If the absolute value of Z exceeds 1.96, this provides statistically significant evidence at the 5% significance level that the proportion of compliance well samples where the compound was detected exceeds the proportion of background well samples where the compound was detected. This would be interpreted as evidence of contamination. (The two-sided test is used to provide information about differences in either direction.)

**EXAMPLE**

Table 8-2 contains data on cadmium concentrations measured in background well and compliance wells at a facility. In the table, "BDL" is used for below detection limit.

JACOBS ENGINEERING

DATE 8/7/90 SUBJECT

BY BJR CHKD.

SHEET NO. 56

JOB NO. 8/20/90

Test of Proportions (TOP)

All Alluvial Wells

| Analytes to be tested: | Percent of Non-Detects |
|---|---|
| Antimony | 62.1 |
| Barium | 87.2 |
| Chromium | 87.2 |
| Lead | 79.3 |
| Nickel | ~~64.1~~ 71.8 |
| Nitrate | 64.1 |
| Ra-226 | 56.4 |
| Silver | 86.2 |

Antimony

Upgradient – Number of Samples (N) = 11

$\hat{P}_u$ = Proportion of Detects = (100−72.7)/100 (% of non-detects)

= 0.273

x = Number of samples w detects = 3

Downgradient – Number of Samples (M) = 14

~~Proportion~~ Percentage of non-detects = 50.0

$\hat{P}_d$ = Proportion of Detects = (100−50)/100

= 0.500

y = 7 (Number of hits)

Standard error of the difference in proportions:

$$S_D = \{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\}^{1/2}$$

$$= \{[(3+7)/(11+14)][1-(3+7)/(11+14)][1/11 + 1/14]\}^{1/2}$$

$$= \{[\tfrac{10}{25}][1 - 10/25][0.0909 + 0.0714]\}^{1/2}$$

$$= \{[0.4][0.6][0.1623]\}^{1/2}$$

$$= \cancel{\sqrt{1.162}} = \sqrt{.0389}$$

$$= \cancel{1.078} = .197$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D = \cancel{(0.273 - 0.5)/1.078} = -0.211$$

$$(.273 - 0.5)/.197 = \quad = 1.15$$

$|-1.15| = 1.15 \leq 1.97$

To determine if there is statistical evidence of contamination, compare the absolute value of Z to the 97.5 th percentile from the standard normal distribution, 1.96.

Because $|-0.211|$ (1.15) $< 1.96$, contamination with antimony is not indicated statistically at the 5% significance level

Barium (TOP)

Upgradient Wells: Number of samples (N) = 15
Percent of non-detects = 86.7
$\hat{P}_u$ = Proportion of detects ~~= 0.137~~ 0.137
X = Number of detects = 2

Downgradient wells:
Number of samples (m) = 18
Percent of non-detects = 88.9
$\hat{P}_d$ = Proportion of detects = ~~11.1~~ 0.111
y = 2 (number of hits)

$$S_D = \left\{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\right\}^{1/2}$$

$$= \left\{[(2+2)/(15+18)][1-(2+2)/(15+18)]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{[0.1212][0.878][0.1222]\right\}^{1/2}$$

$$= 0.114$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

$$= \frac{(0.137-0.111)}{0.114} = 0.228$$

Since $Z < 1.96$, no evidence of contamination w. Barium

DATE _____ SUBJECT _____ SHEET NO. 58

BY BJ CHKD. SK 8/20/90 JOB NO. _____

Chromium (TOP)

Upgradient Wells:

$n$ = number of samples = 15

Percent of non-detects = 86.7

$\hat{P}_u$ = Proportion of detects = 0.133

$x$ = number of detects = 2

Downgradient Wells:

$m$ = 18

Percent of non-detects = 88.9

$\hat{P}_d$ = 0.111

$y$ = 2

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ \left[\frac{(2+2)}{(15+18)}\right]\left[1-\frac{2+2}{15+18}\right]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{ [0.1212][0.8788][0.1222]\right\}^{1/2}$$

$$= 0.114$$

$$Z = (\hat{P}_u - \hat{P}_d)/0.114$$

$$= (0.133 - 0.111)/0.114 = 0.193$$

Since $Z < 1.96$, no evidence of contamination w. Chromium

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 59

BY BS CHKD. SR 8/20/90 JOB NO. _____

Lead (TOP)

Upgradient wells:

$n$ = number of samples = 11
Percent of non-detects = 90.9
$\hat{p}_u$ = Proportion of detects = (100 − 90.9)/100 = 0.091
$x$ = number of detects = 1

Downgradient wells
$m$ = 14
Percent non-detects = 71.4
$\hat{p}_d$ = 0.286
$y$ = 4

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ [(1+4)/(11+14)][1-(1+5)/(11+14)]\left[\frac{1}{11}+\frac{1}{14}\right]\right\}^{1/2}$$

$$= \{[0.2][0.76][0.162]\}^{1/2}$$

$$= 0.157$$

$$Z = (\hat{p}_u - \hat{p}_d)/0.157$$

$$= (0.091 - 0.286)/0.157 = -1.24$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with lead.

FORM 8: 005.1 (4/81)

DATE _____ SUBJECT _____ SHEET NO. 60

BY BR CHKD. SL 8/20/90 JOB NO. _____

Nickel (TOP)

Upgradient wells:

$n$ = number of samples = 15

Percent of non-detects = 86.7

$\hat{p}_u$ = proportion of detects = 0.133 $[(100-86.7)/100]$

$x$ = number of detects = 2

Downgradient wells:

$m$ = 18

% non-detects = 55.6

$\hat{p}_d$ = $(100-55.6)/100 = 0.446$

$y$ = # detects = 8

$$S_D = \left\{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\right\}^{1/2}$$

$$= \left\{[(2+8)/(15+18)][1-(2+8)/(15+18)][\tfrac{1}{15}+\tfrac{1}{18}]\right\}^{1/2}$$

$$= \left\{[0.303][0.697][0.122]\right\}^{1/2}$$

$$= 0.161$$

$$Z = (\hat{p}_u - \hat{p}_d)/S_D$$

$$= (0.091 - 0.286)/0.161 = -1.21$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with ~~lead~~ nickel

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 61

BY BD CHKD. _____ JOB NO. _____

SK

Nitrate (TOP)

Upgradient wells:

$n = 15$

% non-detects = 66.7

$\hat{p}_u = (100 - 66.7)/100 = 0.333$

$x$ = # detects = 5

Downgradient wells:

$m = 18$

% non-detects = 61.1

$\hat{p}_d = (100 - 61.1)/100 = .389$

$y = 7$

$$S_D = \left\{ [(x+y)/(n+m)][1 - (x+y)/(n+m)][\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(5+7)/(15+18)][1 - (x+y)/(n+m))][\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \{ [0.36][0.636][0.122] \}^{1/2}$$

$$= 0.167$$

$$Z = (\hat{p}_u - \hat{p}_d)/S_D$$

$$= (0.333 - 0.389)/0.167$$

$$= -0.335$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with nitrate.

FORM 81-005-1 (4/81)

Ra-226 (TOP)

8k

Upgradient wells:

$n = 15$

% non-detects = 46.7

$\hat{p}_u = (100 - 46.7)/100 = 0.533$

$x = 8$

Downgradient wells..

$m = 18$

% non-detects = 61.1

$\hat{p}_d = (100 - 61.1)/100 = 0.389$

$y = 7$

$$s_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ [(8+7)/(15+18)][1-(8+7)/(15+18)]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \{ [0.45][0.55][0.12] \}^{1/2}$$

$$= 0.172$$

$$Z = (\hat{p}_u - \hat{p}_d)/s_D$$

$$= (0.533 - .389)/0.172$$

$$= 0.83$$

Since $Z < 1.96$, there is no statistical evidence of contamination w. Ra-226.

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 63

BY BD CHKD. _____ JOB NO. _____

Silver (TOR)

Upgradient wells:

$n = 11$

% non-detects $= 90.9$

$\hat{p}_u = (100 - 90.9)/100 = 0.091$

$x = 1$

Downgradient wells:

$m = 14$

% non-detects $= 78.6$

$\hat{p}_d = 0.214$

$y = 3$

$$S_D = \left\{ [(x+y)/(n+m)] [1 - (x+y)/(n+m)] [\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(1+3)/(11+14)] [1 - (1+3)/(11+14)] [\tfrac{1}{11} + \tfrac{1}{14}] \right\}^{1/2}$$

$$= \left\{ [0.16] [0.84] [0.16] \right\}^{1/2}$$

$$= 0.148$$

$$Z = (0.091 - 0.214)/0.148$$

$$= -0.83$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination w. Silver.

FORM 91-005-1 (4/81)

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Vanadium: (TEP)

Upgradient Wells

Number of Samples $(n)$ = 15
Percent of non-detects: 73.3
$\hat{P}_u$ = Proportion of detects: .267
$x$ = Number of detects = 4

Downgradient Wells

Number of Samples $(m)$ = 18
Percent of non-detects = 61.1
$\hat{P}_u$ = Proportion of detects = .389
$y$ = Number of detects = 7

$$S_p = \left\{ \left[ (x+y)/(n+m) \right] \left[ 1 - (x+y)/(n+m) \right] \left[ 1/n + 1/m \right] \right\}^{1/2}$$

$$= \left\{ \left[ (11+7)/(15+18) \right] \left[ 1 - (11+7)/(15+18) \right] \left[ 1/15 + 1/18 \right] \right\}^{1/2}$$

$$\left\{ (.33)(.67)(.12) \right\}^{1/2}$$

$S_p = .162$

$Z = (.267 - .389)/.162$

$Z = -.75$

$|Z| = .75$

$.75 \nless 1.96$, No evidence of contamination in Vanadium.

FORM 81-005-1 (4/81)

GROUNDWATER ( ,Y STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 15 | 20.5000 | 554.0000 | 439.0000 | 411.4333 | 142.1499 | 0.3455 | 0.0 | 315.1248 | 507.7619 | NORMAL | |
| ALUMINUM | | | MG/L | | | | | | | | |
| 15 | 0.0500 | 0.3800 | 0.0500 | NA | NA | NA | 73.3 | 0.0500 | 0.3000 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 15 | 0.0500 | 61.0000 | 0.1000 | NA | NA | NA | 46.7 | 0.0500 | 1.7000 | NONPARAMETRIC | 2 |
| ANTIMONY | | | MG/L | | | | | | | | |
| 11 | 0.0015 | 0.0120 | 0.0015 | NA | NA | NA | 72.7 | 0.0015 | 0.0090 | NONPARAMETRIC | 2 |
| ARSENIC | | | MG/L | | | | | | | | |
| 15 | 0.0050 | 0.0400 | 0.0050 | NA | NA | NA | 66.7 | 0.0050 | 0.0160 | NONPARAMETRIC | 2 |
| BARIUM | | | MG/L | | | | | | | | |
| 15 | 0.0200 | 0.0500 | 0.0500 | NA | NA | NA | 86.7 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 11 | 0.0025 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0025 | 0.0050 | NONPARAMETRIC | 2 |
| BROMIDE | | | MG/L | | | | | | | | |
| 3 | 0.0500 | 0.2000 | 0.1000 | NA | NA | NA | 33.3 | NA | NA | UNKNOWN | 1 |
| CADMIUM | | | MG/L | | | | | | | | |
| 15 | 0.0005 | 0.0390 | 0.0005 | NA | NA | NA | 53.3 | 0.0005 | 0.0130 | NONPARAMETRIC | 2 |
| CALCIUM | | | MG/L | | | | | | | | |
| 15 | 93.1000 | 510.0000 | 427.0000 | 360.0733 | 141.7940 | 0.3938 | 0.0 | 264.0059 | 456.1407 | NORMAL | |
| CHLORIDE | | | MG/L | | | | | | | | |
| 15 | 149.0000 | 730.0000 | 570.0000 | 507.2667 | 212.8646 | 0.4196 | 0.0 | 363.0479 | 651.4854 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHROMIUM | MG/L | 15 | 0.0050 | 0.1500 | 0.0050 | NA | NA | NA | 86.7 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| COBALT | MG/L | 11 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2 |
| COPPER | MG/L | 15 | 0.0100 | 0.0200 | 0.0100 | NA | NA | NA | 80.0 | 0.0100 | 0.0200 | NONPARAMETRIC | 2 |
| CYANIDE | MG/L | 11 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| FLUORIDE | MG/L | 15 | 0.4000 | 1.6000 | 0.7600 | 0.9007 | 0.3800 | 0.4220 | 0.0 | 0.6432 | 1.1582 | NORMAL | |
| GROSS ALPHA | PCI/L | 15 | 0.0000 | 58.0000 | 19.0000 | NA | NA | NA | 13.3 | 2.0000 | 41.0000 | NONPARAMETRIC | 9 |
| GROSS BETA | PCI/L | 15 | 0.0000 | 110.0000 | 32.0000 | NA | NA | NA | 6.7 | 12.0000 | 64.0000 | NONPARAMETRIC | 9 |
| IRON | MG/L | 15 | 0.0100 | 1.5600 | 0.1200 | 0.1274 | 4.9406 | NA | 13.3 | 0.0432 | 0.3759 | LOGNORMAL | 7,8 |
| LEAD | MG/L | 11 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 90.9 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| MAGNESIUM | MG/L | 15 | 39.5000 | 525.0000 | 289.0000 | 296.1733 | 165.3434 | 0.5583 | 0.0 | 184.1509 | 408.1958 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATER Q. ,Y STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| MANGANESE | | | MG/L | | | | | | | | |
| 15 | 0.2800 | 1.9300 | 1.3400 | 1.1680 | 0.4292 | 0.3675 | 0.0 | 0.8772 | 1.4588 | NORMAL | |
| MECHANICAL SIEVE TEST 3/8 INCH | | | % PASSING | | | | | | | | |
| 1 | 3690.0000 | 3690.0000 | 3690.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| MERCURY | | | MG/L | | | | | | | | |
| 11 | 0.0001 | 0.0001 | 0.0001 | NA | NA | NA | 100.0 | 0.0001 | 0.0001 | NONPARAMETRIC | 2 |
| MOLYBDENUM | | | MG/L | | | | | | | | |
| 11 | 0.0050 | 0.1500 | 0.0300 | NA | NA | NA | 18.2 | 0.0050 | 0.1500 | NONPARAMETRIC | 2 |
| NICKEL | | | MG/L | | | | | | | | |
| 15 | 0.0200 | 0.1200 | 0.0200 | NA | NA | NA | 86.7 | 0.0200 | 0.0200 | NONPARAMETRIC | 2 |
| NITRATE | | | MG/L | | | | | | | | |
| 15 | 0.5000 | 29.0000 | 0.5000 | NA | NA | NA | 66.7 | 0.5000 | 3.5000 | NONPARAMETRIC | 2 |
| POTASSIUM | | | MG/L | | | | | | | | |
| 15 | 4.9000 | 19.0000 | 6.5000 | 7.9753 | 3.6348 | 0.4558 | 0.0 | 5.5127 | 10.4379 | NORMAL | |
| RADIUM-226 | | | PCI/L | | | | | | | | |
| 15 | 0.0000 | 0.2000 | 0.0000 | NA | NA | NA | 46.7 | 0.0000 | 0.1000 | NONPARAMETRIC | 2 |
| RADIUM-228 | | | PCI/L | | | | | | | | |
| 15 | 0.0000 | 1.2000 | 0.4000 | NA | NA | NA | 13.3 | 0.1000 | 1.0000 | NONPARAMETRIC | 9 |
| SELENIUM | | | MG/L | | | | | | | | |
| 15 | 0.0025 | 0.1910 | 0.0300 | NA | NA | NA | 26.7 | 0.0025 | 0.0600 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| SILICA - SIO2 | | | MG/L | | | | | | | | |
| 3 | 17.0000 | 17.0000 | 17.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| SILVER | | | MG/L | | | | | | | | |
| 11 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 90.9 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| SODIUM | | | MG/L | | | | | | | | |
| 15 | 144.0000 | 910.0000 | 573.0000 | 581.4667 | 272.9403 | 0.4694 | 0.0 | 396.5458 | 766.3875 | NORMAL | |
| SPECIFIC CONDUCTANCE | | | UMHO/CM | | | | | | | | |
| 15 | 75.0000 | 5500.0000 | 2950.0000 | 2630.6667 | 1746.8123 | 0.6640 | 0.0 | 1447.1771 | 3814.1562 | NORMAL | |
| STRONTIUM | | | MG/L | | | | | | | | |
| 15 | 1.0400 | 7.1000 | 4.5000 | 4.2953 | 2.0643 | 0.4806 | 0.0 | 2.8968 | 5.6939 | NORMAL | |
| SULFATE | | | MG/L | | | | | | | | |
| 15 | 179.0000 | 3690.0000 | 2210.0000 | 2230.3333 | 1240.7943 | 0.5563 | 0.0 | 1389.6780 | 3070.9886 | NORMAL | |
| TEMPERATURE | | | C - DEGREE | | | | | | | | |
| 15 | 7.5000 | 20.5000 | 14.0000 | 14.2000 | 3.3048 | 0.2327 | 0.0 | 11.9610 | 16.4390 | NORMAL | |
| THALLIUM | | | MG/L | | | | | | | | |
| 11 | 0.0050 | 0.0500 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0500 | NONPARAMETRIC | 2 |
| THORIUM-230 | | | PCI/L | | | | | | | | |
| 15 | 0.0000 | 0.6000 | 0.2000 | NA | NA | NA | 26.7 | 0.0000 | 0.4000 | NONPARAMETRIC | 2 |
| TIN | | | MG/L | | | | | | | | |
| 11 | 0.0025 | 0.1080 | 0.0025 | NA | NA | NA | 54.5 | 0.0025 | 0.0520 | NONPARAMETRIC | 2 |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 15 | 844.0000 | 7010.0000 | 4710.0000 | 4468.9333 | 2207.1403 | 0.4939 | 0.0 | 2973.5651 | 5964.3015 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the n[illegible]ected values comprise more than 15% of the samples.

67
89

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| TOTAL ORGANIC CARBON | | | MG/L | | | | | | | | |
| 15 | 0.5000 | 156.0000 | 91.0000 | 75.1400 | 58.3794 | 0.7769 | 6.7 | 35.5871 | 114.6929 | NORMAL | |
| URANIUM | | | MG/L | | | | | | | | |
| 15 | 0.0015 | 0.0590 | 0.0397 | 0.0364 | 0.0192 | 0.5273 | 6.7 | 0.0234 | 0.0494 | NORMAL | |
| VANADIUM | | | MG/L | | | | | | | | |
| 15 | 0.0050 | 0.0900 | 0.0050 | NA | NA | NA | 73.3 | 0.0050 | 0.0700 | NONPARAMETRIC | 2 |
| ZINC | | | MG/L | | | | | | | | |
| 15 | 0.0025 | 0.3620 | 0.0025 | NA | NA | NA | 80.0 | 0.0025 | 0.0170 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: C:\DART\GRJ01\GWQ10015.DAT

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 18 | 411.0000 | 651.0000 | 548.5000 | 542.9444 | 76.2978 | 0.1405 | 0.0 | 496.7807 | 589.1082 | NORMAL | |
| ALUMINUM | | | MG/L | | | | | | | | |
| 18 | 0.0500 | 0.7200 | 0.0500 | NA | NA | NA | 66.7 | 0.0500 | 0.3000 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 18 | 0.0500 | 300.0000 | 1.7000 | NA | NA | NA | 38.9 | 0.0500 | 50.0000 | NONPARAMETRIC | 2 |
| ANTIMONY | | | MG/L | | | | | | | | |
| 14 | 0.0015 | 0.0170 | 0.0052 | NA | NA | NA | 50.0 | 0.0015 | 0.0160 | NONPARAMETRIC | 2 |
| ARSENIC | | | MG/L | | | | | | | | |
| 18 | 0.0050 | 0.0500 | 0.0100 | NA | NA | NA | 38.9 | 0.0050 | 0.0150 | NONPARAMETRIC | 2 |
| BARIUM | | | MG/L | | | | | | | | |
| 18 | 0.0200 | 0.0500 | 0.0500 | NA | NA | NA | 88.9 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 14 | 0.0025 | 0.0050 | 0.0037 | NA | NA | NA | 100.0 | 0.0025 | 0.0050 | NONPARAMETRIC | 2 |
| BROMIDE | | | MG/L | | | | | | | | |
| 3 | 0.1000 | 1.2000 | 1.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| CADMIUM | | | MG/L | | | | | | | | |
| 18 | 0.0005 | 0.0250 | 0.0010 | NA | NA | NA | 44.4 | 0.0005 | 0.0140 | NONPARAMETRIC | 2 |
| CALCIUM | | | MG/L | | | | | | | | |
| 18 | 370.0000 | 560.0000 | 488.5000 | 481.7778 | 58.3454 | 0.1211 | 0.0 | 446.4760 | 517.0795 | NORMAL | |
| CHLORIDE | | | MG/L | | | | | | | | |
| 18 | 700.0000 | 1200.0000 | 935.0000 | 951.7222 | 160.7789 | 0.1689 | 0.0 | 854.4433 | 1049.0011 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| CHROMIUM | | | MG/L | | | | | | | | |
| 18 | 0.0050 | 0.1400 | 0.0050 | NA | NA | NA | 88.9 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| COBALT | | | MG/L | | | | | | | | |
| 14 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2 |
| COPPER | | | MG/L | | | | | | | | |
| 18 | 0.0100 | 0.0700 | 0.0100 | NA | NA | NA | 72.2 | 0.0100 | 0.0300 | NONPARAMETRIC | 2 |
| CYANIDE | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| FLUORIDE | | | MG/L | | | | | | | | |
| 18 | 0.4000 | 3.7000 | 0.6800 | 0.7071 | 1.8820 | NA | 0.0 | 0.4823 | 1.0366 | LOGNORMAL | 7,8 |
| GROSS ALPHA | | | PCI/L | | | | | | | | |
| 18 | 0.0000 | 223.0000 | 110.0000 | NA | NA | NA | 5.6 | 49.0000 | 140.0000 | NONPARAMETRIC | 9 |
| GROSS BETA | | | PCI/L | | | | | | | | |
| 18 | 21.0000 | 176.0000 | 79.5000 | 85.1111 | 47.4191 | 0.5571 | 0.0 | 56.4203 | 113.8020 | NORMAL | |
| IRON | | | MG/L | | | | | | | | |
| 18 | 0.0150 | 16.0000 | 0.2500 | NA | NA | NA | 22.2 | 0.0150 | 5.7000 | NONPARAMETRIC | 2 |
| LEAD | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.0200 | 0.0050 | NA | NA | NA | 71.4 | 0.0050 | 0.0200 | NONPARAMETRIC | 2 |
| MAGNESIUM | | | MG/L | | | | | | | | |
| 18 | 310.0000 | 462.0000 | 386.5000 | 385.2778 | 45.5603 | 0.1183 | 0.0 | 357.7116 | 412.8439 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MANGANESE | MG/L | 18 | 0.9400 | 4.1600 | 1.5900 | 1.9839 | 0.8992 | 0.4532 | 0.0 | 1.4398 | 2.5279 | NORMAL | |
| MERCURY | MG/L | 14 | 0.0001 | 0.0001 | 0.0001 | NA | NA | NA | 100.0 | 0.0001 | 0.0001 | NONPARAMETRIC | 2 |
| MOLYBDENUM | MG/L | 14 | 0.0050 | 0.2400 | 0.0400 | 0.0625 | 0.0619 | 0.9907 | 7.1 | 0.0186 | 0.1064 | NORMAL | |
| NICKEL | MG/L | 18 | 0.0100 | 0.1200 | 0.0200 | NA | NA | NA | 55.6 | 0.0200 | 0.0500 | NONPARAMETRIC | 2 |
| NITRATE | MG/L | 18 | 0.4000 | 5.7000 | 0.5000 | NA | NA | NA | 61.1 | 0.5000 | 2.2000 | NONPARAMETRIC | 2 |
| POTASSIUM | MG/L | 18 | 8.1000 | 71.0000 | 15.9000 | 25.9233 | 22.0474 | 0.8505 | 0.0 | 12.5836 | 39.2631 | NORMAL | |
| RADIUM-226 | PCI/L | 18 | 0.0000 | 0.8000 | 0.0000 | NA | NA | NA | 61.1 | 0.0000 | 0.1000 | NONPARAMETRIC | 2 |
| RADIUM-228 | PCI/L | 18 | 0.0000 | 2.3000 | 0.6000 | NA | NA | NA | 16.7 | 0.2000 | 2.0000 | NONPARAMETRIC | 2 |
| SELENIUM | MG/L | 18 | 0.0025 | 0.1960 | 0.0255 | NA | NA | NA | 38.9 | 0.0025 | 0.1270 | NONPARAMETRIC | 2 |
| SILICA - SIO2 | MG/L | 3 | 17.0000 | 21.0000 | 20.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| SILVER | MG/L | 14 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 78.6 | 0.0050 | 0.0100 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| SODIUM | | | MG/L | | | | | | | | |
| 18 | 728.0000 | 1327.0000 | 1130.0000 | 1094.5556 | 154.4391 | 0.1411 | 0.0 | 1001.1125 | 1187.9986 | NORMAL | |
| SPECIFIC CONDUCTANCE | | | UMHO/CM | | | | | | | | |
| 18 | 1000.0000 | 7500.0000 | 3800.0000 | 3936.1111 | 2012.9847 | 0.5114 | 0.0 | 2718.1593 | 5154.0630 | NORMAL | |
| STRONTIUM | | | MG/L | | | | | | | | |
| 18 | 4.1000 | 6.9500 | 5.1500 | 5.3650 | 0.8413 | 0.1568 | 0.0 | 4.8560 | 5.8740 | NORMAL | |
| SULFATE | | | MG/L | | | | | | | | |
| 18 | 2520.0000 | 3960.0000 | 3420.0000 | 3467.2222 | 385.8650 | 0.1113 | 0.0 | 3233.7555 | 3700.6890 | NORMAL | |
| TEMPERATURE | | | C - DEGREE | | | | | | | | |
| 18 | 9.0000 | 22.5000 | 16.2500 | 15.3056 | 4.0079 | 0.2619 | 0.0 | 12.8806 | 17.7305 | NORMAL | |
| THALLIUM | | | MG/L | | | | | | | | |
| 14 | 0.0050 | 0.0500 | 0.0275 | NA | NA | NA | 100.0 | 0.0050 | 0.0500 | NONPARAMETRIC | 2 |
| THORIUM-230 | | | PCI/L | | | | | | | | |
| 18 | 0.0000 | 1.2000 | 0.3000 | NA | NA | NA | 22.2 | 0.0000 | 0.6000 | NONPARAMETRIC | 2 |
| TIN | | | MG/L | | | | | | | | |
| 14 | 0.0025 | 0.1200 | 0.0265 | NA | NA | NA | 28.6 | 0.0025 | 0.1160 | NONPARAMETRIC | 2 |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 18 | 5390.0000 | 7850.0000 | 6930.0000 | 6903.8889 | 653.0214 | 0.0946 | 0.0 | 6508.7798 | 7298.9980 | NORMAL | |
| TOTAL ORGANIC CARBON | | | MG/L | | | | | | | | |
| 18 | 9.0000 | 193.0000 | 102.5000 | 91.9556 | 66.4230 | 0.7223 | 0.0 | 51.7665 | 132.1446 | NORMAL | |
| URANIUM | | | MG/L | | | | | | | | |
| 18 | 0.0015 | 0.2900 | 0.1160 | 0.1332 | 0.0819 | 0.6146 | 5.6 | 0.0837 | 0.1827 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| VANADIUM | | | MG/L | | | | | | | | |
| 18 | 0.0050 | 0.1500 | 0.0050 | NA | NA | NA | 61.1 | 0.0050 | 0.0900 | NONPARAMETRIC | 2 |
| ZINC | | | MG/L | | | | | | | | |
| 18 | 0.0025 | 0.0270 | 0.0025 | NA | NA | NA | 66.7 | 0.0025 | 0.0090 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: C:\DART\GRJ01\GWQ10016.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT SHEET NO. 74

BY BJ CHKD. _____ JOB NO. _____

Attachment III.

ANOVA Analyses

FORM 91-005-1 (4/81)

JE

DATE 09 Aug 1990 SUBJECT

BY BJ CHKD.

SHEET NO. 75

JOB NO.

Based on a DART statistical analysis of the pooled under quality data set, the statistical distributions for the ANOVA analyses are as follows:

| | Distribution | Recommended ANOVA |
|---|---|---|
| Arsenic | Nonparametric | Nonparametric |
| Cadmium | ↓ | ↓ |
| Gross alpha | | |
| Molybdenum | Normal | Parametric |
| Selenium | Nonparametric | Nonparametric |

FORM 91-005-1 (4/81)

Alluvial water quality statistics for down, cross, and upgradient wells (data pooled)
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | | |
| ALKALINITY | | | MG/L CACO3 | | | | | | | | |
| 38 | 20.5000 | 651.0000 | 478.0000 | 479.5132 | 119.5044 | 0.2492 | 0.0 | 432.3854 | 526.6410 | NORMAL | |
| ALUMINUM | | | MG/L | | | | | | | | |
| 38 | 0.0500 | 0.7200 | 0.0500 | NA | NA | NA | 68.4 | 0.0500 | 0.1000 | NONPARAMETRIC | 2 |
| AMMONIUM | | | MG/L | | | | | | | | |
| 38 | 0.0500 | 300.0000 | 0.3000 | NA | NA | NA | 44.7 | 0.0500 | 1.7000 | NONPARAMETRIC | 2 |
| ANTIMONY | | | MG/L | | | | | | | | |
| 28 | 0.0015 | 0.0170 | 0.0015 | NA | NA | NA | 60.7 | 0.0015 | 0.0120 | NONPARAMETRIC | 2 |
| ARSENIC | | | MG/L | | | | | | | | |
| 38 | 0.0050 | 0.0500 | 0.0075 | NA | NA | NA | 50.0 | 0.0050 | 0.0120 | NONPARAMETRIC | 2 |
| BARIUM | | | MG/L | | | | | | | | |
| 38 | 0.0200 | 0.0500 | 0.0500 | NA | NA | NA | 86.8 | 0.0500 | 0.0500 | NONPARAMETRIC | 2 |
| BERYLLIUM | | | MG/L | | | | | | | | |
| 28 | 0.0025 | 0.0050 | 0.0037 | NA | NA | NA | 100.0 | 0.0025 | 0.0050 | NONPARAMETRIC | 2 |
| BROMIDE | | | MG/L | | | | | | | | |
| 6 | 0.0500 | 1.2000 | 0.1500 | NA | NA | NA | 16.7 | 0.0500 | 1.2000 | NONPARAMETRIC | 2,6 |
| CADMIUM | | | MG/L | | | | | | | | |
| 38 | 0.0005 | 0.0390 | 0.0008 | NA | NA | NA | 50.0 | 0.0005 | 0.0100 | NONPARAMETRIC | 2 |
| CALCIUM | | | MG/L | | | | | | | | |
| 38 | 93.1000 | 570.0000 | 464.5000 | 438.5816 | 116.5657 | 0.2658 | 0.0 | 392.6127 | 484.5505 | NORMAL | |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

| PARAMETER NAME | UNITS | # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHLORIDE | MG/L | 38 | 149.0000 | 1300.0000 | 830.0000 | 799.7368 | 303.2459 | 0.3792 | 0.0 | 680.1487 | 919.3250 | NORMAL | |
| CHROMIUM | MG/L | 38 | 0.0050 | 0.1600 | 0.0050 | NA | NA | NA | 86.8 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| COBALT | MG/L | 28 | 0.0250 | 0.0250 | 0.0250 | NA | NA | NA | 100.0 | 0.0250 | 0.0250 | NONPARAMETRIC | 2 |
| COPPER | MG/L | 38 | 0.0100 | 0.0700 | 0.0100 | NA | NA | NA | 73.7 | 0.0100 | 0.0100 | NONPARAMETRIC | 2 |
| CYANIDE | MG/L | 28 | 0.0050 | 0.0050 | 0.0050 | NA | NA | NA | 100.0 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| FLUORIDE | MG/L | 38 | 0.4000 | 3.7000 | 0.7000 | 0.9289 | 0.6987 | 0.7521 | 0.0 | 0.6534 | 1.2045 | NORMAL | |
| GROSS ALPHA | PCI/L | 38 | 0.0000 | 223.0000 | 45.0000 | NA | NA | NA | 10.5 | 19.0000 | 100.0000 | NONPARAMETRIC | 9 |
| GROSS BETA | PCI/L | 38 | 0.0000 | 176.0000 | 56.0000 | NA | NA | NA | 2.6 | 36.0000 | 77.0000 | NONPARAMETRIC | 9 |
| IRON | MG/L | 38 | 0.0100 | 16.0000 | 0.1550 | NA | NA | NA | 18.4 | 0.1100 | 0.5700 | NONPARAMETRIC | 2 |
| LEAD | MG/L | 28 | 0.0050 | 0.0200 | 0.0050 | NA | NA | NA | 78.6 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| MAGNESIUM | | | MG/L | | | | | | | | |
| 38 | 39.5000 | 565.0000 | 386.5000 | 369.0947 | 131.1267 | 0.3553 | 0.0 | 317.3836 | 420.8059 | NORMAL | |
| MANGANESE | | | MG/L | | | | | | | | |
| 38 | 0.2800 | 4.1600 | 1.4950 | 1.6611 | 0.7796 | 0.4693 | 0.0 | 1.3536 | 1.9685 | NORMAL | |
| MECHANICAL SIEVE TEST 3/8 INCH | | | % PASSING | | | | | | | | |
| 1 | 3690.0000 | 3690.0000 | 3690.0000 | NA | NA | NA | 0.0 | NA | NA | UNKNOWN | 1 |
| MERCURY | | | MG/L | | | | | | | | |
| 28 | 0.0001 | 0.0001 | 0.0001 | NA | NA | NA | 100.0 | 0.0001 | 0.0001 | NONPARAMETRIC | 2 |
| MOLYBDENUM | | | MG/L | | | | | | | | |
| 28 | 0.0050 | 0.2400 | 0.0400 | 0.0609 | 0.0568 | 0.9330 | 10.7 | 0.0343 | 0.0874 | NORMAL | |
| NICKEL | | | MG/L | | | | | | | | |
| 38 | 0.0100 | 0.1300 | 0.0200 | NA | NA | NA | 71.1 | 0.0200 | 0.0200 | NONPARAMETRIC | 2 |
| NITRATE | | | MG/L | | | | | | | | |
| 38 | 0.4000 | 29.0000 | 0.5000 | NA | NA | NA | 65.8 | 0.5000 | 0.5000 | NONPARAMETRIC | 2 |
| POTASSIUM | | | MG/L | | | | | | | | |
| 38 | 4.9000 | 71.0000 | 10.1500 | 12.1114 | 2.0769 | NA | 0.0 | 9.0787 | 16.1573 | LOGNORMAL | 7,8 |
| RADIUM-226 | | | PCI/L | | | | | | | | |
| 38 | 0.0000 | 0.8000 | 0.0000 | NA | NA | NA | 57.9 | 0.0000 | 0.1000 | NONPARAMETRIC | 2 |
| RADIUM-228 | | | PCI/L | | | | | | | | |
| 38 | 0.0000 | 2.3000 | 0.7000 | NA | NA | NA | 13.2 | 0.3000 | 1.0000 | NONPARAMETRIC | 9 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

