APPENDIX 12-5-4
SLOPE STABILITY CALCULATIONS

Richard B White

10/4/95

SLOPE STABILITY EVALUATION
WILLOW CREEK REFUSE REMOVAL PROJECT

Evaluate Pond 1 (operational and reclamation conditions), Pond WC-002, and representative sed. trap under rapid drawdown conditions (worst case).

Pond 1 (operational) – Initial pond (most conservative condition)

Cross sections – see pg 2 and 3 of this calc.

Soil parameters → pond will be incised into natural soils at the base of the refuse pile. Natural soils encountered at Terrematrix drill hole TH-05 (drilled through the refuse into the soil) considered representative of pond soils. According to Terrematrix report (Appendix 12-5-1 of permit application) the foundation soils encountered at TH-05 are classified as a silty sand (SM). The drill log for this hole (Appendix 12-6-1 of the permit application) indicates a high density soil with 120 blows per foot for the Standard Penetration Test. Typical engineering properties for such a soil are:

Moist unit weight = 129 lb/ft³
Saturated unit weight = 144 lb/ft³
} Holtz and Kovacs (1981) See pg 4 of this calc.

Cohesion = 0 (limited clay content. Therefore cohesionless)

Friction angle = 35° (Hunt, 1986) See pg 5 of this calc.

Piezometric surface → saturated embankment due to rapid drawdown. See pg 2 and 3 of this calc.

Horizontal acceleration = 0.08 g (for seismic conditions)

Face	Condition	Safety Factor
Upstream	Static	1.3
Upstream	Seismic	1.0
Downstream	Static	1.0
Downstream	Seismic	0.8

} See pg 6 – 12 of this calc.

Calculation method → modified Bishop

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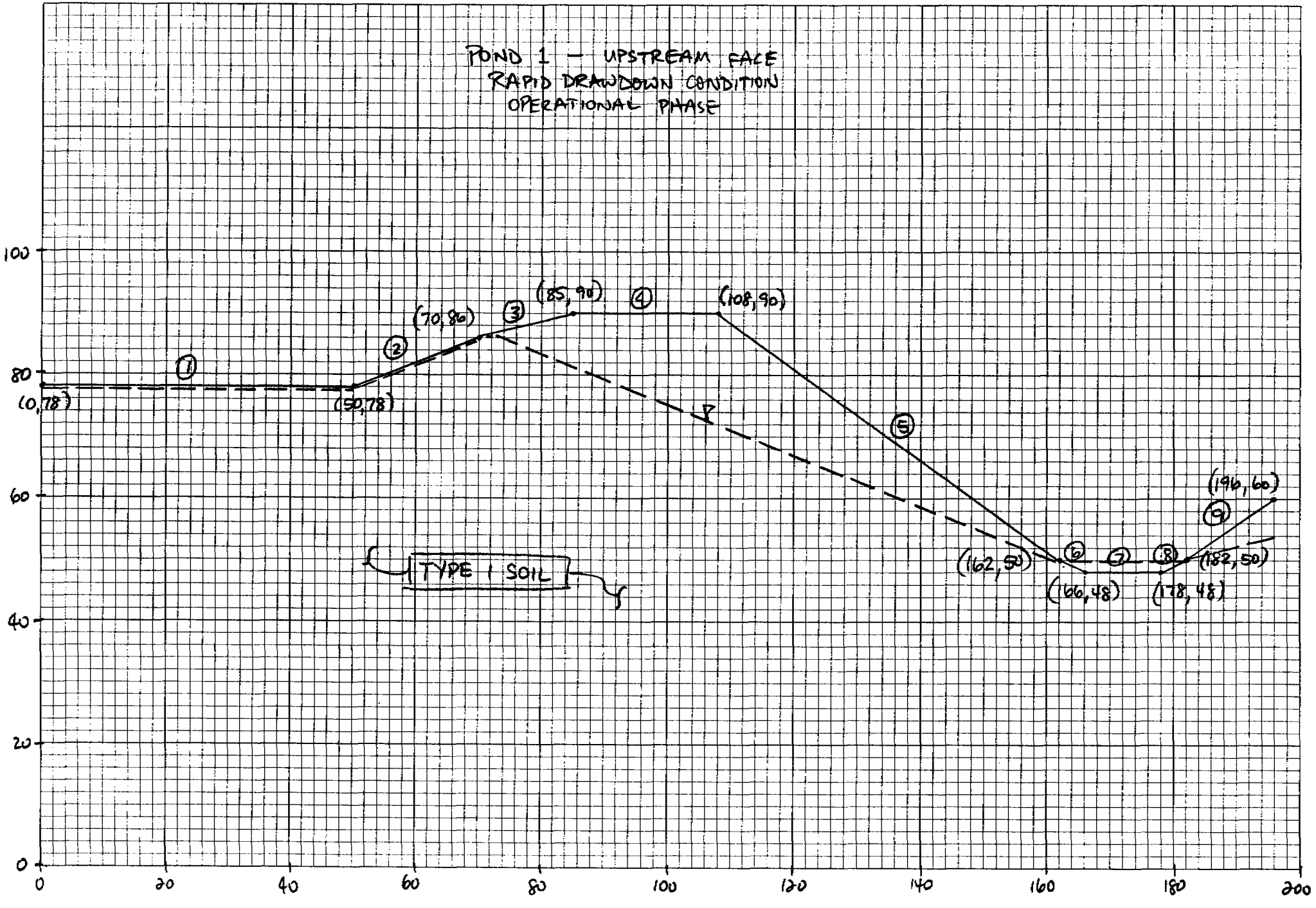

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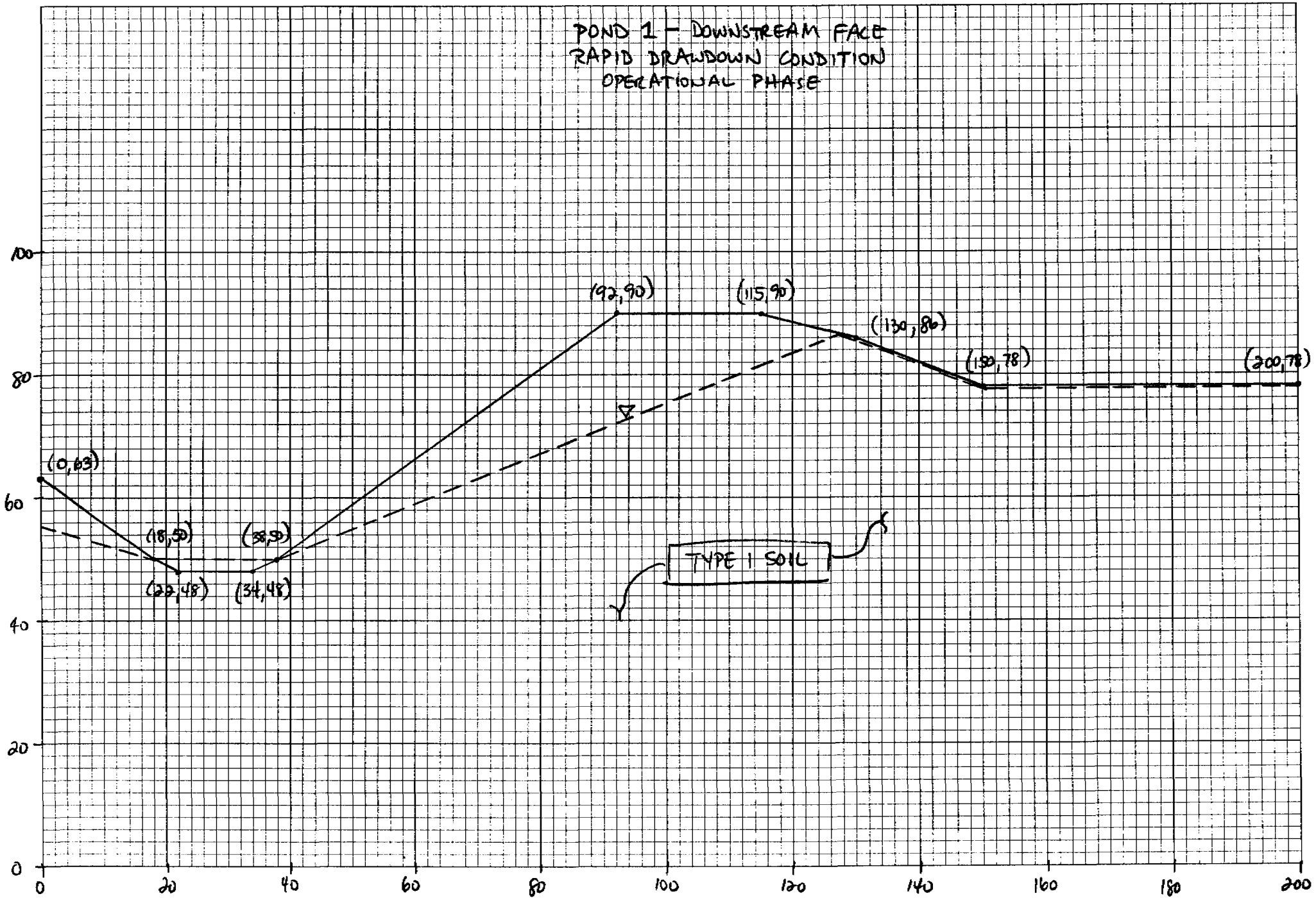

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TABLE 4-2 Typical Index Properties for Granular Soils*

	Particle Size and Gradation				Voids			
	Approx. Size Range (mm)		Approx. D_{10} (mm)	Approx. Range C_u	Void Ratio		Porosity (%)	
	D_{max}	D_{min}			e_{max} (loose)	e_{min} (dense)	n_{max} (loose)	n_{min} (dense)
1. Uniform materials:								
(a) Equal spheres	—	—	—	1.0	0.92	0.35	48	26
(b) Standard Ottawa sand	0.84	0.59	0.67	1.1	0.80	0.50	44	33
(c) Clean, uniform sand (fine or medium)	—	—	—	1.2 to 2.0	1.0	0.40	50	29
(d) Uniform, inorganic silt	0.05	0.005	0.012	1.2 to 2.0	1.1	0.40	52	29
2. Well-graded materials:								
(a) Silty sand	2.0	0.005	0.02	5 to 10	0.90	0.30	47	23
(b) Clean, fine to coarse sand	2.0	0.05	0.09	4 to 6	0.95	0.20	49	17
(c) Micaceous sand	—	—	—	—	1.2	0.40	55	29
(d) Silty sand and gravel	100	0.005	0.02	15 to 300	0.85	0.14	46	12

*Modified after B. K. Hough (1969), *Basic Soils Engineering*, © 1969 by the Ronald Press, Co. Reprinted by permission of John Wiley & Sons, Inc.

TABLE 4-2 Continued

	Density (Mg/m³)†						
	Dry Density, ρ_d			Wet Density, ρ		Submerged Density, ρ'	
	Min. (loose)	100% Mod. Proctor	Max. (dense)	Min. (loose)	Max. (dense)	Min. (loose)	Max. (dense)
1. Uniform materials:							
(a) Equal spheres (theoretical values)	—	—	—	—	—	—	—
(b) Standard Ottawa sand	1.49	—	1.78	1.51	2.12	0.93	1.12
(c) Clean, uniform sand (fine or medium)	1.35	1.86	1.92	1.37	2.20	0.85	1.18
(d) Uniform, inorganic silt	1.29	—	1.92	1.31	2.20	0.83	1.18
2. Well-graded materials:							
(a) Silty sand	1.41	1.98	2.06	1.43	2.30	0.88	1.28
(b) Clean, fine to course sand	1.38	2.14	2.23	1.40	2.39	0.86	1.40
(c) Micaceous sand	1.23	—	1.95	1.24	2.23	0.77	1.23
(d) Silty sand and gravel	1.44	—	2.36	1.46	2.51	0.91	1.49

†Tabulation is based on $\rho_s = 2.65$ Mg/m³. Multiply by 62.4 to obtain lbf/ft³.

2.06 mg/m³ = 129 lb/ft³

2.30 mg/m³ = 144 lb/ft³

Source: Holtz and Kovacs (1981)

TABLE 3.5
COMMON PROPERTIES OF COHESIONLESS SOILS**

Material	Compactness	D_R, %	N*	γ dry,† g/cm³	Void ratio e	Strength‡ ϕ
GW: well-graded gravels, gravel-sand mixtures	Dense	75	90	2.21	0.22	40
	Medium dense	50	55	2.08	0.28	36
	Loose	25	<28	1.97	0.36	32
GP: poorly graded gravels, gravel-sand mixtures	Dense	75	70	2.04	0.33	38
	Medium dense	50	50	1.92	0.39	35
	Loose	25	<20	1.83	0.47	32
SW: well-graded sands, gravelly sands	Dense	75	65	1.89	0.43	37
	Medium dense	50	35	1.79	0.49	34
	Loose	25	<15	1.70	0.57	30
SP: poorly graded sands, gravelly sands	Dense	75	50	1.76	0.52	36
	Medium dense	50	30	1.67	0.60	33
	Loose	25	<10	1.59	0.65	29
SM: silty sands	Dense	75	45	1.65	0.62	35
	Medium dense	50	25	1.55	0.74	32
	Loose	25	<8	1.49	0.80	29
ML: inorganic silts, very fine sands	Dense	75	35	1.49	0.80	33
	Medium dense	50	20	1.41	0.90	31
	Loose	25	<4	1.35	1.0	27

*N is blows per foot of penetration in the SPT. Adjustments for gradation are after Burmister (1962).[24] See Table 6.4 for general relationships of D_R vs. N.

†Density given is for G_s = 2.68 (quartz grains).

‡Friction angle ϕ depends on mineral type, normal stress, and grain angularity as well as D_R and gradation (see Fig. 3.29).

**From Hunt (1984).[1] Reprinted with permission of McGraw-Hill Book Company.

Source: Hunt (1986)

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```

Problem Title : WILLOW CREEK POND 1
Description : OPERATIONAL PHASE, UPSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*************************************************************************
*****                          INPUT DATA                           *****
*************************************************************************
```

Profile Boundaries

Number of Boundaries : 9
Number of Top Boundaries : 9

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*************************************************************************
*****                  TRIAL SURFACE GENERATION                     *****
*************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 20.00 ft
Right Initiation Point : 50.00 ft
Left Termination Point : 78.00 ft
Right Termination Point : 108.00 ft
Minimum Elevation : 10.00 ft

Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 1.330
Circle Center X : 50.02 ft
Circle Center Y : 124.87 ft
Circle Radius : 47.93 ft

```
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Problem Title : WILLOW CREEK POND 1
Description : OPERATIONAL PHASE, UPSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 9
Number of Top Boundaries : 9

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*****************************************************************************
*****                     TRIAL SURFACE GENERATION                      *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 20.00 ft
Right Initiation Point : 50.00 ft
Left Termination Point : 78.00 ft
Right Termination Point : 108.00 ft
Minimum Elevation : 10.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 1.028
Circle Center X : 50.02 ft
Circle Center Y : 124.87 ft
Circle Radius : 47.93 ft

```
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Problem Title : WILLOW CREEK POND 1
Description : OPERATIONAL PHASE, DOWNSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 9
Number of Top Boundaries : 9

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                          RESULTS                                  *****
*****************************************************************************
```

Critical Surface

Factor of Safety : 0.990
Circle Center X : 31.47 ft
Circle Center Y : 114.74 ft
Circle Radius : 66.19 ft

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```
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Problem Title : WILLOW CREEK POND 1
Description : OPERATIONAL PHASE, DOWNSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*************************************************************************
*****                          INPUT DATA                           *****
*************************************************************************
```

Profile Boundaries

Number of Boundaries : 9
Number of Top Boundaries : 9

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*************************************************************************
*****                   TRIAL SURFACE GENERATION                    *****
*************************************************************************
```

Data for Generating Circular Surfaces

```
        Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
              Left Initiation Point : 22.00 ft
             Right Initiation Point : 42.00 ft
             Left Termination Point : 90.00 ft
            Right Termination Point : 120.00 ft
                  Minimum Elevation : 10.00 ft
                     Segment Length : 5.00 ft
                Positive Angle Limit : 0.00 deg
                Negative Angle Limit : 0.00 deg
```

```
*************************************************************************
*****                          RESULTS                              *****
*************************************************************************
```

Critical Surface

```
Factor of Safety : 0.845
Circle Center X : 31.47 ft
Circle Center Y : 114.74 ft
Circle Radius : 66.19 ft
```

Pond 1 (reclamation)

Cross sections → see pp 14 and 15 of this calc.