Alluvial wate...uality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| SELENIUM | | | MG/L | | | | | | | | |
| 38 | 0.0025 | 0.1990 | 0.0260 | NA | NA | NA | 34.2 | 0.0025 | 0.0570 | NONPARAMETRIC | 2 |
| SILICA - SIO2 | | | MG/L | | | | | | | | |
| 6 | 17.0000 | 21.0000 | 17.0000 | 18.1667 | 1.8348 | 0.1010 | 0.0 | 15.6460 | 20.6873 | NORMAL | |
| SILVER | | | MG/L | | | | | | | | |
| 28 | 0.0050 | 0.0100 | 0.0050 | NA | NA | NA | 85.7 | 0.0050 | 0.0050 | NONPARAMETRIC | 2 |
| SODIUM | | | MG/L | | | | | | | | |
| 38 | 144.0000 | 1400.0000 | 951.5000 | 906.6842 | 337.8274 | 0.3726 | 0.0 | 773.4585 | 1039.9099 | NORMAL | |
| SPECIFIC CONDUCTANCE | | | UMHO/CM | | | | | | | | |
| 38 | 75.0000 | 7500.0000 | 3650.0000 | 3660.2632 | 2072.2539 | 0.5661 | 0.0 | 2843.0485 | 4477.4778 | NORMAL | |
| STRONTIUM | | | MG/L | | | | | | | | |
| 38 | 1.0400 | 7.3000 | 5.1500 | 5.1242 | 1.6303 | 0.3182 | 0.0 | 4.4813 | 5.7672 | NORMAL | |
| SULFATE | | | MG/L | | | | | | | | |
| 38 | 179.0000 | 4130.0000 | 3420.0000 | 3045.6579 | 1060.5553 | 0.3482 | 0.0 | 2627.4170 | 3463.8988 | NORMAL | |
| TEMPERATURE | | | C - DEGREE | | | | | | | | |
| 38 | 7.5000 | 22.5000 | 15.0000 | 14.8947 | 3.4586 | 0.2322 | 0.0 | 13.5308 | 16.2587 | NORMAL | |
| THALLIUM | | | MG/L | | | | | | | | |
| 28 | 0.0050 | 0.0500 | 0.0275 | NA | NA | NA | 100.0 | 0.0050 | 0.0500 | NONPARAMETRIC | 2 |
| THORIUM-230 | | | PCI/L | | | | | | | | |
| 38 | 0.0000 | 1.2000 | 0.2000 | NA | NA | NA | 23.7 | 0.1000 | 0.3000 | NONPARAMETRIC | 2 |
| TIN | | | MG/L | | | | | | | | |
| 28 | 0.0025 | 0.1200 | 0.0165 | NA | NA | NA | 42.9 | 0.0025 | 0.0300 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

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Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

| PARAMETER NAME | | | UNITS | | | | | STATISTICAL RANGE 98% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # OF SAMP | MINIMUM | MAXIMUM | MEDIAN | MEAN | STANDARD DEVIATION | COEFF. OF VARIATION | % OF NON DETECTS | MINIMUM | MAXIMUM * | DISTRIBUTION TYPE | FOOT NOTE |
| TOTAL DISSOLVED SOLIDS | | | MG/L | | | | | | | | |
| 38 | 844.0000 | 8670.0000 | 6800.0000 | 6092.4737 | 1992.1555 | 0.3270 | 0.0 | 5306.8467 | 6878.1007 | NORMAL | |
| TOTAL ORGANIC CARBON | | | MG/L | | | | | | | | |
| 38 | 0.5000 | 193.0000 | 97.5000 | 84.2868 | 62.4133 | 0.7405 | 2.6 | 59.6735 | 108.9001 | NORMAL | |
| URANIUM | | | MG/L | | | | | | | | |
| 38 | 0.0015 | 0.2900 | 0.0615 | 0.0863 | 0.0733 | 0.8488 | 5.3 | 0.0574 | 0.1152 | NORMAL | |
| VANADIUM | | | MG/L | | | | | | | | |
| 38 | 0.0050 | 0.1500 | 0.0050 | NA | NA | NA | 65.8 | 0.0050 | 0.0600 | NONPARAMETRIC | 2 |
| ZINC | | | MG/L | | | | | | | | |
| 38 | 0.0025 | 0.3620 | 0.0025 | NA | NA | NA | 73.7 | 0.0025 | 0.0025 | NONPARAMETRIC | 2 |

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: J:\DART\GRJ01\GWQ10020.DAT

Table used to obtain "tabulated" H statistic for one-way nonparametric ANOVA analyses

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# TABLE 1. PERCENTILES OF THE $\chi^2$ DISTRIBUTION WITH $\nu$ DEGREES OF FREEDOM, $\chi^2_{\nu,P}$

| $\nu$ \ $P$ | 0.750 | 0.900 | 0.950 | 0.975 | 0.990 | 0.995 | 0.999 |
|---|---|---|---|---|---|---|---|
| 1 | 1.323 | 2.706 | 3.841 | 5.024 | 6.635 | 7.879 | 10.83 |
| 2 | 2.773 | 4.605 | 5.991 | 7.378 | 9.210 | 10.60 | 13.82 |
| 3 | 4.108 | 6.251 | 7.815 | 9.348 | 11.34 | 12.84 | 16.27 |
| 4 | 5.385 | 7.779 | 9.488 | 11.14 | 13.28 | 14.86 | 18.47 |
| 5 | 6.626 | 9.236 | 11.07 | 12.83 | 15.09 | 16.75 | 20.52 |
| 6 | 7.841 | 10.64 | 12.59 | 14.45 | 16.81 | 18.55 | 22.46 |
| 7 | 9.037 | 12.02 | 14.07 | 16.01 | 18.48 | 20.28 | 24.32 |
| 8 | 10.22 | 13.36 | 15.51 | 17.53 | 20.09 | 21.96 | 26.12 |
| 9 | 11.39 | 14.68 | 16.92 | 19.02 | 21.67 | 23.59 | 27.88 |
| 10 | 12.55 | 15.99 | 18.31 | 20.48 | 23.21 | 25.19 | 29.59 |
| 11 | 13.70 | 17.28 | 19.68 | 21.92 | 24.72 | 26.76 | 31.26 |
| 12 | 14.85 | 18.55 | 21.03 | 23.34 | 26.22 | 28.30 | 32.91 |
| 13 | 15.98 | 19.81 | 22.36 | 24.74 | 27.69 | 29.82 | 34.53 |
| 14 | 17.12 | 21.06 | 23.68 | 26.12 | 29.14 | 31.32 | 36.12 |
| 15 | 18.25 | 22.31 | 25.00 | 27.49 | 30.58 | 32.80 | 37.70 |
| 16 | 19.37 | 23.54 | 26.30 | 28.85 | 32.00 | 34.27 | 39.25 |
| 17 | 20.49 | 24.77 | 27.59 | 30.19 | 33.41 | 35.72 | 40.79 |
| 18 | 21.60 | 25.99 | 28.87 | 31.53 | 34.81 | 37.16 | 42.31 |
| 19 | 22.72 | 27.20 | 30.14 | 32.85 | 36.19 | 38.58 | 43.82 |
| 20 | 23.83 | 28.41 | 31.41 | 34.17 | 37.57 | 40.00 | 45.32 |
| 21 | 24.93 | 29.62 | 32.67 | 35.48 | 38.93 | 41.40 | 46.80 |
| 22 | 26.04 | 30.81 | 33.92 | 36.78 | 40.29 | 42.80 | 48.27 |
| 23 | 27.14 | 32.01 | 35.17 | 38.08 | 41.64 | 44.18 | 49.73 |
| 24 | 28.24 | 33.20 | 36.42 | 39.36 | 42.98 | 45.56 | 51.18 |
| 25 | 29.34 | 34.38 | 37.65 | 40.65 | 44.31 | 46.93 | 52.62 |
| 26 | 30.43 | 35.56 | 38.89 | 41.92 | 45.64 | 48.29 | 54.05 |
| 27 | 31.53 | 36.74 | 40.11 | 43.19 | 46.96 | 49.64 | 55.48 |
| 28 | 32.62 | 37.92 | 41.34 | 44.46 | 48.28 | 50.99 | 56.89 |
| 29 | 33.71 | 39.09 | 42.56 | 45.72 | 49.59 | 52.34 | 58.30 |
| 30 | 34.80 | 40.26 | 43.77 | 46.98 | 50.89 | 53.67 | 59.70 |
| 40 | 45.62 | 51.80 | 55.76 | 59.34 | 63.69 | 66.77 | 73.40 |
| 50 | 56.33 | 63.17 | 67.50 | 71.42 | 76.15 | 79.49 | 86.66 |
| 60 | 66.98 | 74.40 | 79.08 | 83.30 | 88.38 | 91.95 | 99.61 |
| 70 | 77.58 | 85.53 | 90.53 | 95.02 | 100.4 | 104.2 | 112.3 |
| 80 | 88.13 | 96.58 | 101.9 | 106.6 | 112.3 | 116.3 | 124.8 |
| 90 | 98.65 | 107.6 | 113.1 | 118.1 | 124.1 | 128.3 | 137.2 |
| 100 | 109.1 | 118.5 | 124.3 | 129.6 | 135.8 | 140.2 | 149.4 |

SOURCE: Johnson, Norman L. and F. C. Leone. 1977. *Statistics and Experimental Design in Engineering and the Physical Sciences*. Vol. I. Second Edition. John Wiley and Sons, New York.

# TABLE 2. 95th PERCENTILES OF THE F-DISTRIBUTION WITH $v_1$ AND $v_2$ DEGREES OF FREEDOM, $F_{v_1,v_2,0.95}$

Table used to obtain "tabulated" F statistic for ANOVA analyses. (one-way parametric)

| $v_2$ \ $v_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 | 236.8 | 238.9 | 240.5 | 241.9 | 243.9 | 245.9 | 248.0 | 249.1 | 250.1 | 251.1 | 252.2 | 253.3 | 254.3 |
| 2 | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 | 19.35 | 19.37 | 19.38 | 19.40 | 19.41 | 19.43 | 19.45 | 19.45 | 19.46 | 19.47 | 19.48 | 19.49 | 19.5[illegible] |
| 3 | 10.13 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.89 | 8.85 | 8.81 | 8.79 | 8.74 | 8.70 | 8.66 | 8.64 | 8.62 | 8.59 | 8.57 | 8.55 | 8.5[illegible] |
| 4 | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.09 | 6.04 | 6.00 | 5.96 | 5.91 | 5.86 | 5.80 | 5.77 | 5.75 | 5.72 | 5.69 | 5.66 | 5.6[illegible] |
| 5 | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.88 | 4.82 | 4.77 | 4.74 | 4.68 | 4.62 | 4.56 | 4.53 | 4.50 | 4.46 | 4.43 | 4.40 | 4.3[illegible] |
| 6 | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.21 | 4.15 | 4.10 | 4.06 | 4.00 | 3.94 | 3.87 | 3.84 | 3.81 | 3.77 | 3.74 | 3.70 | 3.6[illegible] |
| 7 | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.79 | 3.73 | 3.68 | 3.64 | 3.57 | 3.51 | 3.44 | 3.41 | 3.38 | 3.34 | 3.30 | 3.27 | 3.2[illegible] |
| 8 | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.50 | 3.44 | 3.39 | 3.35 | 3.28 | 3.22 | 3.15 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 | 2.9[illegible] |
| 9 | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.29 | 3.23 | 3.18 | 3.14 | 3.07 | 3.01 | 2.94 | 2.90 | 2.86 | 2.83 | 2.79 | 2.75 | 2.7[illegible] |
| 10 | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.14 | 3.07 | 3.02 | 2.98 | 2.91 | 2.85 | 2.77 | 2.74 | 2.70 | 2.66 | 2.62 | 2.58 | 2.5[illegible] |
| 11 | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 3.01 | 2.95 | 2.90 | 2.85 | 2.79 | 2.72 | 2.65 | 2.61 | 2.57 | 2.53 | 2.49 | 2.45 | 2.4[illegible] |
| 12 | 4.75 | 3.89 | 3.49 | 3.26 | 3.11 | 3.00 | 2.91 | 2.85 | 2.80 | 2.75 | 2.69 | 2.62 | 2.54 | 2.51 | 2.47 | 2.43 | 2.38 | 2.34 | 2.3[illegible] |
| 13 | 4.67 | 3.81 | 3.41 | 3.18 | 3.03 | 2.92 | 2.83 | 2.77 | 2.71 | 2.67 | 2.60 | 2.53 | 2.46 | 2.42 | 2.38 | 2.34 | 2.30 | 2.25 | 2.2 |
| 14 | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.76 | 2.70 | 2.65 | 2.60 | 2.53 | 2.46 | 2.39 | 2.35 | 2.31 | 2.27 | 2.22 | 2.18 | 2.1 |
| 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.71 | 2.64 | 2.59 | 2.54 | 2.48 | 2.40 | 2.33 | 2.29 | 2.25 | 2.20 | 2.16 | 2.11 | 2.0[illegible] |
| 16 | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.66 | 2.59 | 2.54 | 2.49 | 2.42 | 2.35 | 2.28 | 2.24 | 2.19 | 2.15 | 2.11 | 2.06 | 2.0 |
| 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.61 | 2.55 | 2.49 | 2.45 | 2.38 | 2.31 | 2.23 | 2.19 | 2.15 | 2.10 | 2.06 | 2.01 | 1.9[illegible] |
| 18 | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.58 | 2.51 | 2.46 | 2.41 | 2.34 | 2.27 | 2.19 | 2.15 | 2.11 | 2.06 | 2.02 | 1.97 | 1.9 |
| 19 | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.54 | 2.48 | 2.42 | 2.38 | 2.31 | 2.23 | 2.16 | 2.11 | 2.07 | 2.03 | 1.98 | 1.93 | 1.8[illegible] |
| 20 | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.51 | 2.45 | 2.39 | 2.35 | 2.28 | 2.20 | 2.12 | 2.08 | 2.04 | 1.99 | 1.95 | 1.90 | 1.8 |
| 21 | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.49 | 2.42 | 2.37 | 2.32 | 2.25 | 2.18 | 2.10 | 2.05 | 2.01 | 1.96 | 1.92 | 1.87 | 1.8 |
| 22 | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.46 | 2.40 | 2.34 | 2.30 | 2.23 | 2.15 | 2.07 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.7 |
| 23 | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.44 | 2.37 | 2.32 | 2.27 | 2.20 | 2.13 | 2.05 | 2.01 | 1.96 | 1.91 | 1.86 | 1.81 | 1.7 |
| 24 | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.42 | 2.36 | 2.30 | 2.25 | 2.18 | 2.11 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.79 | 1.7 |
| 25 | 4.24 | 3.39 | 2.99 | 2.76 | 2.60 | 2.49 | 2.40 | 2.34 | 2.28 | 2.24 | 2.16 | 2.09 | 2.01 | 1.96 | 1.92 | 1.87 | 1.82 | 1.77 | 1.7 |
| 26 | 4.23 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 | 2.39 | 2.32 | 2.27 | 2.22 | 2.15 | 2.07 | 1.99 | 1.95 | 1.90 | 1.85 | 1.80 | 1.75 | [illegible] |
| 27 | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 | 2.37 | 2.31 | 2.25 | 2.20 | 2.13 | 2.06 | 1.97 | 1.93 | 1.88 | 1.84 | 1.79 | 1.73 | |
| 28 | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.45 | 2.36 | 2.29 | 2.24 | 2.19 | 2.12 | 2.04 | 1.96 | 1.91 | 1.87 | 1.82 | 1.77 | 1.71 | |
| 29 | 4.18 | 3.33 | 2.93 | 2.70 | 2.55 | 2.43 | 2.35 | 2.28 | 2.22 | 2.18 | 2.10 | 2.03 | 1.94 | 1.90 | 1.85 | 1.81 | 1.75 | 1.70 | |
| 30 | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.33 | 2.27 | 2.21 | 2.16 | 2.09 | 2.01 | 1.93 | 1.89 | 1.84 | 1.79 | 1.74 | 1.68 | 1.6 |
| 40 | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.25 | 2.18 | 2.12 | 2.08 | 2.00 | 1.92 | 1.84 | 1.79 | 1.74 | 1.69 | 1.64 | 1.58 | 1.5 |
| 60 | 4.00 | 3.15 | 2.76 | 2.53 | 2.37 | 2.25 | 2.17 | 2.10 | 2.04 | 1.99 | 1.92 | 1.84 | 1.75 | 1.70 | 1.65 | 1.59 | 1.53 | 1.47 | 1.3 |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.17 | 2.09 | 2.02 | 1.96 | 1.91 | 1.83 | 1.75 | 1.66 | 1.61 | 1.55 | 1.50 | 1.43 | 1.35 | 1.2 |
| ∞ | 3.84 | 3.00 | 2.60 | 2.37 | 2.21 | 2.10 | 2.01 | 1.94 | 1.88 | 1.83 | 1.75 | 1.67 | 1.57 | 1.52 | 1.46 | 1.39 | 1.32 | 1.22 | 1.0 |

NOTE: $v_1$: Degrees of freedom for numerator
$v_2$: Degrees of freedom for denominator

SOURCE: Johnson, Norman L. and F. C. Leone. 1977. *Statistics and Experimental Design in Engineering and the Physical Sciences.* Vol. I. Second Edition. John Wiley and Sons, New York.

SHEET NO. 83

JOB NO.

SUBJECT

DATE

BY

CHKD.

# Arsenic ANOVA's

Arsenic

| Sampling Periods | Upgradient | | | | | Downgradient | | | | | | | Cross-gradient | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 741 | 745 | 746 | 515 | 516 | 517 | 518 | 731 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | 0.016 | 0.015 | M | M | M | M | 0.015 | M | 0.012 | 0.012 | M |
| Fall 1988 | M | M | M | 0.02 | 0.04 | M | M | M | 0.04 | 0.05 | M | M | 0.05 ↓ | M ↓ |
| Spring 1989 | 0.005 ~~<0.01~~ | 0.005 ~~<0.01~~ | 0.005 ~~<0.01~~ | 0.005 ~~<0.01~~ | 0.005 | 0.01 | 0.01 | 0.01 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| Summer 1989 | M | M | 0.005 ~~<0.01~~ | 0.005 | 0.005 | M | M | 0.005 | 0.005 | 0.01 | 0.01 | M | 0.01 | M |
| Fall 1989 | M | M | 0.005 ~~<0.01~~ | 0.005 | 0.016 | M | M | M | 0.005 | 0.013 | 0.015 | M | M | M |

M = missing data

N = number of samples = 39

P = number of wells = 14

39 - 14 = 25

Note: Sample results reported as < MDL, are assumed to be $\frac{1}{2}$ MDL.

file name: GRJAS.SX

Arsenic

[illegible] 94
[illegible]

1.5

[illegible] ONE-WAY NONPARAMETRIC ANOVA

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |

[illegible] STATISTIC [illegible]
P VALUE USING CHI-SQUARED APPROXIMATION [illegible]

PARAMETRIC ANOVA APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| WITHIN | [illegible] | [illegible] | [illegible] | | |
| TOTAL | [illegible] | [illegible] | | | |

TOTAL NUMBER OF VALUES WITHIN ONE TIED GROUP [illegible]
MAX DIFF ALLOWED BETWEEN TIES [illegible]

CASES INCLUDED [illegible] MISSING CASES [illegible]

13 degrees of freedom. Table 1 @ 5% significance level to find tabulated H value = 22.36

Since the calculated value (9.15) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

SHEET NO. 7 (B)

JOB NO.

SUBJECT

DATE

BY

CHKD.

Cadmium ANOVAs

## Cadmium

| Sampling Points | Upgradient | | | | | Downgradient | | | | | | | Cross-gradient | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 744 | 745 | 746 | 515 | 516 | 517 | 530 | 713 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | 0.003 | 0.003 | M | M | M | M | 0.003 | M | M | .002 | M |
| Fall 1988 | M | M | M | 0.013 | 0.017 | M | M | M | 0.023 | 0.016 | M | M | .018 | M |
| Spring 1989 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | .0005 | .0005 | .0005 | 0.001 | .0005 | .0005 | .003 | .0005 | .0005 |
| Summer 1989 | M | M | 0.006 | 0.012 | 0.039 | M | M | 0.025 | 0.010 | 0.013 | 0.014 | .0005 | .029 | M |
| Fall 1989 | M | M | 0.005 | 0.002 | 0.002 | M | M | M | 0.002 | 0.001 | 0.002 | M | M | M |

File name: GRJCD.SX

Note: Sample results reported as < method detection limits are assumed to be $= \frac{MDL}{2}$

Cadmium

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| B588 | 7.0 | 1 |
| B710 | 7.0 | 1 |
| B744 | 19.3 | 3 |
| B745 | 21.0 | 5 |
| B746 | 23.7 | 5 |
| M585 | 7.0 | 1 |
| M586 | 7.0 | 1 |
| M589 | 21.5 | 2 |
| M590 | 23.6 | 4 |
| M733 | 21.1 | 5 |
| M736 | 18.7 | 3 |
| M740 | 14.7 | 2 |
| M737 | 24.0 | 4 |
| M742 | 7.0 | 1 |
| TOTAL | 19.5 | 36 |

KRUSKAL-WALLIS STATISTIC 9.2921
P VALUE, USING CHI-SQUARED APPROXIMATION 0.7535

PARAMETRIC AOV APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 1.0968E+03 | 84.45 | 0.62 | 0.8148 |
| WITHIN | 24 | 3.2746E+03 | 136.4 | | |
| TOTAL | 37 | 4.3712E+03 | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED 24
MAX. DIFF. ALLOWED BETWEEN TIES 1.00E-05

CASES INCLUDED 36 MISSING CASES 37.

13 DF. At 5% significance level tabulated H value = 22.36
Since the calculated value (9.29) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

Molybdenum

| Sampling Period | Upgradient | | | | | Downgradient | | | | | Cross-gradient | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 744 | 745 | 746 | 515 | 516 | 519 | 530 | 713 | 736 | 740 | 737 | 741 |
| Fall 1987 | | | | | | | | | | | | | | |
| Fall 1988 | | | | | | | | | | | | | | |
| Spring 1989 | .005 | .06 | .005 | .02 | .15 | .24 | .14 | .04 | .01 | .01 | .005 | .07 | .07 | .03 |
| Summer 1989 | M | M | .01 | .03 | .14 | M | M ~~.005~~ | .06 | .04 | .05 | .09 | M | .09 | M |
| Fall 1989 | M | M | .02 | .05 | .15 | M | M | M | .04 | .04 | .04 | M | M | M |

N = # of samples = 27
P = number of wells = 14

27 − 14 = 13 ∴ sample size large enough to conduct ANOVA

file name : GRJMO.SX

Note : values < MDL are assumed to be = $\frac{MDL}{2}$

SHEET NO. ____ JOB NO. ____ SUBJECT Molybdenum ANOVAs DATE ____ BY ____ CHKD. ____

NE WAY AOV

Molybdenum

| VARIABLE | MEAN | SAMPLE SIZE | GROUP VARIANCE |
|---|---|---|---|
| 3588 | 5.000E-03 | 1 | M |
| 3710 | 6.000E-02 | 1 | M |
| 3744 | 1.167E-02 | 3 | 5.833E-05 |
| 3745 | 3.333E-02 | 3 | 2.333E-04 |
| 3746 | 1.467E-01 | 3 | 3.333E-05 |
| M585 | 2.400E-01 | 1 | M |
| M586 | 1.400E-01 | 1 | M |
| M589 | 5.000E-02 | 2 | 2.000E-04 |
| M590 | 3.000E-02 | 3 | 3.000E-04 |
| M733 | 3.333E-02 | 3 | 4.333E-04 |
| M736 | 4.500E-02 | 3 | 1.825E-03 |
| M740 | 7.000E-02 | 1 | M |
| M737 | 8.000E-02 | 2 | 2.000E-04 |
| M742 | 3.000E-02 | 1 | M |
| TOTAL | 6.089E-02 | 28 | |

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 8.099E-02 | 6.230E-03 | 14.14 | 0.0000 |
| WITHIN | 14 | 6.167E-03 | 4.405E-04 | | |
| TOTAL | 27 | 8.715E-02 | | | |

| | CHi SQ | DF | P |
|---|---|---|---|
| BARTLETT'S TEST OF EQUAL VARIANCES | 8.11 | 7 | 0.3230 |

COCHRAN'S Q 0.5558
LARGEST VAR / SMALLEST VAR 54.75

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.919E-03
EFFECTIVE CELL SIZE 2.0

CASES INCLUDED 28 MISSING CASES 42

The calculated F statistic (14.14) ~~is~~ ~~larger than~~ exceeds the tabulated F (2.51), and the hypothesis of equal well means must be rejected. Contamination is suggested.

SHEET NO. 4 of 4 JOB NO.

SUBJECT Selenium ANOVAs

DATE BY CHKD.

# Selenium

| Sampling Points | Upgradient | | | | | Downgradient | | | | | | | Cross-gradient | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 744 | 745 | 746 | 515 | 516 | 519 | 520 | 732 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | .067 | .060 | M | M | M | M | .164 | M | .127 | .154 | M |
| Fall 1988 | M | M | M | .060 | 0.191 | M | M | M | .142 | .196 | M | M | .199 | M |
| Spring 1989 | .005 | .012 | .005 | .005 | .05 | .012 | .012 | M | .005 | .005 | .005 | .005 | .005 | .005 |
| Summer 1989 | M | M | .012 | .018 | 0.057 | M | M | .028 | .026 | .025 | .026 | M | .026 | M |
| Fall 1989 | M | M | .011 | .030 | .060 | M | M | M | .036 | .039 | .038 | M | M | M |

N = 37 samples
P = 14 wells

37 − 14 = 23 ∴ sample size large enough

file name: GRTSE.SX

Note: Values < MDL are assumed to be = $\frac{MDL}{2}$

Selenium

D-7

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| B588 | 5.0 | 1 |
| B710 | 12.5 | 1 |
| B744 | 9.2 | 3 |
| B745 | 19.8 | 5 |
| B746 | 28.4 | 5 |
| M585 | 12.5 | 1 |
| M586 | 12.5 | 1 |
| M589 | 20.0 | 1 |
| M590 | 18.9 | 4 |
| M733 | 23.1 | 5 |
| M736 | 15.5 | 3 |
| M740 | 18.0 | 2 |
| M737 | 23.4 | 4 |
| M742 | 5.0 | 1 |
| TOTAL | 19.0 | 37 |

KRUSKAL-WALLIS STATISTIC 12.6187
P VALUE, USING CHI-SQUARED APPROXIMATION 0.4780

PARAMETRIC AOV APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 1.454E+03 | 111.9 | 0.95 | 0.5190 |
| WITHIN | 23 | 2.696E+03 | 117.2 | | |
| TOTAL | 36 | 4.150E+03 | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED 20
MAX. DIFF. ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 37 MISSING CASES 33

At 5% significance level, tabulated value = 22.36.
Since the calculated value (12.6) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

1 in Non-Parametric Analysis

| Sampling Periods | ← Upgradient → | | | | | ← Downgradient → | | | | | | | ← Cross-Gradient → | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 749 | 745 | 746 | 585 | 586 | 589 | 590 | 733 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | M | M | M | M | M | M | M | M | M | M | M |
| Fall 1988 | .015 | M | M | M | M | M | M | M | M | M | M | M | M | M |
| Spring 1989 | M | .085 | .015 | .015 | .015 | .015 | .015 | .03 | .015 | .03 | .015 | .03 | .035 | .015 |
| Summer 1989 | M | M | .0025 | .01 | .029 | M | M | .029 | .02 | .024 | .02 | M | .03 | M |
| Fall 1989 | M | M | .013 | .052 | .108 | M | M | M | .117 | .116 | .12 | M | M | M |

M indicates Missing data

17

SHEET NO. 8 of 16

JOB NO. 80

JACOBS ENGINEERING

DATE ____ SUBJECT ____

BY ____ CHKD. ____

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV Tin

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| B588 | 9.0 | 1 |
| B710 | 9.0 | 1 |
| B744 | 4.3 | 3 |
| B745 | 11.7 | 3 |
| B746 | 17.5 | 3 |
| D585 | 9.0 | 1 |
| D586 | 9.0 | 1 |
| D589 | 20.0 | 2 |
| D590 | 17.2 | 3 |
| D733 | 21.5 | 3 |
| D736 | 17.5 | 3 |
| D740 | 21.5 | 1 |
| D737 | 15.2 | 2 |
| D742 | 9.0 | 1 |
| TOTAL | 14.5 | 25 |

At 5% significance level,
tabulated H value = 22.36
Since the calculated value (12.91)
is ~~gr~~ less than tabulated value (22.4)
Accept the hypothesis of no-contamination
at the 5% level.

KRUSKAL-WALLIS STATISTIC ~~12.9142~~
P VALUE, USING CHI-SQUARED APPROXIMATION ~~1.4545~~

PARAMETRIC AOV APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 816.4 | 62.95 | 0.99 | 0.5064 |
| WITHIN | 14 | 892.6 | 63.76 | | |
| TOTAL | 27 | 1.7108-03 | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED 19
MAX. DIFF. ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 25 MISSING CASES 42

SJL 8/20/90

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV

| VARIABLE | MEAN RANK | SAMPLE SIZE |
|---|---|---|
| B585 | 19.0 | 1 |
| B710 | 20.0 | 1 |
| B744 | 20.7 | 3 |
| B745 | 15.6 | 5 |
| B746 | 17.7 | 4 |
| D585 | 9.0 | 1 |
| D586 | 29.0 | 1 |
| D589 | 22.5 | 2 |
| D590 | 24.2 | 4 |
| D733 | 22.6 | 5 |
| D736 | 17.3 | 3 |
| D740 | 9.0 | 2 |
| D737 | 15.0 | 4 |
| D742 | 30.0 | 1 |
| TOTAL | 19.0 | 37 |

Met Gross Alpha

One-Way Non-Parametric Anova

KRUSKAL-WALLIS STATISTIC 8.1852
P VALUE, USING CHI-SQUARED APPROXIMATION 0.8616

At the 5% significance level, tabulated H value = 22.36

Since the calculated value (8.18) is less than the tabulated value (22.36) Accept the hypothesis of no contamination at the 5% level.

PARAMETRIC AOV APPLIED TO RANKS

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 866.3 | 66.64 | 0.52 | 0.8664 |
| WITHIN | 23 | 2.944E+03 | 128.0 | | |
| TOTAL | 36 | 3.810E+03 | | | |

TOTAL NUMBER OF VALUES WHICH WERE TIED 17
MAX. DIFF. ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 37 MISSING CASES 33

Net Gross Hydra Non-parametric

| Sampling Periods | 588 | 710 | 749 | 745 | 746 | 585 | 586 | 589 | 590 | 733 | 736 | 740 | 737 | 742 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ← Upgradient → | | | | | ← Downgradient → | | | | | | | Crossgradient | |
| Fall 1987 | M | M | M | -.27 Ø | 0 | M | M | M | M | -.45 Ø | M | -.15 Ø | -.20 Ø | M |
| Fall 1988 | M | M | M | -.12 Ø | 7.3 Ø | M | M | M | .49 Ø | 16.9 | M | -.22 Ø | 51.9 | M |
| Spring 1989 | 1.02 | 2.5 | 4.59 | -1.57 Ø | 0 | -.17 Ø | 24 | -8.4 Ø | 4.64 | 0 | -.28 Ø | M | 0 | 36.19 |
| Summer 1989 | M | M | .139 | 17.6 | 18.21 | M | M | 81.9 | 63.1 | 125.7 | 53 | M | -10.16 Ø | M |
| Fall 1989 | M | M | 8.04 | 14.0 | 16.57 | M | M | M | 44.23 | 98.9 | -7.7 Ø | M | M | M |

Grjnga.sx

SHEET NO. 7
JOB NO. 22

SUBJECT

DATE
BY
CHKD. SM 8/20/90

Uranium Parametric ANOVA

| Sampling Periods | ← Upgradient → | | | | | ← Downgradient → | | | | | | | ← Cross Gradient → | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 588 | 710 | 749 | 745 | 746 | 585 | 586 | 589 | 590 | 733 | 736 | 740 | 737 | 742 |
| Fall 1987 | M | M | M | .04 | .056 | M | M | M | M | .07 | M | .213 | .052 | M |
| Fall 1988 | M | M | M | .04 | .05 | M | M | M | .229 | .07 | M | M | .07 | M |
| Spring 1989 | .0015 | .027 | .021 | .04 | .06 | 0.29 | .29 | .18 | .19 | .08 | .129 | .12 | .06 | .093 |
| Summer 1989 | M | M | .010 | .03 | .06 | M | M | .071 | .112 | .05 | .083 | M | .06 | M |
| Fall 1989 | M | M | .009 | .03 | .06 | M | M | M | .125 | .0015 | .095 | M | M | M |

File name
Grju.sx

JACOBS ENGINEERING
SUBJECT
DATE
BY
CHKD.
SHEET NO.
JOB NO.
95 JK

ONE WAY AOV

| VARIABLE | MEAN | SAMPLE SIZE | GROUP VARIANCE |
|---|---|---|---|
| B555 | 1.500E-03 | 1 | M |
| B710 | 2.700E-02 | 1 | M |
| B744 | 1.333E-02 | 3 | 4.433E-05 |
| B745 | 3.600E-02 | 5 | 3.000E-05 |
| B746 | 5.720E-02 | 5 | 1.920E-05 |
| D585 | 2.900E-01 | 1 | M |
| D586 | 2.900E-01 | 1 | M |
| D589 | 1.250E-01 | 2 | 6.050E-03 |
| D590 | 1.640E-01 | 4 | 3.042E-03 |
| D733 | 5.400E-02 | 5 | 1.026E-03 |
| D736 | 1.010E-01 | 3 | 6.300E-04 |
| D740 | 1.665E-01 | 2 | 4.325E-03 |
| D737 | 6.050E-02 | 4 | 5.433E-05 |
| D742 | 9.300E-02 | 1 | M |
| TOTAL | 5.566E-02 | 36 | |

| SOURCE | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| BETWEEN | 13 | 1.751E-01 | 1.347E-02 | 12.77 | 0.0000 |
| WITHIN | 24 | 2.531E-02 | 1.055E-03 | | |
| TOTAL | 37 | 2.026E-01 | | | |

| | CHI SQ | DF | P |
|---|---|---|---|
| BARTLETT'S TEST OF EQUAL VARIANCES | 34.09 | 8 | 0.0000 |

COCHRANE'S C 0.3975
LARGEST VAR / SMALLEST VAR 315.1

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 4.679E-03
EFFECTIVE CELL SIZE 2.7

CASES INCLUDED 38 MISSING CASES 32

Uranium

Parametric ANOVA

tabulated value = 2.19

The calculated F statistic (12.77) exceeds the tabulated value (2.19) and the hypotheses of equal well means must be rejected. Contamination is suggested.

GROUNDWATER QUALITY ...SUREMENTS EXCEEDING MAXIMUM CONCENTRATION LIMITS
SITE: GRJ01 GRAND JUNCTION
02/28/89 TO 11/02/89
REPORT DATE: 11/28/90

| PARAMETER NAME | TOTAL # OF SAMP. | UNITS OF MEASURE | MAX CON. LIMIT | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | VALUE EXCEEDING MAX. CON. LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| ARSENIC | 29 | MG/L | 0.05000 | - | - | - | - | - | - | - |
| BARIUM | 29 | MG/L | 1.00000 | - | - | - | - | - | - | - |
| [redacted] | 29 | MG/L | 0.01000 | 0589 | 08/03/89 | 0001 | AL | D | 0.025 | - |
| | | | | 0590 | 08/03/89 | 0001 | AL | D | 0.010 | - |
| | | | | 0733 | 08/03/89 | 0001 | AL | D | 0.013 | - |
| | | | | 0736 | 08/03/89 | 0001 | AL | D | 0.014 | - |
| | | | | 0737 | 08/07/89 | 0001 | AL | C | 0.029 | - |
| | | | | 0745 | 08/03/89 | 0001 | AL | U | 0.012 | - |
| | | | | 0746 | 08/03/89 | 0001 | AL | U | 0.039 | - |
| CHROMIUM | 29 | MG/L | 0.05000 | - | - | - | - | - | - | - |
| [redacted] | 29 | PCI/L | 15.00000 | 0581 | 03/07/89 | 0001 | AL | O | 71. | 33. |
| | | | | 0585 | 03/01/89 | 0001 | AL | D | 182. | 58. |
| | | | | 0586 | 03/01/89 | 0001 | AL | D | 223. | 50. |
| | | | | 0589 | 03/01/89 | 0001 | AL | D | 115. | 45. |
| | | | | 0589 | 08/03/89 | 0001 | AL | D | 130. | 60. |
| | | | | 0590 | 03/01/89 | 0001 | AL | D | 135. | 53. |
| | | | | 0590 | 08/03/89 | 0001 | AL | D | 140. | 60. |
| | | | | 0590 | 11/02/89 | 0001 | AL | D | 130. | 40. |
| | | | | 0710 | 03/06/89 | 0001 | AL | U | 21. | 33. |
| | | | | 0733 | 08/03/89 | 0001 | AL | D | 160. | 70. |
| | | | | 0733 | 11/02/89 | 0001 | AL | D | 49. | 50. |
| | | | | 0736 | 02/28/89 | 0001 | AL | D | 60. | 50. |
| | | | | 0736 | 08/03/89 | 0001 | AL | D | 110. | 70. |
| | | | | 0736 | 11/02/89 | 0001 | AL | D | 58. | 59. |
| | | | | 0737 | 08/07/89 | 0001 | AL | C | 31. | 62. |
| | | | | 0740 | 02/28/89 | 0001 | AL | D | 30. | 36. |
| | | | | 0742 | 03/03/89 | 0001 | AL | C | 101. | 52. |
| | | | | 0744 | 03/05/89 | 0001 | AL | U | 19. | 15. |
| | | | | 0745 | 03/05/89 | 0001 | AL | U | 29. | 24. |
| | | | | 0745 | 08/03/89 | 0001 | AL | U | 41. | 26. |
| | | | | 0745 | 11/02/89 | 0001 | AL | U | 38. | 28. |
| | | | | 0746 | 08/03/89 | 0001 | AL | U | 58. | 61. |
| | | | | 0746 | 11/02/89 | 0001 | AL | U | 56. | 48. |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

GROUNDWATER QUALITY MEASUREMENTS EXCEEDING MAXIMUM CONCENTRATION LIMITS
SITE: GRJ01 GRAND JUNCTION
02/28/89 TO 11/02/89
REPORT DATE: 11/28/90

| PARAMETER NAME | TOTAL # OF SAMP. | UNITS OF MEASURE | MAX CON. LIMIT | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | VALUE EXCEEDING MAX. CON. LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| LEAD | 29 | MG/L | 0.05000 | - | - | - | - | - | - | - |
| MERCURY | 29 | MG/L | 0.00200 | - | - | - | - | - | - | - |
| [redacted] | 29 | MG/L | 0.10000 | 0581 | 03/07/89 | 0001 | AL | O | 0.10 | - |
| | | | | 0585 | 03/01/89 | 0001 | AL | D | 0.24 | - |
| | | | | 0586 | 03/01/89 | 0001 | AL | D | 0.14 | - |
| | | | | 0746 | 03/05/89 | 0001 | AL | U | 0.15 | - |
| | | | | 0746 | 08/03/89 | 0001 | AL | U | 0.14 | - |
| | | | | 0746 | 11/02/89 | 0001 | AL | U | 0.15 | - |
| [redacted] | 29 | PCI/L | 15.00000 | 0581 | 03/07/89 | 0001 | AL | O | 41.5 | - |
| | | | | 0586 | 03/01/89 | 0001 | AL | D | 24.1 | - |
| | | | | 0589 | 08/03/89 | 0001 | AL | D | 81.3 | - |
| | | | | 0590 | 08/03/89 | 0001 | AL | D | 63.2 | - |
| | | | | 0590 | 11/02/89 | 0001 | AL | D | 44.3 | - |
| | | | | 0733 | 08/03/89 | 0001 | AL | D | 125.7 | - |
| | | | | 0733 | 11/02/89 | 0001 | AL | D | 48.0 | - |
| | | | | 0736 | 08/03/89 | 0001 | AL | D | 53.1 | - |
| | | | | 0742 | 03/03/89 | 0001 | AL | C | 37.2 | - |
| | | | | 0745 | 08/03/89 | 0001 | AL | U | 17.7 | - |
| | | | | 0746 | 08/03/89 | 0001 | AL | U | 18.2 | - |
| | | | | 0746 | 11/02/89 | 0001 | AL | U | 16.9 | - |
| NITRATE | 29 | MG/L | 44.00000 | - | - | - | - | - | - | - |
| RA-226 & RA-228 | 29 | PCI/L | 5.00000 | - | - | - | - | - | - | - |
| [redacted] | 29 | MG/L | 0.01000 | 0581 | 03/07/89 | 0001 | AL | O | 0.01 | - |
| | | | | 0585 | 03/01/89 | 0001 | AL | D | 0.025 | - |
| | | | | 0586 | 03/01/89 | 0001 | AL | D | 0.025 | - |
| | | | | 0588 | 03/06/89 | 0001 | AL | U | 0.01 | - |
| | | | | 0589 | 03/01/89 | 0001 | AL | D | 0.025 | - |
| | | | | 0589 | 08/03/89 | 0001 | AL | D | 0.028 | - |
| | | | | 0590 | 03/01/89 | 0001 | AL | D | 0.01 | - |

* NET GROSS ALPHA (GROSS ALPHA - DISSOLVED URANIUM) WITH 1 MG DISSOLVED URANIUM = 686 PCI

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

GROUNDWATER QUALITY MEASUREMENTS EXCEEDING MAXIMUM CONCENTRATION LIMITS
SITE: GRJ01 GRAND JUNCTION
02/28/89 TO 11/02/89
REPORT DATE: 11/28/90

| PARAMETER NAME | TOTAL # OF SAMP. | UNITS OF MEASURE | MAX CON. LIMIT | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | VALUE EXCEEDING MAX. CON. LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | 29 | MG/L | 0.01000 | 0590 | 08/03/89 | 0001 | AL | D | 0.025 | - |
| | | | | 0590 | 11/02/89 | 0001 | AL | D | 0.036 | - |
| | | | | 0710 | 03/06/89 | 0001 | AL | U | 0.025 | - |
| | | | | 0733 | 02/28/89 | 0001 | AL | D | 0.01 | - |
| | | | | 0733 | 08/03/89 | 0001 | AL | D | 0.025 | - |
| | | | | 0733 | 11/02/89 | 0001 | AL | D | 0.039 | - |
| | | | | 0736 | 02/28/89 | 0001 | AL | D | 0.01 | - |
| | | | | 0736 | 08/03/89 | 0001 | AL | D | 0.026 | - |
| | | | | 0736 | 11/02/89 | 0001 | AL | D | 0.038 | - |
| | | | | 0737 | 03/04/89 | 0001 | AL | C | 0.01 | - |
| | | | | 0737 | 08/07/89 | 0001 | AL | C | 0.026 | - |
| | | | | 0740 | 02/28/89 | 0001 | AL | D | 0.01 | - |
| | | | | 0742 | 03/03/89 | 0001 | AL | C | 0.01 | - |
| | | | | 0744 | 03/05/89 | 0001 | AL | U | 0.01 | - |
| | | | | 0744 | 08/03/89 | 0001 | AL | U | 0.012 | - |
| | | | | 0744 | 11/02/89 | 0001 | AL | U | 0.011 | - |
| | | | | 0745 | 03/05/89 | 0001 | AL | U | 0.01 | - |
| | | | | 0745 | 08/03/89 | 0001 | AL | U | 0.018 | - |
| | | | | 0745 | 11/02/89 | 0001 | AL | U | 0.030 | - |
| | | | | 0746 | 03/05/89 | 0001 | AL | U | 0.05 | - |
| | | | | 0746 | 08/03/89 | 0001 | AL | U | 0.057 | - |
| | | | | 0746 | 11/02/89 | 0001 | AL | U | 0.060 | - |
| SILVER | 29 | MG/L | 0.05000 | - | - | - | - | - | - | - |
| [redacted]ISSOLVED) | 29 | MG/L | 0.04400 | 0585 | 03/01/89 | 0001 | AL | D | 0.29 | - |
| | | | | 0586 | 03/01/89 | 0001 | AL | D | 0.29 | - |
| | | | | 0589 | 03/01/89 | 0001 | AL | D | 0.18 | - |
| | | | | 0589 | 08/03/89 | 0001 | AL | D | 0.071 | - |
| | | | | 0590 | 03/01/89 | 0001 | AL | D | 0.19 | - |
| | | | | 0590 | 08/03/89 | 0001 | AL | D | 0.112 | - |
| | | | | 0590 | 11/02/89 | 0001 | AL | D | 0.125 | - |
| | | | | 0733 | 02/28/89 | 0001 | AL | D | 0.08 | - |
| | | | | 0733 | 08/03/89 | 0001 | AL | D | 0.050 | - |
| | | | | 0736 | 02/28/89 | 0001 | AL | D | 0.129 | - |
| | | | | 0736 | 08/03/89 | 0001 | AL | D | 0.083 | - |
| | | | | 0736 | 11/02/89 | 0001 | AL | D | 0.095 | - |
| | | | | 0737 | 03/04/89 | 0001 | AL | C | 0.064 | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
D - DOWN GRADIENT
C - CROSS GRADIENT

GROUNDWATER QUALITY MEASUREMENTS EXCEEDING MAXIMUM CONCENTRATION LIMITS
SITE: GRJ01 GRAND JUNCTION
02/28/89 TO 11/02/89
REPORT DATE: 11/28/90

| PARAMETER NAME | TOTAL # OF SAMP. | UNITS OF MEASURE | MAX CON. LIMIT | LOCATION ID | LOG DATE | SAMPLE ID | FORM COMP | FLOW REL. | VALUE EXCEEDING MAX. CON. LIMIT | PARAMETER UNCERTAINTY |
|---|---|---|---|---|---|---|---|---|---|---|
| URANIUM (DISSOLVED) | 29 | MG/L | 0.04400 | 0737 | 08/07/89 | 0001 | AL | C | 0.059 | - |
| | | | | 0740 | 02/28/89 | 0001 | AL | D | 0.12 | - |
| | | | | 0742 | 03/03/89 | 0001 | AL | C | 0.093 | - |
| | | | | 0745 | 03/05/89 | 0001 | AL | U | 0.045 | - |
| | | | | 0746 | 03/05/89 | 0001 | AL | U | 0.059 | - |
| | | | | 0746 | 08/03/89 | 0001 | AL | U | 0.058 | - |
| | | | | 0746 | 11/02/89 | 0001 | AL | U | 0.057 | - |
| URANIUM (TOTAL) | 0 | PCI/L | 30.00000 | - | - | - | - | - | - | - |

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT

DATA FILE NAME: J:\DART\GRJ01\GWQ10024.DAT

# CALCULATION GRJ-05-91-12-05-00

# TRANSIENT DRAINAGE AND STEADY STATE SEEPAGE

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. GRJ-05-91-12-05-00 DISCIPLINE CIVIL/HYDRO NO. OF SHEETS 11 209 w/ appendices

PROJECT:

UMTRA

SITE:

GRAND JUNCTION - CHENEY DISPOSAL CELL

FEATURE:

TRANSIENT DRAINAGE & STEADY STATE SEEPAGE

SOURCES OF DATA:

SEE PAGE 6

SOURCES OF FORMULAE & REFERENCES:

SEE PAGE 6

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

| | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | G. SMITH | 5/91 | | | | |
| 01 | Conduct permeability update | G. Smith | 6/91 | [illegible] | 6/19/91 | [illegible] | 6/19/91 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

8/86

**PURPOSE:**

The purpose of this calculation is to reanalyze the transient drainage of construction waters used to meet placement specifications of contaminated materials on the overall Cheney Disposal Cell performance. For simplicity and consistency, this reanalysis will utilize the same computer code originally used, the UNSAT2 code by Davis and Neuman (1983). Also, as much of this original analysis is reused as possible. The reanalysis is necessary because of two modifications in assumptions made for the original transient drainage calculation, GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" which are presented below.

These computer analyses reported herein provide insight into time-dependent transient drainage and moisture redistributions occurring within the cell. Unfortunately, absolute determinations of these phenomena are not possible at this time due to limitations in field characterization techniques and in state-of-the-art analysis techniques concerning saturated and unsaturated flow through porous media.

The first modification made to the original analysis is an increased excavation depth of 6 feet in the disposal cell exposing two different material conditions for the Mancos Shale: a fractured, slightly weathered unit underlying the weathered to highly weathered Mancos shale. When the fractured shale was uncovered during excavation of the cell it became necessary to preform additional Sealed Ring Infiltrometer Testing (SDRI) to determine the vertical infiltration rate ($I_v$) and saturated hydraulic conductivity ($K_s$) of this unit. This additional testing was performed in the autumn of 1990. Test results indicate a highly permeable zone at the base of the cell in the competent, fractured Mancos Shale possessing a $K_s$ on the order of 1E-05 cm/sec, two orders of magnitude greater than previously determined. Tests were also performed in the weathered shale to confirm conductivity results from the original testing done in 1989. Results from these tests indicate conductivities approximately one order of magnitude lower than originally tested within the weathered Mancos Shale. Conductivity values utilized in this analysis are provided in the Data section of this report.

The second modification is concerned with the effect of placement of tailings materials within the 90 percent ASTM D698 relative compaction without regard to moisture content on the groundwater compliance strategy. Possible ponding of contaminated construction waters within the cell due to transient drainage of construction waters, plus steady-state operating conditions, are analyzed. Placement of the tailings in this 'wet' condition, in conjunction with the low conductivity foundation necessitates a reassessment of the maximum possible depth of ponded water which may occur within the disposal cell and the expected time for drainage. This analysis is performed by assigning a matric

potential to the tailings which is below their optimum moisture content potential.

The original transient drainage calculation, GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell", contains all the hydraulic parameters, both unsaturated and saturated, the FEM mesh specifications, and boundary conditions applied for this reanalysis. A copy of the original Calculation is attached for reference in Appendix I. Modifications required for this analysis involve, separation of the Mancos shale unit into two materials and reassignment of matric potentials to the tailings materials.

**METHOD:**

Procedures followed in this calculation follow those outlined in the original calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" with the following additions.

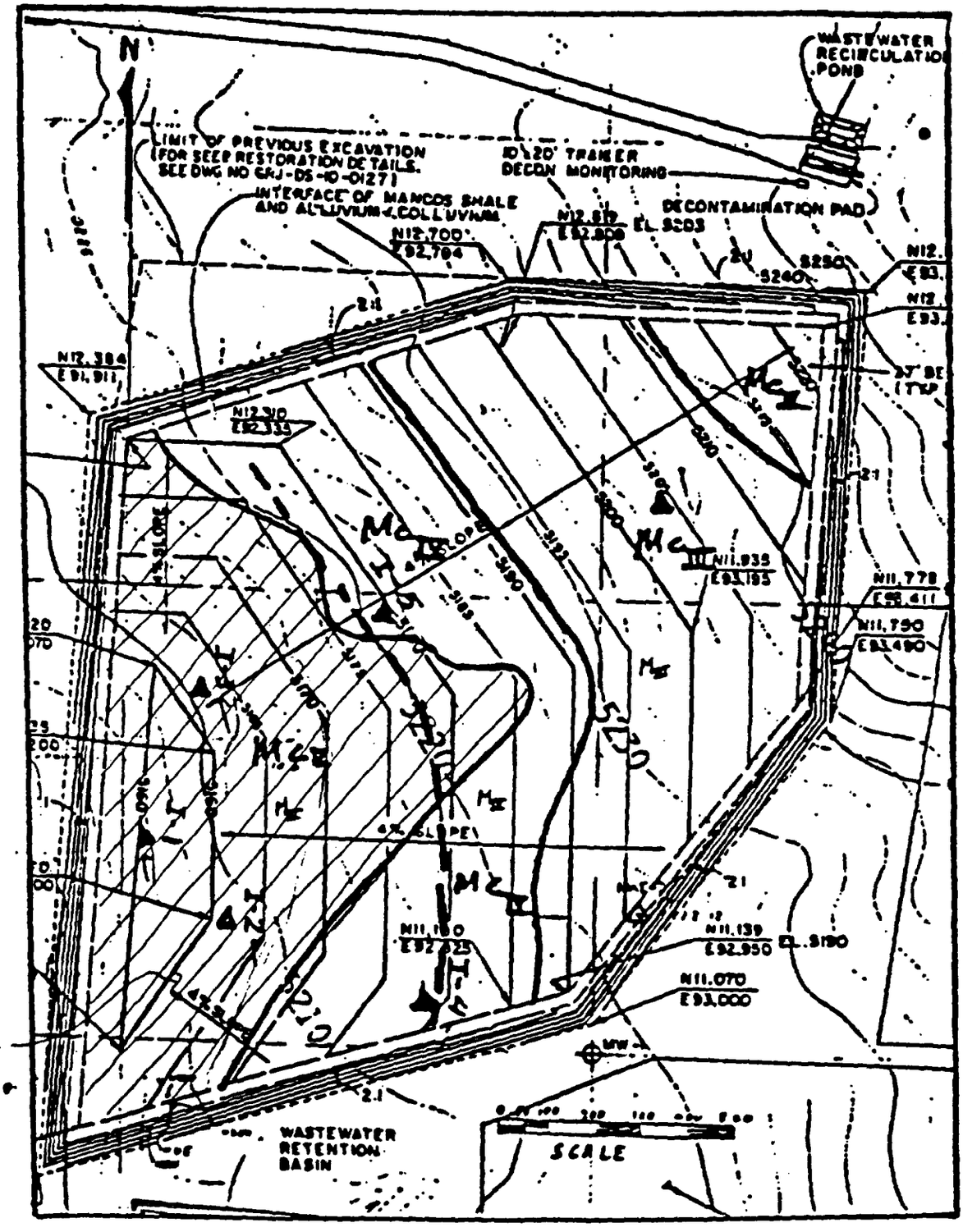
The original FEM mesh necessary to run the UNSAT2 model was <u>not</u> regenerated to incorporate the additional 6 foot excavation depth. The original mesh was used, knowing that waters could pond to an elevation 6 feet higher than the lowest paleochannel elevation. For contaminated water to flow from the cell, horizontal hydraulic gradients would have to exist that are great enough to force the moisture through a 10 foot thick clean-fill dike. The dikes surround the cell and consist of compacted Mancos Shale possessing a saturated hydraulic conductivity of $3 \times 10^{-7}$ cm/sec.

As mentioned above, the lower portion of the cell was excavated into fractured Mancos Shale. The fractured layer extends beneath the entire cell based on interpretation of corehole logs from borings advanced through the Mancos Shale unit. The Geology report, Attachment 2 of the RAP discusses in detail fracture system. The base of the excavation was mapped during an inspection made in April, 1991 (see reference 3) delineating material types as shown in Figure 1. The original mesh was modified by assigning new material properties to elements in the fractured zones, as scaled off the map and beneath the cell as shown in Figure 2 to model the field conditions.

**ASSUMPTIONS:**

Same as outlined in calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell".

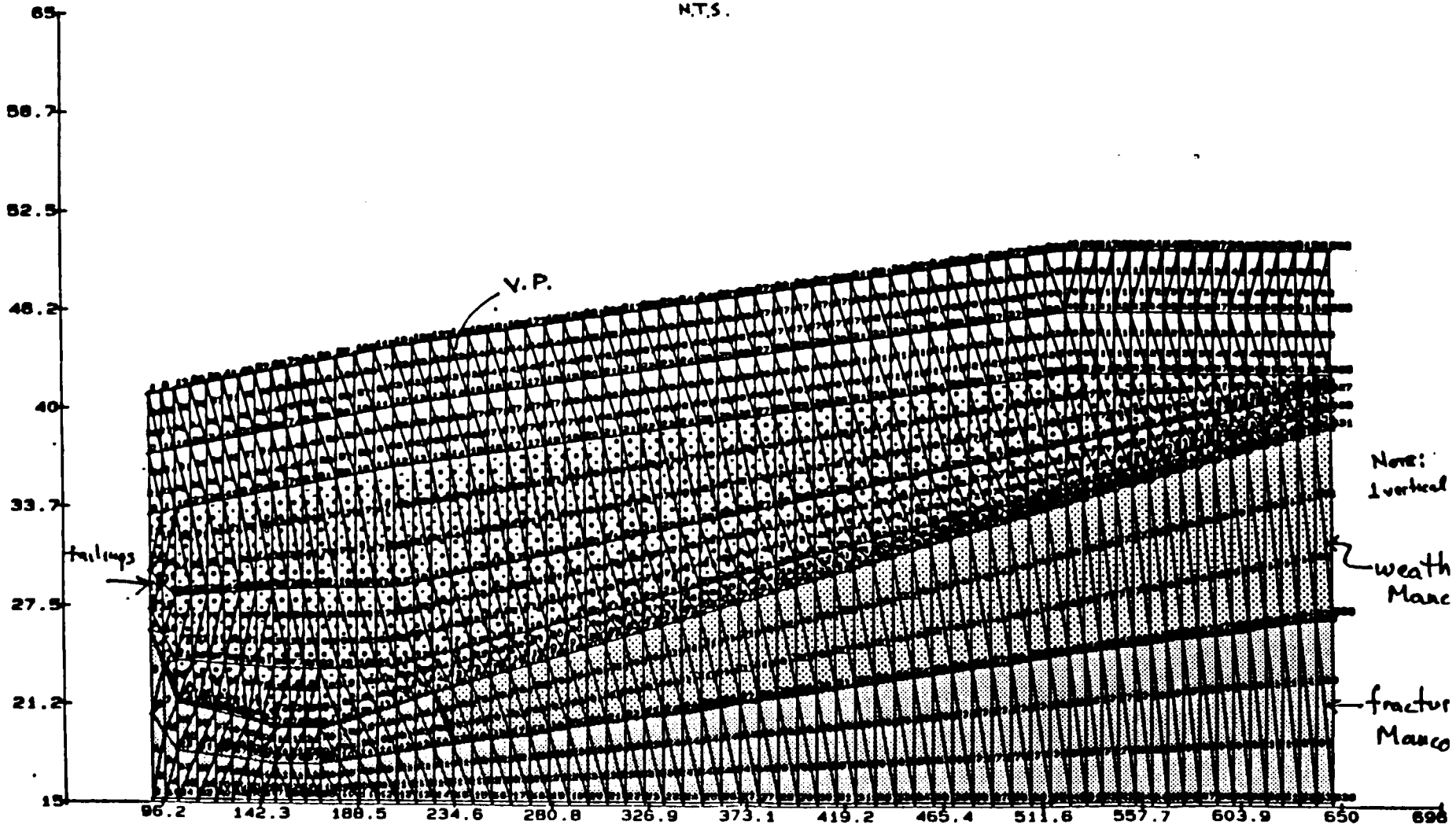
FIGURE 1




fractured, fresh zone

CHENEY DISPOSAL CELL

N.T.S.



**REFERENCES:**

Same as outlined in calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" with the addition of:

1) Smith, G., August 1990., TAC calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady-State Seepage from Cheney Disposal Cell".

2) In Situ Permeability Tests on the Mancos Shale Foundation of the Cheney Disposal Cell, UMTRA Project, Grand Junction, Colorado, prepared for MK-Ferguson by Daniel B. Stevens & Associates, December, 1990.

3) "Final Inspection of the Bottom of the Cheney Disposal Embankment Site, UMTRA Project - Grand Junction, Colorado", a report prepared by Morrison-Knudsen Environmental Services, April 1991.

**DATA SOURCE:**

Same as outlined in calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" with the addition of reference (2).

**DATA:**

Initial Conditions

Same as outlined in calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" with the additional saturated hydraulic parameters for the fractured Mancos Shale as listed below in Table A.

Table A

Hydraulic Parameters for UNSAT2 Input

| material | $\theta_s$ / $\theta_r$(%) vol./vol. | $\alpha$(1/m) | N | $K_s$(m/day) | $\psi$(m) |
|---|---|---|---|---|---|
| V.P. | 0.~~197~~/.4025/ 0.~~095~~ .2130 | 0.45 | 5.92 | ~~2.62E-03~~ $9.42 \times 10^{-2}$ | -2.75 |
| tailings | 0.~~361~~/.4676/ 0.~~126~~ .2211 | 0.65 | 1.24 | ~~4.84E-02~~ $1.25 \times 10^{-2}$ | -2.50 to -20.0 |
| wthrd Mancos | 0.160/ 0.080 | 0.63 | 1.08 | 3.46E-04/ 1.73E-05 $4.0 \times 10^{-7}$ cm/sec $2.0 \times 10^{-8}$ | -10.2 |
| frctrd Mancos | 0.160/ 0.080 | 0.63 | 1.08 | 3.46E-01/ 1.73E-02 | -10.2 |

check w/ input to UNSATZ

GMS 8/12/91

The hydraulic parameters utilized in these analyses for the initial conditions are presented in Table A and Table B. The matric potentials used were obtained from the original calculation listed as 'previous' data, but are applied to the unsaturated hydraulic parameters determined for DBS&A data. The tailings materials are best represented by data presented by Daniel B. Stephens and Associates, sample S5-3. The reasons for this selection are presented in the original calculation.

The matric potentials for the tailings materials are varied as indicated in Table B to analyzing the different placement saturations considered. Matric potential values are theoretical suctions that would exist at placement. It is not expected that gravity drainage would produce suction values greater than -1 bar (-1.02 meters of water), however these high suctions could be created during placement. Each of the values were calculated from the phase relationship, $G_s * w_c = S * e$.

Where,

$G_s$ = the specific gravity of solids,

$w_c$ = gravimetric water content,

$S$ = saturation,

$e = [G_s * \gamma_w / \gamma_d] - 1.0$ with,

$\gamma_w$ = unit weight of water,

$\gamma_d$ = specified placement dry unit weight.

The placement moisture content of the V.P. material was not varied from the value used in the original calculation. The V.P. material should be placed as originally specified.

Table B

Matric Potentials Related to Placement Moisture Contents and Saturations for Tailings

| Dry Density (g/cc) | Saturation (%) | moisture content (g/g %) | $\psi$(meters) |
|---|---|---|---|
| 1.46 | 60 | 19 | -20.0 |
| 1.46 | 70 | 23 | -8.50 |
| 1.46 | 80 | 26 | -4.30 |
| 1.46 | 90 | 29 | -2.50 |

The geometric mean of the saturated hydraulic conductivity for the weathered to highly weathered Mancos Shale was originally

tested to be 2 x 10-7 cm/sec. However, when the geometric mean of the results from all SDRI testing performed was computed,a value of 4 x $10^{-8}$ cm/sec resulted. Possible reasons for this conductivity difference are provided in the Discussion section.

Boundary Conditions

The boundary conditions utilized in these analyses are identical to those used in the original calculation. The sides and base of the model are specified as unsaturated seepage faces which allows them to exist in a partially saturated condition until moisture influx achieves full saturation. When this occurs, flow is allowed through the node and unrealistic ponding will not occur. The upper boundary surface of the V.P. material has a continuous influx varying from zero to the design saturated hydraulic conductivity of the radon/infiltration barrier of 1.0 x $10^{-7}$ cm/sec.

**CALCULATION:**

The UNSAT2 computer code was used to perform the calculation. Typical input and output listings are provided for reference in Appendix II. Listings of all the runs performed are too voluminous to be attached, however complete records of the runs are kept on 5¼ inch micro-computer disks at the UMTRA Project Office in Albuquerque, New Mexico.

**RESULTS:**

Table C presents results of a series of computer runs which were made to provide some insight into the effect of the two modifications discussed in the Purpose section. Reviewing this Table it is evident that ponding of contaminated water is possible along the weathered portion of the cell if the saturated hydraulic conductivity is on the order of $10^{-8}$ cm/sec assuming moisture is allowed to pass through the cover at $10^{-7}$ cm/sec. This condition occurs at any placement moisture content of the tailings. When the cover flux is set to zero, ponding does not occur when the fractures are accounted for. This suggests that transient drainage of construction water will pass from the cell.

When the cover flux is set at 1.0 x $10^{-7}$ cm/sec and fractures are not accounted for with the foundation conductivity is set at $10^{-7}$ cm/sec, ponding is likely to occur to a depth of approximately 13 feet if the tailings are placed very wet. Placing the tailings at a workable moisture content under these conditions results in no occurrence of ponding. Accounting for fractures under this condition with a $10^{-7}$ cm/sec cover flux and tailings placed at a 90% saturation, slight ponding (2-3 meters) may occur along the weathered portion of the cell base, but drains within 5 years.

Table C

Results of UNSAT2 Analyses

| cover flux | base flux | tailings saturation (%) | result |
|---|---|---|---|
| $1 \times 10^{-7}$ | $1 \times 10^{-7}$ w/ fractures | 90 | no significant ponding |
| $1 \times 10^{-7}$ | $1 \times 10^{-8}$ w/ fractures | 90 | ponding to V.P./tailings interface |
| $1 \times 10^{-7}$ | $4 \times 10^{-8}$ w/ fractures | 90 | ponding to V.P./tailings interface |
| $1 \times 10^{-7}$ | $4 \times 10^{-8}$ w/ fractures | 80 | ponding to V.P./tailings interface |
| $1 \times 10^{-7}$ | $4 \times 10^{-8}$ w/ fractures | 70 | ponding up through tailings |
| $1 \times 10^{-7}$ | $1 \times 10^{-7}$, no fractures | 90 | approx. 13 ft @ base due to transient drainage |
| $1 \times 10^{-7}$ | $1 \times 10^{-7}$, no fractures | 60, optimum | no ponding |
| zero flux | $4 \times 10^{-8}$ w/ fractures | 70 | no ponding |
| zero flux | $4 \times 10^{-8}$ w/ fractures | 90 | no ponding |

**DISCUSSION:**

The transient drainage and moisture redistribution under long-term conditions were modeled in this calculation set assuming both a fractured and non fracturated Mancos Shale foundation possessing saturated hydraulic conductivities on the order of $10^{-8}$ cm/sec and $10^{-7}$ cm/sec. Placement moisture contents for the tailings material varying between 60 to 90 percent saturated. The effect of each of these conditions on the overall cell performance is discussed.

In general, when the flux through the cover is greater than the saturated hydraulic conductivity of the foundation material, ponding will occur. In this model, a portion of the foundation is fractured and possesses a relatively high saturated hydraulic conductivity, while the majority of the foundation may be

considered homogeneous. Ponding occurs over the homogeneous section and never over the fractured section when the conductivity of the cover is greatest. The saturated surface will not drain completely as long as the cover flux is greater than the flux allowed through the foundation. When the cover and foundation conductivies are equal, ponding occurs for a short period of time and then drains. This water is transient drainage of construction placement water.

Sealed double ring infiltrometer testing performed in the late autumn of 1990 resulted in lower permeability values for the foundation materials than originally determined. These lower values resulted in a geometric mean of the foundation to be lower than the cover permeability. Consequently, a greater quantity of moisture is allowed to enter the cell than is allowed to leave. This situation results in ponding of water within the cell. The testing that was performed in 1990 was undertaken during late fall to early winter. At this time of year at the site the night time temperatures drop below freezing. Although this was expected and the SDRI devices were equipped with circulation pumps to prevent the water from freezing within the outer-ring (see reference 2), temperatures within the inner-ring of the SDRI device during testing are unknown. Flowrate of water through the inner-ring is measured to calculate the infiltration rate and saturated hydraulic conductivity. It is possible that partial or total freezing of water within the small diameter tubes occurred. These ¼ inch diameter tubes carry flow from flexible bags to the inner ring. Any freezing would have blocked flow, producing an artifical result, indicating an apparent low conductivity material. Likewise, a decrease in temperature also changes the viscosity of the water. However, corrections made for the viscosity do not cause a significant change in the results. Since conditions within the inner-ring cannot accurately be assessed during the testing period, reasonable doubt concerning the accuracy of the results can be made. Therefore, the results from the month long tests performed during 1990 are questionable, and the saturated conductivity of the weathered portion of the Mancos Shale foundation should be taken as originally tested, on the order of $10^{-7}$ cm/sec.

The range of placement moisture contents for the tailings materials ranged between 19 to 29 percent by weight which relates to 60 to 90 percent saturation. Optimum moisture content for the tailings material is determined by ASTM D698 to be 19 percent. Typically, optimum moisture content of a soil material compacted under ASTM D698 specifications is approximately 80 to 85 % saturated. It is understood that some of the tailings materials exist in situ at a higher moisture content than optimum and drying or mixing the tailings material will cause construction delays. Based on this analysis, the depth of ponding which may occur within the cell is more sensitive to the relative difference between the cover and foundation permeabilities than it is to the placement moisture contents. This is indicated by the fact that the depth of

ponding which was indicated by the computer model was approximately the same, independent of initial moisture content.

A quick analytical check can be made to verify the results of the numerical model. Ponding will occur within the cell if the outflow through the base of the cell is less than the influx through the cover. Assumming saturated conditions, Darcy's Law for 1-D flow can be utilized to compute the flow through the boundaries of the cell. Using the coordinates from the FEM mesh the lengths of the cover and foundation can be simply calculated. The lengths are listed below with the respective coefficients of permeability.

Analytical Computations

| component | length (m) | permeability (m/day) | flow (cmd) |
|---|---|---|---|
| cover | 554.9 | $8.64 \times 10^{-5}$ | 0.0479 |
| wthrd base | 391.1 | $1.73 \times 10^{-5}$ | 0.0068 |
| frctrd base | 164.8 | $1.73 \times 10^{-2}$ | 2.8502 |

Ponding will not occur if the ratio of the outflow over the inflow is greater than one. Thus,

$$[2.8502 + 0.0068]/0.0479 = 59.6$$

$$59.6 \geq 1.0 \therefore \text{ponding should not occur.}$$

**SUMMARY:**

It is felt that the saturated conductivity of the foundation is most accurately represented by the original testing, on the order of $10^{-7}$ cm/sec. The numerical analysis and analytical computation both indicate that ponding should not occur within the cell if the fractures are considered and a reasonable saturated conductivity for the weathered foundation are used. An additional safeguard is provided by the fact that all moisture apparently drains from the cell into the underlying fracture system. Therefore, the compaction specifications for the tailings materials only, can safely be relaxed allowing the subcontractor to only meet the 90% dry density specification without regard to moisture content specifications.

# APPENDIX I

## ORIGINAL CALCULATION

**JACOBS ENGINEERING GROUP INC.**
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

# CALCULATION COVER SHEET

CALC NO. ~~GRJ 08 90 12 05 00~~ STET ~~GRJ 05 91 12 05 01~~ DISCIPLINE Geotech/Hydro NO. OF SHEETS 25

**PROJECT:**
UMTRA

**SITE:**
GRAND JUNCTION

**FEATURE:**
TRANSIENT DRAINAGE AND STEADY STATE SEEPAGE FROM CHENEY DISPOSAL CELL

**SOURCES OF DATA:**
Daniel B. Stevens & Associates
~~Shan-Northern Consulting Geotechnical Engineers~~
MKE-S, Final Grading Plans & Embankment Area Excavations

**SOURCES OF FORMULAE & REFERENCES:**

SEE PG 3

PRELIMINARY CALC. [X] FINAL CALC. [ ] SUPERSEDES CALC. NO. _____

| REV. NO. | REVISION | CALCULATION BY | DATE | CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|---|
| | | G. SMITH | 8/90 | [illegible] | 8/9/90 | [illegible] | 9/6/90 |
| 01 | ~~Incorporate base & wet tailings~~ | ~~G. SMITH~~ | ~~5/91~~ | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

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PURPOSE:

To evaluate effects of transient drainage of construction water from placed contaminated materials on overall cell performance. To determine if any ponding and the resulting depth that water is expected to reach within the cell. Compare the resulting water level to the location of the nearest paleochannel and evaluate the possibility of contaminate water leaching from the cell into the channel.

METHOD:

Utilize finite element method (FEM) analysis provided by the UNSAT2 computer code to evaluate the time-drainage effects of transient drainage. Use Maulem's parameters determined from Van Gneuthen's RETC analyses in conjunction with moisture/pressure test data obtained from laboratory analyses performed on the various materials to be used in the final cell construction. Test data were selected from samples that have materials properties and were prepared closest to expected final field conditions. Tailings materials possess any overall slime or fines content (% material passing a #200 mesh sieve) of around 25% (see reference 4). The vicinity property materials have over 60% slimes according to laboratory test results. Samples chosen contain percentage of fine material which are closest to design specifications and were remolded to design densities and water contents.

Two separate analyses are performed to bound the range of estimated material moisture/pressure relationships. Flux rates determined through previous infiltration studies will be applied to the surface of the contaminated materials. These earlier analyses are listed in the reference section. The cover is not included in the model. The condition imposed is the flux through the cover will be governed by the flux rate as determined by the UNSAT-H calculation of 1.78 cm/year (5.68E-08 cm/sec). This rate is conservatively modeled as the design saturated permeability of the radon/infiltration barrier of 1.0E-07 cm/sec.

ASSUMPTIONS:

- laboratory test methods utilized accurately reproduce expected field behavior of placed materials.

- transient drainage of construction waters do not begin until all cell components have been constructed.

- densities and moisture contents of placed materials precisely meet construction specifications.