Soil parameters → as noted on pg 1 of this calc.

Results:

Face	Condition	Safety Factor
Upstream	Static	1.0
Upstream	Seismic	0.8
Downstream	Static	1.5
Downstream	Seismic	1.2

See pp 16-22 of this calc.

Trap 5

Worst case of the sediment traps (closest to stream channel, deep pond). Analyze this trap for stability and assume others are better.

Cross sections → see pp 23 and 24 of this calc.

Soil parameters → as noted on pg 1 of this calc.

Results:

Face	Condition	Safety Factor
Upstream	Static	1.0
Upstream	Seismic	0.8
Downstream	Static	1.1
Downstream	Seismic	0.9

See pp 25-32 of this calc.

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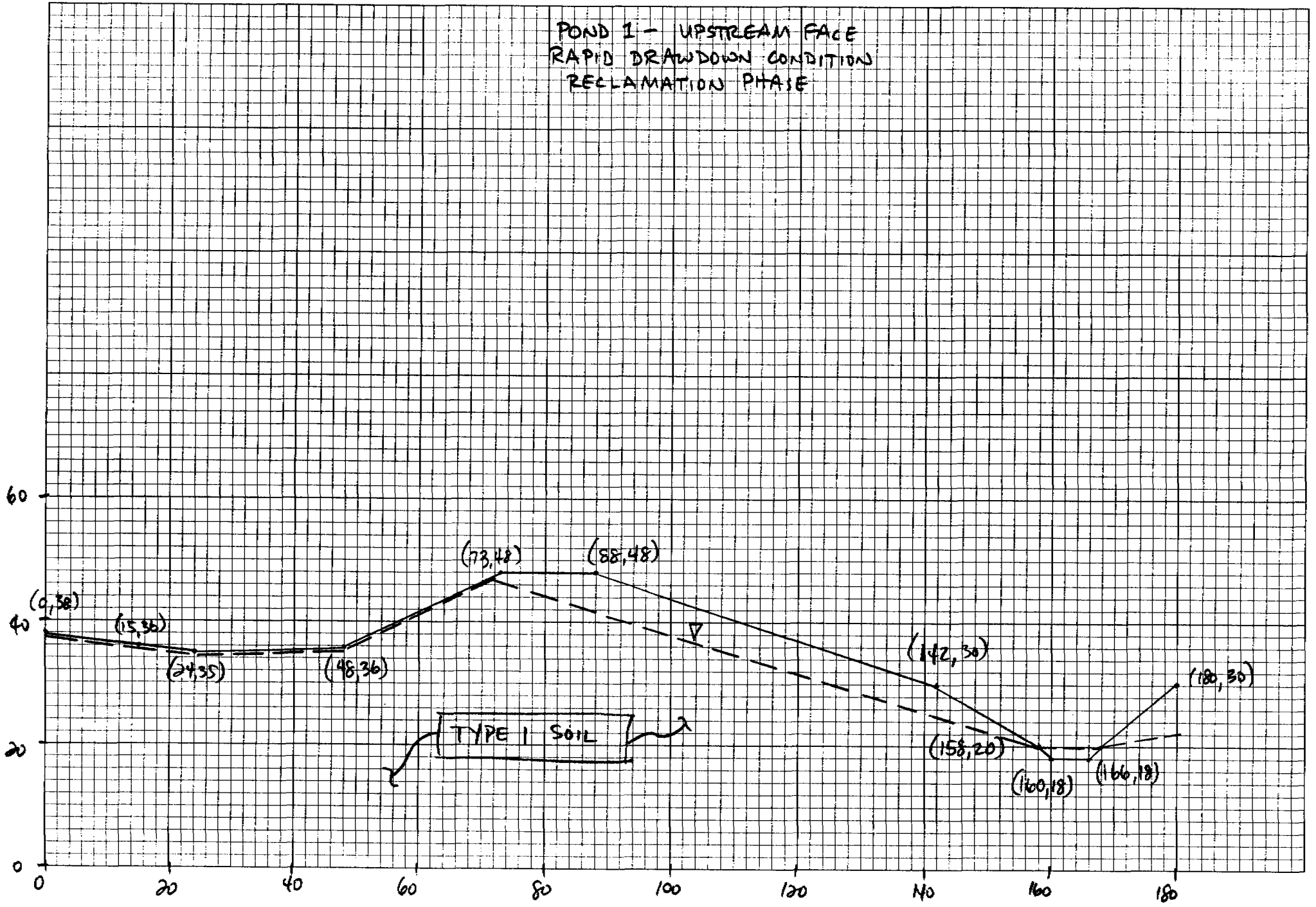
POND 1 – UPSTREAM FACE
RAPID DRAWDOWN CONDITION
RECLAMATION PHASE



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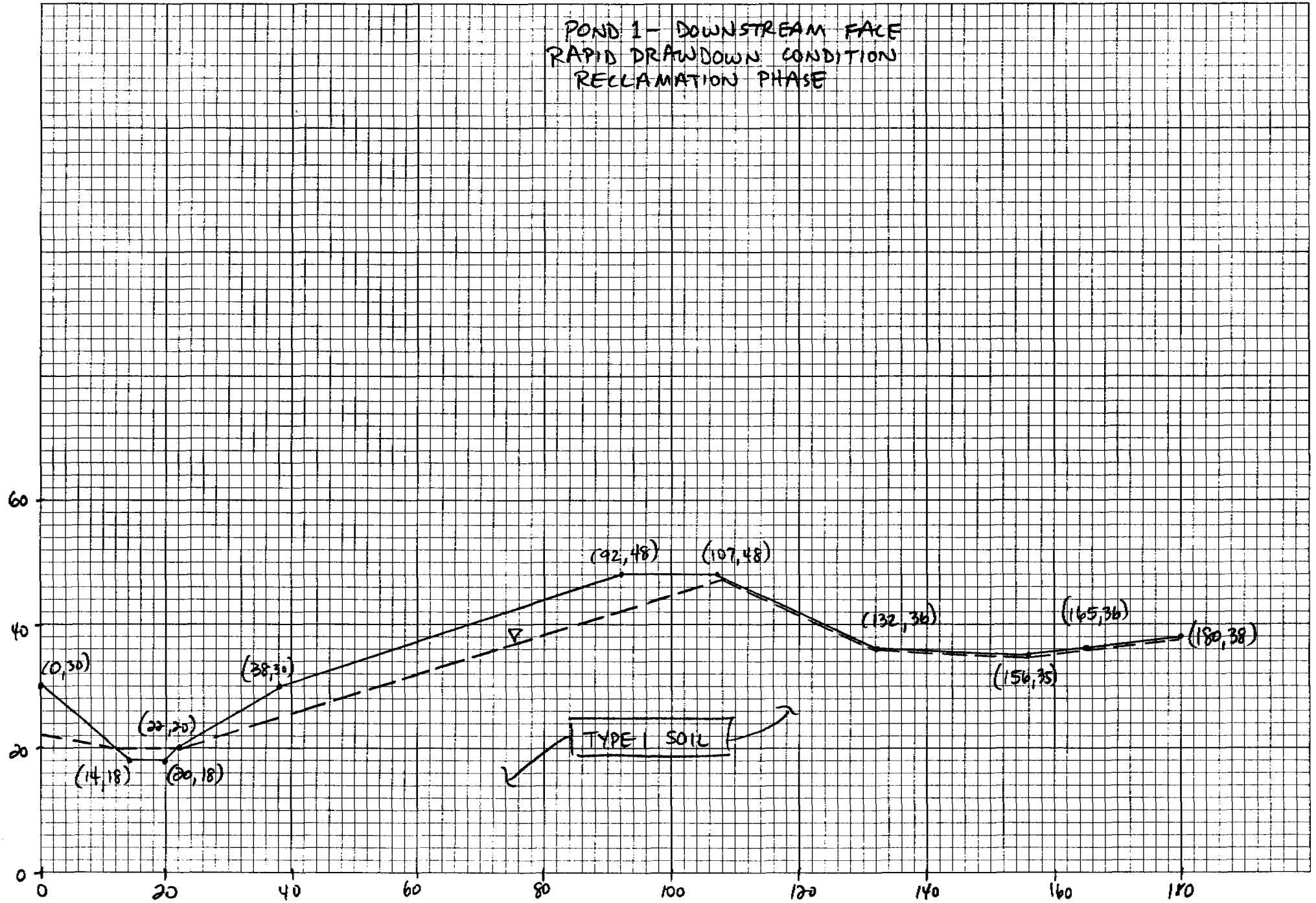

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Problem Title : WILLOW CREEK POND 1
Description : RECLAMATION PHASE, UPSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                          RESULTS                                  *****
*****************************************************************************
```

Critical Surface

Factor of Safety : 1.009
Circle Center X : 43.18 ft
Circle Center Y : 84.51 ft
Circle Radius : 49.80 ft

```
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Problem Title : WILLOW CREEK POND 1
Description : RECLAMATION PHASE, UPSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*************************************************************************
*****                        INPUT DATA                             *****
*************************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*************************************************************************
*****                   TRIAL SURFACE GENERATION                    *****
*************************************************************************
```

Data for Generating Circular Surfaces

```
        Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
             Left Initiation Point : 24.00 ft
            Right Initiation Point : 48.00 ft
            Left Termination Point : 72.00 ft
           Right Termination Point : 88.00 ft
                 Minimum Elevation : 10.00 ft
                    Segment Length : 5.00 ft
              Positive Angle Limit : 0.00 deg
              Negative Angle Limit : 0.00 deg
```

```
*******************************************************************************
*****                                RESULTS                                *****
*******************************************************************************
```

Critical Surface

```
Factor of Safety : 0.800
Circle Center X : 43.18 ft
Circle Center Y : 84.51 ft
Circle Radius : 49.80 ft
```

```
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```

Problem Title : WILLOW CREEK POND 1
Description : RECLAMATION PHASE, DOWNSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                  TRIAL SURFACE GENERATION                         *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 14.00 ft
Right Initiation Point : 24.00 ft
Left Termination Point : 90.00 ft
Right Termination Point : 107.00 ft
Minimum Elevation : 0.00 ft

Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 1.516
Circle Center X : 33.32 ft
Circle Center Y : 94.98 ft
Circle Radius : 78.41 ft

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```
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Problem Title : WILLOW CREEK POND 1
Description : RECLAMATION PHASE, DOWNSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*****************************************************************************
*****                     TRIAL SURFACE GENERATION                      *****
*****************************************************************************
```

Data for Generating Circular Surfaces

```
        Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
             Left Initiation Point : 14.00 ft
            Right Initiation Point : 24.00 ft
            Left Termination Point : 90.00 ft
           Right Termination Point : 107.00 ft
                 Minimum Elevation : 0.00 ft
                    Segment Length : 5.00 ft
              Positive Angle Limit : 0.00 deg
              Negative Angle Limit : 0.00 deg
```

```
*****************************************************************************
*****                              RESULTS                              *****
*****************************************************************************
```

Critical Surface

```
Factor of Safety : 1.207
Circle Center X : 31.93 ft
Circle Center Y : 106.89 ft
Circle Radius : 90.08 ft
```

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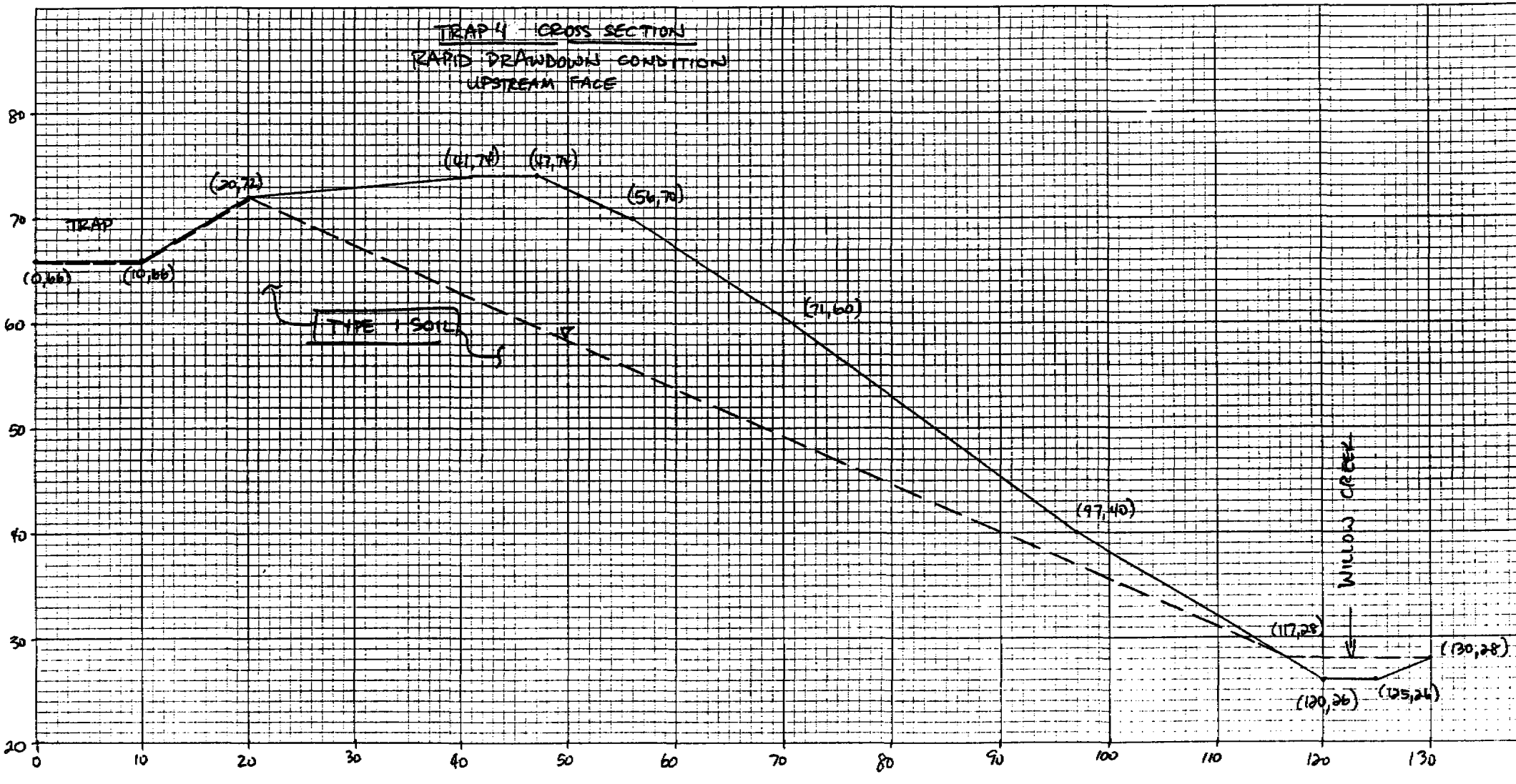

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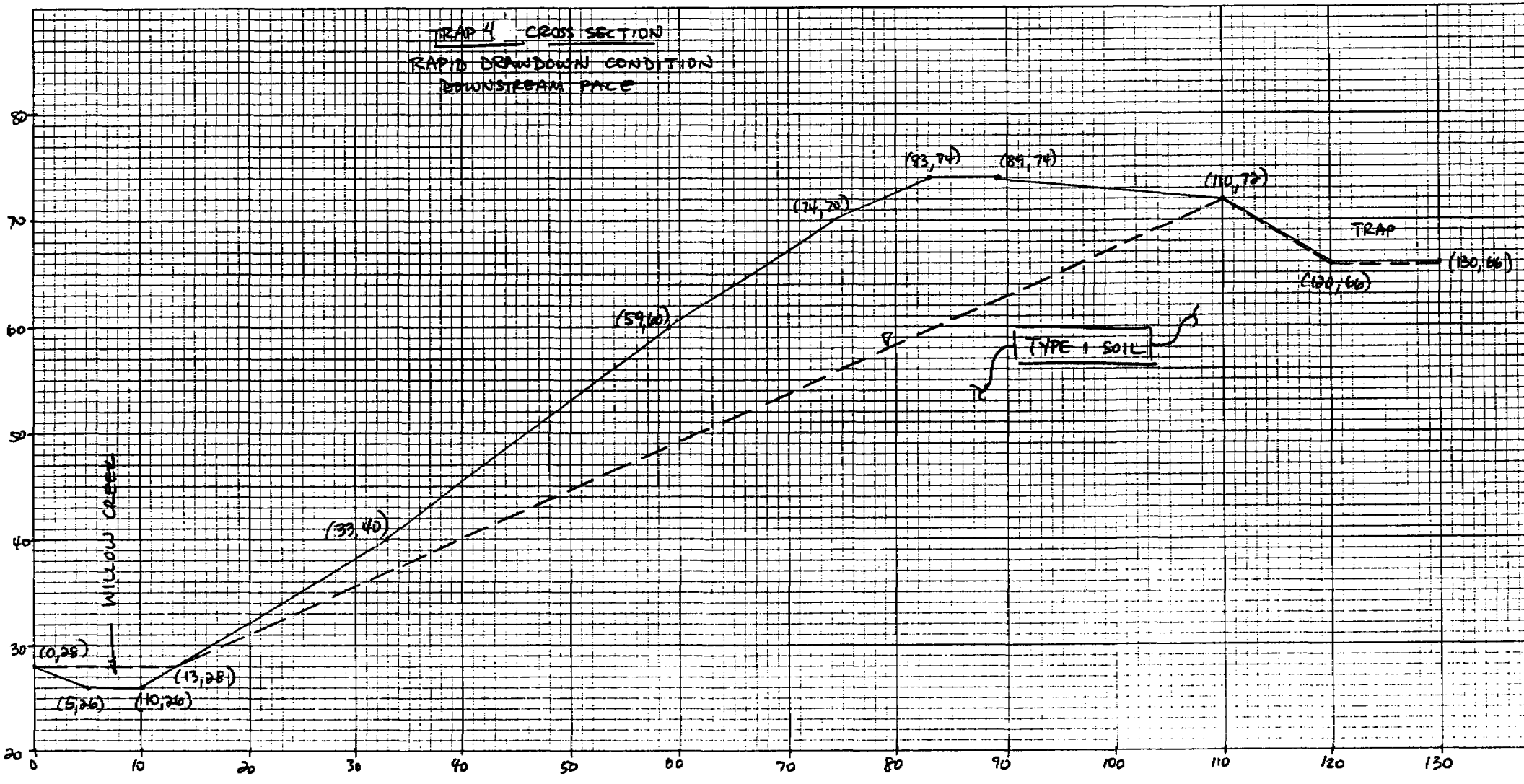

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Problem Title : WILLOW CREEK TRAP 4
Description : UPSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************
*****                   INPUT DATA                          *****
*****************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

****
***** TRIAL SURFACE GENERATION *****
****

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 0.00 ft
Right Initiation Point : 15.00 ft
Left Termination Point : 25.00 ft
Right Termination Point : 40.00 ft
Minimum Elevation : 0.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.966
Circle Center X : -16.26 ft
Circle Center Y : 150.72 ft
Circle Radius : 88.69 ft

```
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Problem Title : WILLOW CREEK TRAP 4
Description : UPSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************
*****                   INPUT DATA                          *****
*****************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

****
***** TRIAL SURFACE GENERATION *****
****

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 0.00 ft
Right Initiation Point : 15.00 ft
Left Termination Point : 25.00 ft
Right Termination Point : 40.00 ft
Minimum Elevation : 40.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.766
Circle Center X : -16.26 ft
Circle Center Y : 150.72 ft
Circle Radius : 88.69 ft

```
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Problem Title : WILLOW CREEK TRAP 4
Description : DOWNSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************
*****                   INPUT DATA                          *****
*****************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

****
***** TRIAL SURFACE GENERATION *****
****

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 5.00 ft
Right Initiation Point : 20.00 ft
Left Termination Point : 100.00 ft
Right Termination Point : 120.00 ft
Minimum Elevation : 0.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 1.087
Circle Center X : 21.20 ft
Circle Center Y : 129.42 ft
Circle Radius : 102.85 ft

```
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Problem Title : WILLOW CREEK TRAP 4
Description : DOWNSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************
*****                   INPUT DATA                          *****
*****************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

****
***** TRIAL SURFACE GENERATION *****
****

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 5.00 ft
Right Initiation Point : 20.00 ft
Left Termination Point : 100.00 ft
Right Termination Point : 120.00 ft
Minimum Elevation : 0.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.905
Circle Center X : 21.20 ft
Circle Center Y : 129.42 ft
Circle Radius : 102.85 ft

Pond WC-002

Cross sections → see pp 34 and 35 of this calc.

Soil parameters → as noted on pg 1 of this calc.

Results:

Face	Condition	Safety Factor
Upstream	Static	1.0
Upstream	Seismic	0.8
Downstream	Static	1.0
Downstream	Seismic	0.8

See pp 36-43 of this calc.

Conclusions

Pond 1 → generally stable under static, rapid drawdown conditions. However, seismic conditions may create some instability.

Trap 4 → Same as Pond 1

Pond WC-002 → Same as Pond 1

Avoid rapid drawdown. Ponds otherwise considered to be stable (see Terramatrix report in Appendix 12-5-2 of the permit app).

References

Holtz, R.D. and W.D. Kovacs, 1981. An Introduction to Geotechnical Engineering. Prentice-Hall, Inc. Englewood Cliffs, NJ.

Hunt, R.E. 1986. Geotechnical Engineering Analysis and Evaluation. McGraw-Hill Book Company. New York, NY.

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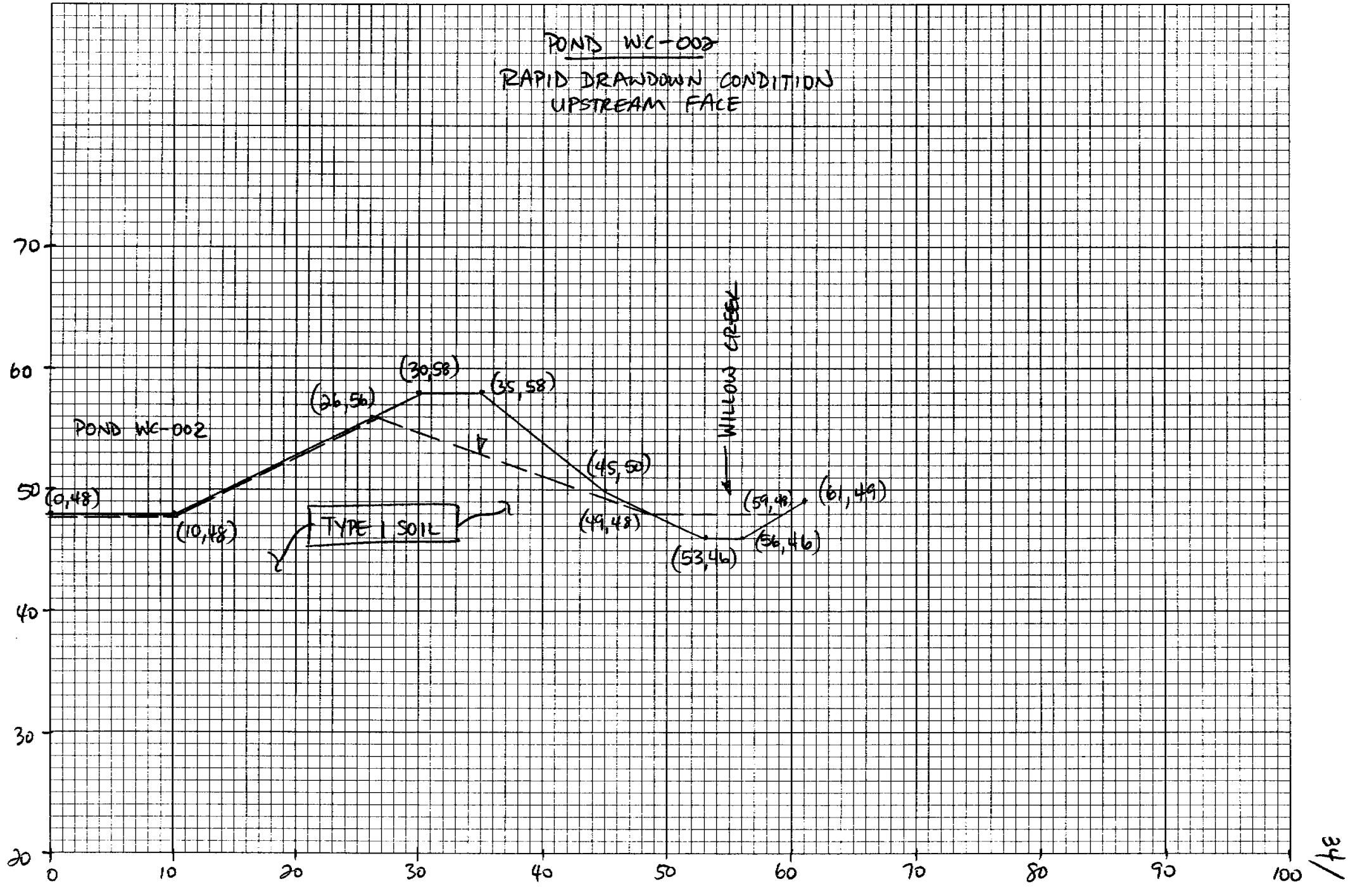

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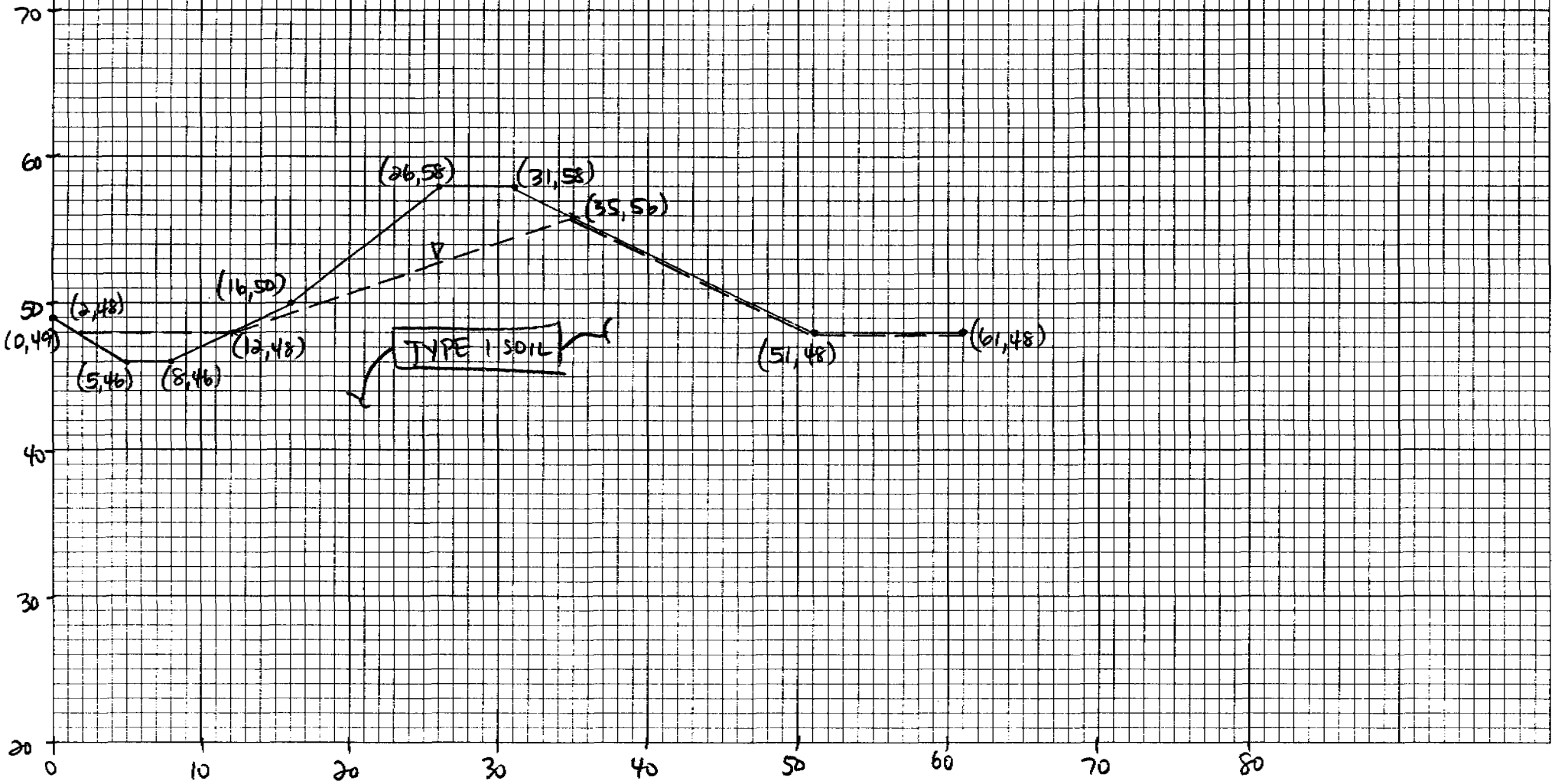
POND WC-002

RAPID DRAWDOWN CONDITION
DOWNSTREAM FACE



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Problem Title : WILLOW CREEK POND WC-002
Description : UPSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************
*****                    INPUT DATA                         *****
*****************************************************************
```

Profile Boundaries

Number of Boundaries : 7
Number of Top Boundaries : 7

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

****
***** TRIAL SURFACE GENERATION *****
****

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 0.00 ft
Right Initiation Point : 15.00 ft
Left Termination Point : 30.00 ft
Right Termination Point : 40.00 ft
Minimum Elevation : 20.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.960
Circle Center X : 16.73 ft
Circle Center Y : 67.27 ft
Circle Radius : 16.86 ft

```
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Problem Title : WILLOW CREEK POND WC-002
Description : UPSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************
*****                   INPUT DATA                          *****
*****************************************************************
```

Profile Boundaries

Number of Boundaries : 7
Number of Top Boundaries : 7

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

****
***** TRIAL SURFACE GENERATION *****
****

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 0.00 ft
Right Initiation Point : 15.00 ft
Left Termination Point : 30.00 ft
Right Termination Point : 40.00 ft
Minimum Elevation : 20.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.778
Circle Center X : 16.73 ft
Circle Center Y : 67.27 ft
Circle Radius : 16.86 ft

```
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```

Problem Title : WILLOW CREEK POND WC-002
Description : DOWNSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************
*****                    INPUT DATA                         *****
*****************************************************************
```

Profile Boundaries

Number of Boundaries : 7
Number of Top Boundaries : 7

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

****
***** TRIAL SURFACE GENERATION *****
****

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 5.00 ft
Right Initiation Point : 15.00 ft
Left Termination Point : 25.00 ft
Right Termination Point : 35.00 ft
Minimum Elevation : 20.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.968
Circle Center X : 4.34 ft
Circle Center Y : 73.54 ft
Circle Radius : 27.30 ft