- all materials are homogenous and isotropic except where specified anisotropity exists.

REFERENCES:

1) Crain, J., March 1990., TAC calculation GRJ-03-90-11-01-00, "Infiltration Through Cover System and Vicinity Properties Material".

2) Crain, J. & Smith, G., Jan. 1990., TAC calculation GRJ-01-90-02-03-00, "Grand Junction, Cheney Disposal Site, Transient Drainage".

3) Davis, L. and Neuman, 1983. Documentation and User's Guide: UNSAT-2 Variably Saturated Flow Model, NRC.

4) Merritt, R.C., 1971., "The Extractive Metallurgy of Uranium", Colorado School of Mines Research Institute.

5) Smith, G., August 1990., TAC calculation GRJ-08-90-12-02-00, "Determination of Unsaturated Hydrologic Properties, Tailings and Vicinity Property Materials".

6) United States Department of Agriculture, 1987. User's Guide: RETC.

7) Van Genuchten, R., 1980. "A Closed-Form Solution for Predicting the Hydraulic Conductivity of Unsaturated Soils", Journal, Soil Science Society - American, No. 44.

DATA SOURCE:

Daniel B. Stevens and Associates

University of Arizona Hydrology Laboratory

MKE preliminary drawings GRJ-DS-10-0220 rev.1 & GRJ-DS-10-0134 rev.2 of Final Gradings Plans & Tailing Embankment Area Excavation Plan.

DATA:

Copies of laboratory determined moisture/pressure relationship test results from the firm of Daniel B. Stevens & Assoc.(DBS&A) are presented on pages 5 to 7. Computer results of the RETC analyses (see references 6 & 7) of these data are presented in the Appendix with the resulting best fit curves shown on Figures #1 to #2. This data is reproduced from calculation GRJ-08-90-12-02-00, "Determination of Unsaturated Hydrologic Properties, Tailings and Vicinity Property Materials".

Capillarity moisture tests were not successfully performed on the Mancos Formation shale material. Therefore, test results for a similar substitute material were used. Data were obtained from testing performed by the University of Arizona Hydrology Laboratory on Wasatch Formation shale. This material was taken from the UMTRA disposal site in Rifle, Colorado at Estes Gulch. Plots of the unsaturated moisture/pressure relationships are presented on Figures #3 to #4 on pages 10 and 11 . A justification for this substitution is presented in the discussion section of this calculation set.

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve

| Sample No. | Pressure Head (-cm of water) | Moisture Content (% $cm^3/cm^3$) |
|---|---|---|
| 5-1 | 0.0 | 45.66 |
| | 112.2 | 16.49 |
| | 305.9 | 1.98 |
| | 1019.8 | 6.89 |
| | 3059.4 | 5.19 |
| | 7138.6 | 4.38 |
| | 15399.0 | 3.77 |
| 5-2 | 0.0 | 45.17 |
| | 112.2 | 20.15 |
| | 305.9 | 8.70 |
| | 1019.8 | 7.04 |
| | 3059.4 | 5.30 |
| | 7138.6 | 4.60 |
| | 15399.0 | 3.66 |
| 5-3 S5-3 Tailings | 0.0 | 50.36 |
| | 112.2 | 46.27 |
| | 305.9 | 38.91 |
| | 1019.8 | 33.22 |
| | 3059.4 | 25.65 |
| | 7138.6 | 24.33 |
| | 15399.0 | 24.16 |
| 5-4 | 0.0 | 51.35 |
| | 112.2 | 47.28 |
| | 305.9 | 41.07 |
| | 1019.8 | 34.69 |
| | 3059.4 | 26.20 |
| | 7138.6 | 23.88 |
| | 15399.0 | 17.87 |
| 5-5 | 0.0 | 47.19 |
| | 112.2 | 30.62 |
| | 305.9 | 25.49 |
| | 1019.8 | 22.00 |
| | 3059.4 | 17.36 |
| | 7138.6 | 16.54 |
| | 15399.0 | 14.28 |

* measurement error

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

| Sample No. | Pressure Head (-cm of water) | Moisture Content (% $cm^3/cm^3$) |
|---|---|---|
| 5-11 | 0.0 | 48.34 |
| | 112.2 | 34.35 |
| | 305.9 | 32.49 |
| | 1019.8 | 29.72 |
| | 3059.4 | 22.13 |
| | 7138.6 | 20.60 |
| | 15399.0 | 19.38 |
| 5-12 | 0.0 | 45.27 |
| | 112.2 | 35.60 |
| | 305.9 | 33.56 |
| | 1019.8 | 31.14 |
| | 3059.4 | 25.80 |
| | 7138.6 | 24.46 |
| | 15399.0 | 24.76 |
| 5-13 | 0.0 | 46.48 |
| | 112.2 | 37.49 |
| | 305.9 | 35.57 |
| | 1019.8 | 32.68 |
| | 3059.4 | 27.95 |
| | 7138.6 | 26.69 |
| | 15399.0 | 25.77 |
| 5-14 | 0.0 | 47.39 |
| | 112.2 | 39.10 |
| | 305.9 | 35.24 |
| | 1019.8 | 32.05 |
| | 3059.4 | 26.64 |
| | 7138.6 | 24.20 |
| | 15399.0 | 19.45 |
| 5-15 ½ RS-3 Vicinity Property | 0.0 | 40.69 |
| | 102.0 | 33.11 |
| | 305.9 | 29.70 |
| | 1019.8 | 26.71 |
| | 3059.4 | 26.09 |
| | 7138.6 | 23.80 |
| | 15297.0 | 23.25 |

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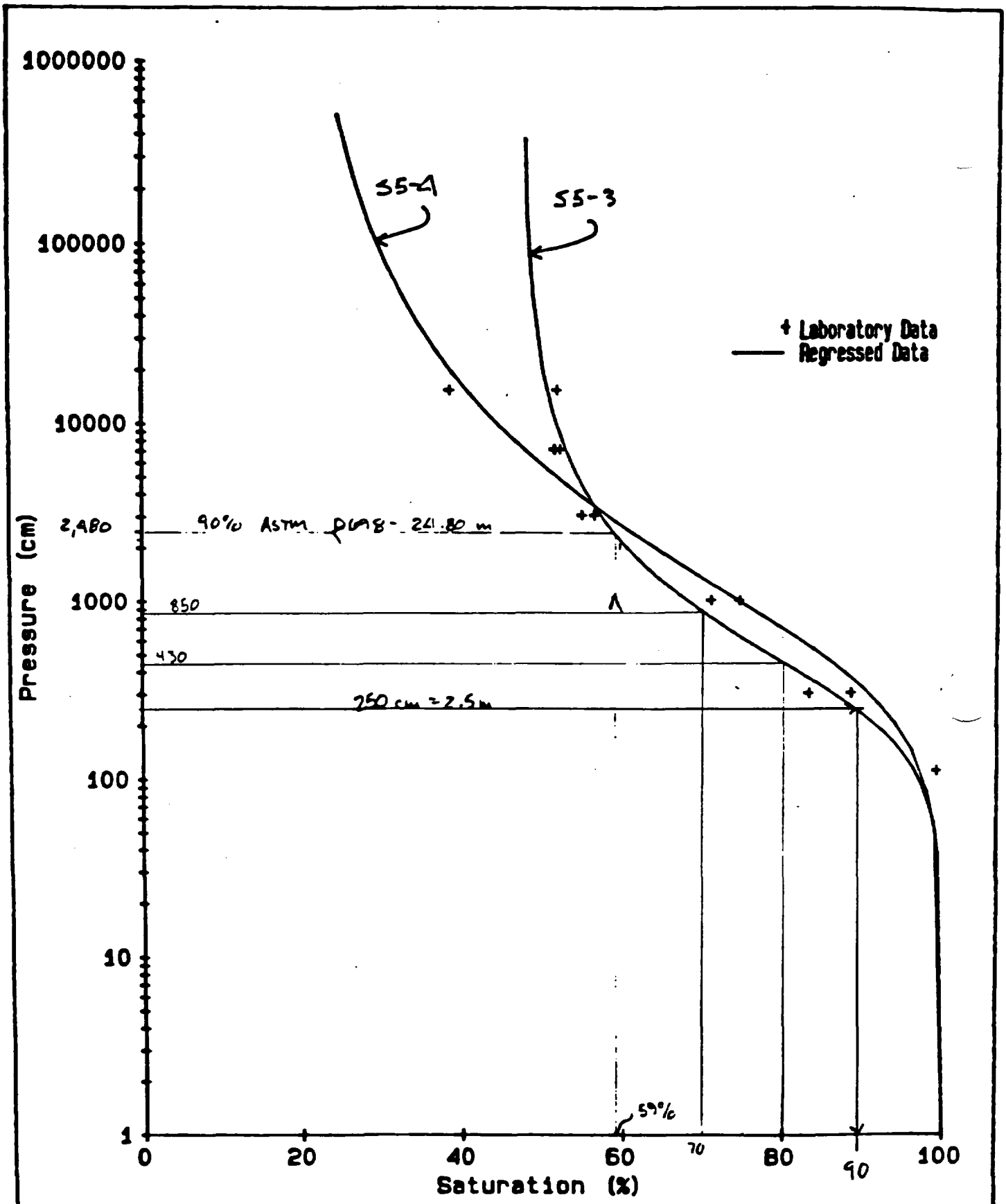
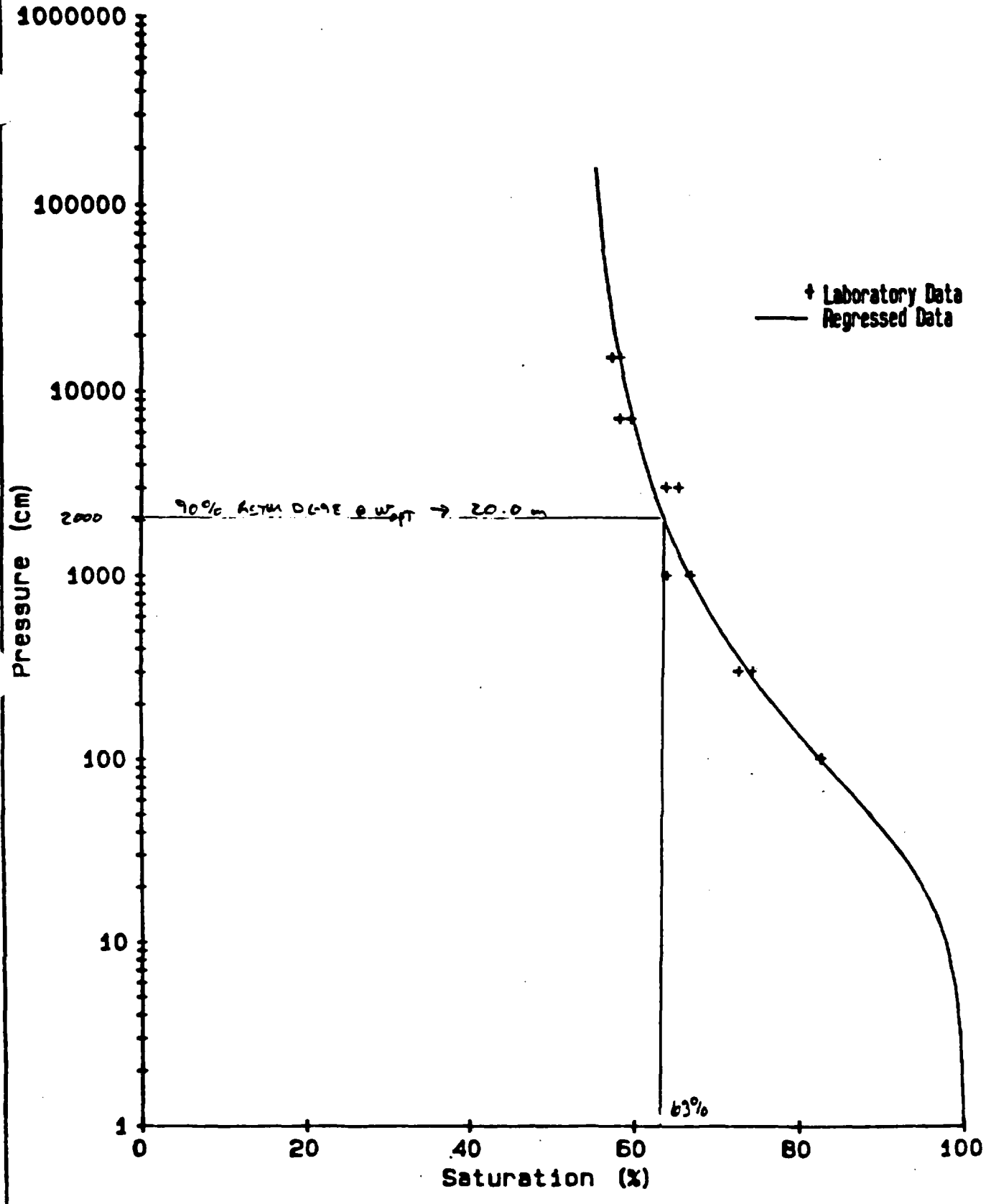
Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

| Sample No. | Pressure Head (-cm of water) | Moisture Content (% $cm^3/cm^3$) |
|---|---|---|
| 5-16 | 0.0 | 39.78 |
| Vicinity | 102.0 | 33.16 |
| Property | 305.9 | 29.04 |
| | 1019.8 | 25.60 |
| | 3059.4 | 25.50 |
| | 7138.6 | 23.25 |
| ½ RS-3 | 15297.0 | 22.85 |
| 5-17 | 0.0 | 37.53 |
| | 102.0 | 33.79 |
| | 305.9 | 31.82 |
| | 1019.8 | 29.36 |
| | 3059.4 | 29.17 |
| | 7138.6 | 27.96 |
| | 15297.0 | 28.00 |
| 5-18 | 0.0 | 39.84 |
| | 102.0 | 34.27 |
| | 305.9 | 31.93 |
| | 1019.8 | 29.16 |
| | 3059.4 | 28.39 |
| | 7138.6 | 27.35 |
| | 15297.0 | 25.85 |
| 5-19 | 0.0 | 39.85 |
| | 102.0 | 36.29 |
| | 305.9 | 33.62 |
| | 1019.8 | 30.22 |
| | 3059.4 | 29.38 |
| | 7138.6 | 28.46 |
| | 15297.0 | 27.53 |
| 5-20 | 0.0 | 39.41 |
| | 102.0 | 36.36 |
| | 305.9 | 33.67 |
| | 1019.8 | 30.29 |
| | 3059.4 | 28.47 |
| | 7138.6 | 26.90 |
| | 15297.0 | 26.50 |



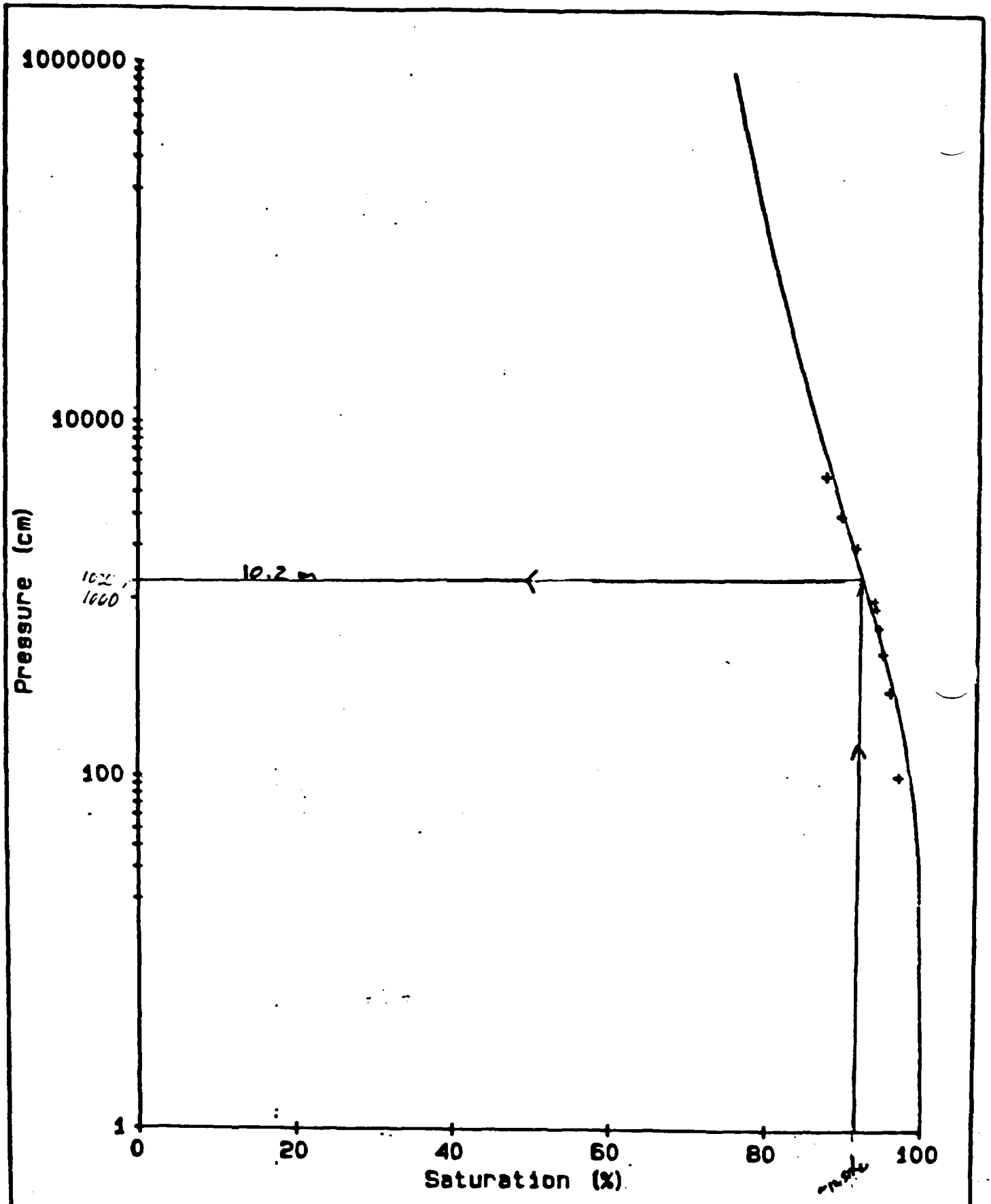

GRJ. MAIN PILE TAILINGS. 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS. 17.7% -200 (S5-4)

FIGURE No. 1



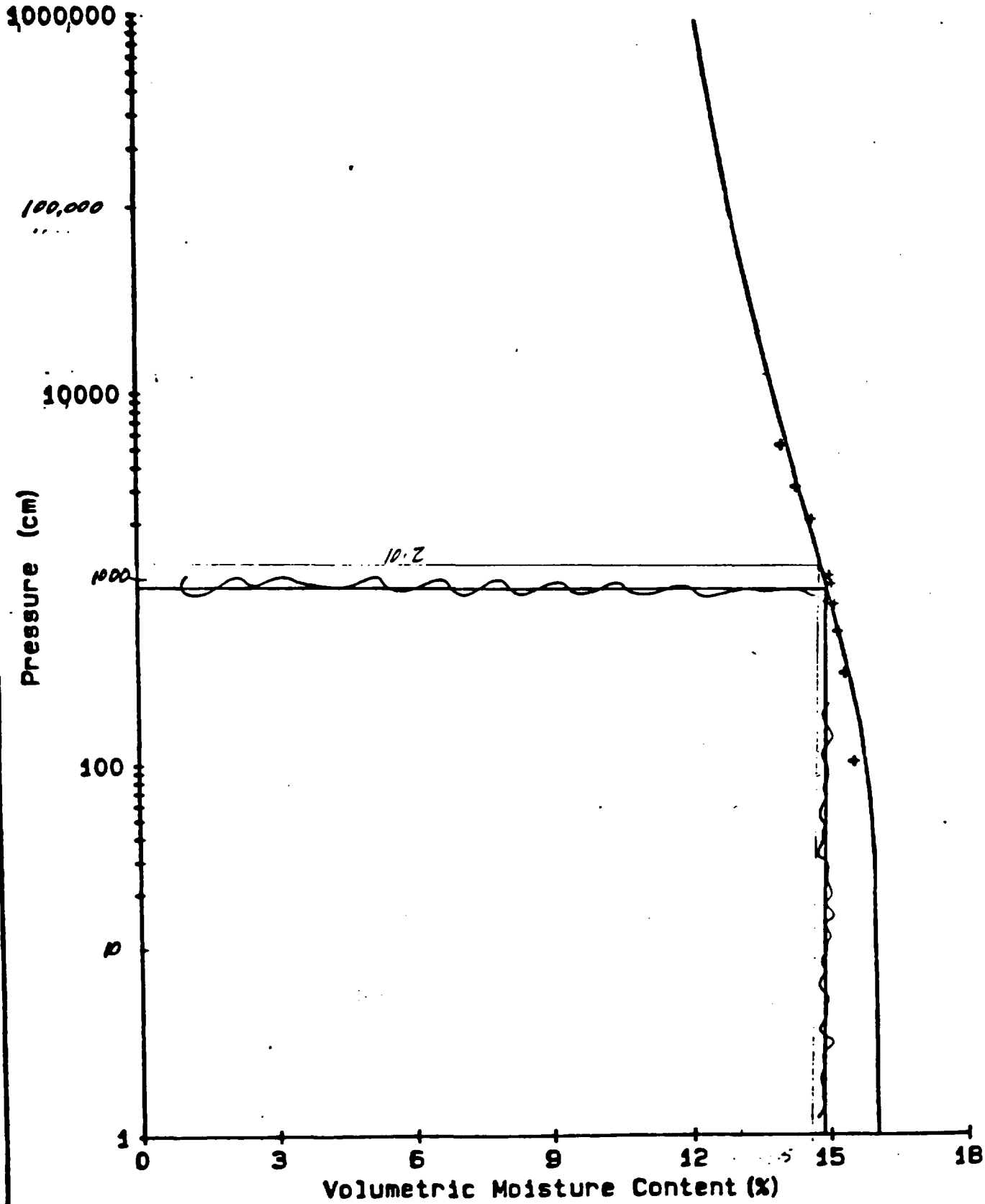

GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE NO. 2




ESTES GULCH, WASATCH FORMATION

Figure #3




ESTES GULCH, WASATCH FORMATION

Figure # 4

CALCULATION:

Utilization of a FEM analysis such as the UNSAT-2 computer code requires construction of a finite element mesh. The FEM mesh utilizied is a two-dimensional (2D) section through the disposal cell. The mesh is required to model the physical system for algorithms to solve partial differential equations governing variably saturated flow simulating both horizontal and vertical movement of water. The mesh used in this analysis was determined by locating the longest downgradient drainage path along the base of the proposed disposal cell excavation. This section is indicated on Figures #5 and #6 showing plan views of the proposed excavation and final grading plans, respectively. This excavation plan is MKE's design of Case 2BX which is for a moderate depth excavation. From these drawings the upper and lower boundaries of the mesh are specified. Thickness of the vicinity property and tailings materials were obtained from a preliminary cross-sectional sketch provided by MKE shown in Figure #7. Using this information the finite element mesh shown in Figure #8 is constructed. Metric units are used in this analysis for consistency with the UNSAT2 computer code. Therefore, all input is in meters or meters/day when units are necessary.

From the moisture/pressure relationships determined in laboratory testing, the unsaturated hydraulic parameters can be obtained. Unsaturated hydraulic properties are given by an analysis suggested by van Genuchten to solve a closed-form equation relating soil moisture contents to hydraulic conductivities derived by Mualem. For input into the UNSAT2 computer code a restriction is placed on determination of the Mualem "m" parameter of $m = 1 - 1/N$. A more detailed discussion on this restriction is provided in the TAC calculation GRJ-01-90-02-03-00 by J. Crain and G. Smith, "Grand Junction, Cheney Disposal Site, Transient Drainage". Unsaturated hydraulic Maulem parameters for each material type are listed in Table I below.

Results of the RETC analyses performed on DBS&A test data indicate the placed materials existing at much drier moisture conditions, holding less moisture at considerably greater negative matric potentials than previous testing had indicated. Therefore, comparative FEM analyses were performed using unsaturated material properties that were utilized in preliminary analyses by Crain and Smith (reference 2) and Crain (reference 1).

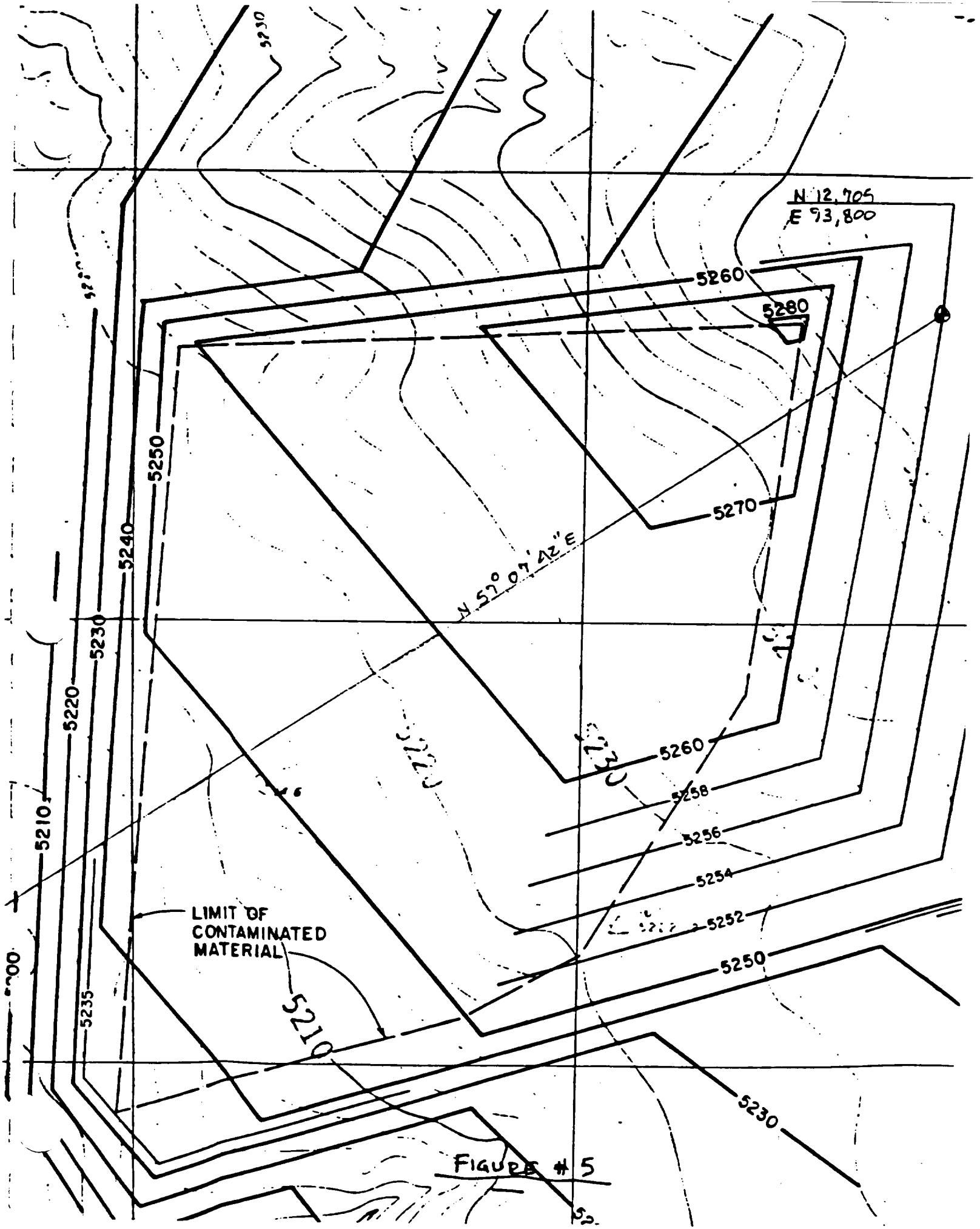

N 12,705
E 93,800
5260
5280
5250
5270
5240
N 52° 07' 42" E
5230
5220
5260
5258
5256
5254
5252
5250
5210
LIMIT OF
CONTAMINATED
MATERIAL
5210
5235
5230

FIGURE # 5

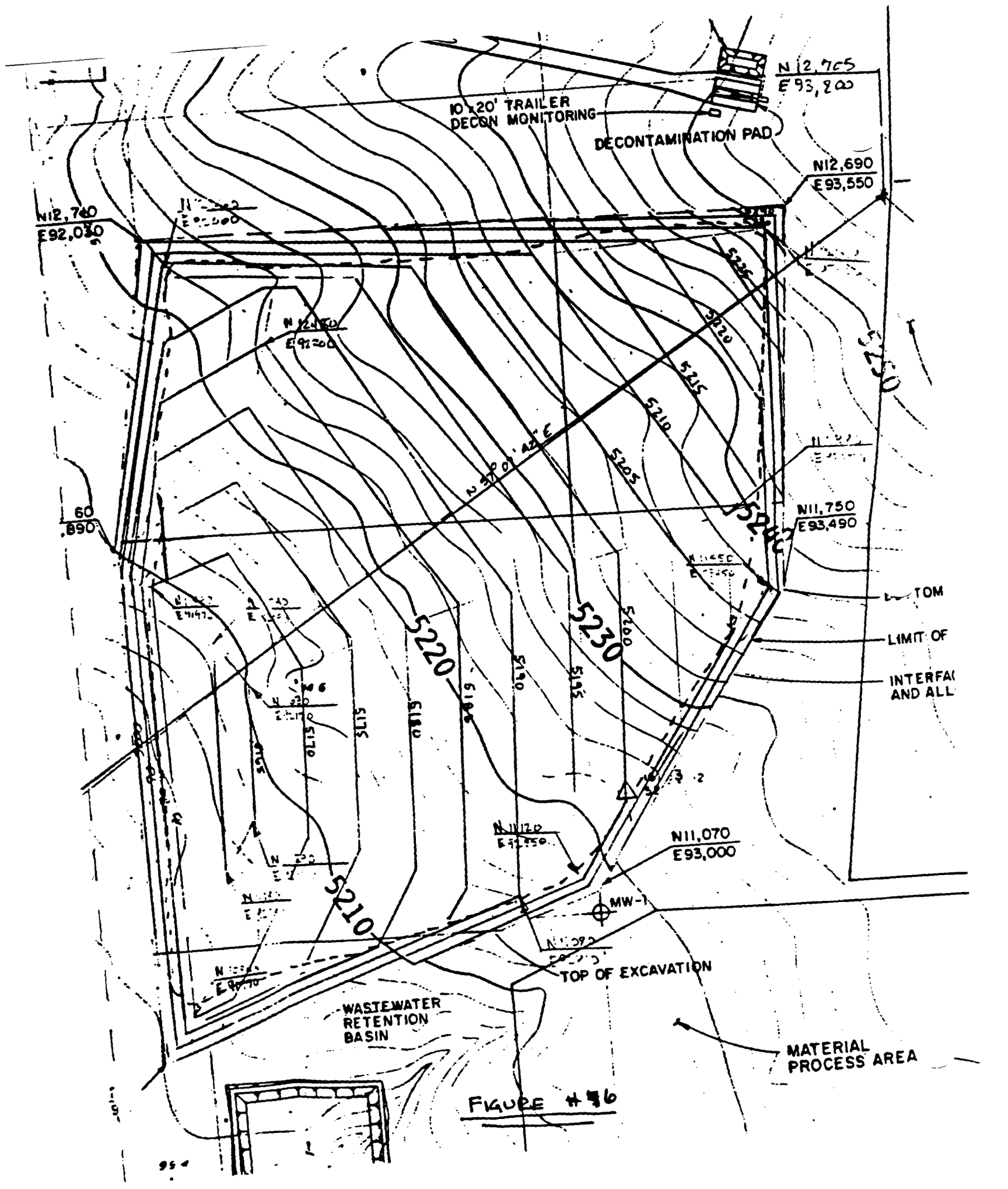

N12,765
E93,800
10'x20' TRAILER
DECON MONITORING
DECONTAMINATION PAD
N12,690
E93,550
N12,760
E92,030
N12,760
E92,200
N11,750
E93,490
60
890
N 40° 01' 42" E
5230
5220
5210
5235
5220
5215
5210
5205
5200
5195
5190
5185
5180
5175
5170
5165
TOM
LIMIT OF
INTERFA
AND ALL
N11,070
E93,000
MW-1
TOP OF EXCAVATION
WASTEWATER
RETENTION
BASIN
MATERIAL
PROCESS AREA

FIGURE #6

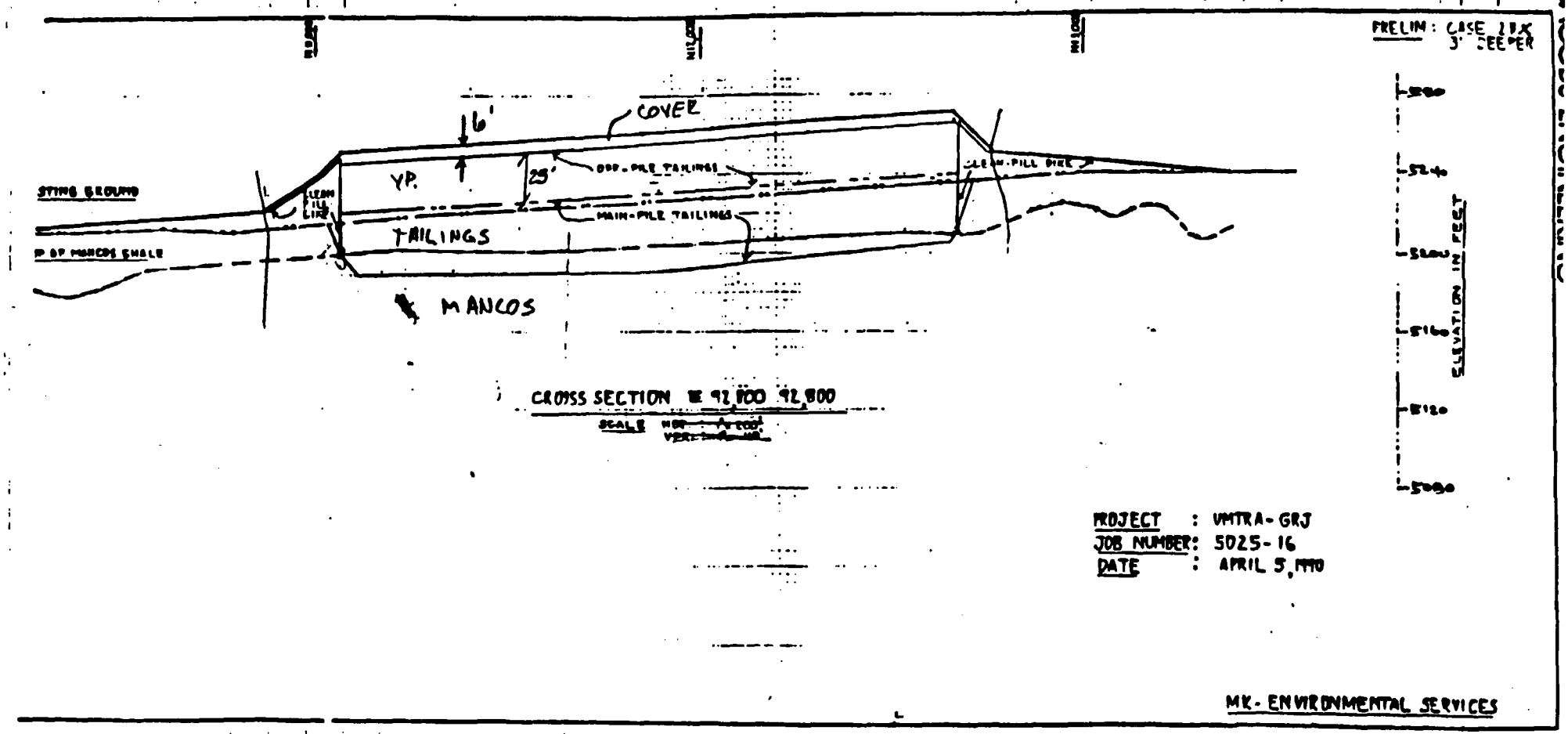



FIGURE #7

NOTE: THIS FIGURE USED TO DETERMINE RELATIVE THICKNESSES OF CONTAMINATED MATERIALS

DATE
BY
SHEET NO. 15/26
JOB NO.