```
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```

Problem Title : WILLOW CREEK POND WC-002
Description : DOWNSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************
*****                   INPUT DATA                          ****
*****************************************************************
```

Profile Boundaries

Number of Boundaries : 7
Number of Top Boundaries : 7

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

****
***** TRIAL SURFACE GENERATION *****
****

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 5.00 ft
Right Initiation Point : 15.00 ft
Left Termination Point : 25.00 ft
Right Termination Point : 35.00 ft
Minimum Elevation : 20.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.819
Circle Center X : 4.34 ft
Circle Center Y : 73.54 ft
Circle Radius : 27.30 ft

APPENDIX 12-5-5
SLOPE STABILITY CALCULATIONS

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
7/21/95
STATE OF UTAH

APPENDIX 12-5-5
SLOPE STABILITY CALCULATIONS

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
7/21/95
STATE OF UTAH

SLOPE STABILITY EVALUATION
WILLOW CREEK REFUSE REMOVAL PROJECT

Evaluate Pond 1 (operational and reclamation conditions) and representative Sediment Trap under rapid drawdown conditions (worst case).

Pond 1 (operational) – Initial pond (most conservative condition)

Cross sections – see pg 2 and 3 of this calc.

Soil parameters → pond will be incised into natural soils at the base of the refuse pile. Natural soils encountered at Terrametrix drill hole TH-05 (drilled through the refuse into the soil) considered representative of pond soils. According to Terrametrix report (Appendix 12-5-2 of permit application), the foundation soils encountered at TH-05 are classified as a silty sand (SM). The drill log for this hole (Appendix 12-6-1 of the permit application) indicates a high density soil with 120 blows per foot for the Standard Penetration Test. Typical engineering properties for such a soil are:

Moist unit weight = 129 lb/ft³
Saturated unit weight = 144 lb/ft³
} Holtz and Kovacs (1981) see pg 4 of this calc.

Cohesion = 0 (limited clay content. Therefore, cohesionless)

Friction angle = 35° (Hunt, 1986) See pg 5 of this calc.

Piezometric surface → saturated embankment due to rapid drawdown. See pg 2 and 3 of this calc.

Horizontal acceleration = 0.08 g (for seismic conditions)

Face	Condition	Safety Factor
Upstream	Static	1.3
Upstream	Seismic	1.0
Downstream	Static	1.0
Downstream	Seismic	0.8

} See pg 6 – 12 of this calc.

Calculation method → modified Bishop

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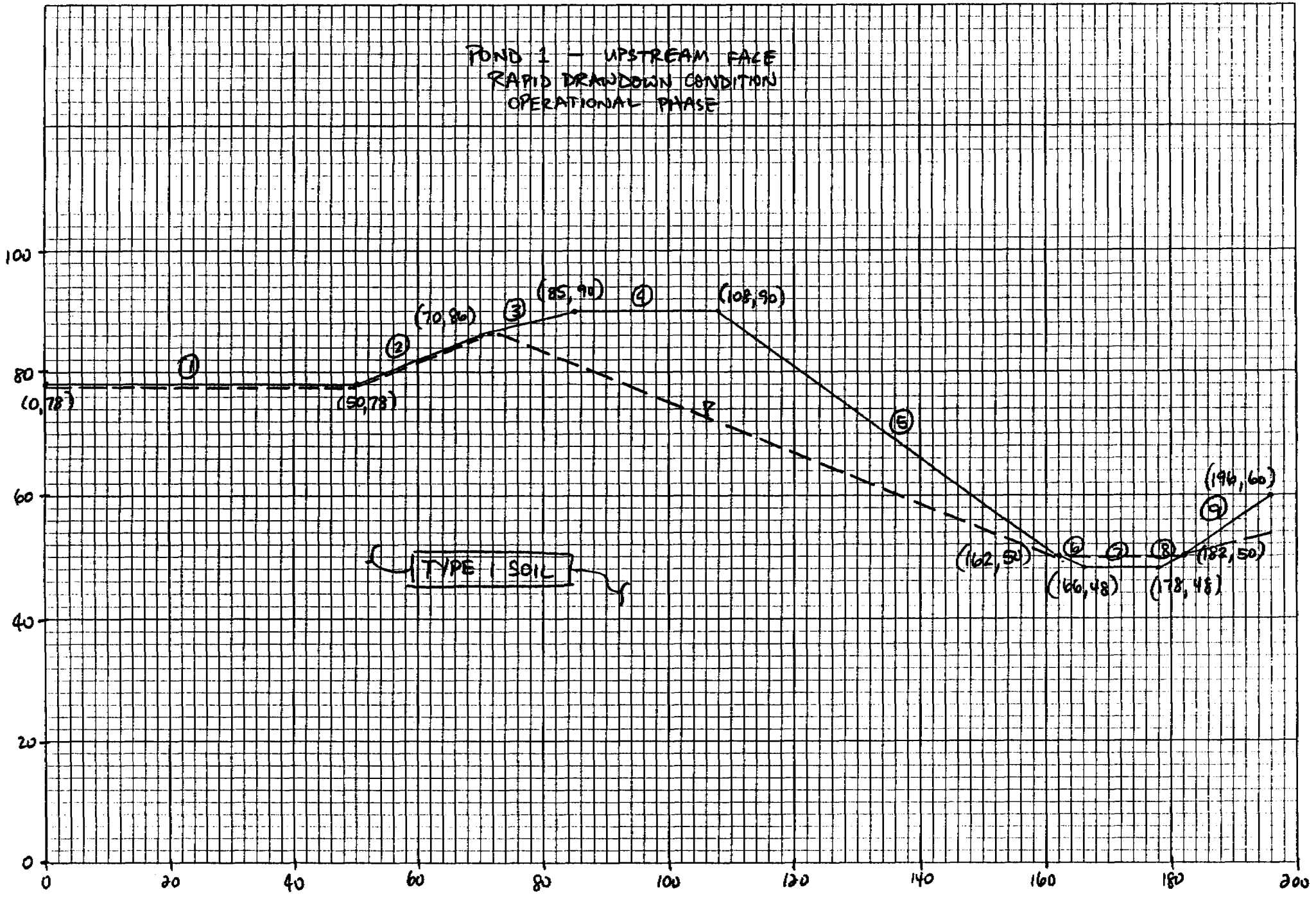

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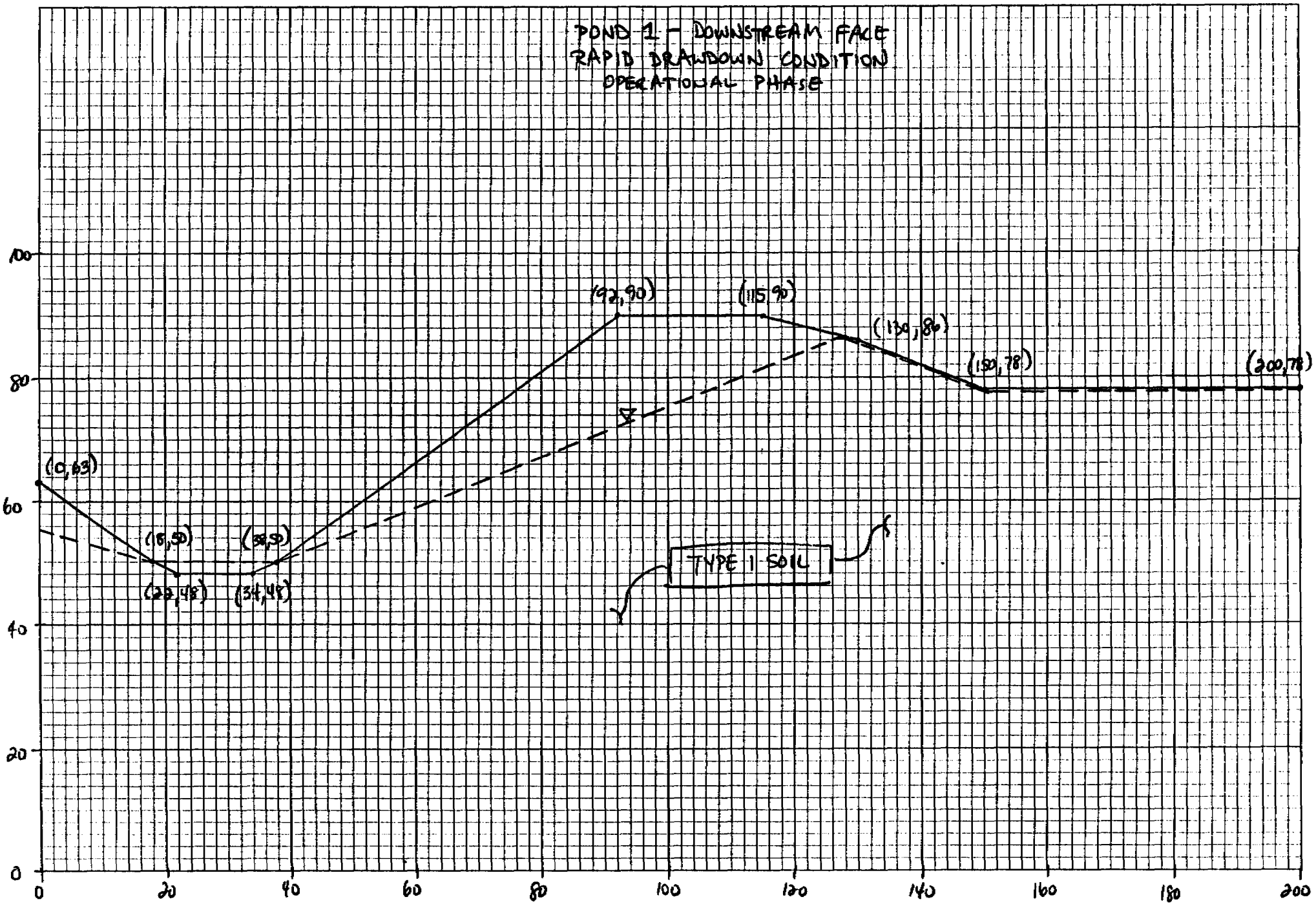

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TABLE 4-2 Typical Index Properties for Granular Soils*

	Particle Size and Gradation				Voids			
	Approx. Size Range (mm)		Approx. D_{10} (mm)	Approx. Range C_u	Void Ratio		Porosity (%)	
	D_{max}	D_{min}			e_{max} (loose)	e_{min} (dense)	n_{max} (loose)	n_{min} (dense)
1. Uniform materials:								
(a) Equal spheres	—	—	—	1.0	0.92	0.35	48	26
(b) Standard Ottawa sand	0.84	0.59	0.67	1.1	0.80	0.50	44	33
(c) Clean, uniform sand (fine or medium)	—	—	—	1.2 to 2.0	1.0	0.40	50	29
(d) Uniform, inorganic silt	0.05	0.005	0.012	1.2 to 2.0	1.1	0.40	52	29
2. Well-graded materials:								
(a) Silty sand	2.0	0.005	0.02	5 to 10	0.90	0.30	47	23
(b) Clean, fine to coarse sand	2.0	0.05	0.09	4 to 6	0.95	0.20	49	17
(c) Micaceous sand	—	—	—	—	1.2	0.40	55	29
(d) Silty sand and gravel	100	0.005	0.02	15 to 300	0.85	0.14	46	12

*Modified after B. K. Hough (1969), *Basic Soils Engineering*, © 1969 by the Ronald Press, Co. Reprinted by permission of John Wiley & Sons, Inc.

TABLE 4-2 Continued

	Density (Mg/m³)†						
	Dry Density, ρ_d			Wet Density, ρ		Submerged Density, ρ'	
	Min. (loose)	100% Mod. Proctor	Max. (dense)	Min. (loose)	Max. (dense)	Min. (loose)	Max. (dense)
1. Uniform materials:							
(a) Equal spheres (theoretical values)	—	—	—	—	—	—	—
(b) Standard Ottawa sand	1.49	—	1.78	1.51	2.12	0.93	1.12
(c) Clean, uniform sand (fine or medium)	1.35	1.86	1.92	1.37	2.20	0.85	1.18
(d) Uniform, inorganic silt	1.29	—	1.92	1.31	2.20	0.83	1.18
2. Well-graded materials:							
(a) Silty sand	1.41	1.98	2.06	1.43	2.30	0.88	1.28
(b) Clean, fine to course sand	1.38	2.14	2.23	1.40	2.39	0.86	1.40
(c) Micaceous sand	1.23	—	1.95	1.24	2.23	0.77	1.23
(d) Silty sand and gravel	1.44	—	2.36	1.46	2.51	0.91	1.49

†Tabulation is based on $\rho_s = 2.65$ Mg/m³. Multiply by 62.4 to obtain lbf/ft³.

2.06 mg/m³ = 129 lb/ft³

2.30 mg/m³ = 144 lb/ft³

Source: Holtz and Kovacs (1981)

TABLE 3.5
COMMON PROPERTIES OF COHESIONLESS SOILS**

Material	Compactness	D_R, %	N*	γ_{dry},† g/cm³	Void ratio e	Strength‡ ϕ
GW: well-graded gravels, gravel-sand mixtures	Dense	75	90	2.21	0.22	40
	Medium dense	50	55	2.08	0.28	36
	Loose	25	<28	1.97	0.36	32
GP: poorly graded gravels, gravel-sand mixtures	Dense	75	70	2.04	0.33	38
	Medium dense	50	50	1.92	0.39	35
	Loose	25	<20	1.83	0.47	32
SW: well-graded sands, gravelly sands	Dense	75	65	1.89	0.43	37
	Medium dense	50	35	1.79	0.49	34
	Loose	25	<15	1.70	0.57	30
SP: poorly graded sands, gravelly sands	Dense	75	50	1.76	0.52	36
	Medium dense	50	30	1.67	0.60	33
	Loose	25	<10	1.59	0.65	29
SM: silty sands	Dense	75	45	1.65	0.62	35
	Medium dense	50	25	1.55	0.74	32
	Loose	25	<8	1.49	0.80	29
ML: inorganic silts, very fine sands	Dense	75	35	1.49	0.80	33
	Medium dense	50	20	1.41	0.90	31
	Loose	25	<4	1.35	1.0	27

*N is blows per foot of penetration in the SPT. Adjustments for gradation are after Burmister (1962).[24] See Table 6.4 for general relationships of D_R vs. N.

†Density given is for G_s = 2.68 (quartz grains).

‡Friction angle ϕ depends on mineral type, normal stress, and grain angularity as well as D_R and gradation (see Fig. 3.29).

**From Hunt (1984).[1] Reprinted with permission of McGraw-Hill Book Company.

Source: Hunt (1986)

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Problem Title : WILLOW CREEK POND 1
Description : OPERATIONAL PHASE, UPSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 9
Number of Top Boundaries : 9

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                   TRIAL SURFACE GENERATION                        *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 20.00 ft
Right Initiation Point : 50.00 ft
Left Termination Point : 78.00 ft
Right Termination Point : 108.00 ft
Minimum Elevation : 10.00 ft

Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 1.330
Circle Center X : 50.02 ft
Circle Center Y : 124.87 ft
Circle Radius : 47.93 ft

```
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Problem Title : WILLOW CREEK POND 1
Description : OPERATIONAL PHASE, UPSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 9
Number of Top Boundaries : 9

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*****************************************************************************
*****                     TRIAL SURFACE GENERATION                      *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 20.00 ft
Right Initiation Point : 50.00 ft
Left Termination Point : 78.00 ft
Right Termination Point : 108.00 ft
Minimum Elevation : 10.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 1.028
Circle Center X : 50.02 ft
Circle Center Y : 124.87 ft
Circle Radius : 47.93 ft

```
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Problem Title : WILLOW CREEK POND 1
Description : OPERATIONAL PHASE, DOWNSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 9
Number of Top Boundaries : 9

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                          RESULTS                                  *****
*****************************************************************************
```

Critical Surface

Factor of Safety : 0.990
Circle Center X : 31.47 ft
Circle Center Y : 114.74 ft
Circle Radius : 66.19 ft

4/

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Problem Title : WILLOW CREEK POND 1
Description : OPERATIONAL PHASE, DOWNSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 9
Number of Top Boundaries : 9

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*****************************************************************************
*****                   TRIAL SURFACE GENERATION                        *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 22.00 ft
Right Initiation Point : 42.00 ft
Left Termination Point : 90.00 ft
Right Termination Point : 120.00 ft
Minimum Elevation : 10.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.845
Circle Center X : 31.47 ft
Circle Center Y : 114.74 ft
Circle Radius : 66.19 ft

Pond 1 (reclamation)

Cross sections → See pp 14 and 15 of this calc.

Soil parameters → as noted on pg 1 of this calc.

Results:

Face	Condition	Safety Factor
Upstream	Static	1.0
Upstream	Seismic	0.8
Downstream	Static	1.5
Downstream	Seismic	1.2

See pp 16-22 of this calc.

Trap 3B

Worst case of the sediment traps (closest to stream channel, deep pond). Analyze this trap for stability and assume others are better.

Cross sections → see pp 23 and 24 of this calc.

Soil parameters → as noted on pg 1 of this calc.

Results:

Face	Condition	Safety Factor
Upstream	Static	0.8
Upstream	Seismic	0.6
Downstream	Static	0.9
Downstream	Seismic	0.7

See pp 25-31 of this calc.

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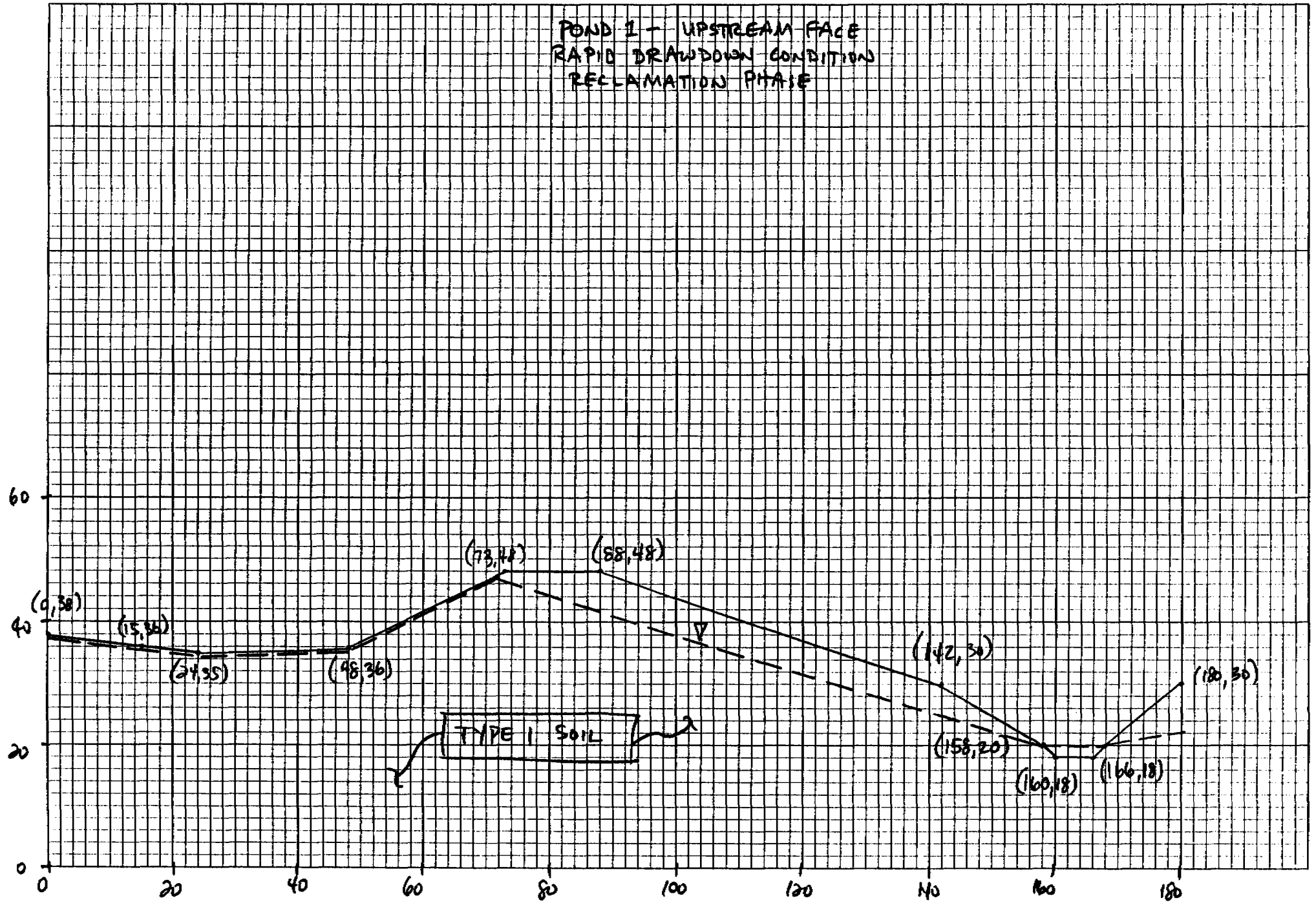

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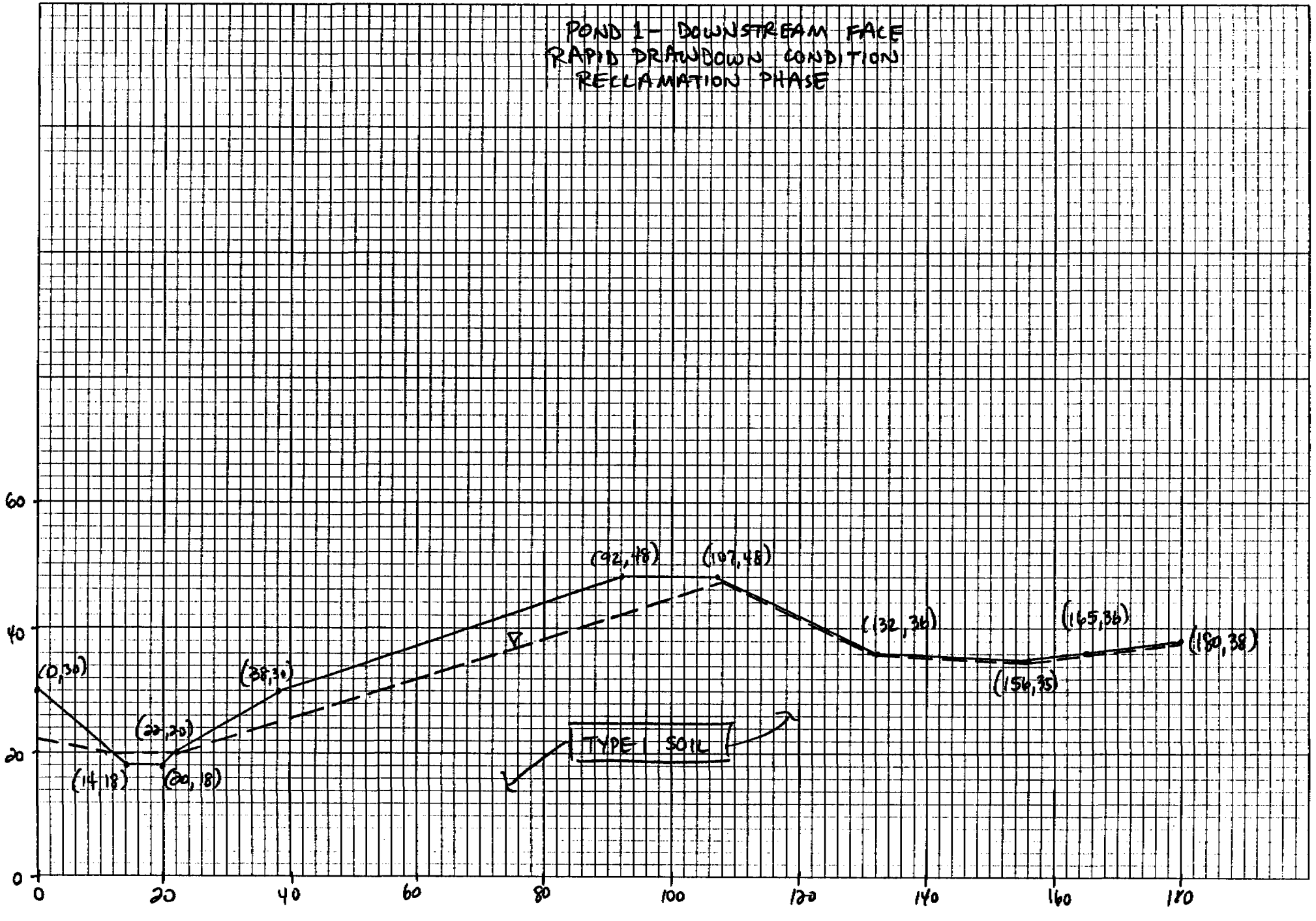
POND 1 - DOWNSTREAM FACE
RAPID DRAWDOWN CONDITION
RECLAMATION PHASE



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Problem Title : WILLOW CREEK POND 1
Description : RECLAMATION PHASE, UPSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                          RESULTS                                  *****
*****************************************************************************
```

Critical Surface

Factor of Safety : 1.009
Circle Center X : 43.18 ft
Circle Center Y : 84.51 ft
Circle Radius : 49.80 ft

```
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Problem Title : WILLOW CREEK POND 1
Description : RECLAMATION PHASE, UPSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*****************************************************************************
*****                   TRIAL SURFACE GENERATION                        *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 24.00 ft
Right Initiation Point : 48.00 ft
Left Termination Point : 72.00 ft
Right Termination Point : 88.00 ft
Minimum Elevation : 10.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.800
Circle Center X : 43.18 ft
Circle Center Y : 84.51 ft
Circle Radius : 49.80 ft

```
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Problem Title : WILLOW CREEK POND 1
Description : RECLAMATION PHASE, DOWNSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                   TRIAL SURFACE GENERATION                        *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 14.00 ft
Right Initiation Point : 24.00 ft
Left Termination Point : 90.00 ft
Right Termination Point : 107.00 ft
Minimum Elevation : 0.00 ft

Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 1.516
Circle Center X : 33.32 ft
Circle Center Y : 94.98 ft
Circle Radius : 78.41 ft

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```
*****************************************************************************
*****                          GeoSlope                                 *****
*****                        Version 5.00                               *****
*****                                                                   *****
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*****************************************************************************
```

Problem Title : WILLOW CREEK POND 1
Description : RECLAMATION PHASE, DOWNSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 10
Number of Top Boundaries : 10

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*****************************************************************************
*****                   TRIAL SURFACE GENERATION                        *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 14.00 ft
Right Initiation Point : 24.00 ft
Left Termination Point : 90.00 ft
Right Termination Point : 107.00 ft
Minimum Elevation : 0.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

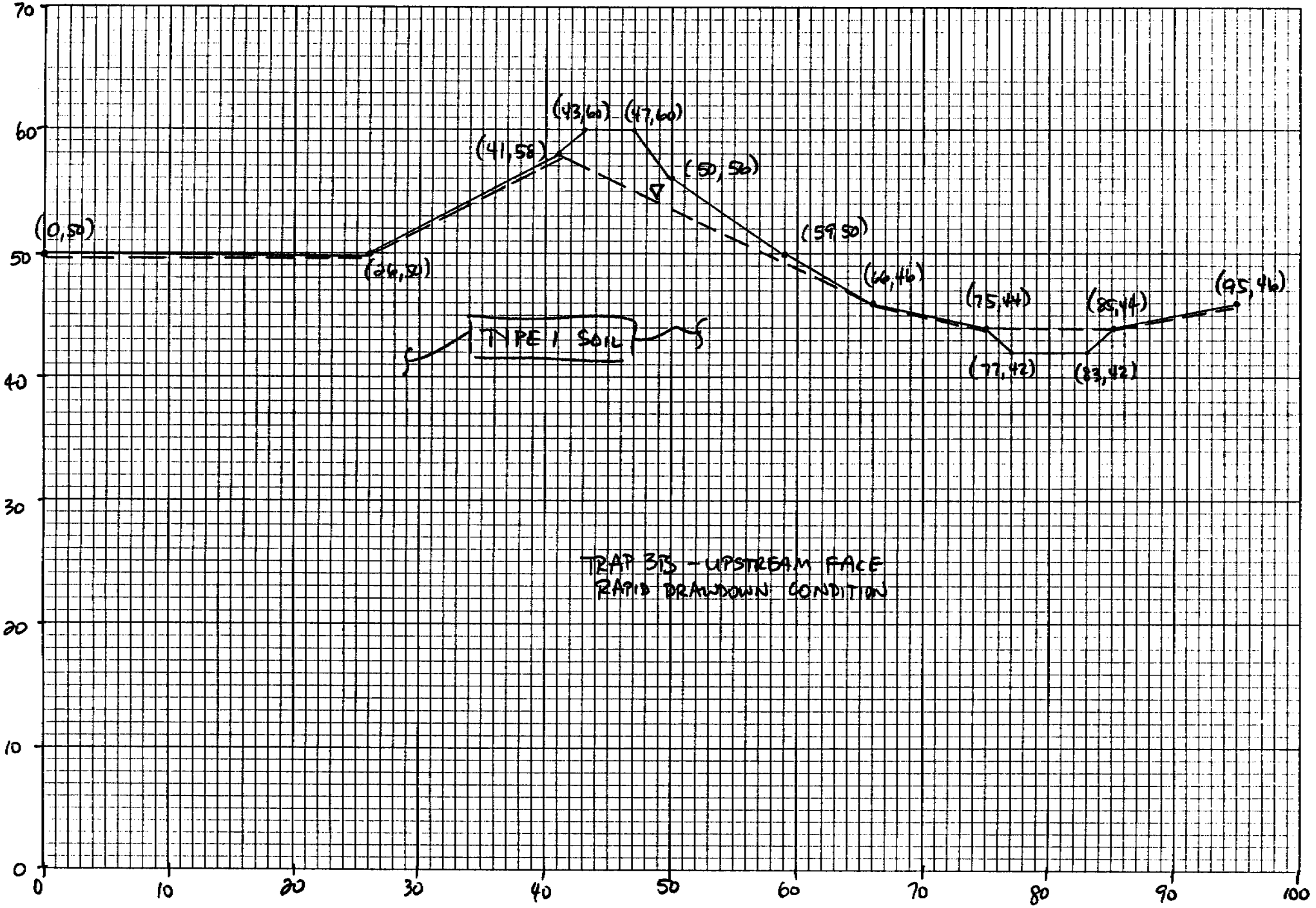
****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 1.207
Circle Center X : 31.93 ft
Circle Center Y : 106.89 ft
Circle Radius : 90.08 ft