FORM 81-006-1 (4/81)

CHENEY DISPOSAL CELL

N.T.S.

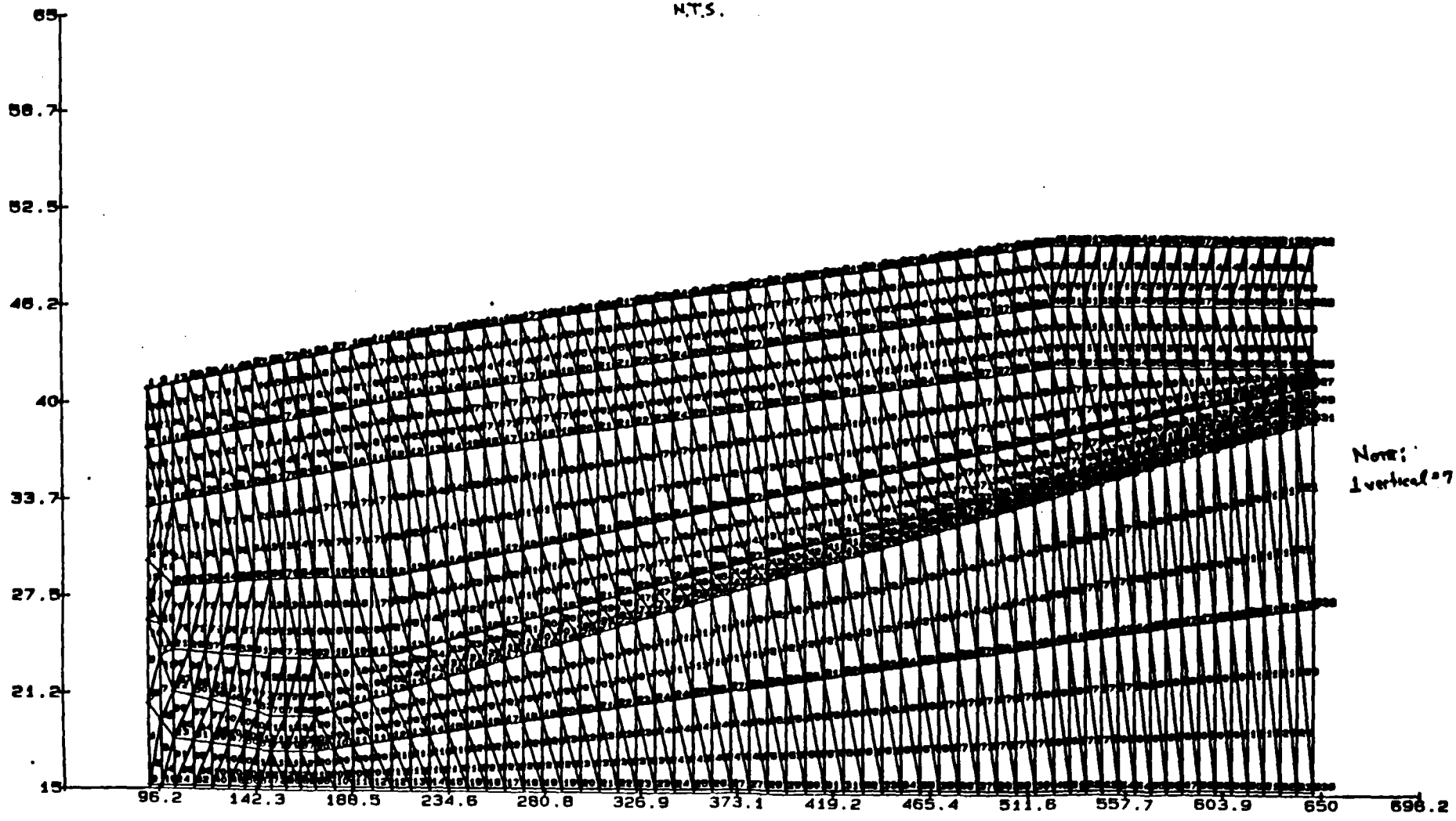



FIGURE 4.8

## Table I

## Unsaturated Hydraulic Parameters

### (DBS&A)

| material | %-200 sieve | $\theta_s$ (%) | $\theta_r$(%) | $\alpha$ (1/meter) | N |
|---|---|---|---|---|---|
| V.P. | 66.5 | 0.4025 | 0.2103 | 3.30 | 1.35 |
| tailings | 23.8 | 0.4670 | 0.2211 | 0.34 | 1.71 |
| oundation | | | | | |
| bedrock | - | 0.1600 | 0.0800 | 0.63 | 1.08 |

### (previous)

| material | %-200 sieve | $\theta_s$ (%) | $\theta_r$(%) | $\alpha$ (1/meter) | N |
|---|---|---|---|---|---|
| V.P. | 52 | 0.1969 | 0.0949 | 0.45 | 5.92 |
| tailings | 32 | 0.3613 | 0.1257 | 0.65 | 1.24 |
| oundation | | | | | |
| bedrock | - | 0.1600 | 0.0800 | 0.63 | 1.08 |

The UNSAT2 computer code also requires data in addition to that provided in Table 1, including saturated hydraulic conductivies and matric potential, in consistent units. These properties should be determined for the materials at initial placement conditions. Saturated permeabilities ($k_{sat}$) are obtained from laboratory testing and matric potential ($\psi$) are determined from RETC output.

Determination of $\psi$ follows this conservative method: from the moisture density relationship defined by ASTM D698 (standard Proctor test), the maximum dry density, $\gamma_d$ and optimum moisture content, $w_{opt}$ are provided. Construction specifications indicate contaminated materials will be placed at 90% maximum dry density within -3% optimum to optimum moisture content. The placement volumetric moisture content ( $\theta$ ) or corresponding saturation (S) is determined by computing the optimum moisture content at 90% maximum dry density. This provides the most moisture in the materials existing at the lowest dry density or maximum void ratio, e . This computation is outlined below and requires the ratio of material weight of solids to weight of water, or the specific gravity of solids, $G_s$ .

$$0.9 \times \gamma_d = \gamma_{placement} \quad (1)$$

$$e = ((G_s \times \gamma_w) / \gamma_{placement}) - 1.0 \quad (2)$$

$$S = (G_s \times w_c) / e \quad (3)$$

where $\gamma_w$ = unit weight of water = 1.0 g/cc

Using the formulas listed above, information pertaining to remolded materials supplied by DBS&A are presented in Table 2 below. Water contents listed are gravimetric.

Table 2

| material | $G_s$ | $\gamma_d$ (g/cc) | $90\%\gamma_d$ | e | $w_{opt}$ (%) | S(%) |
|---|---|---|---|---|---|---|
| V.P. | 2.66 | 1.88 | 1.69 | 0.592 | 13.6 | 63 |
| tailings | 2.76 | 1.62 | 1.46 | 0.893 | 19.1 | 59 |

From RETC produced plots of saturation versus $\Psi$ given in Figure no. s 1 and 2 the matric potential for each remolded material type is determined. Since the foundation materials will remain in situ, the value of -10.2 meters is determined from computed saturation varying between 87 tO 90%. This determination is presented on Figure no. 3.

Saturated permeabilities are also needed for UNSAT2 input. Remolded values are required for placed contaminated materials while an in situ value is needed for foundation bedrock. Values listed in Table 3 were determined in the laboratory and field accordingly.

Table 3

DBS&A

| material | $k_s$ (meters/day) | $\Psi$ (meters) |
|---|---|---|
| V.P. | $k_v = k_h = 9.42 \times 10^{-2}$ | -20.0 |
| tailings | $k_v = k_h = 1.25 \times 10^{-2}$ | -24.8 |
| foundation bedrock | $k_h = 3.46 \times 10^{-3}$ | -10.2 |
| | $k_v = 1.73 \times 10^{-4}$ | -10.2 |

previous data

| material | $k_s$ (meters/day) | $\Psi$ (meters) |
|---|---|---|
| V.P. | $k_v = k_h = 2.62 \times 10^{-3}$ | -2.75 |
| tailings | $k_v = k_h = 4.84 \times 10^{-2}$ | -2.50 |
| foundation bedrock | $k_h = 3.46 \times 10^{-3}$ | -10.2 |
| | $k_v = 1.73 \times 10^{-4}$ | -10.2 |

To model expected field as close as possible, nodes along the base of the mesh were coded intially as unsaturated seepage nodes at there initial matric potential. This allowed moisture to exit the model under atmospheric pressure at a rate controlled by the matric potential of the overlying nodes. A complete copy of the input files used are provided in the Appendix.

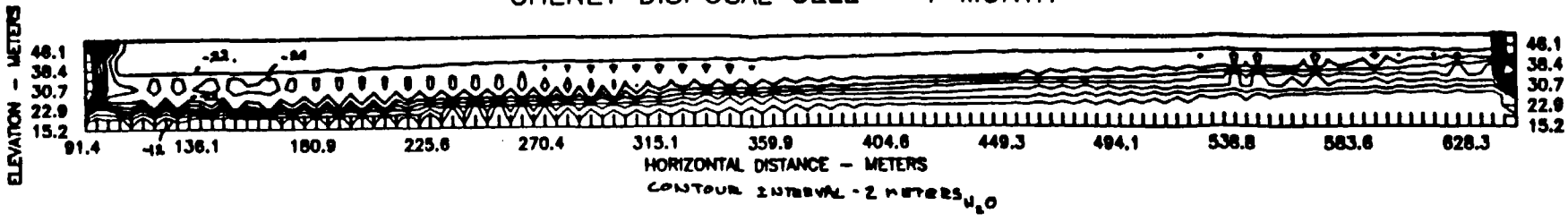
In these analyses the mesh extended around 14 feet into the underlying foundation bedrock beneath the lowest portion of the cell. This enables the moisture to be tracked through the upper foundation materials. Analysis indicates any moisture entering the foundation is accepted vertically downward and does not extend laterally beyond the downstream edge of the cell. Since the vertical hydraulic conductivity of the foundation is considered to be homogeneous and isotropic, once water enters the foundation no mounding of water is possible.

## RESULTS

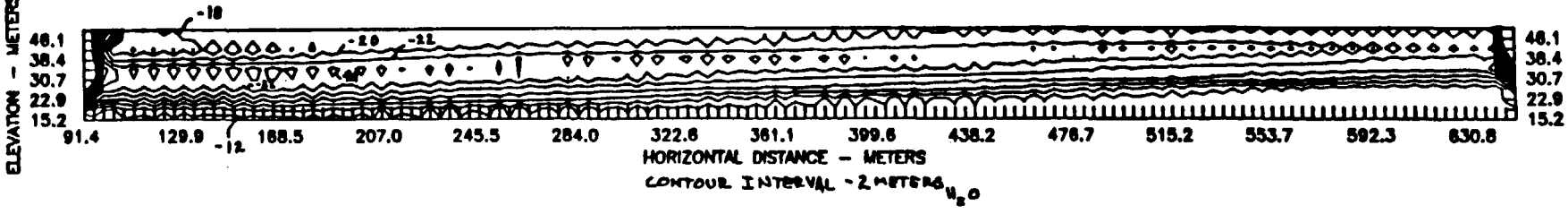
Using the capillarity data provided by DBS&A results in no ponding of any water within the cell. However, changes in matric potential (soil tension) do occur with time as indicated on Figure no.'s 9 and 10 showing pressure contours at variuos times throughout the life of the cell. Soil tensions increase from influx at the top of the cell are indicated by noticing the increasing values of matric potential with time from the surface downward into the cell. From the time progression shown the pressures can be seen to equalize with time through the 87.8 year plot. The next two time plots, (500 and 1000 years) show the influx through the cover being held by the vicinity property material, which is indicated by the closely spaced contours near midheight. This influx is accepted by the tailings before entering the foundation. Tailings are not holding the moisture as indicated by the more widely spaced contours. The closely spaced contours at the edge of the cell shown in the first time plots reflect the high negative matric potentials introduced by compaction of fine grained soils near maximum dry density and optimum moisture content.

When the previous moisture data is utilizied, a ponding depth of 3.75 meters (12.3 feet) is predicted in the cell. Ponding of water is in the base of the cell with the highest pressures indicated at node #94. A plot of positive pressure versus time obtained from node #94 is presented on Figure no. 11. This plot illustrates how moisture is accepted by the underlying foundation clayshales.

## CHENEY DISPOSAL CELL – 1 MONTH




## CHENEY DISPOSAL CELL – 32.5 YEARS




## CHENEY DISPOSAL CELL – 87.8 YEARS

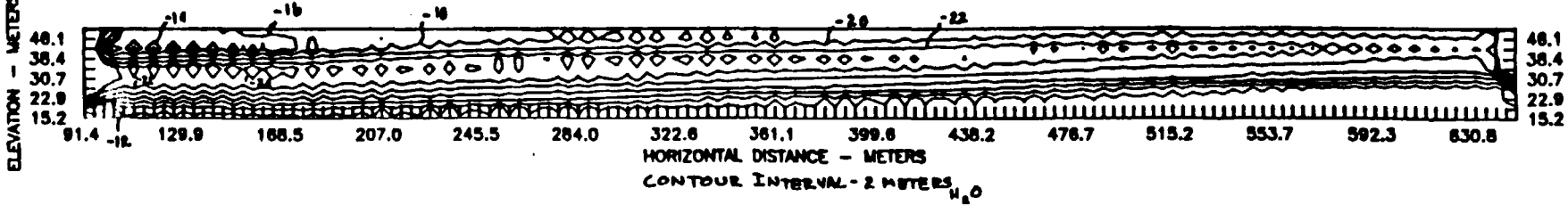
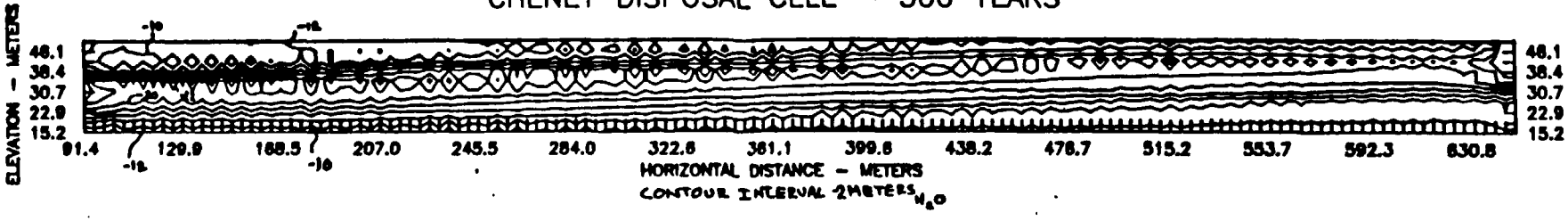
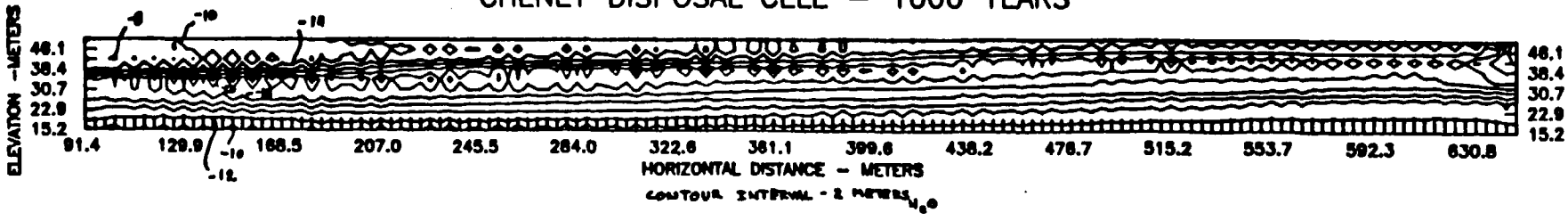



FIGURE #9

## CHENEY DISPOSAL CELL – 500 YEARS




## CHENEY DISPOSAL CELL – 1000 YEARS



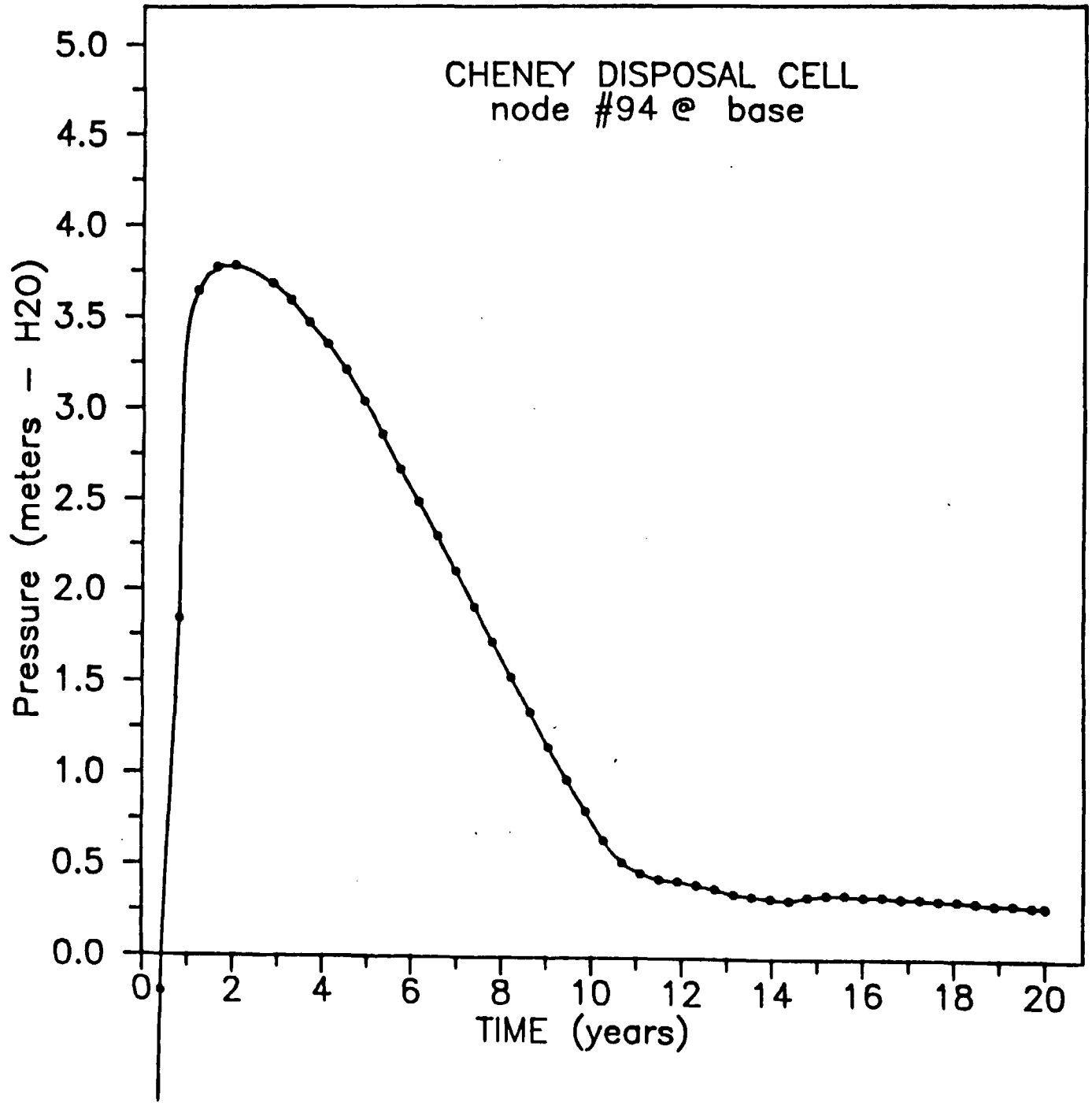

CHENEY DISPOSAL CELL
node #94 @ base
Pressure (meters - H20)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
TIME (years)

Figure #11

## DISCUSSION:

### Wasatch Formation in lieu of Mancos Formation:

Geotechnical engineering properties and infiltration characteristics of Mancos Formation shale and Wasatch Formation shale may be considered similar for this analysis because of the following conditions. Both lithologic units would carry the same engineering classification. Both materials are clayshales high in smectite minerals. Although the Mancos material is an older formation of the Cretaceous period while the Wasatch was formed during the much younger Tertiary period, both materials possess similar effects from weathering. Both units occur at similar depths beneath similar overburden materials. This overburden generally consists of silty, sandy clays derived from the underlying parent shale. The consistent overburden material and depth produced a closely matched depth of weathering in both units. Semi-arid climatic conditions exist at both locations which creates a similar force causing the weathering.

Weathering produces fracturing and micro-fracturing and general degradation within the rock mass. These fractures provide flow paths through the material. It is widely accepted that smectite minerals possess a high swell potential. Because the overburden material and depths are similar at both locations, the applied overburden stress will be similar. Thus, the possible degree of swell that can occur upon moisture increases will also be similar. The above swell similarity will produce similar void ratios in both materials. This is confirmed by approximately equal dry unit weights. Similar void ratios and mineral types produce similar pore sizes which control pore fluid tensions which govern unsaturated flow characteristics.

Considering all of the above, differences in hydraulic characteristics between Mancos Formation shales and Wasatch Formation shales are negligible.

## SUMMARY OF RESULTS:

Using results from this analysis in conjunction with results from previous analyses indicated that some ponding will possibly occur. The actual depth of this ponding ranges from no ponding to slightly over 12 feet. The spread in resulting depths is mainly due to varations in the capillarity data. None of the analyses indicate that the level of the water approaches the elevation of the lowest paleochannel. Thus, these models have indicated that seepage of contaminates out of the cell into paleochannels allowing an exit path for the contamination to reach useable aquifers, is not shown to occur.

# APPENDIX

TAC CALCULATION GRJ-08-90-12-05-00

RETC INPUT - VICINITY PROPERTY MATERIALS
- MAIN PILE TAILINGS
- WASATCH FORMATION

UNSAT2 INPUT - DBSÉA data
- previous data

```
*************************************************************
*                                                           *
*     ANALYSIS OF SOIL HYDRAULIC PROPERTIES                 *
*                                                           *
*GRJ, VICINITY PROPERTY MATERIALS, (RS-3/ #5-15 & #5-16)    *
*                                                           *
      MUALEM-BASED RESTRICTION, M=1-1/N                     *
      ANALYSIS OF RETENTION DATA ONLY                       *
*     MTYPE= 3     METHOD= 2                                *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

| NO | NAME | INITIAL VALUE | INDEX |
|---|---|---|---|
| 1 | WCR | .2285 | 1 |
| 2 | WCS | .4069 | 1 |
| 3 | ALPHA | .0500 | 1 |
| 4 | N | 2.0000 | 1 |
| 5 | M | .5000 | 0 |
| 6 | EXPO | .5000 | 0 |
| 7 | CONDS | 1.09E-04 | 0 |

OBSERVED DATA

| OBS. NO. | PRESSURE HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | .100 | .4069 | 1.0000 |
| 2 | .100 | .3978 | 1.0000 |
| [illegible] | 102.000 | .3311 | 1.0000 |
| [illegible] | 102.000 | .3316 | 1.0000 |
| 5 | 305.900 | .2970 | 1.0000 |
| 6 | 305.900 | .2904 | 1.0000 |
| 7 | 1019.800 | .2671 | 1.0000 |
| 8 | 1019.800 | .2560 | 1.0000 |
| 9 | 3059.400 | .2609 | 1.0000 |
| 10 | 3059.400 | .2550 | 1.0000 |
| 11 | 7138.600 | .2380 | 1.0000 |
| 12 | 7138.600 | .2325 | 1.0000 |
| 13 | 15297.000 | .2325 | 1.0000 |
| 14 | 15297.000 | .2285 | 1.0000 |

| NIT | SSQ | WCR | WCS | ALPHA | N |
|---|---|---|---|---|---|
| 0 | .01877 | .2285 | .4069 | .0500 | 2.0000 |
| 10 | .00042 | .2103 | .4025 | .0330 | 1.3504 |

CORRELATION MATRIX

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 1.0000 | | | |
| 2 | -.0354 | 1.0000 | | |
| 3 | -.8130 | .2576 | 1.0000 | |
| 4 | .9671 | -.0485 | -.9117 | 1.0000 |

[illegible]UARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .99070334

| | | | | | |
|---|---|---|---|---|---|
| WCR | .21025 | .01530 | 13.74 | .1762 | .2444 |
| WCS | .40246 | .00460 | 87.44 | .3922 | .4127 |
| ALPHA | .03297 | .01231 | 2.68 | .0055 | .0604 |
| N | 1.35042 | .09971 | 13.54 | 1.1283 | 1.5726 |

OBSERVED AND FITTED DATA

| NO | P | LOG-P | WC-OBS | WC-FIT | WC-DIF |
|---|---|---|---|---|---|
| 1 | .1000D+00 | -1.0000 | .4069 | .4024 | .0045 |
| 2 | .1000D+00 | -1.0000 | .3978 | .4024 | -.0046 |
| 3 | .1020D+03 | 2.0086 | .3311 | .3302 | .0009 |
| 4 | .1020D+03 | 2.0086 | .3316 | .3302 | .0014 |
| 5 | .3059D+03 | 2.4856 | .2970 | .2948 | .0022 |
| 6 | .3059D+03 | 2.4856 | .2904 | .2948 | -.0044 |
| 7 | .1020D+04 | 3.0085 | .2671 | .2662 | .0009 |
| 8 | .1020D+04 | 3.0085 | .2560 | .2662 | -.0102 |
| 9 | .3059D+04 | 3.4856 | .2609 | .2484 | .0125 |
| 10 | .3059D+04 | 3.4856 | .2550 | .2484 | .0066 |
| 11 | .7139D+04 | 3.8536 | .2380 | .2386 | -.0006 |
| 12 | .7139D+04 | 3.8536 | .2325 | .2386 | -.0061 |
| 13 | .1530D+05 | 4.1846 | .2325 | .2320 | .0005 |
| 14 | .1530D+05 | 4.1846 | .2285 | .2320 | -.0035 |

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES

| | UNWEIGHTED | WEIGHTED |
|---|---|---|
| RETENTION DATA | .00042 | .00042 |
| COND/DIFF DATA | .00000 | .00000 |
| ALL DATA | .00042 | .00042 |

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)

| WC | P | LOGP | COND | LOGK | DIF | LOGD |
|---|---|---|---|---|---|---|
| .2115 | .5912D+08 | 7.772 | .5965D-23 | -23.224 | .8377D-12 | -12.077 |
| .2127 | .8179D+07 | 6.913 | .1763D-20 | -20.754 | .1713D-10 | -10.766 |
| .2151 | .1131D+07 | 6.054 | .5211D-18 | -18.283 | .3502D-09 | -9.456 |
| .2199 | .1565D+06 | 5.195 | .1540D-15 | -15.812 | .7159D-08 | -8.145 |
| .2247 | .4921D+05 | 4.692 | .4294D-14 | -14.367 | .4183D-07 | -7.378 |
| .2295 | .2165D+05 | 4.335 | .4553D-13 | -13.342 | .1464D-06 | -6.834 |
| .2343 | .1145D+05 | 4.059 | .2843D-12 | -12.546 | .3868D-06 | -6.412 |
| .2391 | .6805D+04 | 3.833 | .1270D-11 | -11.896 | .8558D-06 | -6.068 |
| .2439 | .4381D+04 | 3.642 | .4502D-11 | -11.347 | .1675D-05 | -5.776 |
| .2487 | .2991D+04 | 3.476 | .1348D-10 | -10.870 | .2999D-05 | -5.523 |
| .2535 | .2135D+04 | 3.329 | .3546D-10 | -10.450 | .5013D-05 | -5.300 |
| .2583 | .1579D+04 | 3.198 | .8431D-10 | -10.074 | .7944D-05 | -5.100 |
| .2631 | .1201D+04 | 3.080 | .1846D-09 | -9.734 | .1206D-04 | -4.919 |
| .2679 | .9351D+03 | 2.971 | .3778D-09 | -9.423 | .1766D-04 | -4.753 |
| .2727 | .7422D+03 | 2.871 | .7307D-09 | -9.136 | .2511D-04 | -4.600 |
| .2775 | .5987D+03 | 2.777 | .1347D-08 | -8.871 | .3482D-04 | -4.458 |
| .2823 | .4898D+03 | 2.690 | .2382D-08 | -8.623 | .4727D-04 | -4.325 |
| .2871 | .4054D+03 | 2.608 | .4066D-08 | -8.391 | .6302D-04 | -4.200 |
| .2919 | .3390D+03 | 2.530 | .6726D-08 | -8.172 | .8271D-04 | -4.082 |
| .2967 | .2859D+03 | 2.456 | .1083D-07 | -7.965 | .1071D-03 | -3.970 |
| .3015 | .2430D+03 | 2.386 | .1702D-07 | -7.769 | .1370D-03 | -3.863 |
| .3064 | .2079D+03 | 2.318 | .2617D-07 | -7.582 | .1736D-03 | -3.760 |
| .3112 | .1788D+03 | 2.252 | .3951D-07 | -7.403 | .2180D-03 | -3.662 |
| .3160 | .1545D+03 | 2.189 | .5864D-07 | -7.232 | .2717D-03 | -3.566 |
| .3208 | .1340D+03 | 2.127 | .8574D-07 | -7.067 | .3366D-03 | -3.473 |
| .3256 | .1166D+03 | 2.067 | .1237D-06 | -6.908 | .4148D-03 | -3.382 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| | | | | | | |
|---|---|---|---|---|---|---|
| .3496 | .5894D+02 | 1.770 | .6690D-06 | -6.175 | .1137D-02 | -2.944 |
| .3544 | .5124D+02 | 1.710 | .9197D-06 | -6.036 | .1392D-02 | -2.856 |
| .3592 | .4435D+02 | 1.647 | .1261D-05 | -5.899 | .1712D-02 | -2.766 |
| .3640 | .3814D+02 | 1.581 | .1726D-05 | -5.763 | .2118D-02 | -2.674 |
| .3688 | .3252D+02 | 1.512 | .2366D-05 | -5.626 | .2645D-02 | -2.578 |
| .3736 | .2737D+02 | 1.437 | .3256D-05 | -5.487 | .3345D-02 | -2.476 |
| .3784 | .2262D+02 | 1.354 | .4516D-05 | -5.345 | .4309D-02 | -2.366 |
| .3832 | .1817D+02 | 1.259 | .6351D-05 | -5.197 | .5706D-02 | -2.244 |
| .3880 | .1395D+02 | 1.145 | .9144D-05 | -5.039 | .7891D-02 | -2.103 |
| .3928 | .9835D+01 | .993 | .1375D-04 | -4.862 | .1178D-01 | -1.929 |
| .3977 | .5613D+01 | .749 | .2279D-04 | -4.642 | .2095D-01 | -1.679 |
| .4001 | .3283D+01 | .516 | .3240D-04 | -4.489 | .3380D-01 | -1.471 |
| .4025 | .0000D+00 | | .1090D-03 | -3.963 | | |

END OF PROBLEM
==========

| | | | | | | |
|---|---|---|---|---|---|---|
| .4424 | .14130+03 | 2.150 | .30450-05 | -5.516 | .12270-01 | -1.913 |
| .4486 | .11610+03 | 2.065 | .38920-05 | -5.410 | .16350-01 | -1.786 |
| .4547 | .95160+02 | 1.950 | .51030-05 | -5.292 | .23610-01 | -1.627 |
| .4609 | .57910+02 | 1.763 | .70690-05 | -5.151 | .40670-01 | -1.391 |
| .4639 | .36120+02 | 1.581 | .87760-05 | -5.057 | .65050-01 | -1.187 |
| .4670 | .00000+00 | | .15000-04 | -4.824 | | |

END OF PROBLEM
==========

```
*************************************************************
*                                                           *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                  *
*                                                           *
*ESTES GULCH, WASATCH FORMATION                             *
*                                                           *
*    MUALEM-BASED RESTRICTION, M=1-1/N                      *
*    ANALYSIS OF RETENTION DATA ONLY                        *
*    MTYPE= 3     METHOD= 2                                 *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

| NO | NAME | INITIAL VALUE | INDEX |
|---|---|---|---|
| 1 | WCR | .0800 | 0 |
| 2 | WCS | .1600 | 0 |
| 3 | ALPHA | .0500 | 1 |
| 4 | N | 2.0000 | 1 |
| 5 | M | .5000 | 0 |
| 6 | EXPO | .5000 | 0 |
| 7 | CONDS | 2.00E-06 | 0 |

OBSERVED DATA

| OBS. NO. | PRESSURE HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | 5103.600 | .1392 | 1.0000 |
| 2 | 3062.200 | .1425 | 1.0000 |
| 3 | 2041.400 | .1456 | 1.0000 |
| 4 | 1020.700 | .1494 | 1.0000 |
| 5 | 918.700 | .1499 | 1.0000 |
| 6 | 714.500 | .1505 | 1.0000 |
| 7 | 510.400 | .1515 | 1.0000 |
| 8 | 306.200 | .1529 | 1.0000 |
| 9 | 102.100 | .1548 | 1.0000 |
| 10 | .000 | .1578 | 1.0000 |

| NIT | SSQ | ALPHA | N |
|---|---|---|---|
| 0 | .03821 | .0500 | 2.0000 |
| 8 | .00002 | .0063 | 1.0803 |

CORRELATION MATRIX

| | 1 | 2 |
|---|---|---|
| 1 | 1.0000 | |
| 2 | -.9610 | 1.0000 |

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .96008671

NONLINEAR LEAST-SQUARES ANALYSIS: FINAL RESULTS

95% CONFIDENCE LIMITS

| VARIABLE | VALUE | S.E.COEFF. | T-VALUE | LOWER | UPPER |
|---|---|---|---|---|---|
| ALPHA | .00628 | .00241 | 2.60 | .0007 | .0116 |
| N | 1.08227 | .01252 | 86.42 | 1.0514 | 1.1091 |

OBSERVED AND FITTED DATA
==========

| NO | P | LOG-P | WC-OBS | WC-FIT | WC-DIF |
|---|---|---|---|---|---|
| 1 | .5104D+04 | 3.7079 | .1392 | .1405 | -.0013 |
| 2 | .3062D+04 | 3.4860 | .1425 | .1429 | -.0004 |
| 3 | .2041D+04 | 3.3099 | .1454 | .1449 | .0007 |
| 4 | .1021D+04 | 3.0099 | .1494 | .1483 | .0011 |
| 5 | .9187D+03 | 2.9632 | .1499 | .1488 | .0011 |
| 6 | .7145D+03 | 2.8540 | .1505 | .1500 | .0005 |
| 7 | .5104D+03 | 2.7079 | .1515 | .1515 | -.0000 |
| 8 | .3062D+03 | 2.4860 | .1529 | .1537 | -.0008 |
| 9 | .1021D+03 | 2.0090 | .1545 | .1572 | -.0024 |
| 10 | .1000D-04 | -5.0000 | .1576 | .1600 | -.0022 |

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES
==========

| | UNWEIGHTED | WEIGHTED |
|---|---|---|
| RETENTION DATA | .00002 | .00002 |
| COND/DIFF DATA | .00000 | .00000 |
| ALL DATA | .00002 | .00002 |

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)
==========

| WC | P | LOGP | COND | LOGK | DIF | LOGD |
|---|---|---|---|---|---|---|
| .0940 | .4283D+12 | 11.632 | .1955D-30 | -30.709 | .7451D-16 | -16.128 |
| .0960 | .8116D+11 | 10.909 | .7603D-29 | -29.119 | .4805D-15 | -15.318 |
| .0980 | .1871D+11 | 10.272 | .1920D-27 | -27.717 | .2487D-14 | -14.604 |
| .1000 | .5036D+10 | 9.702 | .3450D-26 | -26.462 | .1082D-13 | -13.966 |
| .1020 | .1536D+10 | 9.186 | .4705D-25 | -25.327 | .4093D-13 | -13.388 |
| .1040 | .5196D+09 | 8.716 | .5111D-24 | -24.291 | .1379D-12 | -12.861 |
| .1060 | .1917D+09 | 8.283 | .4557D-23 | -23.339 | .4213D-12 | -12.375 |
| .1080 | .7616D+05 | 7.882 | .3498D-22 | -22.456 | .1185D-11 | -11.926 |
| .1100 | .3225D+05 | 7.508 | .2319D-21 | -21.635 | .3105D-11 | -11.508 |
| .1120 | .1443D+08 | 7.159 | .1360D-20 | -20.866 | .7643D-11 | -11.117 |
| .1140 | .6781D+07 | 6.831 | .7169D-20 | -20.145 | .1781D-10 | -10.749 |
| .1160 | .3327D+07 | 6.522 | .3436D-19 | -19.464 | .3956D-10 | -10.403 |
| .1180 | .1696D+07 | 6.230 | .1513D-18 | -18.820 | .8413D-10 | -10.075 |
| .1200 | .8954D+06 | 5.952 | .6173D-18 | -18.210 | .1721D-09 | -9.764 |
| .1220 | .4876D+06 | 5.686 | .2352D-17 | -17.629 | .3402D-09 | -9.468 |
| .1240 | .2731D+06 | 5.436 | .8420D-17 | -17.075 | .6512D-09 | -9.186 |
| .1260 | .1569D+06 | 5.196 | .2849D-16 | -16.545 | .1211D-08 | -8.917 |
| .1280 | .9231D+05 | 4.965 | .9154D-16 | -16.038 | .2195D-08 | -8.659 |
| .1300 | .5547D+05 | 4.744 | .2805D-15 | -15.552 | .3884D-08 | -8.411 |
| .1320 | .3399D+05 | 4.531 | .8230D-15 | -15.085 | .6722D-08 | -8.172 |
| .1340 | .2120D+05 | 4.326 | .2320D-14 | -14.634 | .1141D-07 | -7.943 |
| .1360 | .1344D+05 | 4.128 | .6307D-14 | -14.200 | .1901D-07 | -7.721 |
| .1380 | .8639D+04 | 3.936 | .1658D-13 | -13.780 | .3118D-07 | -7.506 |
| .1400 | .5623D+04 | 3.750 | .4230D-13 | -13.374 | .5044D-07 | -7.297 |
| .1420 | .3696D+04 | 3.568 | .1051D-12 | -12.978 | .8066D-07 | -7.093 |
| .1440 | .2448D+04 | 3.389 | .2551D-12 | -12.593 | .1279D-06 | -6.893 |
| .1460 | .1627D+04 | 3.211 | .6080D-12 | -12.216 | .2019D-06 | -6.695 |
| .1480 | .1080D+04 | 3.033 | .1431D-11 | -11.845 | .3188D-06 | -6.496 |
| .1500 | .7105D+03 | 2.852 | .3349D-11 | -11.475 | .5077D-06 | -6.294 |

| | | | | | | |
|---|---|---|---|---|---|---|
| .152D | .4576D+03 | 2.661 | .7896D-11 | -11.103 | .8251D-06 | -6.084 |
| .154D | .2821D+03 | 2.450 | .1912D-10 | -10.718 | .1398D-05 | -5.855 |
| .156D | .1584D+03 | 2.200 | .4953D-10 | -10.305 | .2579D-05 | -5.589 |
| .158D | .6911D+02 | 1.840 | .1535D-09 | -9.814 | .5870D-05 | -5.231 |
| .159D | .3330D+02 | 1.522 | .3311D-09 | -9.480 | .1116D-04 | -4.952 |
| 160D | .0000D+00 | | .2000D-07 | -7.699 | | |

END OF PROBLEM

**********

# Calculation Cover Sheet

Contract No. 3885-02 Discipline Geohydrology Calc. No. 05-670-15 No. of Sheets 16

Project UMTRA – Grand Junction Site Appendices I, II & III & IV

Feature Disposal Cell

Item Seepage Analysis (Amendment to the calc. no. 05-670-13-00)

Sources of Data

Sources of Formulae & References

See page 1

Preliminary Calc. ☐ Final Calc. ☒ Supersedes Calc. No. ____

| Rev. No. | Revision | Calculation By | Date | Checked By | Date | Approved By | Date |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| 0 | — | James Kam | 11/18/91 | D.K. Chen | 12/16/91 | D.K. Chen | 7/8/92 |

Form 42-110

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1.0

INTRODUCTION

Under the Uranium Mill Tailings Remedial Action Plan, approximately 3 million CY of tailings and 2.5 milliion CY of Vicinity Property (VP) materials will be transported from the processing site at Grand Junction ,Colorado, to the Cheney Reservoir disposal site. Both the tailings and the VP materials will be encapsulated in a partially below-grade disposal cell, surrounded by a peripheral dike made of compacted shale and other selected fills. The compacted shale and other selected fills are obtained from excavation of the disposal cell.

Since both the tailings and the VP have a higher permeability than the foundation materials (the Wasatch Formation), there is a potential for water buildup in the cell, particularly along the interface between the foundation and the contaminated materials. Please note hereinafter, "contaminated materials" is used interchangeably with "tailings and VP materials".

A previous study was performed by MKES/SF in August 1990 to evaluate the flooding potential of the cell for transient drainage condition (ie. during drainage of construction water in the contaminated materials) based on certain sequences of contaminated material placement (Ref. 3).

Jacobs Engineering has done a similar study in June 1991 and has extended the analysis to consider also steady-state condition (Ref. 1), again assuming a certain sequence of material placement. Since then, MKES/SF has obtained more accurate information from the field regarding the disposed volumes of tailings and VP materials and more current information on the sequence of placement of these contaminated materials (as-built drawings of October 1991 ,Ref. 6). Thus, there is a need to revise the seepage analysis using this current information.

2.0

## PURPOSE

The purpose of this study is to revise the seepage studies performed earlier by MKES/SF and Jacobs Engineering to evaluate the ponding potential in the disposal cell under the following conditions:

* transient drainage without the influence of any cover flux.

* long-term, quasi-steady state infiltration/drainage with influence of cover flux.

3.0

## APPROACH

The approach of this study will be to use as much previous information as possible as it applies to the current condition. Therefore, the X - section and computer grid used here will be the same as that adopted in the previous MKES study (Ref.3). The major revisions consist of refinement of material properties based on up-to-date testings and adjustment of material placement sequence based on the current plans and specifications. A schematic sketch of a one-dimensional representation of material placement sequence is shown in Figure 1. Minor revision involves modification of the downstream sideslope of the cell to model as a seepage face rather than as a no-flow boundary.

Figure 2 (sh. 5 ) shows a plan view of the disposal cell from the as-built drawings (Ref. 6) as of Nov. 1991 indicating the X - section used in the analysis.

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Project UMTRA - Grand Junction
Feature Disposal Cell
Item Seepage Analysis

Contract No. 3885-02
Designed JTK
Checked PKK

Sheet 4
File No.
Date 11/18/91
Date 12/16

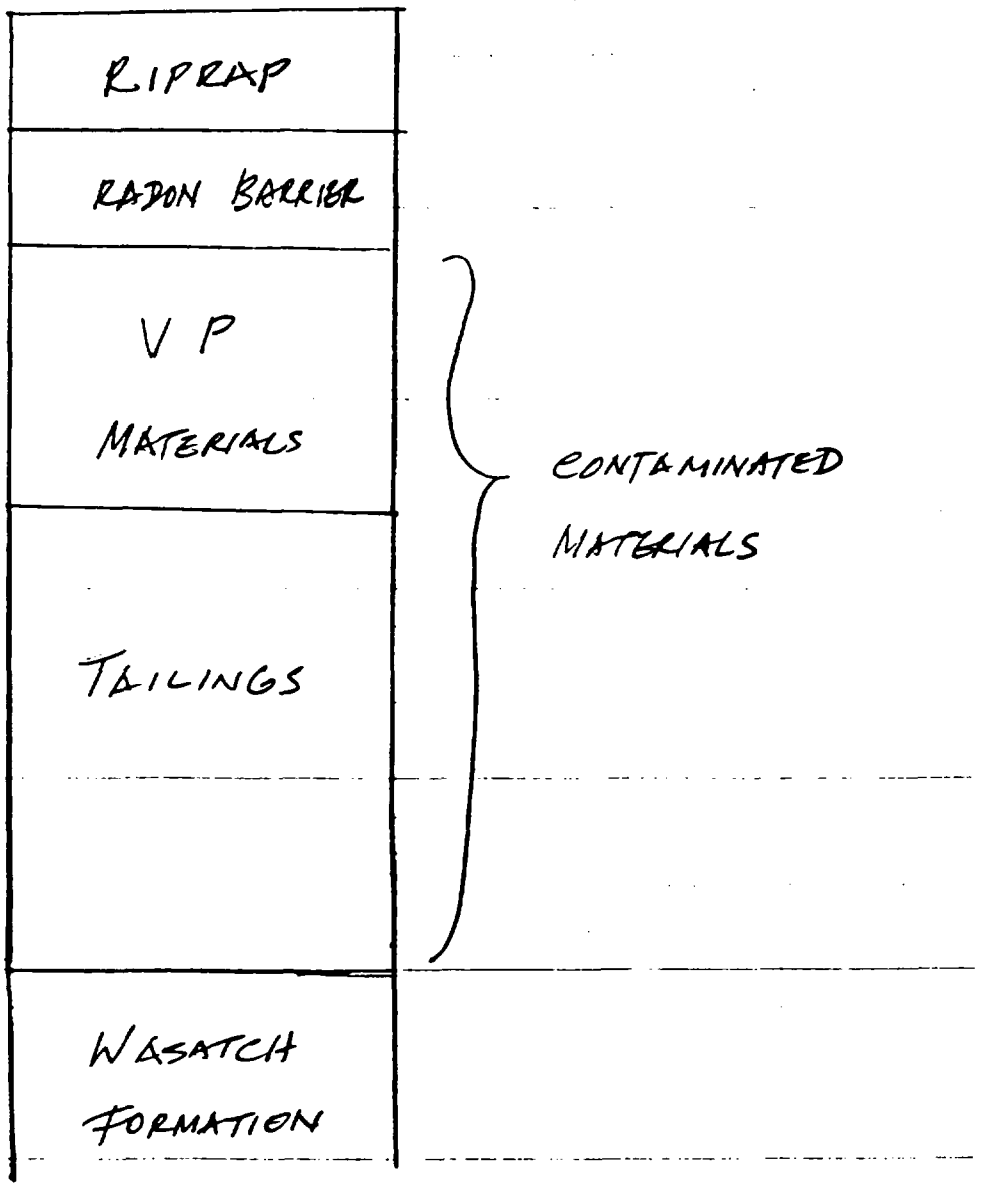



FIGURE 1. Schematic SEQUENCE OF MATERIAL PLACEMENT
(Not in scale)

UMTRA – Grand Junction
Disposal Cell
Seepage Analysis

3685-02

X-Section for
Insert
Simulation

10/25/91

Sh. 5

JTK 10/31/91
PKL 12/16/91

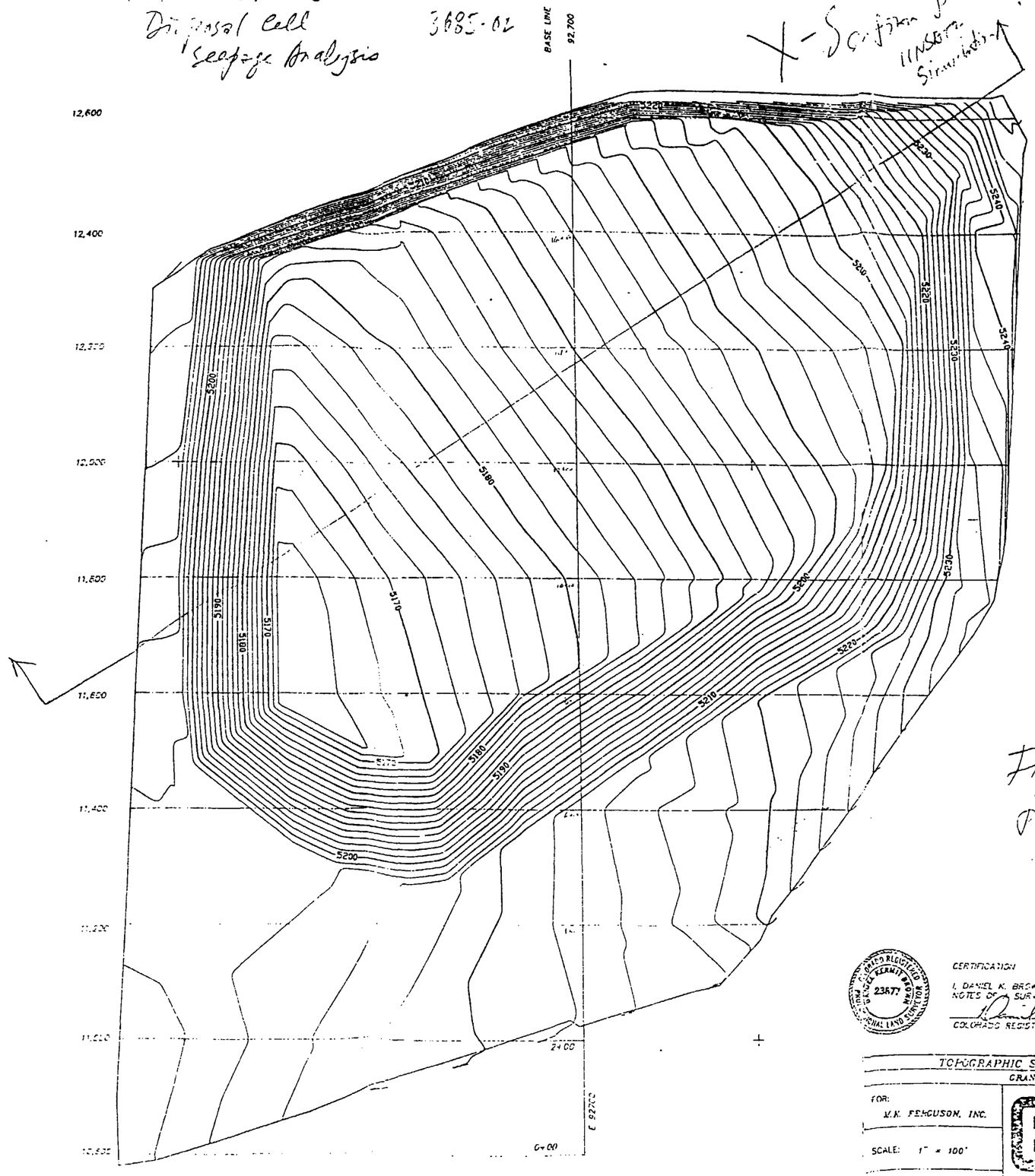



Figure 2
Plan view of
Disposal Cell

CERTIFICATION

I, DANIEL K. BROWN, CERTIFY THAT THIS PLAT IS PREPARED FROM FIELD NOTES OF A SURVEY MADE BY ME IN 1991.

10/1/91

COLORADO REGISTERED PROFESSIONAL LAND SURVEYOR LS 23877

COLORADO REGISTERED PROFESSIONAL LAND SURVEYOR 23877

TOPOGRAPHIC SURVEY OF CHENEY DISPOSAL CELL
GRAND JUNCTION UMPTRA PROJECT

| | | |
|---|---|---|
| FOR: M.K. FERGUSON, INC. | Q.E.D. SURVEYING SYSTEMS Inc. 1018 COLO. AVE. GRAND JUNCTION COLORADO 81501 (303) 241-2370 | SURVEYED BY: DKB, DMM |
| | | DRAWN BY: DKB |
| SCALE: 1" = 100' | | ACAD ID: MKCHX |
| | | SHEET NO. 1 OF 1 |

The encapsulated cell will consist of a cover made of ripraps and a radon barrier. Since these materials have no bearings on this study , they are not considered in the analysis.

The current construction plan and specification call for placing the majority of tailings at the bottom of the cell, with the VP materials on top of it. Subsequently, the cover discussed earlier will be placed above the VP.

The foundation consists of the Wasatch Formation which varies from fractured shale at the downstream end of the pile to weathered shale at the upstream end.

## 4.0 MATERIAL PROPERTIES

Average dry densities and moisture contents are estimated from laboratory test results on samples of tailings, VP and shale from the site (Ref. 8) and are included in Appendix I. Since sand tailings constitutes approximately 95 precent of the pile volume as reported in Ref. 8, properties of the sand tailings are assumed for the average tailings. The porosity and initial moisture content of the Watsatch Formation used in this study are derived from previous studies (Ref. 1 and 7).

Saturated hydraulic conductivity (K) for the sand tailings, the VP and the compacted shale are obtained from laboratory testing (Ref. 8) and are shown in Appendix I. Saturated hydraulic conductivities for the weathered and fractured Wasatch are obtained from field testings(Ref. 4) and are reported by Jacobs Engineering in Ref. 1. Accordingly, the K of the weathered and fractured Wasatch used in this study are consistent with those used in the previous analysis by Jacobs Engineering (Ref. 1).

The K values, porosity and moisture content data for all materials used in this study are listed in Table 1 on sheet 8.

Capillary moisture test results for the sand tailings, the VP, and the compacted shale are available in Ref. 8 and are presented in Appendix II. These data are used to derive the unsaturated K vs. moisture content relationship for the above-mentioned materials using the van Genuchten model in the RETC computer program. Results of the RETC runs are included in Appendix II.

TABLE 1
UMTRA - Grand Junction Site Seepage Analysis
Input Hydraulic Parameters
Design Simulation

| Materials | Saturated K (cm/sec) | | Porosity | Initial Moisture Content (%) | | | Van Genuuchen Parameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | Horiz. | Vert. | | Gravi. | Vol. | | WCR | ALPHA | N |
| 1.Tailings (sand) | 8.6e-4 | 8.6e-4 | 0.430 | 11.0 | 16.8 | * | 0.056 | 0.9996 | 1.67 |
| | | | | 14.8 | 22.4 | ** | | | |
| 2.Vicinity Property | 3.2e-5 | 3.2e-5 | 0.340 | 13.6 | 24.1 | ** | 0.194 | 0.6662 | 1.30 |
| 3.Weathered Wasatch | 4.0e-6 | 2.0e-7 | 0.235 | | 23.5 | | 0.0864 | 0.1780 | 1.33 |
| 4.Trans. Wasatch | 4.0e-5 | 2.0e-6 | 0.235 | | 23.5 | | 0.0864 | 0.1780 | 1.33 |
| 5.Fractured Wasatch | 4.0e-4 | 2.0e-5 | 0.235 | | 23.5 | | 0.0864 | 0.1780 | 1.33 |

* 90 % compaction, dry of optimum

** optimum

The capillary moisture and unsat. K vs. moisture content relationship for the Wasatch Formation are obtained from previous studies (Ref. 1 and 7) and are presented in Appendix II.

The van Genuchten parameters for all material types used in the analysis are shown in Table 1 on sheet 8.

The compacted shale is not listed in the Table because it is not used in the the model analysis for the reasons stated later on sheet 10.

## 5.0 ANALYSIS

The UNSAT2 computer program is used to simulate flow in the cell during transient state drainage of construction water trapped in the contaminated materials. As stated earlier, a 2-D finite element grid used in a previous study (Ref. 3) is adopted for this analysis and is shown in Figure 3 on sheet 13 with boundary conditions. Shown also in the same figure are approximate location of the interfaces between different material types used in the model, corresponding to the as-built drawings (Ref. 6).

For simplication of analysis, the compacted shale is excluded from the model and is assumed to be replaced by the tailings and the VP materials. This is a conservative assumption because the compacted shale, being less permeable than the tailings and the VP materials, has a tendency to restrain flow from reaching the sideslope of the cell. Hence, its replacement by the contaminated materials will favor the development of a seepage face along the downstream side of the cell. Besides, incorporating more contaminated materials into the model than in reality would induce more drainage of construction water during the transient phase.

The current specification calls for 90% compaction per ASTM D698 (Standard Proctor) for the tailings materials. The sand tailings shall be compacted on the dry side of the optimum moisture content, whereas the slime tailings shall be compacted on the wet side of the optimum moisture content. Compaction requirement for the VP materials is 95% at moisture content on the dry side of optimum.

In this study, the initial moisture content of the VP materials is assumed to be the optimum moisture content (24.1% volumetric) for all four simulation runs (see Table 2). In Runs 1, 2 and 4, the initial moisture content of tailings is taken as the average ~~in-situ~~ moisture content (16.8% volumetric) of the sand tailings in the processing site. This moisture content falls on the dry side of optimum, with achievable compaction level higher than 90%. For Run No. 3, the initial moisture content for the tailings is taken as the optimum moisture content for the sand tailings (22.4% volumetric).

All four runs are conservative with respect to the assumed initial moisture content. Table 3 lists the initial moisture assumptions for the model as compared with reality. For a total volume of 2.5 million CY of VP materials, about 32 ac-ft more construction water than reality is introduced into the VP materials in the model when its moisture content is increased from dry of optimum (about 18% volumetric) to optimum (24.1%).

A worst case scenario is represented by Run No. 3, using the optimum moisture content for the sand tailings as the initial moisture content. As reported in Ref.8, of about 3 million CY of tailings, only 5% is slimes tailings; the rest is sand tailings. Therefore, as the moisture content of slime is brought from wet of optimum to optimum, the volume of water reduced is relatively small compared with the volume of water added as the moisture content of the sand tailings is brought from dry of optimum to optimum. As shown in Table 3, as slimes tailings ~~in reality~~

is compacted to 90% wet of optimum (about 50% volumetric), the volume of water in the slimes is about 16 ac-ft; whereas sand tailings compacted to 90% dry of optimum (16.8%) contains about 100 ac-ft of water. In contrast, there is approximately 140 ac-ft of water in the 3 million CY of tailings in the model, assuming that the tailings is compacted at optimum moisture content. That is, an excess of 24 ac-ft of water in the tailings over existing condition is assumed in the model. Thus, considering the 32 ac-ft of additional water assumed in the VP materials, a total excess of 56 ac-ft of water is imposed in the model.

For Runs 1, 2 and 4 with initial moisture content of tailings at dry of optimum, there is about 10 ac-ft less water in the tailings than in the existing condition because, in reality, 0.15 million CY of slimes is compacted at wet of optimum. However, considering the 32 ac-ft of additional water assumed in the VP materials, there is a net excess of 22 ac-ft of water in the model compared with the existing condition. Thus, these runs are still conservative.

The foundation is composed of the Wasatch Formation, varying from weathered to fractured shale. The capillary suction and unsaturated properties of the Wasatch are assumed the same as those of the Weathered Wasatch used in the UMTRA - Rifle Site Seepage study (Ref.3 and 7). Saturated K of the weathered and the fractured Wasatch in this study are derived from References 1 and 4. A transitional Wasatch between the Weathered and the Fractured Shale is assumed to have a permeability average of those of the Weathered and the Fractured Wasatch.

YMPRA - GRJ Seepage Analysis 3885-02

Sh. 13

Upper boundary
transient state: No-flow boundary

No-flow boundary

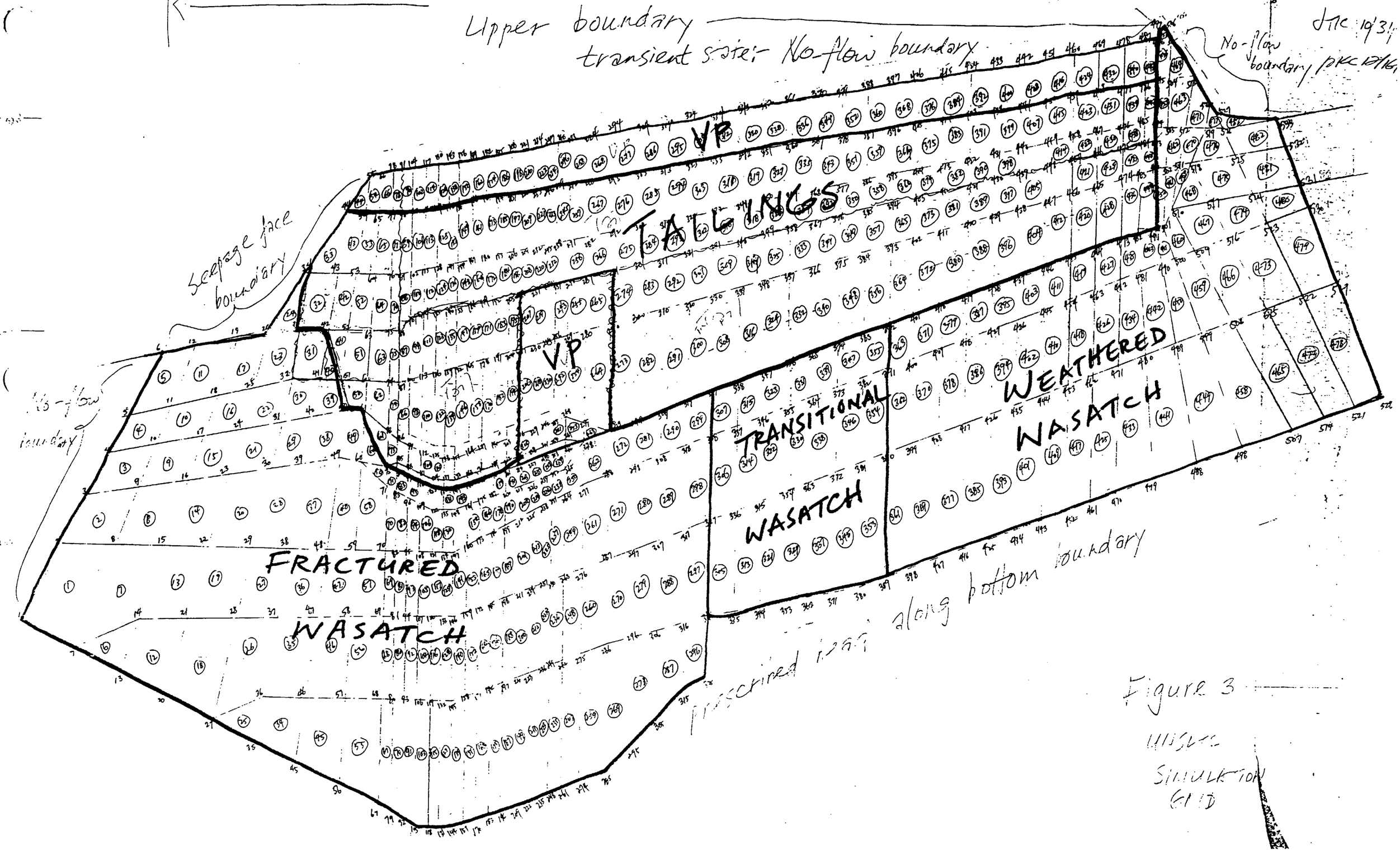



Figure 3

WINSLOW SIMULATION GRID

## 6.0 RESULTS / CONCLUSIONS

### A. Transient State

Table 2 lists the computer runs conducted in this study. The printout of the runs are included in Appendix III. Run No. 1 represents the design case simulation showing no saturation of contaminated materials anywhere during the 20 years of simulation. In this run, the 90% compaction (dry of optimum) and optimum moisture contents are used as initial moisture contents of the tailings and the VP materials, respectively.

Runs 2 through 4 are sensitivity runs with increase in initial moisture content of tailings to optimum (No.3); increase in bottom boundary suction (No.2); and decrease in the Fractured Wasatch permeability (No.4). All shows no flooding in the cell except No.3 which indicates a head buildup of about zero to five feet at the interface between the VP materials and the foundation. However, this will not cause any adverse effects on the cell performance.

### B. Long-term or quasi-steady state

The long-term performance of the cell is evaluated by comparing the design cover flux (1.0e-7 cm/sec) with the saturated permeability of the Wasatch. Since the Wasatch permeability is, in general, at least 1 or 2 orders of magnitudes higher than the cover flux, it can be concluded that long-term flooding in the cell is not expected to occur.

TABLE 2. LIST OF COMPUTER RUNS

UMTRA - GRJ

Seepage Analysis

| Run No. | Run I.D. | Contaminated Materials | | Wasatch K | Bottom B.C. | Cover flux |
|---|---|---|---|---|---|---|
| | | Initial moisture content (Vol.) | | | Prescribed suction (ft) | |
| | | Tailings | VP | | | |
| 1 | GRJPRO3 | 16.8 | 24.2 | * | -0.05 | No |
| 2 | GRJPRO4 | 16.8 | 24.2 | * | -50.0 | No |
| 3 | GRJPRO5 | 22.4 | 24.2 | * | -0.05 | No |
| 4 | GRJPRO6 | 16.8 | 24.2 | ** | -0.05 | No |

* same as in TABLE 1.

** same as in TABLE 1 except K for Fractured Wasatch

K (Horizontal) = 4.0e-5 cm/sec
K (Vertical) = 2.0e-6 cm/sec

## TABLE 3 INITIAL MOISTURE CONTENT ASSUMPTIONS

| Run No. | Run I.D. | Contaminated Materials | Approx. Volume (million c.y.) | Initial Moisture Content (Vol.) | | Volume of Water (Ac-ft) | | Total Vol. of Water (Ac-ft) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Model | Reality | Model | Reality | Model | Reality |
| 1 | GRJPRO3 | Sand Tailings | 2.85 | 16.8% | 16.8% | 104.1 | 98.9 | | |
| | | Slime Tailings | 0.15 | | 50.0% | | 15.5 | 228.6 | 207.4 |
| | | VP | 2.5 | 24.1% | 18.0% | 124.5 | 93.0 | | |
| 2 | GRJPRO4 | Sand Tailings | 2.85 | 16.8% | 16.8% | 104.1 | 98.9 | | |
| | | Slime Tailings | 0.15 | | 50.0% | | 15.5 | 228.6 | 207.4 |
| | | VP | 2.5 | 24.1% | 18.0% | 124.5 | 93.0 | | |
| 3 | GRJPRO5 | Sand Tailings | 2.85 | 22.4% | 16.8% | 138.8 | 98.9 | | |
| | | Slime Tailings | 0.15 | | 50.0% | | 15.5 | 263.3 | 207.4 |
| | | VP | 2.5 | 24.1% | 18.0% | 124.5 | 93.0 | | |
| 4 | GRJPRO6 | Sand Tailings | 2.85 | 16.8% | 16.8% | 104.1 | 98.9 | | |
| | | Slime Tailings | 0.15 | | 50.0% | | 15.5 | 228.6 | 207.4 |
| | | VP | 2.5 | 24.1% | 18.0% | 124.5 | 93.0 | | |

URANIUM STORAGE FACILITY
D-3 POS 2/Cell
Seepage Analysis

3885-02
OTE 11/18/91
PKE 10/16/91

Results/Conclusions (continued)

c. An assessment of the effect of the existence of a paleochannel in the vicinity of the disposal cell on the cell is presented in Appendix IV. The results of the assessment indicate that the disposal cell will perform satisfactorily as expected with insignificant impact from the paleochannel.

# APPENDIX I

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet A 0

Project UMTRA-GRJ | Contract No. 3885-34 | File No.
Feature Embankment Design | Designed LL | Date 11/05/91
Item Infiltration Study | Checked PYL | Date 11/5/91

# REFERENCES


1. UMTRA-GRJ, "Material Properties," MKE CALCULATION No. 05-670-05-04

2. UMTRA-GRJ, "Infiltration Study," MKE CALCULATION No. 05-670-13-00

3. UMTRA-GRJ, "CHENEY Disposal Site, Transient Drainage," Jacobs Engineering Group, Calculation No. GRJ-01-98-02-03-00

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet A 1

Project UMTRA - GJT | Contract No 3885-34 | File No
Feature Embankment Design | Designed HL | Date 11/04/91
Item Infiltration Study | Checked PYL | Date 11/ '91

# MATERIAL PROPERTIES FOR INFILTRATION STUDY

The following materials are included in the model:

- VP Material
- SAND Tailings
- MANCOS SHALE (In-Situ)
- COMPACTED MANCOS SHALE (Clean-Fill below grade)
- MINUS 1" Material (Clean-Fill above grade)
- ALLUVIUM (In-Situ)

The following tables are presented:

- TABLE 1: Summary of Max. dry density, optimum moisture content, In-place density and Moisture Content
- TABLE 2: Summary Of Input Hydraulic Parameters for UNSAT 2 analysis
- TABLE 3: Material Properties Initial Conditions

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet A 2

Project UMTRA - GRJ
Feature Embankment Design
Item Infiltration Study

Contract No. 3385-34
Designed HL
Checked PYL

File No.
Date 11/04/91
Date 11/5/91

TABLE 1

SUMMARY OF MAXIMUM DRY DENSITY, OPTIMUM MOISTURE CONTENT, IN-PLACE DENSITY AND MOISTURE CONTENT (Reference 1, Sheet O)

| MATERIAL | COMPACTION MAX DRY DENSITY (PCF) | WOPT (GRAVIMETRIC, %) | IN-PLACE DRY DENSITY (PCF) | IN-PLACE W.C.** (VOL, %) | R.C. |
|---|---|---|---|---|---|
| VP | 116.1 | 13.6 | 110.3 | 21.2 | 95 |
| SAND | 106.7 | 14.8 | 96 | 16.9 | 90 |
| MANCOS SHALE (IN-SITU) | NA | NA | * | * | NA |
| COMPACTED SHALE | 109.6 | 17.4 | 104.1 | 29.0 | 95 |
| -1" MATERIAL | 120.0 | 13.1 | 114.0 | 23.9 | 95 |
| ALLUVIUM | NA | NA | * | * | NA |

NOTES

R.C. = Relative Compaction, using ASTM D-698.

* - Used Data from TAC and presented in the following page.

NA = Not Applicable

** - WATER CONTENT AS INITIAL VOLUMETRIC MOISTURE CONTENT

TABLE 2

SUMMARY

UMTRA - GRAND JUNCTION INFILTRATION STUDY

INPUT HYDRAULIC PARAMETERS

| Material | Saturated K (cm/sec) | Porosity | Initial Volumetric Moisture Content (%) | Van Genuchten Parameters | | |
|---|---|---|---|---|---|---|
| | | | | WCR | ALPHA | N |
| Vicinity Property | 3.2E-05 | 0.34 | 21.2 | (a) 0.1939 | 0.6662 | 1.3005 |
| Sand Tailings | 8.6E-04 | 0.43 | 16.9 | (b) 0.0561 | 0.9996 | 1.6689 |
| Mancos Shale (In-Situ) | Vertical: 2.0E-08<br>Horizontal: 4.0E-07 | 0.16 | 14.8 | (c) 0.0800 | 0.1915 | 1.0803 |
| Compacted Mancos Shale | 1.0E-06 | 0.39 | 29.0 | (d) 0.0003 | 0.0842 | 1.0450 |
| Minus 1" Material | 7.2E-07 | 0.30 | 23.9 | (e) 0.1911 | 0.3254 | 1.5639 |
| Alluvium (In-Situ) | 1.0E-04 | 0.36 | 17.0 | (f) 0.1374 | 0.1394 | 1.4806 |

NOTES (a) - From Sheet 8
(b) - From Sheet 14
(c) - From Sheet 19
(d) - From Sheet 25
(e) - From Sheet 31
(f) - From Sheet 36

GRUTLAK - GRJT
3885-34
Infiltration Study
EF 1/01
PYL 11/5/91

Sh. A3

TABLE 3

UMTRA - GRAND JUNCTION INFILTRATION STUDY

MATERIAL PROPERTIES - INITIAL CONDITIONS

1. Material Interfaces - Initial Conditions

| Material Interfaces | Average Head (ft) |
|---|---|
| VP-SAND | 763 |
| VP-COMPACTED SHALE | 4219 |
| VP-MINUS 1" | 766 |
| SAND-SHALE | 21 |
| SAND-COMPACTED SHALE | 3462 |
| SAND-ALLUVIUM | 211 |
| SAND-MINUS 1" | 9 |
| SHALE-COMPACTED SHALE | 3477 |
| SHALE-ALLUVIUM | 226 |
| ALLUVIUM-MINUS 1" | 214 |
| ALLUVIUM-COMPACTED SHALE | 3667 |
| MINUS 1"-COMPACTED SHALE | 3465 |
| SAND-VP-MINUS 1" | 513 |
| SAND-VP-COMPACTED SHALE | 2815 |
| SAND-SHALE-ALLUVIUM | 152 |
| SAND-ALLUVIUM-COMPACTED SHALE | 2447 |
| SAND-SHALE-COMPACTED SHALE | 2320 |
| SHALE-COMPACTED SHALE-ALLUVIUM | 2456 |
| ALLUVIUM-COMPACTED SHALE-MINUS 1" | 2449 |
| VP-COMPACTED SHALE-MINUS 1" | 2817 |
| VP-SAND-COMPACTED SHALE-MINUS 1" | 2114 |

Sh. A4
UMTRA - GJOT
3885-34
Infiltration Study
HL 11/04/91
PYL 11/4/91

TABLE 3 (CONT'D)

2. Hydraulic Conductivities At Initial Moisture Content

| Material | Initial Volumetric Moisture Content (%) | Hydraulic Conductivities, K (ft/sec) | Hydraulic Conductivities, K (ft/day) |
|---|---|---|---|
| VP | 21.2 | 3.02E-16 | 2.61E-11 |
| SAND | 16.9 | 6.29E-9 | 5.40E-04 |
| MANCOS SHALE | 14.8 | Vertical: 4.69E-14 | Vertical: 4.40E-09 |
| COMPACTED SHALE | 29 | 1.6E-16 | 1.37E-11 |
| MINUS 1" | 23.9 | 3.19E-11 | 2.76E-06 |
| ALLUVIUM | 17.0 | 1.03E-12 | 8.90E-08 |

Sh. #5

Contract - GPT
38RS-34
Infil. Estimation
FK 11/04/91
PYL 11/4/91

APPENDIX I

## SUMMARY OF MATERIAL PROPERTIES

Reference: 1 and 2 (Sheet 0)

MATERIAL : Vicinity Property Material

SATURATED K: $3.2 \times 10^{-5}$ cm/sec = $9.1 \times 10^{-2}$ ft/day

POROSITY : 34 %

INITIAL VOL. MOISTURE CONTENT : 21.2 %*

HEAD: 1520 feet

M.C. vs Kr & HEAD PER KETC:

| VOLUMETRIC MOISTURE CONTENT, % | SUCTION HEAD, ft | Kr |
|---|---|---|
| 19.5 | 3.24E+07 | 3.53E 2 |
| 19.8 | 3.22E+05 | 1.15E-16 |
| 21.2 | 1.52E+03 | 2.88E-10 |
| 22.7 | 2.15E+02 | 6.26E-08 |
| 24.1 | 6.28E+01 | 1.82E-06 |
| 25.6 | 2.53E+01 | 2.16E-05 |
| 26.7 | 1.45E+01 | 9.74E-05 |
| 28.5 | 6.44 | 8.03E-04 |
| 29.6 | 4.09 | 2.44E-03 |
| 30.7 | 2.57 | 6.97E-03 |
| 31.8 | 1.53 | 1.97E-02 |
| 32.5 | 0.98 | 4.07E-02 |
| 34.0 | 0 | 1.00 |

Number of data pairs = 13

NOTE:

* ASSUMED VALUE

Project Grand Junction
Feature Disposal cell
Item VP material properties for UNSATH

Contract No. 385-34
Designed ACC
Checked H.L.