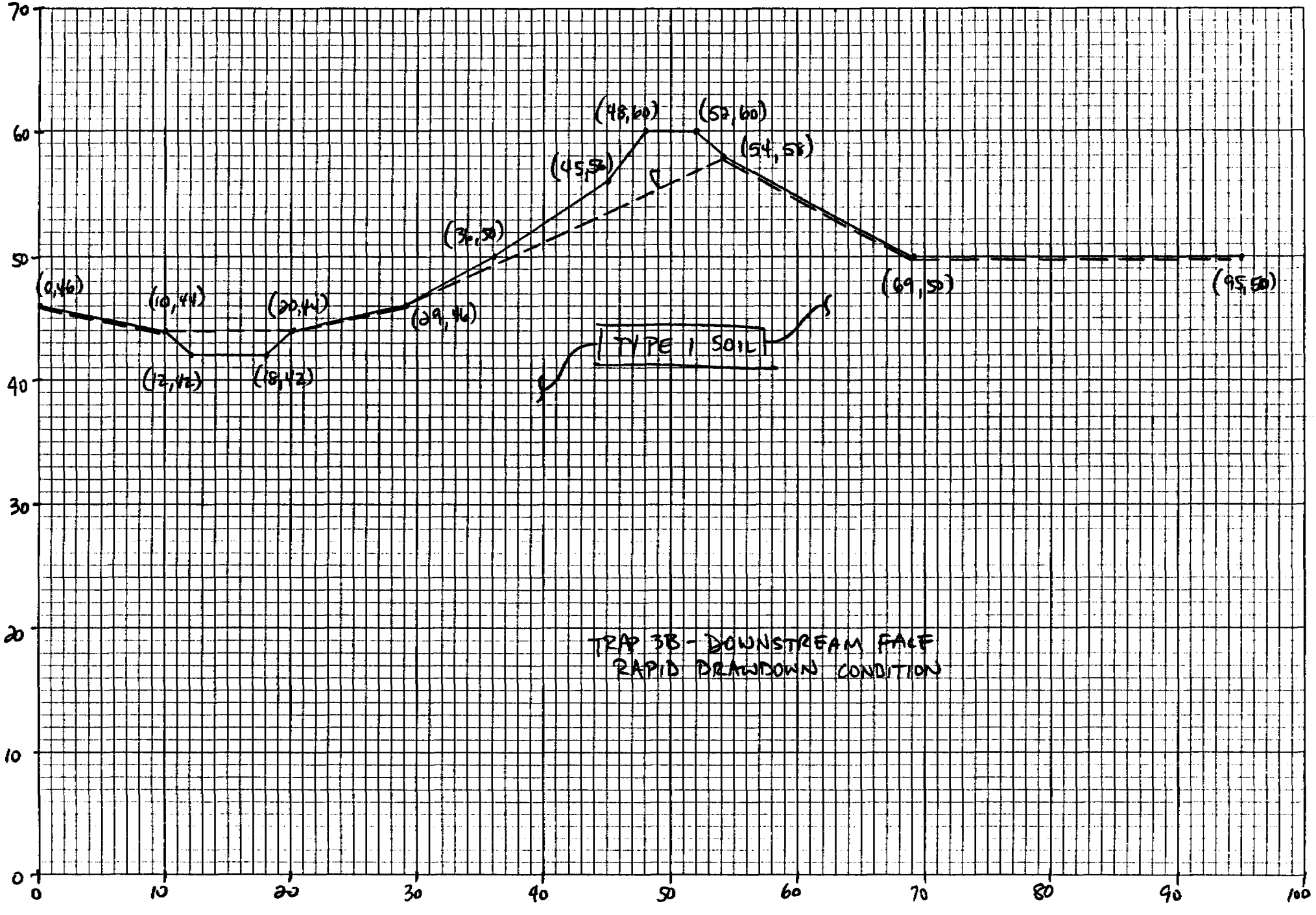
K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 0700



/ce

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 0700



24

```
*****************************************************************************
*****                          GeoSlope                                 *****
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```

Problem Title : WILL CREEK TRAP 3B
Description : UPSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 12
Number of Top Boundaries : 12

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                          RESULTS                                  *****
*****************************************************************************
```

Critical Surface

Factor of Safety : 0.790
Circle Center X : 26.93 ft
Circle Center Y : 71.42 ft
Circle Radius : 21.44 ft

```
*****************************************************************************
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*****                                                                   *****
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*****************************************************************************
```

Problem Title : WILL CREEK TRAP 3B
Description : UPSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 12
Number of Top Boundaries : 12

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*****************************************************************************
*****                     TRIAL SURFACE GENERATION                      *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 16.00 ft
Right Initiation Point : 26.00 ft
Left Termination Point : 41.00 ft
Right Termination Point : 47.00 ft
Minimum Elevation : 10.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.645
Circle Center X : 26.93 ft
Circle Center Y : 71.42 ft
Circle Radius : 21.44 ft

```
*****************************************************************************
*****                          GeoSlope                                 *****
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*****                                                                   *****
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*****************************************************************************
```

Problem Title : WILLOW CREEK TRAP 3B
Description : DOWNSTREAM FACE
Remarks : STATIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 12
Number of Top Boundaries : 12

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

```
*****************************************************************************
*****                     TRIAL SURFACE GENERATION                      *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 12.00 ft
Right Initiation Point : 20.00 ft
Left Termination Point : 45.00 ft
Right Termination Point : 52.00 ft
Minimum Elevation : 10.00 ft

Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.893
Circle Center X : 19.29 ft
Circle Center Y : 85.41 ft
Circle Radius : 41.42 ft

```
*****************************************************************************
*****                          GeoSlope                                 *****
*****                        Version 5.00                               *****
*****                                                                   *****
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*****************************************************************************
```

Problem Title : WILLOW CREEK TRAP 3B
Description : DOWNSTREAM FACE
Remarks : SEISMIC SAFETY FACTOR, RAPID DRAWDOWN

```
*****************************************************************************
*****                          INPUT DATA                               *****
*****************************************************************************
```

Profile Boundaries

Number of Boundaries : 12
Number of Top Boundaries : 12

Soil Parameters

Number of Soil Types : 1

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Earthquake Loading

Horizontal Acceleration Coefficient : 0.080
Vertical Acceleration Coefficient : 0.000

```
*****************************************************************************
*****                   TRIAL SURFACE GENERATION                        *****
*****************************************************************************
```

Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 12.00 ft
Right Initiation Point : 20.00 ft
Left Termination Point : 45.00 ft
Right Termination Point : 52.00 ft
Minimum Elevation : 10.00 ft
Segment Length : 5.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

****
***** RESULTS *****
****

Critical Surface

Factor of Safety : 0.742
Circle Center X : 19.29 ft
Circle Center Y : 85.41 ft
Circle Radius : 41.42 ft

Conclusions

Pond 1 generally stable under static, rapid drawdown conditions. However, seismic conditions may result in instability.

Trap 3B may be instable under all rapid drawdown conditions.

Avoid rapid drawdown. Ponds otherwise considered to be stable (see Terramatrix report in Appendix 12-5-2 of the permit application).

References

Holtz, R.D. and W.D. Kovacs. 1981. An Introduction to Geotechnical Engineering. Prentice-Hall, Inc. Englewood Cliffs, NJ.

Hunt, R.E. 1986.

APPENDIX 12-6-1
DRILL LOGS

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
7/21/95
STATE OF UTAH

TH-01

BOREHOLE NUMBER: TH-01 SHEET 1 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6301.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hartley

DATE/TIME STARTED: 16 NOV 94/ 1245

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 17 NOV 94/ 0930

WATER DEPTH: 44.8 DATE/TIME OF DEPTH: 17-11-94/ 0930

LOGGED BY: G.E. Miller

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
								Top PVC elev: N/A
6301.0 / 0.1	*Compact to very dense, brown to yellowish and grayish brown, SAND, some Silt, little Sandstone fragments, trace Clay, trace Coal, dry (ROAD FILL)*							
		SM	1	SPT	22/27/27	5.0	▲	
						10.0		
		SM	2	SPT	7/8/26		▲	
						15.0		
		SP	3	SPT	7/11/17		▲	
						20.0		
		SM	4	SPT	60/6"			
6278.5 / 22.5	*Very dense, light yellowish brown to light grayish yellow, Silty SAND, little to some Sandstone fragments, trace Clay, dry to damp*							
						25.0		

Continued Next Page

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology NOTE 2: N/A

Project No.: 866	Design By: G. E. Miller	Scale: 66:1	Willow Creek
File: CYPR6	Drawn By: M. Fairhurst	Date: December 15, 1994	
TerraMatrix Engineering & Environmental Services, 1475 Pine Grove Road, P.O. Box 774010, Steamboat Springs, Colorado 80477	Figure 1		Cyprus Plateau Mining Company

ACZE .10 JAN 95

TH-01

BOREHOLE NUMBER: TH-01 | SHEET 2 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6301.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hardey

DATE/TIME STARTED: 16 NOV 94/ 1245

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 17 NOV 94/ 0930

WATER DEPTH: 44.8 DATE/TIME OF DEPTH: 17-11-94/ 0930

LOGGED BY: G.E. Miller

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
	(Continued)							
		SM	5	SPT	35/70/45		>>	
						30.0		
		SM	6	SPT	40/38/60			
	DRAFT					35.0		
		SM	7	SPT	5/20/60			
6263.0 / 38.0	*Very dense, light yellow brown to light gray brown, Clayey c-f SAND, some Sandstone, some Siltstone, wet*					40.0		
		SC	8	SPT	100/6"			
						45.0		
		SC	9	SPT	5/33/33			
6253.0 / 48.0	*Bedrock Sandstone*					50.0		

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: G. E. Miller	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

TerraMatrix
Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774010
Steamboat Springs, Colorado 80477

Figure 1

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-01

BOREHOLE NUMBER: TH-01 SHEET 3 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6301.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hartley

DATE/TIME STARTED: 16 NOV 94/ 1245

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 17 NOV 94/ 0930

WATER DEPTH: 44.8 DATE/TIME OF DEPTH: 17-11-94/ 0930

LOGGED BY: G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT 20 40 60 80 / WATER CONTENT, PERCENT & RANGE Wp 20 40 Wn 60 WL 80	WELL CONSTRUCTION
Feet	*(Continued)*					Feet		
	Mudstone from 51.0' to 51.5'	N/A	10	SPT	60/0"			
						55.0		
6245.0 / 56.0	*Bottom of Hole at 56.0'* *NOTE: Lost 5' of NX casing (43-48') in hole.* *NOTE: Water table at 44.8' from ground level.*							

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: G. E. Miller	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 16, 1994	
TerraMatrix Engineering & Environmental Services, 1476 Pine Grove Road, P.O. Box 774018, Steamboat Springs, Colorado 80477	Figure 1		Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-02

BOREHOLE NUMBER: TH-02 SHEET 1 OF 6

BORING LOCATION:

SURFACE ELEVATION: 6361.0

DRILLING CO.: R8 & G Engineering Inc. DRILLER: B. Hardey

DATE/TIME STARTED: 17 NOV 94/ 1226

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 21 NOV 94/ 1630

WATER DEPTH: 96.6 DATE/TIME OF DEPTH: 22-11-94/ 0815

LOGGED BY: G.E. Miller

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
								Top PVC elev: N/A
6361.0 / 0.1	*Compact, dark yellow brown to brown red to burnt orange-red, mottled, SAND, little Clay, wet (from water introduced downhole) (FILL)*							
6356.0 / 5.0	*NOTE: Driving NX pipe after tri-cone.*	SW-SC	1	SPT	7/7/9	5.0	▲	
6354.0 / 7.0	*Compact to very dense, red brown to yellow brown to light brown yellow, mottled, Clayey SAND, some Sandstone, wet (COLLUVIUM)*							
		SC	2	SPT	8/10/12	10.0	▲	
	DRAFT							
		SC	3	SPT	38/34/30	15.0	▲	
6342.0 / 19.0	*SANDSTONE BEDROCK*							
		N/A	4	SPT	60/0"	20.0	▲	
						25.0		

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: 0 - 119.6'
CASING MATERIAL: Schedule 40 & 80 PVC
CASING DIAMETER: 1.0"
FILTER INTERVAL/TYPE: 120'-96.2'/ 10-20 sand

BENTONITE INTERVAL: 96.2' - 92.2'
GROUT INTERVAL/TYPE: 92.2' - 0
SCREENED INTERVAL: 119.6' - 99.6'
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology NOTE 2: N/A

Project No.: 866	Design By: G. E. Miller	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	
TerraMatrix Engineering & Environmental Services, 1476 Pine Grove Road, P.O. Box 774616, Steamboat Springs, Colorado 80477	Figure 2		Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-02

BOREHOLE NUMBER: TH-02 SHEET 2 OF 6

BORING LOCATION:

SURFACE ELEVATION: 6361.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hartley

DATE/TIME STARTED: 17 NOV 94/ 1225

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 21 NOV 94/ 1630

WATER DEPTH: 96.6 DATE/TIME OF DEPTH: 22-11-94/ 0815

LOGGED BY: G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT 20 40 60 80 / WATER CONTENT, PERCENT & RANGE Wp Wn WL 20 40 60 80	WELL CONSTRUCTION
Feet	(Continued)					Feet		
6335.0 / 26.0	Switch to coring. See Rock Core Log for coring detail.							
						30.0		
						35.0		
						40.0		
						45.0		
						50.0		

DRAFT

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: 0 - 119.6'
CASING MATERIAL: Schedule 40 & 80 PVC
CASING DIAMETER: 1.0"
FILTER INTERVAL/TYPE: 120'-96.2'/ 10-20 sand

BENTONITE INTERVAL: 96.2' - 92.2'
GROUT INTERVAL/TYPE: 92.2' - 0
SCREENED INTERVAL: 119.6' - 99.6'
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 868	Design By: G. E. Miller	Scale: 55:1
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994

Willow Creek

TerraMatrix
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Steamboat Springs, Colorado 80477

Figure 2

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-02

BOREHOLE NUMBER:
BORING LOCATION:
DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hartley
EQUIPMENT: CME - 55
WATER DEPTH: 96.6 DATE/TIME OF DEPTH: 22-11-94/ 0815

SURFACE ELEVATION: 6361.0
DATE/TIME STARTED: 17 NOV 94/ 1226
DATE/TIME FINISHED: 21 NOV 94/ 1630
LOGGED BY: G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT 20 40 60 80 / WATER CONTENT, PERCENT & RANGE Wp Wn WL 20 40 60 80	WELL CONSTRUCTION
Feet	*(Continued)*					Feet		
	DRAFT					55.0		
						60.0		
						65.0		
						70.0		
						75.0		
	Continued Next Page							

WELL CONSTRUCTION DETAILS

CASED INTERVAL: 0 - 119.6'
CASING MATERIAL: Schedule 40 & 80 PVC
CASING DIAMETER: 1.0"
FILTER INTERVAL/TYPE: 120'-96.2'/ 10-20 sand

BENTONITE INTERVAL: 96.2' - 92.2'
GROUT INTERVAL/TYPE: 92.2' - 0
SCREENED INTERVAL: 119.6' - 99.6'
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: G. E. Miller	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Steamboat Springs, Colorado 80477

Figure 2

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-02

BOREHOLE NUMBER: TH-02 SHEET 4 OF 6

BORING LOCATION:

SURFACE ELEVATION: 6361.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hardey

DATE/TIME STARTED: 17 NOV 94/ 1225

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 21 NOV 94/ 1630

WATER DEPTH: 96.8 DATE/TIME OF DEPTH: 22-11-94/ 0815

LOGGED BY: G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT 20 40 60 80 / WATER CONTENT, PERCENT & RANGE Wp Wn WL 20 40 60 80	WELL CONSTRUCTION
Feet	*(Continued)*					Feet		
	DRAFT					80.0		
						85.0		
						90.0		
						95.0		
						100.0		

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: 0 - 119.6'
CASING MATERIAL: Schedule 40 & 80 PVC
CASING DIAMETER: 1.0"
FILTER INTERVAL/TYPE: 120'-96.2'/ 10-20 sand

BENTONITE INTERVAL: 96.2' - 92.2'
GROUT INTERVAL/TYPE: 92.2' - 0
SCREENED INTERVAL: 119.6' - 99.6'
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 966	Design By: G. E. Miller	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Engineering & Environmental Services
1426 Pine Grove Road, P.O. Box 774010
Steamboat Springs, Colorado 80477

Figure 2

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-02

BOREHOLE NUMBER: TH-02 SHEET 5 OF 6

BORING LOCATION: SURFACE ELEVATION: 6361.0

DRILLING CO.: RS & G Engineering Inc. DRILLER: B. Hardey DATE/TIME STARTED: 17 NOV 94/ 1225

EQUIPMENT: CME - 55 DATE/TIME FINISHED: 21 NOV 94/ 1630

WATER DEPTH: 96.6 DATE/TIME OF DEPTH: 22-11-94/ 0815 LOGGED BY: G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
Feet	(Continued)					Feet		
	DRAFT					105.0		
						110.0		
						115.0		
						120.0		
						125.0		
	Continued Next Page							

WELL CONSTRUCTION DETAILS

CASED INTERVAL: 0 - 119.6'
CASING MATERIAL: Schedule 40 & 80 PVC
CASING DIAMETER: 1.0"
FILTER INTERVAL/TYPE: 120'-96.2'/ 10-20 sand

BENTONITE INTERVAL: 96.2' - 92.2'
GROUT INTERVAL/TYPE: 92.2' - 0
SCREENED INTERVAL: 119.6' - 99.6'
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: G. E. Miller	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

TerraMatrix
Engineering & Environmental Services
1476 Pine Grove Road, P.O. Box 774010
Steamboat Springs, Colorado 80477

Figure 2

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-02

BOREHOLE NUMBER: TH-02 | SHEET 6 OF 6

BORING LOCATION:

DRILLING CO.: RB & G Engineering Inc. DRILLER: S. Hartley

EQUIPMENT: CME - 55

WATER DEPTH: 96.6 DATE/TIME OF DEPTH: 22-11-94/ 0815

SURFACE ELEVATION: 6361.0

DATE/TIME STARTED: 17 NOV 94/ 1225

DATE/TIME FINISHED: 21 NOV 94/ 1630

LOGGED BY: G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT 20 40 60 80 / WATER CONTENT, PERCENT & RANGE Wp Wn WL 20 40 60 80	WELL CONSTRUCTION
Feet	*(Continued)*					Feet		
	DRAFT					130.0		
						135.0		
6222.5 / 138.5	*Bottom of Hole at 138.5'*							

WELL CONSTRUCTION DETAILS

CASED INTERVAL: 0 - 119.6'
CASING MATERIAL: Schedule 40 & 80 PVC
CASING DIAMETER: 1.0"
FILTER INTERVAL/TYPE: 120'-96.2'/ 10-20 sand

BENTONITE INTERVAL: 96.2' - 92.2'
GROUT INTERVAL/TYPE: 92.2' - 0
SCREENED INTERVAL: 119.6' - 99.6'
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 806	Design By: G. E. Miller	Scale: 55:1
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994

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Steamboat Springs, Colorado 80477

Figure 2

Willow Creek

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-03

BOREHOLE NUMBER: TH-03 SHEET 1 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6334.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hardey

DATE/TIME STARTED: 15 NOV 94/ 1350

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 16 NOV 94/ 1015

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

LOGGED BY: G.E. Miller

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL)	WELL CONSTRUCTION
								Top PVC elev: N/A
6334.0	*Cuttings are a Light brown to yellow, CLAY, some Sand, little Sandstone fragments*							
0.1								
6333.0	*Dense to very dense, black, shaley, COAL, some mudstone fragments, little Sand, little Clayey, dry (COAL REFUSE)*							
1.0								
		COAL REF	1	SPT	17/35/47	5.0	▲	
		COAL REF	2	SPT	7/14/19	10.0	▲	
		COAL REF	3	SPT	16/25/29	15.0	▲	
		COAL REF	4	SPT	16/18/26	20.0	▲	
						25.0		

DRAFT

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology NOTE 2: N/A

Project No.: 966	Design By: G. E. Miller	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Figure 3

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-03

BOREHOLE NUMBER: TH-03 SHEET 2 OF 3

BORING LOCATION:

DRILLING CO.: RE & G Engineering Inc. DRILLER: B. Hardey

EQUIPMENT: CME - 55

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

SURFACE ELEVATION: 6334.0

DATE/TIME STARTED: 15 NOV 94/ 1350

DATE/TIME FINISHED: 16 NOV 94/ 1015

LOGGED BY: G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
Feet	(Continued)					Feet		
		COAL REF	5	SPT	10/17/21		▲	
6306.5 27.5	Note: Added water downhole							
6306.0 28.0	Note: Clayey and sticky (expensive) from 28.0' to 29.0'.							
		COAL REF	6	SPT	23/38/27	30.0	▲	
		COAL REF	7	SPT	19/34/36	35.0	▲	
	DRAFT							
		COAL REF	8	SPT	20/24/28	40.0	▲	
		COAL REF	9	SPT	25/40/35	45.0	▲	
6288.0 46.0	Note: Clayey and sticky							
6286.0 48.0	Note: Added water downhole							
	Continued Next Page					50.0		

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: G. E. Miller	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Figure 3

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-03

BOREHOLE NUMBER: TH-03 SHEET 3 OF 3

BORING LOCATION:

DRILLING CO.: RB & G Engineering Inc. DRILLER: S. Hartley

EQUIPMENT: CME - 55

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

SURFACE ELEVATION: 6334.0

DATE/TIME STARTED: 15 NOV 94/ 1360

DATE/TIME FINISHED: 16 NOV 94/ 1015

LOGGED BY: G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL)	WELL CONSTRUCTION
Feet	(Continued)					Feet		
		COAL REF	10	SPT	18/26/38		▲	
6281.0 / 53.0	Note: trace Clay							
6279.0 / 55.0	Note: Firm drilling	COAL REF	11	SPT	18/28/34	55.0	▲	
6277.0 / 57.0	Note: Hard drilling with sandstone fragments							
6273.4 / 60.6	Very dense, brown gray, fine grained, SANDSTONE, little clay, wet (SANDSTONE BEDROCK)	COAL SP	12	SPT	24/80/4"	60.0		
		SP	13	SPT	80/2"	65.0		
6266.0 / 68.0	Dark gray, Clayey MUDSTONE							
6265.0 / 69.0	SANDSTONE					70.0		
6262.0 / 72.0	Bottom of Hole at 72.0'							

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: G. E. Miller	Scale: 55:1
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994

Willow Creek

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Figure 3

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-05

BOREHOLE NUMBER: TH-05 SHEET 1 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6298.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hardey

DATE/TIME STARTED: 14 NOV 94/ 1146

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 16 NOV 94/ 1130

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

LOGGED BY: MMFairhurst/G.E. Miller

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT 20 40 60 80 / WATER CONTENT, PERCENT & RANGE Wp Wn WL 20 40 60 80	WELL CONSTRUCTION
6298.0	*Cuttings are a Light yellowish brown, GRAVEL and SAND, dry (TOPSOIL)*							*Top PVC elev: N/A*
0.1								
6297.0	*Log cuttings: Black COAL (COAL REFUSE)*							
1.0								
						5.0		
						10.0		
						15.0		
						20.0		
6277.0								
21.0	*Note: Sandstone boulder from 21.0' to 22.0'*							
						25.0		

DRAFT

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology NOTE 2: N/A

Project No.: 866	Design By: M. Fairhurst	Scale: 66:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 16, 1994	

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Figure 5

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-05

BOREHOLE NUMBER: TH-05 | SHEET 2 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6298.0

DRILLING CO.: R& & G Engineering Inc. DRILLER: S. Hardey

DATE/TIME STARTED: 14 NOV 94/ 1145

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 16 NOV 94/ 1130

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

LOGGED BY: MMFairhu/G.E. Miller

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL)	WELL CONSTRUCTION
	(Continued)							
6271.5 / 26.5	*Note: Drilling more dense*	COAL REF	1	SPT	16/13/33		▲	
		COAL REF	2	SPT	14/22/26	30.0	▲	
		COAL REF	3	SPT	10/14/9	35.0	▲	
						40.0		
6256.0 / 42.0	*Sandstone boulder zone*							
6253.0 / 45.0	*No sample recovery*	N/A	4	SPT	50/0"	45.0		
6251.0 / 47.0	*Very dense, light yellow brown (10YR 5/4), weakly cemented to some areas well cemented, very fine grained, SANDSTONE/QUARTZITE and c-f*					50.0		

Continued Next Page

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A
BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Figure 5

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-05

BOREHOLE NUMBER: TH-05 SHEET 3 OF 3

BORING LOCATION: SURFACE ELEVATION: 6298.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hardey DATE/TIME STARTED: 14 NOV 94/ 1146

EQUIPMENT: CME - 55 DATE/TIME FINISHED: 15 NOV 94/ 1130

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A LOGGED BY: MMFairhu/G.E. Miller

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
Feet	(Continued)					Feet		
	silty SAND, trace c-f Gravel (sub-angular sandstone), damp to dry	SP	5	SPT	27/66/55		>>	
						55.0		
		SP-SM	6	SPT	34/58/60/1"		>>	
						60.0		
6236.9		SP	7	SPT	60/2"			
61.1	Bottom of Hole at 61.1'							

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Figure 5

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-06

BOREHOLE NUMBER: TH-06 | SHEET 1 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6346.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hartley

DATE/TIME STARTED: 11 NOV 94/ 0755

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 11 NOV 94/ 1600