File No.
Date
Date 7/17

From Ref. 2

Pressure Head vs. Moisture Content

7A & 7B

Based on DBS/A data for VP material (see sheets ~~6 & 7~~)

| Pressure head (cm $H_2O$) | Average Moisture Content (% Vol) | | Moisture Content (% vol) | |
|---|---|---|---|---|
| 0 | ~~38.71~~ 39.01 | Adjust for $\gamma_d$ = 95% $\gamma_{max}$ by ratio of porosities (ie ~~32.88~~ / ~~33.71~~ 39.01) | ~~32.88~~ | 39.01 |
| 102.2 | 34.51 | | ~~29.31~~ | 29.09 |
| 305.9 | 31.66 | | ~~26.89~~ | 26.68 |
| 1019.8 | 28.52 | | ~~24.22~~ | 24.04 |
| 3059.4 | 27.29 | | ~~23.18~~ | 23.00 |
| 7138.6 | 25.86 | | ~~21.97~~ | 21.80 |
| 15399.0 | 25.11 | | ~~21.33~~ | 21.16 |

SUPERSEDED

Adjust for $\gamma_d$ = 95% $\gamma_d$ by ratio of porosities

$\frac{34}{39.01}$

use this as "observed data" for RETC

⇓ moisture content (% vol)

34
30.08
27.59
24.86
23.79
22.54
21.89

HL 11/04/91
PYL 11/4/91

Sh. 34 A8

From Ref. 2

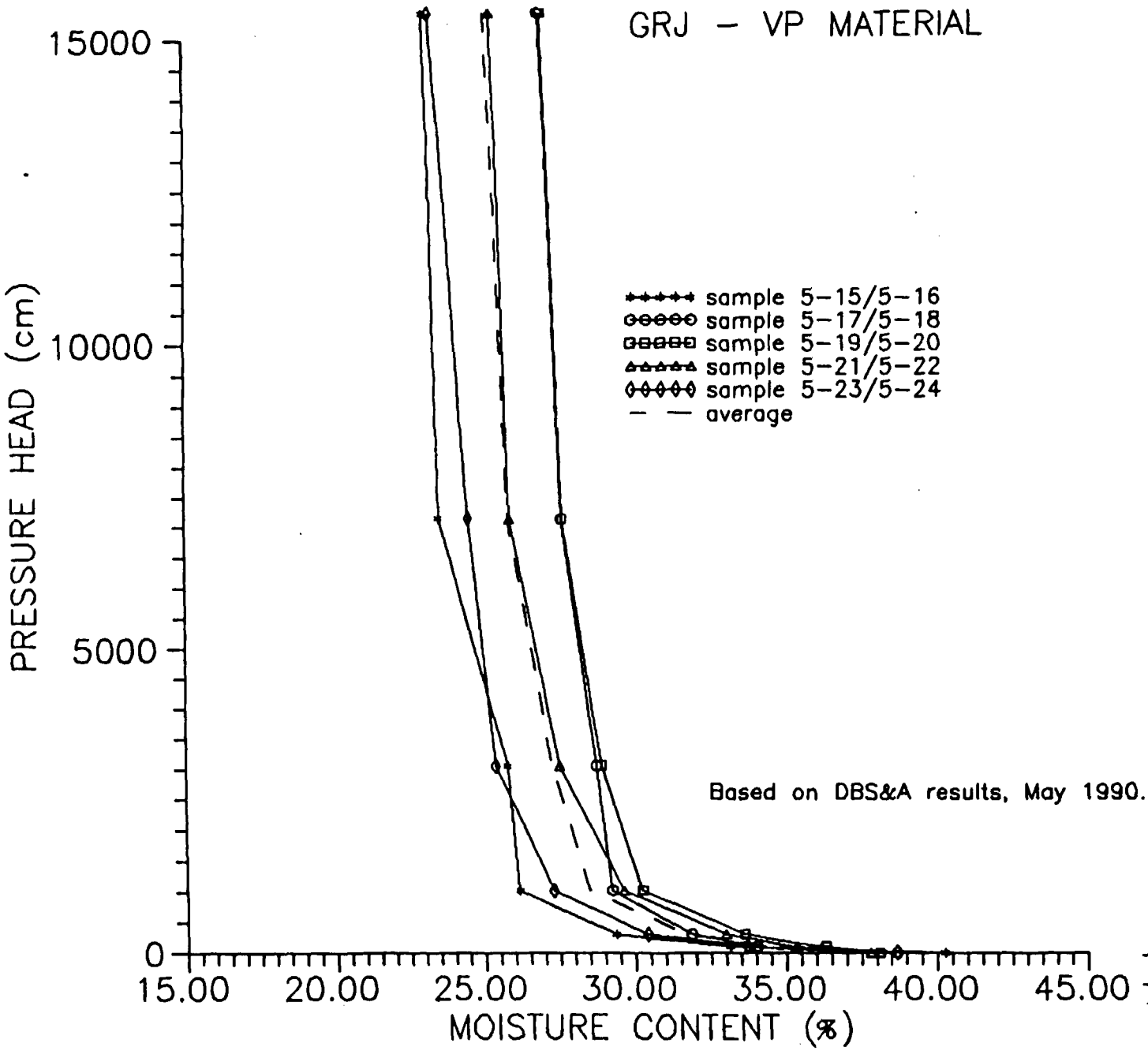
UMTRA-G.
3885-34
Infiltration
Study
HL 11/05/91
PYL 11/5/91

ACC
28-Jun 1990
FILE= GRJVP.WK1

GRAND JUNCTION
VICINITY PROPERTIES - BASED ON 10 SAMPLES
SOURCE OF DATA: DANIEL B. STEPHENS & ASSOCIATES, INC., MAY 1990, LABORATORY ANALYSIS OF SOIL HYDRAULIC PROPERTIES OF THE MAIN GRJ TAILINGS AND VICINTIY PROPERTY MATERIALS, DELIVERY ORDER 005 (Table 6)

VOLUMETRIC MOISTURE CONTENT (%) AT INDICATED PRESSURE HEAD (cm H2O)

| SAMPLE NUMBER | 0.0 | 102.2 | 305.9 | 1019.8 | 3059.4 | 7138.6 | 15399.0 |
|---|---|---|---|---|---|---|---|
| 5-15 | 40.69 | 33.11 | 29.70 | 26.71 | 26.09 | 23.80 | 23.25 |
| 5-16 | 39.78 | 33.16 | 29.04 | 25.60 | 25.50 | 23.25 | 22.85 |
| AVERAGE | 40.24 | 33.14 | 29.37 | 26.16 | 25.80 | 23.53 | 23.05 |
| 5-17 | 37.53 | 33.79 | 31.82 | 29.36 | 29.17 | 27.96 | 28.00 |
| 5-18 | 39.84 | 34.27 | 31.93 | 29.16 | 28.39 | 27.35 | 25.85 |
| AVERAGE | 38.69 | 34.03 | 31.88 | 29.26 | 28.78 | 27.66 | 26.93 |
| 5-19 | 39.85 | 36.29 | 33.62 | 30.22 | 29.38 | 28.46 | 27.53 |
| 5-20 | 39.41 | 36.36 | 33.67 | 30.29 | 28.47 | 26.90 | 26.50 |
| AVERAGE | ~~38.11~~ 39.63 | 36.33 | 33.65 | 30.26 | 28.93 | 27.68 | 27.02 |
| 5-21 | 36.72 | 35.57 | 33.26 | 29.91 | 26.67 | 25.14 | 25.05 |
| 5-22 | 38.92 | 35.11 | 32.76 | 29.36 | 28.40 | 26.67 | 25.57 |
| AVERAGE | 37.82 | 35.34 | 33.01 | 29.64 | 27.54 | 25.91 | 25.31 |
| 5-23 | 39.69 | 34.01 | 30.38 | 27.05 | 25.37 | 24.50 | 23.12 |
| 5-24 | 37.69 | 33.41 | 30.45 | 27.55 | 25.43 | 24.57 | 23.33 |
| AVERAGE | 38.69 | 33.71 | 30.42 | 27.30 | 25.40 | 24.54 | 23.23 |
| AVERAGE | ~~38.77~~ 39.01 | 34.51 | 31.66 | 28.52 | 27.29 | 25.86 | 25.11 |




Attm Ref. 2

Page 19

UNITRA-GRJ
Z 835-34
HT 11/05-11
PYC 11/5/91

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: JMTRA - GRJ
Feature: EMBANKMENT DESIGN
Item: INFILTRATION

Contract No.: [illegible]
Designed: HL
Checked: PYL

Sheet # 10
File No.
Date: 9/19/91
Date: 10/31/91

REFERENCE: 1 and 2 (sheet 0)

MATERIAL: Sand Tailings

SATURATED K: $8.6 \times 10^{-4}$ cm/sec = 2.4 ft/day

POROSITY: 43 %

INITIAL VOL. MOISTURE CONTENT: 16.9 %* HEAD: 5.9 feet

M.C. vs $K_r$ and HEAD PER RETC

| Volumetric Moisture Content, % | Suction Head, feet | $K_r$ |
|---|---|---|
| 5.8 | 1974 | 1.27E-13 |
| 7.5 | 88.1 | 1.16E-08 |
| 9.4 | 31.2 | 5.21E-07 |
| 13.1 | 10.9 | 2.36E-05 |
| 16.8 | 5.9 | 2.23E-4 |
| 20.6 | 3.7 | 1.11E-3 |
| 24.3 | 2.5 | 4.01E-03 |
| 28.1 | 1.8 | 1.18E-02 |
| 34.6 | 0.9 | 5.98E-02 |
| 38.3 | 0.6 | 0.1472 |
| 41.1 | 0.3 | 0.3192 |
| 43.0 | 0.0 | 1.0 |

Number of data pairs = 12

NOTE: assumed initial moisture content for sand = in-situ moisture content (11% gravimetric)
$\gamma_d$ @ 11% moisture content ≥ 90% $\gamma_d$ max

Project [illegible]
Feature Disposal Cell
Item Tailings Properties for UNSAT2 input

Contract No. [illegible] File No.
Designed ACC Date 6/7/9[illegible]
Checked H. L. Date 7/13/[illegible]

From: REF. 2

## Pressure head vs. Moisture Content

Based on DBS/A's results for samples with less than 12% passing 200 sieve (see sheets ~~7/11~~ 13A/13B)

| Pressure head (cm $H_2O$) | Average Volumetric Moisture content (%) | Sample 7/8 Volumetric Moisture Content (%) |
|---|---|---|
| 0 | 49.73 | 45.72 |
| 112.2 | 20.37 | 22.16 |
| 305.9 | 13.28 | 13.58 |
| 1019.8 | 10.74 | 10.52 |
| 3059.4 | 8.20 | 7.95 |
| 7138.6 | 7.34 | 7.26 |
| 15399.0 | 6.27 | 5.98 |

∴ for UNSAT2 runs, use pressure head vs. moisture content based on sample 7/8.

6/28/90 However, need to adjust volumetric moisture contents to be consistent with $\gamma_d$ - 90% $\gamma_{dmax}$ & recomputed porosity (see sheet 17).

∴ for UNSAT2 (as "observed data" for RETC), adjust by porosity (= ~~41.52/45~~ = 43/45.=

| Pressure Head (cm $H_2O$) | M.C. (% vol) | Adjusted M.C. (% vol) |
|---|---|---|
| 0 | 45.72 | ~~41.52~~ 43 |
| 112.2 | 22.16 | HL 11/4/91 ~~20.12~~ 20.84 |
| 305.9 | 13.58 | PYL 11/4/91 ~~12.33~~ 12.77 |
| 1019.8 | 10.52 | ~~9.55~~ 9.89 |
| 3059.4 | 7.95 | ~~7.22~~ 7.48 |
| 7138.6 | 7.26 | ~~6.59~~ 6.83 |
| 15399.0 | 5.98 | ~~5.43~~ 5.62 |

Sh. ~~B~~ A12

From Rep. 2

UMTRA-GRJ
3885-36
Infiltration
Study
HL 11/5/91
PYL 11/5/91

ACC
07-Jun 1990

GRAND JUNCTION FILE = GRJTAIL6.WK1

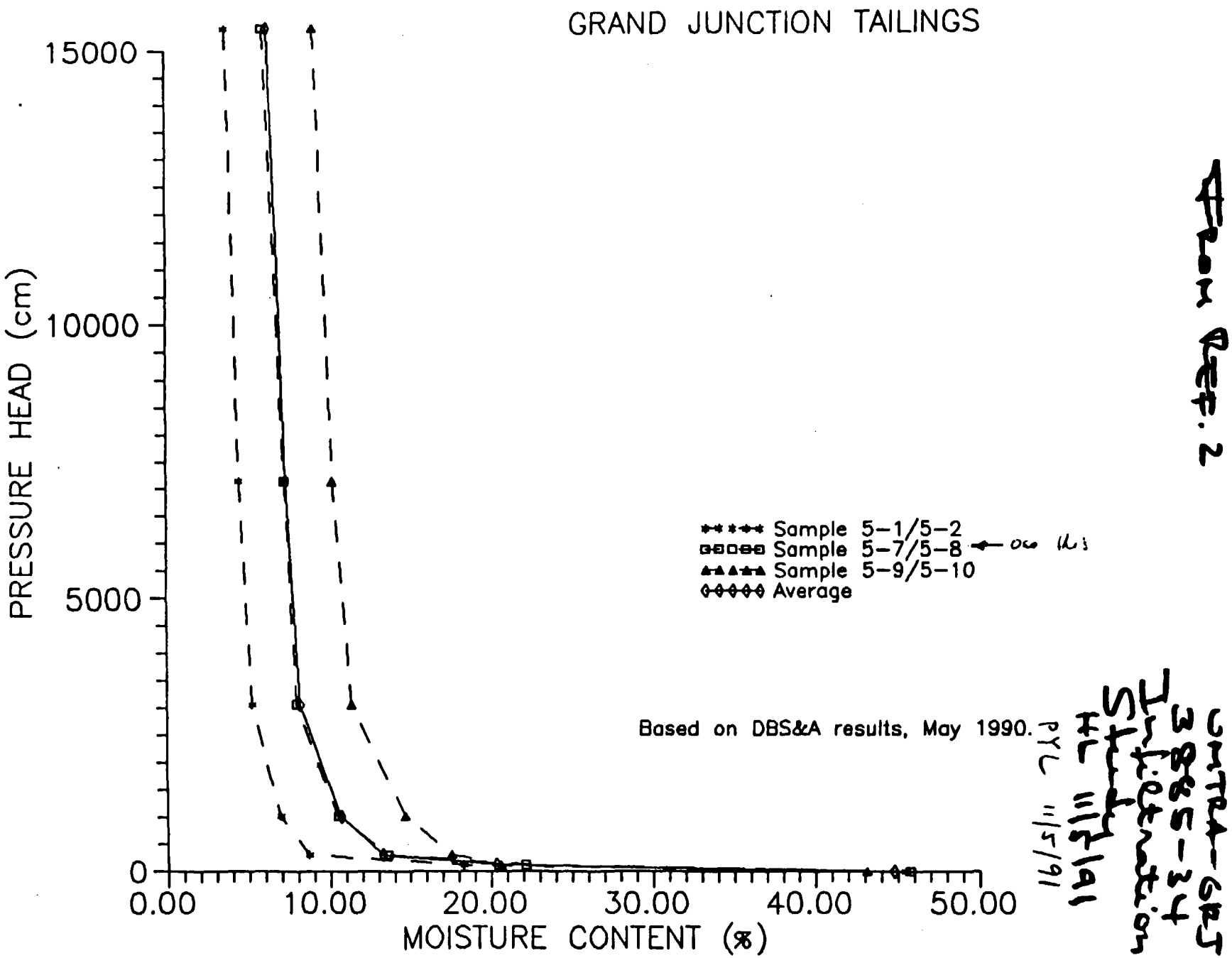
TAILINGS PROPERTIES - BASED ON 6 SAMPLES (PASSING 200 SIEVE < 12%)

SOURCE OF DATA: DANIEL B. STEPHENS & ASSOCIATES, INC., MAY 1990, LABORATORY ANALYSIS OF SOIL HYDRAULIC PROPERTIES OF THE MAIN GRJ TAILINGS AND VICINTIY PROPERTY MATERIALS, DELIVERY ORDER 005 (Table 6)

VOLUMETRIC MOISTURE CONTENT (%) AT INDICATED PRESSURE HEAD (cm H20)

| SAMPLE NUMBER | 0.0 | 112.2 | 305.9 | 1019.8 | 3059.4 | 7138.6 | 15399.0 | |
|---|---|---|---|---|---|---|---|---|
| 5-1 | 45.66 | 16.49 | **1.98 | 6.89 | 5.19 | 4.38 | 3.77 | |
| 5-2 | 45.17 | 20.15 | 8.70 | 7.04 | 5.30 | 4.60 | 3.66 | |
| AVERAGE | 45.42 | 18.32 | 8.70 | 6.97 | 5.25 | 4.49 | 3.72 | |
| 5-7 | 45.06 | 19.37 | 13.09 | 10.06 | 7.57 | 6.87 | 6.00 | |
| 5-8 | 46.37 | 24.94 | 14.06 | 10.98 | 8.33 | 7.64 | 5.95 | |
| AVERAGE | 45.72 | 22.16 | 13.58 | 10.52 | 7.95 | 7.26 | 5.98 | ← Use this |
| 5-9 | 42.21 | 20.98 | 17.69 | 14.98 | 11.48 | 10.25 | 9.31 | |
| 5-10 | 43.90 | 20.28 | 17.45 | 14.49 | 11.33 | 10.27 | 8.93 | |
| AVERAGE | 43.06 | 20.63 | 17.57 | 14.74 | 11.41 | 10.26 | 9.12 | |
| AVERAGE | 44.73 | 20.37 | 13.28 | 10.74 | 8.20 | 7.34 | 6.27 | |

** Measurement error, not used.




FROM REF. 2

Sh. 13 A/13

CONTRA-GRJ
3 BBS-34
Liquefaction
Study
FF 11/27/91
PYC 11/5/91

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: UMTRA - GRJ
Feature: Embankment Design
Item: Infiltration

Contract No.: 525-34
Designed: HL
Checked: PYL

Sheet: H14
File No.:
Date: 9/19/91
Date: 11/5/91

REFERENCE: 3 (Sheet 0), copies ATTACHED
MATERIAL: Mancos Shale (In-Situ)

SATURATED K: VERTICAL 5.67E-05 ft/day; HORIZONTAL 1.13E-03 ft/day

POROSITY: 16%

INITIAL VOL. MOISTURE CONTENT: 14.8%  HEAD: 35.4 feet

M.C. vs $K_r$ & HEAD PER RETC:

| VOLUMETRIC MOISTURE CONTENT, % | SUCTION HEAD, feet | $K_r$ |
|---|---|---|
| 9.4 | 1.4E+10 | 9.77E-24 |
| 10.2 | 5.0E+07 | 2.35E-18 |
| 11.0 | 1.1E+06 | 1.16E-14 |
| 12.0 | 29370 | 3.08E-11 |
| 12.8 | 3028 | 4.58E-09 |
| 13.6 | 440.8 | 3.15E-07 |
| 14.2 | 121.2 | 5.25E-06 |
| 14.8 | 35.4 | 7.15E-05 |
| 15.2 | 15.0 | 3.95E-04 |
| 15.8 | 2.3 | 7.68E-03 |
| 16.0 | 0.0 | 1.00E+00 |

Number of data pairs: 11

Sh. A15

from Ref. 3

UMTRA-GRT
3 SHT-34
Infiltration

Table 4

| Material | Theta(wt) | Gamma, lb/ft$^3$ | Theta(vol) | Pressure, meters | K(sat), m/day |
|---|---|---|---|---|---|
| Tailings | 0.180 | 110.0 | 0.320 | -2.50 | 4.84E-02 |
| Alluvium | 0.140 | 103.6 | 0.240 | -10.00 | 8.64E-02 |
| Mancos | 0.060 | 154.2 | 0.148 | -10.20 | $K_v$ 1.73E-04<br>$K_h$ 3.46E-03 |

PYL 11/5/

Case 1 (deep excavation)

A plot of water level as a function of time at node no. 473, which is the low point of the cross-section, is presented on Figure 5. The maximum water level above the Mancos/tailings interface is 0.53 meter (1.74 feet) and occurs after 3.5 years of simulation. Based on the curve presented on Figure 5, water remains perched on the Mancos for a period of 12 years. The extent of the saturated zone as a function of time is presented on Figure 6 and 7. After a period of 5 years, the model predicts that unsaturated flow occurs in the Mancos beneath the low point of the cross-section.

## Discussion

UNSAT2

The program predicts that some water will perch on the Mancos shale. It is expected that with additional moisture coming from the above grade tailings and surface-water infiltration, the depth of perched water would be greater - although not substantially greater. There are several rationale for not expecting a significant rise in the water level above the Mancos even with cover flux and above-grade tailing's moisture included in the model:

1) Preliminary simulations of cover performance using the program UNSAT-H suggests the influx will be extremely low even without the presence of vegetation on the cover.

2) The below-grade cross-section used in the current simulation represents 65 percent of the contaminated material. The remaining 35 percent of the contaminated material at this cross-section are from vicinity properties. Based on laboratory and field tests, the vicinity properties material is dry (moisture content 12.4% by volume) and would not contribute a substantial volume of additional moisture.

Based on the results presented in Figures 6 and 7, the effect of

From Ref. 3

Dr. A16
UMTRA-GRT
3885-34
Infiltration

HL 11/5/91
PYL 11/5/91

```
*************************************************************
*                                                           *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                  *
*                                                           *
WESTES GULCH, WASATCH FORMATION                             *
*                                                           *
*    MUALEM-BASED RESTRICTION, M=1-1/N                      *
*    ANALYSIS OF RETENTION DATA ONLY                        *
*    MTYPE= 3     METHOD= 2                                 *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

| NO | NAME | INITIAL VALUE | INDEX |
|---|---|---|---|
| 1 | WCR | .0800 | 0 |
| 2 | WCS | .1600 | 0 |
| 3 | ALPHA | .0500 | 1 |
| 4 | N | 2.0000 | 1 |
| 5 | M | .5000 | 0 |
| 6 | EXPO | .5000 | 0 |
| 7 | CONDS | 2.00E-08 | 0 |

OBSERVED DATA

| OBS. NO. | PRESSURE HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | 5103.600 | .1392 | 1.0000 |
| 2 | 3062.200 | .1425 | 1.0000 |
| 3 | 2041.400 | .1456 | 1.0000 |
| 4 | 1020.700 | .1494 | 1.0000 |
| 5 | 918.700 | .1499 | 1.0000 |
| 6 | 714.500 | .1505 | 1.0000 |
| 7 | 510.400 | .1515 | 1.0000 |
| 8 | 306.200 | .1529 | 1.0000 |
| 9 | 102.100 | .1545 | 1.0000 |
| 10 | .000 | .1578 | 1.0000 |

RETC use data

| NIT | SSQ | ALPHA | N |
|---|---|---|---|
| 0 | .03821 | .0500 | 2.0000 |
| 8 | .00002 | .0063 | 1.0803 |

CORRELATION MATRIX

| | 1 | 2 |
|---|---|---|
| 1 | 1.0000 | |
| 2 | -.9610 | 1.0000 |

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .96008671

NONLINEAR LEAST-SQUARES ANALYSIS: FINAL RESULTS

95% CONFIDENCE LIMITS

**MK-ENVIRONMENTAL SERVICES**
A DIVISION OF MK-FERGUSON

Sheet A17

Project UMTRA - GRJ | Contract No. 3985-34 | File No.
Feature EMBANKMENT DESIGN | Designed HL | Date 11/01/91
Item INFILTRATION | Checked PYL | Date 11/4/91

REFERENCE : 1 and 2 (Sheet 0)
MATERIAL : Compacted Mancos Shale
SAT K : $1 \times 10^{-6}$ cm/sec = $2.8 \times 10^{-3}$ ft/day

POROSITY : 39%

INITIAL VOL. MOISTURE CONTENT : 29%  HEAD : 6918 feet

MC vs $K_r$ & HEAD Per RETC :

| VOL. MOISTURE CONTENT (%) | SUCTION HEAD (feet) | $K_r$ |
|---|---|---|
| 9.6 | 3.17E+14 | 7.98E-32 |
| 11.5 | 5.42E+12 | 4.29E-28 |
| 13.5 | 1.74E+11 | 6.11E-25 |
| 16.4 | 2.29E+9 | 5.73E-21 |
| 18.3 | 1.92E+8 | 1.08E-18 |
| 20.2 | 2.06E+7 | 1.21E-16 |
| 23.1 | 1.05E+6 | 6.51E-14 |
| 25.0 | 1.76E+5 | 2.83E-12 |
| 26.9 | 33620 | 9.28E-11 |
| 28.9 | 7208 | 2.40E-9 |
| 30.8 | 1702 | 5.04E-8 |
| 32.7 | 432.9 | 8.9E-7 |
| 34.6 | 113.5 | 1.40E-5 |
| 36.5 | 26.2 | 2.30E-4 |
| 38.5 | 0 | 1 |

Number of data points = 15

Feature Disposal Cell
Item Material Properties Summary for UNSAT2

Contract No. 1885-37 File No.
Designed ACC Date 27
Checked H.L. Date 7/9

# From Ref. 2

## Compacted Shale

- Ksat = ~~4.5~~ 2.8 x $10^{-7}$ cm/sec (vertical = horizontal)
- initial moisture content = 32.3 % volumetric
- porosity = 20.9 % gravimetric

$$= 20.9 \times \frac{32.3}{18.5} = 36.5\ \%\ \text{volumetric}$$

per H.L's calc's ~~ca~~ sh

- pressure head vs. moisture content

| Pressure Head (cm $H_2O$) | Water Content (% Vol) | | Compacted Shale Water Content (% Vol) |
|---|---|---|---|
| 5103.6 | 13.92 | | ~~31.75~~ 33.93 |
| 3062.2 | 14.25 | | ~~32.5~~ 34.73 |
| 2041.4 | 14.56 | | ~~33.22~~ 35.49 |
| 1020.7 | 14.94 | | ~~34.08~~ 36.42 |
| 918.7 | 14.99 | * ~~36~~ / 10 = | ~~34.20~~ 36.54 |
| 714.5 | 15.05 | 39 / 16 | ~~34.33~~ 36.68 |
| 510.4 | 15.15 | | ~~34.56~~ 36.93 |
| 306.2 | 15.29 | | ~~34.88~~ 37.27 |
| 102.1 | 15.48 | | ~~35.31~~ 37.73 |
| 0 | 15.78 | | ~~36.00~~ 38.46 |

HL 11/04/91
PYL 11/04/91

Marcos Shale
"observed data" per TAC report

Note: 27 June 90
checked w/ P. Sircar, ...
to adjust water contents (% vol.)
by ratio of porosities

- K vs. moisture content
  → to be developed using RETC

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: JMTRA GRJ
Feature: Embankment Design
Item: Infiltration

Contract No. 3535-34
Designed: HL
Checked: PYL

Sheet: II 1.7
File No.:
Date: 9/19/91
Date: 10/31/91

REFERENCE: 1 and 2 (Sheet 0)

Material: -1" material

Saturated k: $7.2 \times 10^{-7}$ cm/sec = $2 \times 10^{-3}$ ft/day

Porosity: 30 %

Initial Vol. Moisture Content: 23.9 %  Head: 12.2 feet

M.C. vs $K_r$ & HEAD PER RETC:

| Volumetric Moisture Content, % | Suction Head, feet | $K_r$ |
|---|---|---|
| 19.2 | 24910 | 6.11E-15 |
| 19.6 | 623.5 | 1.77E-09 |
| 20.2 | 182.2 | 1.17E-07 |
| 20.7 | 88.6 | 1.36E-06 |
| 21.3 | 52.9 | 7.77E-06 |
| 22.3 | 25.4 | 9.17E-05 |
| 23.4 | 14.8 | 5.37E-04 |
| 24.4 | 9.5 | 2.17E-03 |
| 25.5 | 6.4 | 7.03E-03 |
| 26.9 | 3.9 | 2.55E-02 |
| 27.9 | 2.5 | 6.76E-02 |
| 29.0 | 1.2 | 1.91E-0 |
| 29.8 | 0.0 | 1.00E+0 |

Number of data pairs = 13

Project Grand Junction
Feature Disposal Cell
Item Material Properties Summary for UNSAT2

Contract No. 335-34 File No.
Designed ACC Date 2/7
Checked H.L. Date 7/93

FROM REF. 2

Illinois 1" material

clean-fill for above grade

- Ksat = $4.8 \times 10^{-5}$ cm/sec (log average of HL calc's.) see sheet

- Pressure Head vs. Moisture Content: (per PS) see sheet 4 attached

| Tension (bar) | Pressure Head (cm $H_2O$) | Moisture Content (% volumetric) |
|---|---|---|
| 0.1 | 102 | 27.0 |
| 0.3 | 306 | 24.9 |
| 0.5 | 510 | 22.9 |
| 1.0 | 1020 | 21.5 |
| 2.0 | 2040 | 20.9 |
| 4.0 | 4080 | 20.4 |
| 7.0 | 7140 | (20.6) |
| 15.0 | 15300 | 19.4 |

use this for RETC

- K vs. moisture content → to be developed using RETC

- Initial Moisture Content = optimum moisture content = 24.1 % volumetric per H.L. calc see sheet

- porosity = 15.2 * $\frac{24.1}{12.3}$ = 29.8 % volumetric per H.L. calcs see sheet 5

($\theta_{sat}$)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet #21

Project UMTRA — SRJ | Contract No. 3345-34 | File No.
Feature Embankment Design | Designed HL | Date 9/19/8
Item Infiltration | Checked PYC | Date 10/3/8

Reference: 3 (Copies Attached)

Material: Alluvium

Saturated k: $1 \times 10^{-4}$ cm/sec $= 2.84 \times 10^{-1}$ ft/day

Porosity: 36%

Initial Vol. Moisture Content: 17%* Head: 415.7f

M.C. vs $K_r$ & Head for RETC:

| Volumetric Moisture Content, % | Suction Head, feet | $K_r$ |
|---|---|---|
| 13.9 | 276700 | 2.19E-16 |
| 14.3 | 15460 | 2.24E-1 |
| 16.0 | 863.4 | 2.29E-0 |
| 17.1 | 370.8 | 3.43E-0 |
| 19.9 | 103.9 | 1.96E-0 |
| 22.7 | 46.3 | 2.45E-0 |
| 23.8 | 35.6 | 5.48E-0 |
| 25.4 | 24.8 | 1.59E-0 |
| 28.2 | 14.3 | 7.31E-0 |
| 31.0 | 8.1 | 2.83E-0 |
| 33.8 | 3.8 | 1.10E-0 |
| 36.0 | 0.0 | 1.00E+0 |

Number of data pairs = 12

* ASSUMED VALUE (TAC used 24%)

From Ref. 3

Table 4

| Material | Theta(wt) | Gamma, lb/ft³ | Theta(vol) | Pressure, meters | K(sat) m/day |
|---|---|---|---|---|---|
| Tailings | 0.180 | 110.0 | 0.320 | -2.50 | 4.84E-02 |
| Alluvium | 0.140 | 103.6 | 0.240 | -10.00 | 8.64E-02 |
| Mancos | 0.060 | 154.2 | 0.148 | -10.20 | $K_v$ 1.73E-04<br>$K_h$ 3.46E-03 |

Case 1 (deep excavation)

A plot of water level as a function of time at node no. 473, which is the low point of the cross-section, is presented on Figure 5. The maximum water level above the Mancos/tailings interface is 0.53 meter (1.74 feet) and occurs after 3.5 years of simulation. Based on the curve presented on Figure 5, water remains perched on the Mancos for a period of 12 years. The extent of the saturated zone as a function of time is presented on Figure 6 and 7. After a period of 5 years, the model predicts that unsaturated flow occurs in the Mancos beneath the low point of the cross-section.

Discussion

UNSAT2

The program predicts that some water will perch on the Mancos shale. It is expected that with additional moisture coming from the above grade tailings and surface-water infiltration, the depth of perched water would be greater - although not substantially greater. There are several rationale for not expecting a significant rise in the water level above the Mancos even with cover flux and above-grade tailing's moisture included in the model:

1) Preliminary simulations of cover performance using the program UNSAT-H suggests the influx will be extremely low even without the presence of vegetation on the cover.

2) The below-grade cross-section used in the current simulation represents 65 percent of the contaminated material. The remaining 35 percent of the contaminated material at this cross-section are from vicinity properties. Based on laboratory and field tests, the vicinity properties material is dry (moisture content 12.4% by volume) and would not contribute a substantial volume of additional moisture.

Based on the results presented in Figures 6 and 7, the effect o

```
*****************************************************************
*                                                               *
*     ANALYSIS OF SOIL HYDRAULIC PROPERTIES                     *
*                                                               *
*CHENEY                  , MEDIUM COMPACTION, EMPIRICAL CORRELAT *
*                                                               *
*     MUALEM-BASED RESTRICTION, M=1-1/N                         *
*     ANALYSIS OF RETENTION DATA ONLY                           *
*     MTYPE= 3      METHOD= 2                                   *
*                                                               *
*****************************************************************
```

Guerra-Ent 3B05-34 Infiltration

HL 11/5/91

PYL 11/5/91

ALLUVIUM

INITIAL VALUES OF THE COEFFICIENTS

| NO | NAME | INITIAL VALUE | INDEX |
|---|---|---|---|
| 1 | WCR | .1700 | 1 |
| 2 | WCS | .3600 | 0 |
| 3 | ALPHA | .0200 | 1 |
| 4 | N | 2.3000 | 1 |
| 5 | M | .5652 | 0 |
| 6 | EXPO | .5000 | 0 |
| 7 | CONDS | 5.00E-05 | 0 |

OBSERVED DATA

| OBS. NO. | PRESSURE HEAD | WATER CONTENT | WEIGHTING COEFFICIENT |
|---|---|---|---|
| 1 | 15300.000 | .1624 | 1.0000 |
| 2 | 10000.000 | .1721 | 1.0000 |
| 3 | 5000.000 | .1899 | 1.0000 |
| 4 | 2000.000 | .2179 | 1.0000 |
| 5 | 1000.000 | .2432 | 1.0000 |
| 6 | 600.000 | .2644 | 1.0000 |
| 7 | 400.000 | .2830 | 1.0000 |
| 8 | 340.000 | .2909 | 1.0000 |
| 9 | 300.000 | .2971 | 1.0000 |
| 10 | 200.000 | .3179 | 1.0000 |
| 11 | 150.000 | .3323 | 1.0000 |
| 12 | 100.000 | .3474 | 1.0000 |
| 13 | 80.000 | .3516 | 1.0000 |
| 14 | 60.000 | .3540 | 1.0000 |
| 15 | 40.000 | .3549 | 1.0000 |
| 16 | 30.000 | .3551 | 1.0000 |
| 17 | 20.000 | .3551 | 1.0000 |
| 18 | 10.000 | .3551 | 1.0000 |
| 19 | 1.000 | .3551 | 1.0000 |

RETC observed data.

| NIT | SSQ | WCR | ALPHA | N |
|---|---|---|---|---|
| 0 | .10345 | .1700 | .0200 | 2.3000 |
| 8 | .00024 | .1374 | .0046 | 1.4807 |

CORRELATION MATRIX

| | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 1.0000 | | |
| 2 | -.5543 | 1.0000 | |

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

| | | | | | |
|---|---|---|---|---|---|
| Project | UMTRA – GRT | Contract No. | 88-34 | Sheet | |
| Feature | Disposal Cell | Designed | JK | File No. | |
| Item | Seepage Analysis | Checked | MK | Date | 7/29/92 |
| | | | | Date | 7/29/92 |

# APPENDIX IV

According to Ref. 9, a paleochannel exists in the vicinity of the disposal cell. A plan view of the direction of flow in the paleochannel is shown in figure D-1. Figures D-3 through D-6 are X-sections through the cell and the paleochannel with their locations shown in figure D-2. The flow gradients between X-sections C and D and between B and A are computed to be 0.033 and 0.032 (see sh. D-2), respectively.

Results of the seepage analysis (see sh. 14) indicate that a head buildup of up to 5 feet may occur around the lowest point within the disposal cell during the transient drainage in the cell. Because the lowest point in the cell is always below the paleochannel, it is unlikely that the flow in the cell will migrate to the paleochannel (see figures D-3 thru. D-6) and therefore, contamination of the paleochannel by flow from the cell seems impossible.

**MK-ENVIRONMENTAL SERVICES**
A DIVISION OF MK-FERGUSON

Sheet D-2

Project UNTRA – GRT | Contract No. 385-34 | File No.
Feature | Designed HL | Date 7/27/92
Item Paleochannel | Checked HK | Date 7/ /92

## ESTIMATED GRADIENT (see figures D3 – D6)

Between cross section C – D (Point 1 @ C, Point 1 @ D)

Distance = 800 ft
ΔElevation = 5197 – 5170 = 27 ft.

$$\text{Gradient} = \frac{27}{800} = 0.03375$$

Between cross section A – B (Point 1 @ A, Point 1 @ B)

Distance = 600 ft
ΔElevation = 5217 – 5198 = 19 ft

$$\text{Gradient} = \frac{19}{600} = 0.0317$$

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet D-3

Project UMTRA - Grand Junction Contract No. 3885-[illegible] File No.
Feature Designed LL Date 7/27/92
Item Paleochannel Checked [illegible] Date 7/29/92

## ESTIMATED SATURATED PERMEABILITY

Based on the paleochannel materials:

$$k = 3.7 \times 10^{-1} \text{ cm/sec}$$

Based on the measured steady-state flow of 0.1 gpm:

$$k = 4.7 \times 10^{-3} \text{ cm/sec}$$

REF. NORTHWEST PALEOCHANNEL RESTORATION AT CHENEY DISPOSAL EMBANKMENT, DOC # 3885-GRJ-R-01-DRAFT-00, JULY 1992.

On the other hand, the permeability of the paleochannel is estimated to be at least 2 orders of magnitude higher than that of the Mancos shale (see sh. D-3 and sh. 8). Therefore, relatively insignificant flow from the paleochannel into the shale will occur.

In conclusion, it is unlikely that there will be any hydraulic connection between the disposal cell and the paleochannel and that a minimal or no impact of the existence of the paleochannel on the cell performance will be expected.

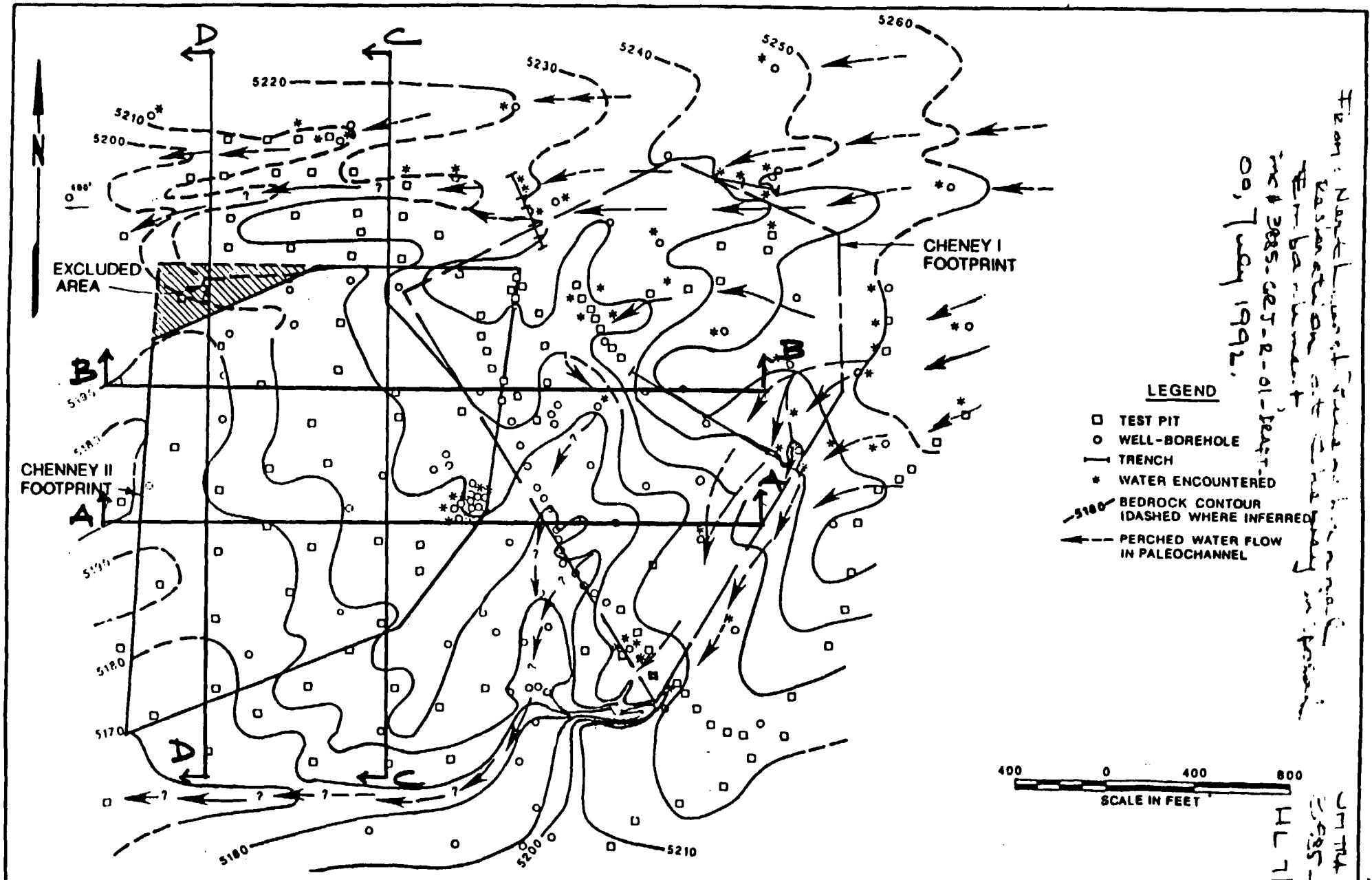
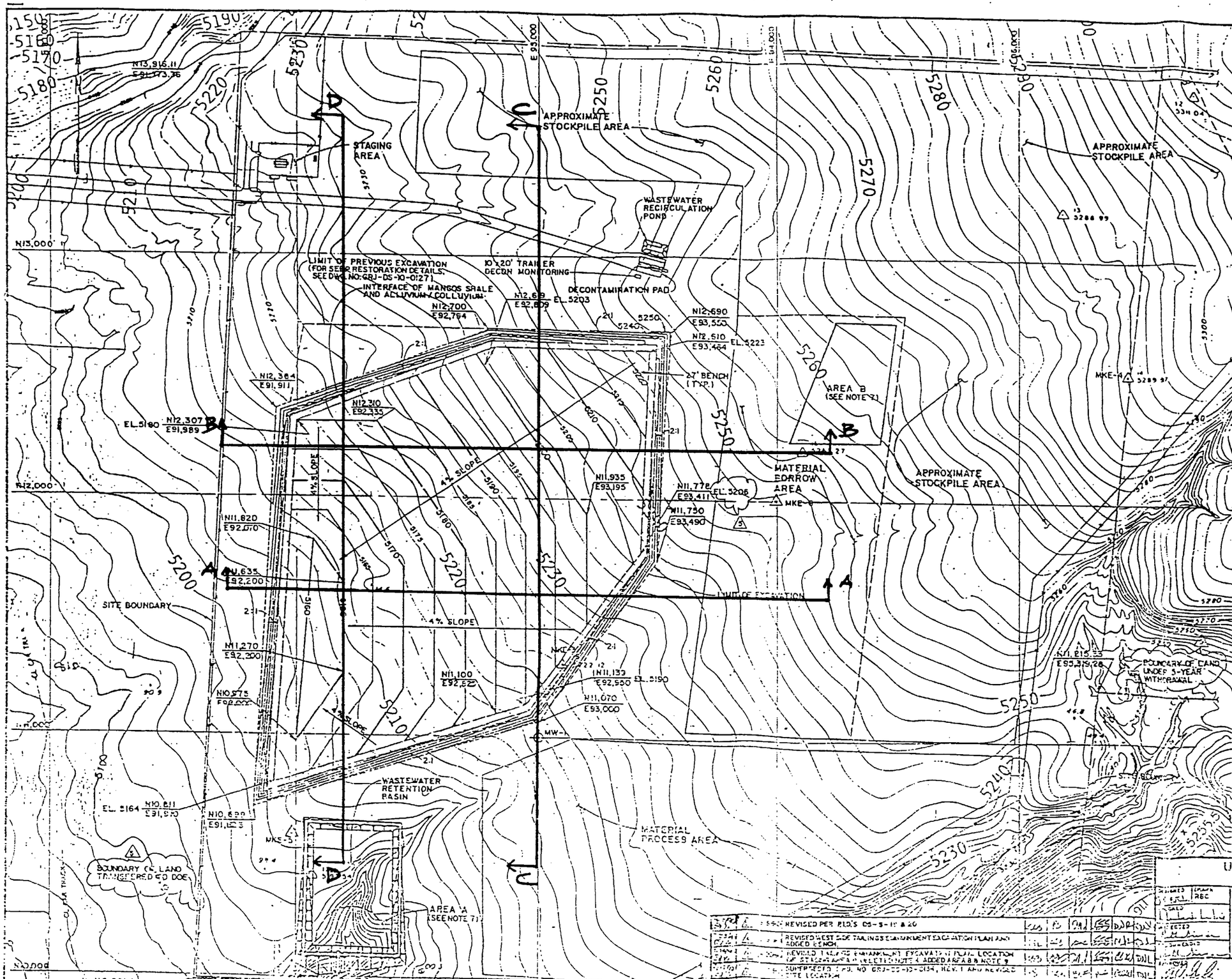



FIGURE D-1- BEDROCK CONTOUR MAP SHOWING WATER-FILLED PALEOCHANNELS CHENEY DISPOSAL SITE




NOTES:

1. ALL UNCONTAMINATED MATERIAL EXCAVATED FROM THE SITE DURING CONSTRUCTION SHALL BE PLACED TEMPORARILY WITHIN THE AREAS INDICATED WITH STABLE SLOPES NO STEEPER THAN 2(H) TO 1(V). MAXIMUM HEIGHT OF THE PILE SHALL BE 30 FEET.
2. THE SUBCONTRACTOR SHALL PROVIDE SUMP AND PUMP TO DRAIN THE PONDED NON-CONTAMINATED WATER FROM RAINSTORM AND SNOW MELT FROM THE TAILINGS EMBANKMENT AREA INTO THE NATURAL DRAIN.
3. THE SUBCONTRACTOR SHALL NOT EXCAVATE INTO THE MANCOS SHALE PRIOR TO THE ISSUANCE OF SUCH INSTRUCTIONS BY THE CONTRACTOR.
4. (DELETED)
5. THE LOCATION OF THE INTERFACE OF MANCOS SHALE WITH ALLUVIUM/COLLUVIUM IS APPROXIMATE ONLY AND IS BASED ON SOIL BORING LOGS. ACTUAL LOCATION MAY VARY IN THE FIELD.
6. THE DESIGNATED MATERIAL BORROW AREA SHALL NOT BE USED AS STOCKPILE AREA WITHOUT THE CONTRACTOR'S APPROVAL.
7. THE SUBCONTRACTOR MAY SPOIL OVERSIZE ROCK FROM THE DISPOSAL CELL EXCAVATION INTO THE DRAINAGE GULLY UNDER THE PROPOSED WASTEWATER RETENTION BASIN (AREA A) IF, AND AS AVAILABLE. IF THIS AREA IS NOT AVAILABLE, THE SUBCONTRACTOR SHALL TEMPORARILY STOCKPILE THE OVERSIZE MATERIAL IN THE DESIGNATED AREA B. HE SHALL DISPOSE OF THIS MATERIAL AS REQUIRED BY THE CONTRACTOR.
8. LOCATIONS OF WASTEWATER RECIRCULATION POND AND DECONTAMINATION PAD ARE APPROXIMATE.
9. A WORKING BENCH APPROXIMATELY 27' WIDE SHALL BE PLACED BELOW THE TRANSITION BETWEEN MANCOS SHALE AND ALLUVIUM. THE SIDESLOPE IN THE MANCOS MAY VARY AS APPROVED BY THE CONTRACTOR.

REFERENCE DRAWINGS:

GRJ-DS-10-0125, CONSTRUCTION FACILITIES AND SITE DRAINAGE
GRJ-DS-10-0223, BORINGS AND TEST PITS LOCATION PLAN

LEGEND:

- 5240 — EXISTING SITE FEATURES AND CONTOURS
- N 12,000 — CONSTRUCTION GRID COORDINATE
- 5250 — CONTOURS OF EXCAVATION
- TEMPORARY CHAIN LINK FENCE AND GATE
- TEMPORARY WIRE FENCE
- ACCESS ROAD
- EXCAVATION
- EMBANKMENT
- MKE-3 — EXISTING PERMANENT SURVEY MONUMENT
- MW-1 — EXISTING WATER SUPPLY WELL

200 0 200 400
SCALE FEET

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

CHENEY RESERVOIR DISPOSAL SITE
GRAND JUNCTION, COLORADO
PHASE II CONSTRUCTION

TAILINGS EMBANKMENT AREA EXCAVATION PLAN

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL19796

DRAWING NO. GRJ-DS-10-0134

| REVISIONS |
|---|
| REVISED PER RFI'S DS-5-19 & 20 |
| REVISED WEST SIDE TAILINGS EMBANKMENT EXCAVATION PLAN AND ADDED BENCH |
| REVISED TAILINGS EMBANKMENT EXCAVATION INITIAL LOCATION OF STOCKPILE AREA B (SEE NOTE 7) ADDED AREA B & NOTE 9 |
| SUPERSEDES DWG. NO. GRJ-DS-10-0134, REV. 1 AND REVISED SITE LOCATION |
| REVISED TAILINGS EXCAVATION AREA, GRADING, TEMPORARY WIRE FENCE AND STOCKPILE AREA |
| ISSUED FOR CONSTRUCTION |

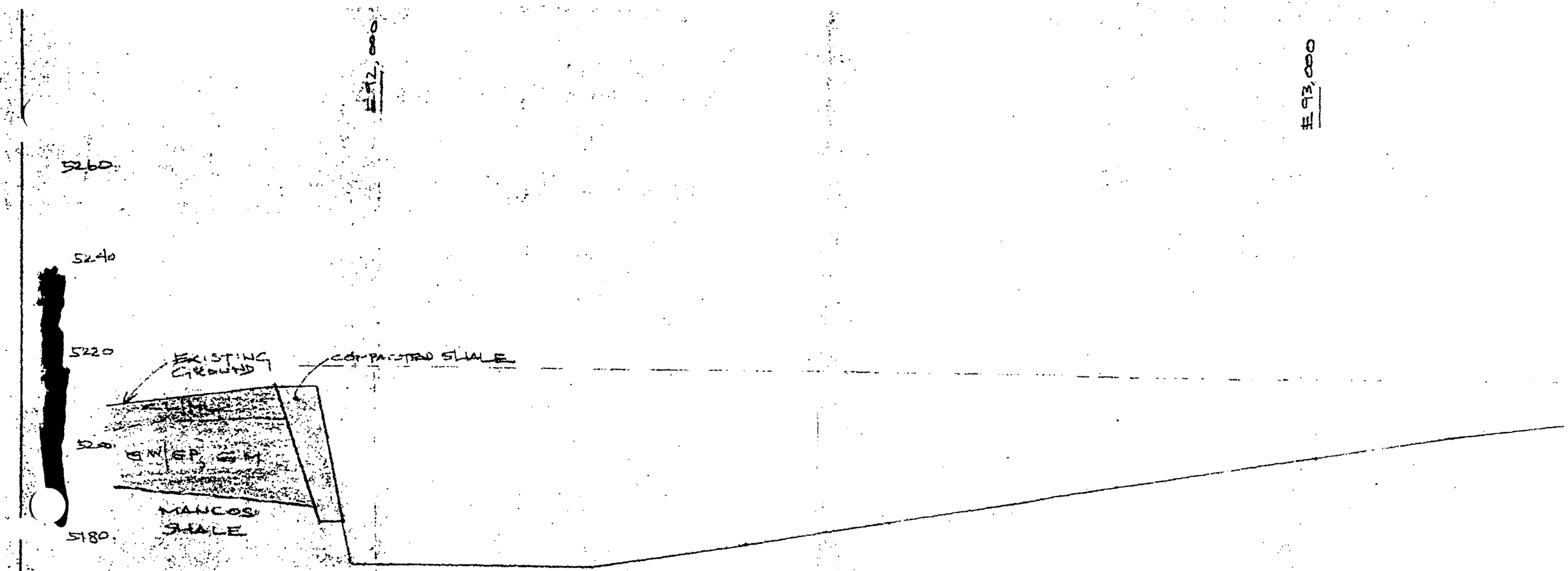


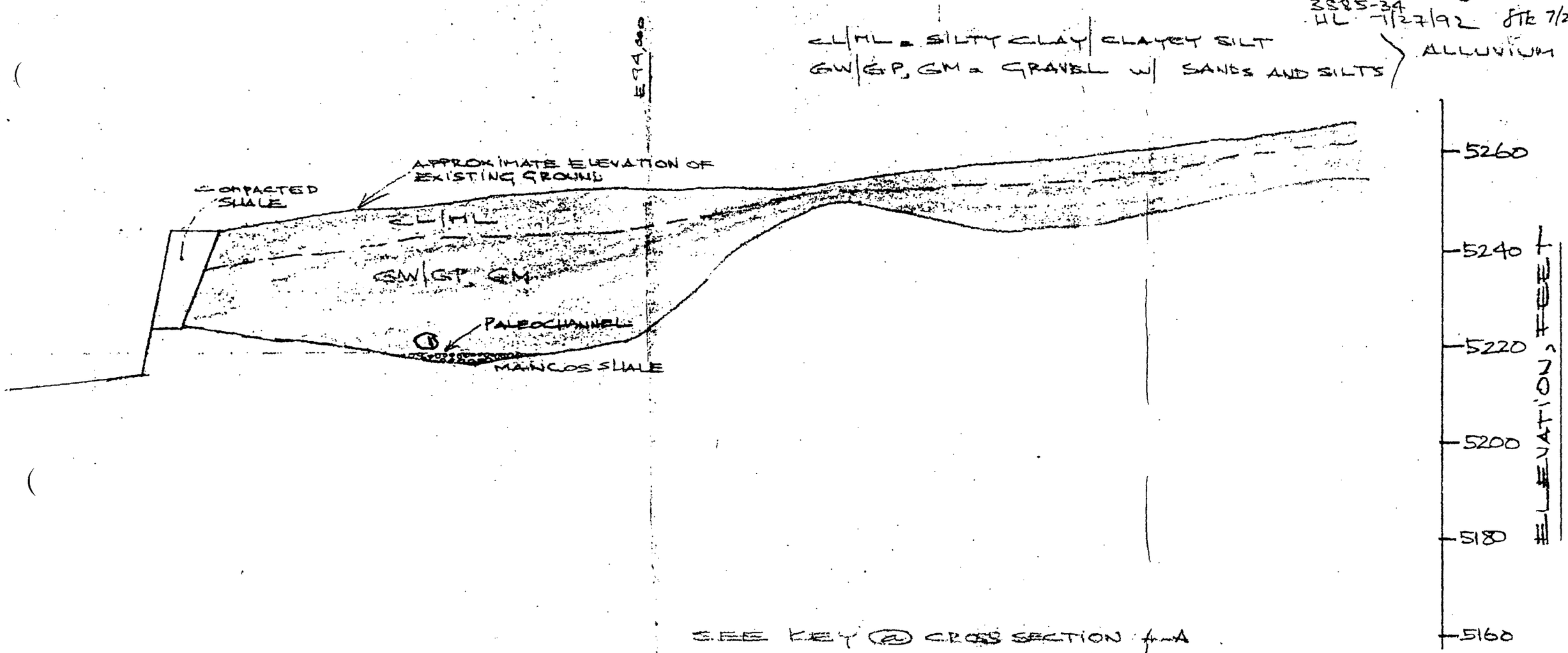

FIGURE D-3

CROSS-SECTION [redacted]

SCALE: HOR 1" = 100'
VER 1" = 20'

UMTRA - GRJ
3885-34
HL 7/27/92

Sh. D-7
STK 7/29/92




SEE KEY (2) CROSS SECTION A-A

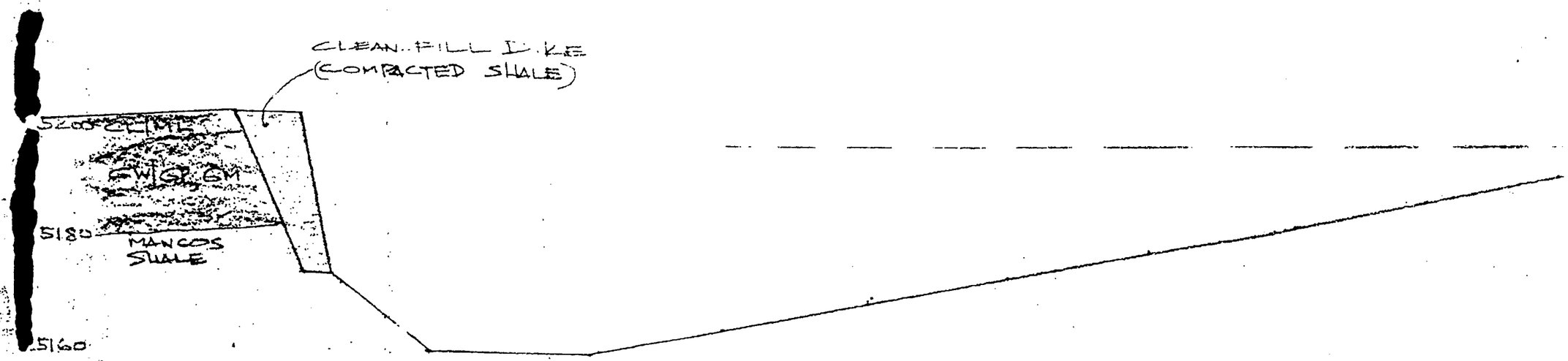



FIGURE D-4

CROSS-SECTION

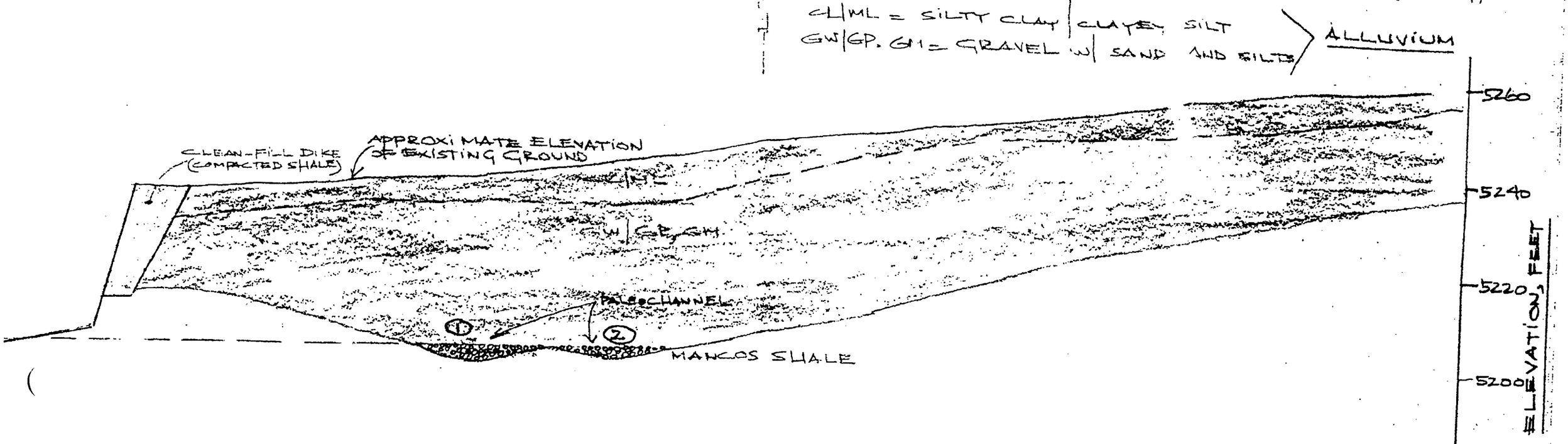
SCALE : DR.

VER.

UMTRA-GRJ
2285-24
HL 7/27/92

Sh. D-8

JTK 7/29/92




KEY

- ALLUVIUM — $k_{sat} = 1.0 \times 10^{-4}$ cm/sec
- COMPACTED SHALE — $k_{sat} = 1.0 \times 10^{-6}$ cm/sec
- IN-SITU SHALE — $k_{sat}$ (HOR) = $4.0 \times 10^{-7}$ cm/sec; $k_{sat}$ (VERT) = $2.0 \times 10^{-8}$ cm/sec
- PALEOCHANNEL

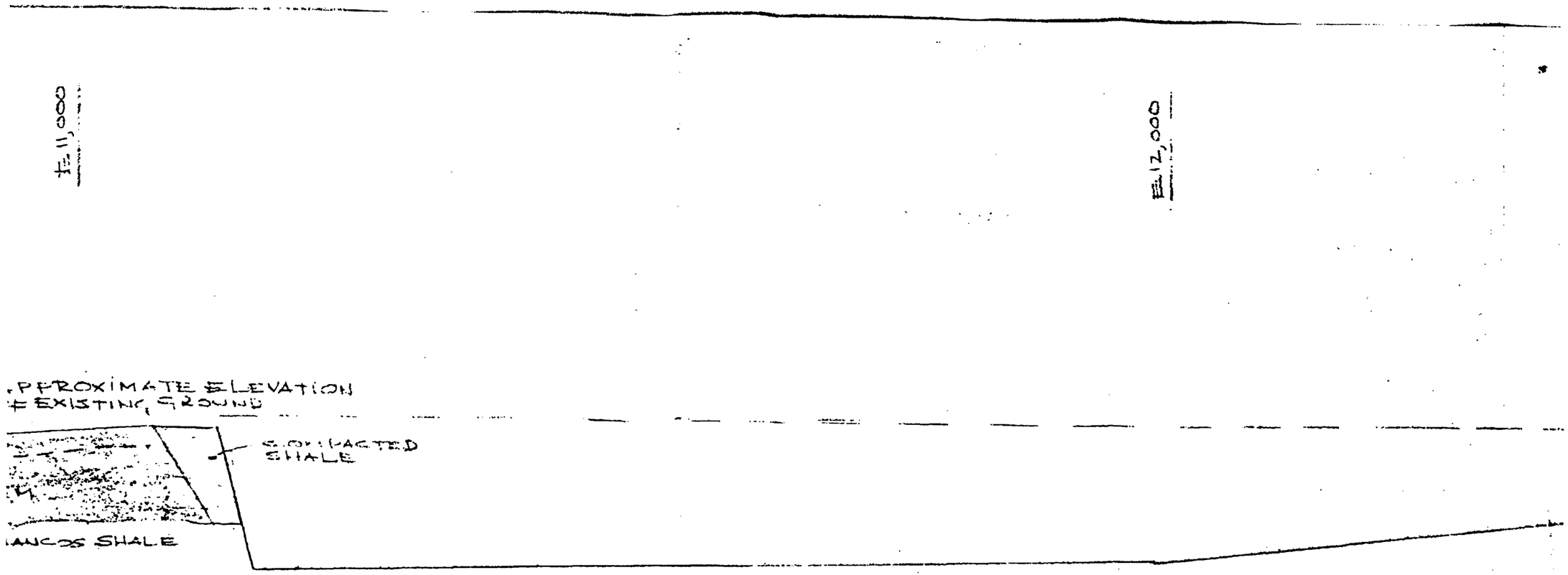

EL 11,000
EL 12,000
APPROXIMATE ELEVATION
OF EXISTING GROUND
COMPACTED
SHALE
MANCOS SHALE

FIGURE D-5

UPMORA-GRJ 4A 8-9
3835-34
HL 7/27/92 JTK 7/27/92

CL|ML = SILTY CLAY|CLAYEY SILT
GW|GP, GM = GRAVEL w/ SANDS AND SILTS
ALLUVIUM

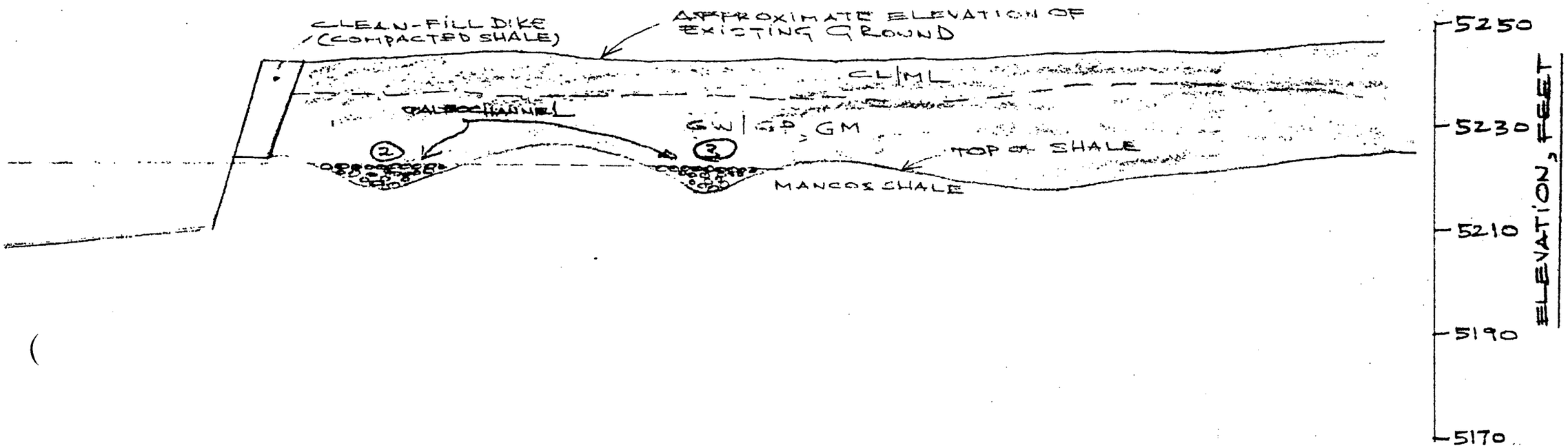


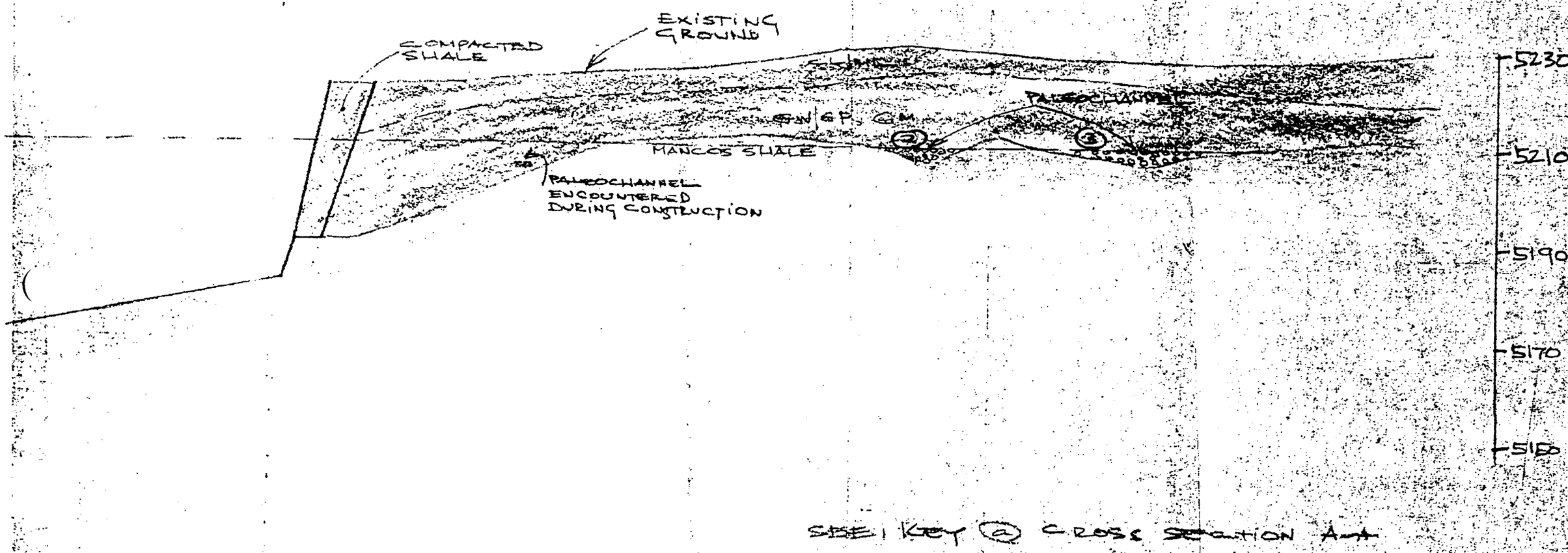

FIG. 4 CROSS SECTION A-A

N 11,000
N 12,000
EXISTING GROUND
COMPACTED SHALE
MANCOS SHALE

UMTRA - GRJ SHD-
3885-34
UL 7/27/92
JTK 7/29/92

N 13,000

CL|ML = SILTY CLAY|CLAYEY SILT
GW|GP, GM = GRAVELL W|SANDS AND SILTS
ALLUVIUM




SEE KEY ② CROSS SECTION A-A