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

LOGGED BY: M. Fairhurst

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
								Top PVC elev: N/A
6346.0 / 0.1	*Very dense, grayish orange to pale - moderate yellowish brown, c-f SAND, trace to some Silt, trace to little c-f sub-angular Gravel, trace Clay, damp to dry (COLLUVIUM)*							
		SW-SM	1	SPT	18/25/42	5.0	▲	
		SW-SM	2	SPT	38/34/27	10.0	● ▲	
						15.0		
		SW-SM	3	SPT	28/60/6"			
		SM	4	SPT	60/5"	20.0		
						25.0		

DRAFT

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A
BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology NOTE 2: N/A

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994

Willow Creek

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Steamboat Springs, Colorado 80477

Figure 6

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-06

BOREHOLE NUMBER:
BORING LOCATION:
DRILLING CO.: RB & G Engineering Inc. DRILLER: S. Hardey
EQUIPMENT: CME - 55
WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

SURFACE ELEVATION: 6346.0
DATE/TIME STARTED: 11 NOV 94/ 0755
DATE/TIME FINISHED: 11 NOV 94/ 1600
LOGGED BY: M. Fairhurst

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL)	WELL CONSTRUCTION
	(Continued)							
		SW	5	SPT	28/32/25		▲	
						30.0		
		SW	6	SPT	14/40/50		▲	
	DRAFT					35.0		
		SM	7	SPT	32/60/50		>>	
						40.0		
		SM	8	SPT	50/55/35		▲	
6303.5 / 42.5	Hard, dark grey and black, laminated, Clayey LIGNITE, iron stained, damp							
						45.0		
		OL	9	SPT	20/43/50/3"		>>	
6296.0						50.0		

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Figure 6

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-06

BOREHOLE NUMBER: TH-06 SHEET 3 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6346.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hardey

DATE/TIME STARTED: 11 NOV 94/ 0755

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 11 NOV 94/ 1800

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

LOGGED BY: M. Fairhurst

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
	(Continued)							
50.0	*Hard, dark gray, Sandy SILTSTONE and SILTY CLAY, damp (Sandy SILTSTONE/CLAY)*	CL	10	SPT	60/2"			
6291.0 / 55.0	*Bottom of Hole at 55.0'*					55.0		

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A
BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 868	Design By: M. Fairhurst	Scale: 66:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	
TerraMatrix Engineering & Environmental Services, 1435 Pine Grove Road, P.O. Box 774010, Steamboat Springs, Colorado 80477	Figure 6		Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-08

BOREHOLE NUMBER: TH-08 SHEET 1 OF 2

BORING LOCATION:

SURFACE ELEVATION: 6297.0

DRILLING CO.: R8 & G Engineering Inc. DRILLER: B. Hartley

DATE/TIME STARTED: 10 NOV 94/ 1215

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 10 NOV 94/ 1600

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

LOGGED BY: M. Fairhurst

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
								Top PVC elev: N/A
6297.0 / 0.1	*Dense, pale reddish brown to moderate yellowish brown to grayish orange, m-f SAND, little Silt, little c-f sub-angular Gravel, trace coal, iron staining noted, dry to damp (ALLUVIUM/COLLUVIUM?)*							
		SP-SM	1	SPT	26/23/22	5.0	● ▲	
	DRAFT					10.0		
		SP-SM	2	SPT	10/23/16		▲	
						15.0		
		SM	3	SPT	3/5/28		▲	
6277.0 / 20.0	*Note: Boulder from 20.0' to 21.5'*					20.0		
6276.3 / 21.7	*Note: Boulder from 21.7' to 22.7'*							
6272.0						25.0		

Continued Next Page

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology NOTE 2: N/A

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Steamboat Springs, Colorado 80477

Figure 8

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-08

BOREHOLE NUMBER: TH-08 | SHEET 2 OF 2

BORING LOCATION:

SURFACE ELEVATION: 6297.0

DRILLING CO.: RB & G Engineering Inc. | DRILLER: B. Hardey

DATE/TIME STARTED: 10 NOV 94/ 1216

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 10 NOV 94/ 1600

WATER DEPTH: N/A | DATE/TIME OF DEPTH: N/A

LOGGED BY: M. Fairhurst

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION (Continued)	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
25.0	*Note: Switch out to tricone and case hole with NX casing after driving sample*	SP	4	SPT	40/50/55		>>	
						30.0		
		SW	5	SPT	48/58/60/1"		>>	
	Driller notes: From 34.0' on hitting boulders but is predominantly a softer drilling zone. Note: Hole caved at 35.0'. Drive casing. No recovery.					35.0		
		7	6	SPT	60/0.5"			
6256.7 / 40.3	*Bottom of Hole at 40.3'*	SM	7	SPT	60/4"	40.0		

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

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Figure 8

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-09

BOREHOLE NUMBER: TH-09 SHEET 1 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6292.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hardey

DATE/TIME STARTED: 9 NOV 94/ 1340

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 10 NOV 94/ 1030

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

LOGGED BY: M. Fairhurst

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL; 20 40 60 80)	WELL CONSTRUCTION
								Top PVC elev: N/A
6292.0	Yellowish-brown, m-f SAND and c-f Gravel, dry (COLLUVIUM/TOPSOIL)							
0.1 / 6291.0								
1.0	Compact to very dense, black, non-stratified, COAL, some Sand, scattered coal lumps, burnt coal noted, damp-dry (COAL REFUSE/FILL)							
		COAL REF	1	SPT	10/9/9	5.0	▲	
		COAL REF	2	SPT	9/8/9	10.0	▲	
	Note: Switch to a PT sampler to obtain greater amounts of sample	COAL REF	3	PT	9/25/40	15.0	▲	
6274.5 / 17.5	Dense to very dense, moderate yellowish brown, mottled, weakly stratified, m-f SAND, trace to some Silt, little to some c-f Gravel, trace Clay, trace Coal, iron staining noted in places, damp (COLLUVIUM)	SP-SM	4	PT	10/16/17	20.0	▲	
6267.0						25.0		

Continued Next Page

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A
BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology NOTE 2: N/A

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

TerraMatrix
Engineering & Environmental Services
1476 Pine Grove Road, P.O. Box 774010
Steamboat Springs, Colorado 80477

Figure 9

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-09

BOREHOLE NUMBER: TH-09 SHEET 2 OF 3

BORING LOCATION: SURFACE ELEVATION: 6292.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hartley DATE/TIME STARTED: 9 NOV 94/ 1340

EQUIPMENT: CME - 55 DATE/TIME FINISHED: 10 NOV 94/ 1030

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A LOGGED BY: M. Fairhurst

ELEV. / DEPTH (Feet)	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS) (Feet)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT (20 40 60 80) / WATER CONTENT, PERCENT & RANGE (Wp Wn WL)	WELL CONSTRUCTION
	(Continued)							
25.0	*Note: Hit hard rock from 25.0' to 26.5'*	SP	5	PT	80/4"			
6266.0 26.0	*Note: Add water to hole*							
6261.5		SP	6	PT	70/6"	30.0		
30.5	*Note: Stuck in rock, switch to tricone. Very Hard boulder from 30.5' to 32.5'*							
	Note: Hit another boulder. Case hole with NW casing and tricone through	GM	7	PT	58/58/45	35.0	>>	
6252.0 40.0	*Note: Boulder from 40.0' to 41.0'. Take drive sample at 41.0'*					40.0		
		SM	8	PT	98/66/48		>>	
		SM	9	PT	46/43/40	45.0	▲	
6244.5 47.5	*Very dense, Olive gray and light brown, mottled, weakly stratified, Silty m-f SAND and SANDSTONE, little mottled Clayey Sand at*					50.0		

Continued Next Page

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A
BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

TerraMatrix
Engineering & Environmental Services
14/6 Pine Grove Road, P.O. Box 774010
Steamboat Springs, Colorado 80477

Figure 9

Cyprus Plateau Mining Company

ACZE 10 JAN 95

TH-09

BOREHOLE NUMBER: TH-09 SHEET 3 OF 3

BORING LOCATION:

SURFACE ELEVATION: 6292.0

DRILLING CO.: RB & G Engineering Inc. DRILLER: B. Hardey

DATE/TIME STARTED: 9 NOV 94/ 1340

EQUIPMENT: CME - 55

DATE/TIME FINISHED: 10 NOV 94/ 1030

WATER DEPTH: N/A DATE/TIME OF DEPTH: N/A

LOGGED BY: M. Fairhurst

ELEV. / DEPTH	SOIL PROFILE: SOIL DESCRIPTION	SAMPLES: USCS CLASS	NO.	TYPE	BLOW COUNT/6"	DEPTH (UNITS)	STANDARD PENETRATION TEST ▲ 'N' BLOWS PER FOOT 20 40 60 80 / WATER CONTENT, PERCENT & RANGE Wp Wn WL 20 40 60 80	WELL CONSTRUCTION
Feet	*(Continued)*					Feet		
6240.5 / 51.5	*bottom of sample, iron staining noted, trace fine sub-angular Gravel, damp (ALLUVIUM)*	SM	10	PT	40/38/36		▲	
	Bottom of Hole at 51.5'							

DRAFT

WELL CONSTRUCTION DETAILS

CASED INTERVAL: N/A
CASING MATERIAL: N/A
CASING DIAMETER: N/A
FILTER INTERVAL/TYPE: N/A

BENTONITE INTERVAL: N/A
GROUT INTERVAL/TYPE: N/A
SCREENED INTERVAL: N/A
SURFACE CASING WITH LOCK: YES ☐ NO ☒

DISCLAIMER: This log is not to be used separately from the engineering report.

NOTE 1: See Cover Page For Legend And Soil Description Methodology

Project No.: 866	Design By: M. Fairhurst	Scale: 55:1	Willow Creek
File: CYPRS	Drawn By: M. Fairhurst	Date: December 15, 1994	

TerraMatrix
Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774010
Steamboat Springs, Colorado 80477

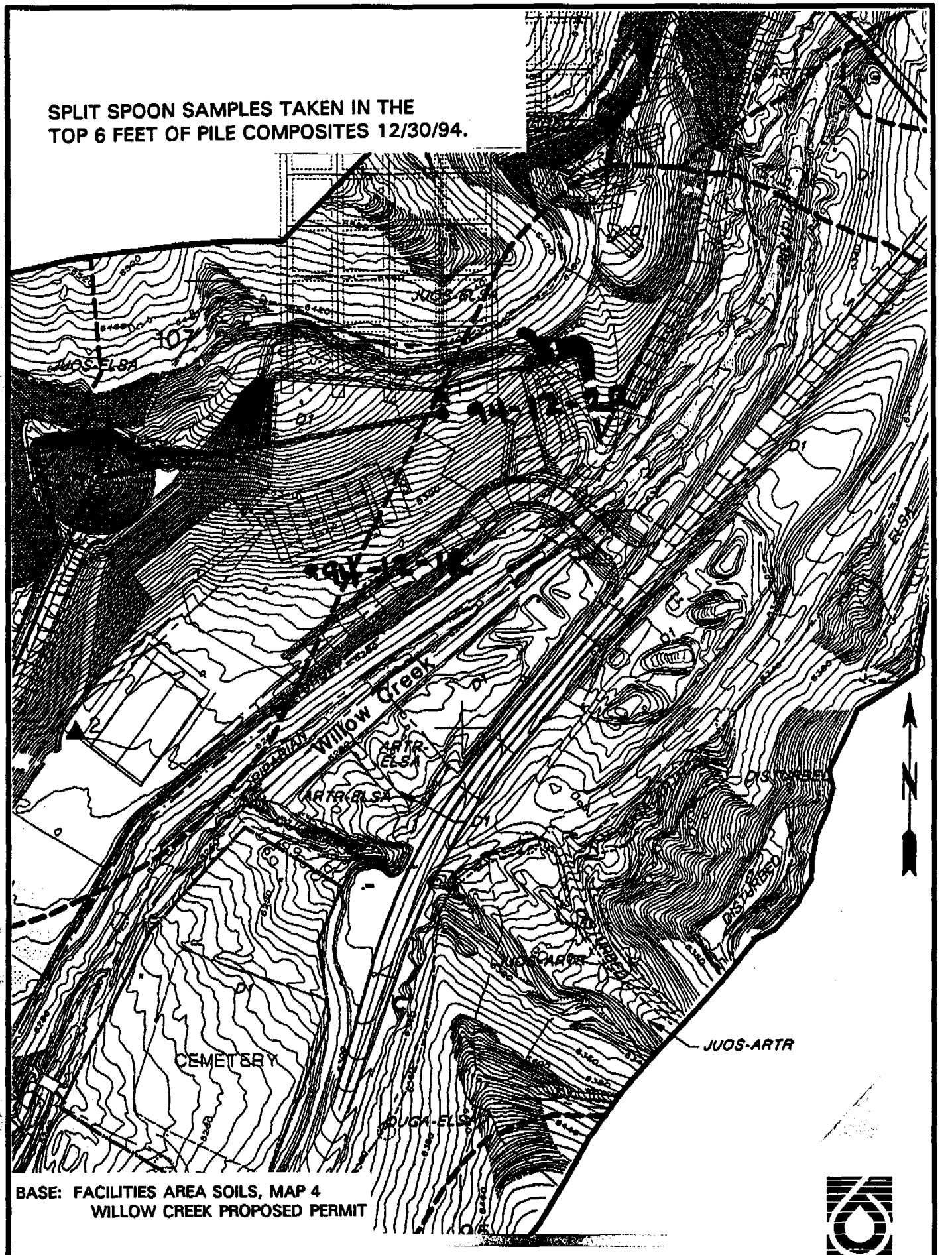
Figure 9

Cyprus Plateau Mining Company

ACZE 10 JAN 95

APPENDIX 12-6-2
CHEMICAL ANALYSES

REGISTERED PROFESSIONAL ENGINEER
Richard B White
No. 7102
RICHARD B. WHITE
7/21/95
STATE OF UTAH



BASE: FACILITIES AREA SOILS, MAP 4
WILLOW CREEK PROPOSED PERMIT

SPLIT SPOON SAMPLE LOCATIONS.

EarthFax

ACZ

Analytical Results

ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487
(800) 334-5493

Lab Sample ID: *L4304-02*
Client Sample ID: *94-12-2R*
Client Project ID: *WILLOW CREEK MINE*
ACZ Report ID: *RG3959*

Cyprus Plateau Mining Corp.
P.O. Drawer PMC
Price, UT 84501
Attn: Ben Grimes

Date Sampled: *12/30/94*
Date Received: *1/9/95*
Date Reported: *1/31/95*

Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Boron, soluble	M6010 ICP	7.2		mg/Kg	0.05	0.3	1/22/95	fp
Calcium, soluble	M6010 ICP	16.8		meq/L	0.01	0.05	1/21/95	fp
Cation Exchange Capacity (CEC)	USDA No. 60 (19) (calc)	0.61		meq/100g	0.03	0.2	1/26/95	fp
Exchangeable Sodium Percent (ESP)	USDA No. 60 (20B) (calc)	24.2		%	0.1	0.5	1/26/95	fp
Magnesium, soluble	M6010 ICP	16.8		meq/L	0.02	0.1	1/21/95	fp
Selenium, soluble	M270.2 GFAA	0.02	B	mg/Kg	0.005	0.03	1/20/95	cb
Sodium Absorption Ratio	USGS - 11738-78	1.5			0.03	0.15	1/31/95	rp
Sodium, soluble	M6010 ICP	5.17		meq/L	0.01	0.05	1/21/95	fp

Soil Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Acid-Base Potential (calc)	M600/2-78-054 1.	39		tons/KT	0.1	0.1	1/31/95	fp
Carbon, total organic (TOC)	M9060A - Combustion	508000		mg/kg	20	100	1/25/95	as
Coarse Fragment >2mm	ASA No. 9, 15-4.2.2	40.5		%	0.1	0.5	1/10/95	as
Conductivity @25C	M120.1 - Meter, w/ Saturated Paste Prep	2.74		mmhos/cm	0.001	0.01	1/1/94	jb
Neutralization Potential as CaCO3	M600 2-78-054 3.	5.3		%	0.1	0.5	1/20/95	mb
pH, Saturated Paste	USDA No. 60 (21A)	7.5		units	0.1	0.1	1/1/94	jb
Saturation Percent	USDA No. 60 (2)	52.6		%	0.01	0.1	1/1/94	jb
Sulfur Forms	M600/2-78-054 3.							
Sulfur Organic		0.32		%	0.01	0.1	1/20/95	mb
Sulfur Pyritic		0.12		%	0.01	0.1	1/20/95	mb
Sulfur Sulfate		0.03	B	%	0.01	0.1	1/20/95	mb
Sulfur Total		0.46		%	0.01	0.1	1/20/95	mb

Soil Preparation

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Cation Exchange Capacity Extraction	USDA No. 60 (19)						1/19/95	jb
Crush and Pulervize	USDA No. 1, 1972						1/17/95	jb
Dry at Room Temperature	USDA No. 1, 1972						1/10/95	as
Exchangeable Sodium Extraction	USDA No. 60 (20B)						1/18/95	jb
Hot Water Extraction	M80-3, ASA No. 9						1/18/95	jb
Saturated Paste Extraction	M2, USDA Handbook 66						1/18/95	jb
Water Extraction	ASA No. 9 10-2.3.2						1/19/95	jb

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Nitrate as N, soluble	M353.2 - Automated	0.5	B	mg/Kg	0.5	5	1/19/95	hm
Nitrogen, total Kjeldahl	M351.2 - TKN by Block Digester	0.46		%	0.01	0.1	1/12/95	sh

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected

B = Analyte concentration detected at a value between MDL and PQL

PQL = Practical Quantitation Limit

Ralph V. Poulsen

VP, Operations: Ralph Poulsen

FEB 06 95 9:24 NO.006 P.05

ACZ

Analytical Results

ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487
(800) 334-5493

Lab Sample ID: *L4304-01*
Client Sample ID: *94-12-1R*
Client Project ID: *WILLOW CREEK MINE*
ACZ Report ID: *RG3955*

Cyprus Plateau Mining Corp.
P.O. Drawer PMC
Price, UT 84501
Attn: Ben Grimes

Date Sampled: *12/30/94*
Date Received: *1/9/95*
Date Reported: *1/31/95*

Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Boron, soluble	M6010 ICP	4.5		mg/Kg	0.05	0.3	1/22/95	fp
Calcium, soluble	M6010 ICP	17.6		meq/L	0.01	0.05	1/21/95	fp
Cation Exchange Capacity (CEC)	USDA No. 60 (19) (calc)	1.08		meq/100g	0.03	0.2	1/26/95	fp
Exchangeable Sodium Percent (ESP)	USDA No. 60 (20B) (calc)	9		%	0.1	0.5	1/26/95	fp
Magnesium, soluble	M6010 ICP	11		meq/L	0.02	0.1	1/21/95	fp
Selenium, soluble	M270.2 GFAA	0.03	B	mg/Kg	0.03	0.1	1/20/95	cb
Sodium Absorption Ratio	USGS - 11738-78	1			0.03	0.15	1/31/95	rp
Sodium, soluble	M6010 ICP	2.9		meq/L	0.01	0.05	1/21/95	fp

Soil Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Acid-Base Potential (calc)	M600/2-78-054 1.	66		tons/KT	0.1	0.1	1/31/95	fp
Carbon, total organic (TOC)	M9060A - Combustion	486000		mg/kg	20	100	1/25/95	as
Coarse Fragment >2mm	ASA No. 9, 15-4.2.2	43.7		%	0.1	0.5	1/10/95	as
Conductivity @25C	M120.1 - Meter, w/ Saturated Paste Prep	2.32		mmhos/cm	0.001	0.01	1/1/94	jb
Neutralization Potential as CaCO3	M600 2-78-054 3.	7.7		%	0.1	0.5	1/20/95	mb
pH, Saturated Paste	USDA No. 60 (21A)	7.4		units	0.1	0.1	1/1/94	jb
Saturation Percent	USDA No. 60 (2)	52.1		%	0.01	0.1	1/1/94	jb
Sulfur Forms	M600/2-78-054 3.							
Sulfur Organic		0.26		%	0.01	0.1	1/20/95	mb
Sulfur Pyritic		0.04	B	%	0.01	0.1	1/20/95	mb
Sulfur Sulfate		0.05	B	%	0.01	0.1	1/20/95	mb
Sulfur Total		0.35		%	0.01	0.1	1/20/95	mb

Soil Preparation

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Cation Exchange Capacity Extraction	USDA No. 60 (19)						1/19/95	jb
Crush and Pulervize	USDA No. 1, 1972						1/17/95	jb
Dry at Room Temperature	USDA No. 1, 1972						1/10/95	as
Exchangeable Sodium Extraction	USDA No. 60 (20B)						1/18/95	jb
Hot Water Extraction	M80-3, ASA No. 9						1/18/95	jb
Saturated Paste Extraction	M2, USDA Handbook 66						1/18/95	jb
Water Extraction	ASA No. 9 10-2.3.2						1/19/95	jb

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Nitrate as N, soluble	M353.2 - Automated	1.9	B	mg/Kg	0.5	5	1/19/95	hm
Nitrogen, total Kjeldahl	M351.2 - TKN by Block Digester	0.39		%	0.01	0.1	1/12/95	sh

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

Ralph V. Poulsen

VP - Operations: Ralph Poulsen

FEB 06 '95 9:22 NO.006 P.02

APPENDIX 12-6-3

GUIDELINES FOR MANAGEMENT OF TOPSOIL AND OVERBURDEN FOR UNDERGROUND AND SURFACE COAL MINING

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
7/21/95
STATE OF UTAH

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
3 Triad Center, Suite 350
355 West North Temple
Salt Lake City, Utah 84180-1203
(801) 538-5340

GUIDELINES FOR MANAGEMENT OF TOPSOIL AND OVERBURDEN FOR UNDERGROUND AND SURFACE COAL MINING

Revised By
James Leatherwood and Dan Duce

April 1988

INTRODUCTION

The objective of the topsoil and overburden guidelines is to help assist operations in formulation of a management plan. These guidelines should assist in: (A) identification and characterization of the soil resource; (B) protection and enhancement of all soil materials; (C) redistribution and treatment of soil to allow for the establishment of a successful stand of vegetation (i.e., one capable of supporting the post mining land use and achieving bond release); (D) identification and characterization of the overburden material; and (E) redistribution and grading of overburden materials.

Utah Division of Oil, Gas, and Mining (Division) encourages research and development in land reclamation due to the high environmental variability between various ecosystems in which coal mining operations exist. Known practices and newly developed practices may be required to establish a successful plant community with each specific ecosystem. Research should be used to develop: site specific vegetation regimes, better methods of soil profile reconstruction, proper fertilization rates, and to improve soil and water conservation.

These guidelines are a guide on the Division's view of its regulations. Any departure from the presented guidelines should be discussed with the Division before they are initiated.

TOPSOIL

A. Topsoil Maps, Baseline Data Needs and Removal Practices

Typical information and efforts necessary to produce a topsoil management plan include: (1) a soil survey and map; (2) proper sampling methodology; (3) baseline chemical and physical soils data; (4) a physical and chemical profile of all materials proposed as substitute or supplement to topsoil; (5) a soil stripping (isopach) map and calculations of soil volume's available for reclamation; and, (6) methods to be employed in the field to ensure proper implementation of soil removal plans.

A(1) The plan should include a soil survey and map. An order 3 survey is adequate for the permit area except for areas of surface disturbance. An order 1 soil survey is preferred for all areas to be disturbed. All soil surveys shall be conducted and/or approved by a qualified professional Soil Scientist.

If a Soil Conservation Service (SCS) survey and map are available they should be expanded to a minimum scale of 1:6,000 and upgraded to an order I survey. The survey and map must identify all soil sample sites, phases of soil series and inclusions that are distinctly more limiting for use than the identified soil. The survey should include the percentage of inclusions within each soil mapping unit. All proposed surface facilities must be shown on an overlay or separate map of the same scale. The soil survey must be performed prior to topsoil stripping to verify topsoil depth removal.

A(2) The goal of sampling is to characterize inherent properties of each soil type by choosing representative sample locations. Representative sample locations should have similar parent material, slopes, vegetative communities, and aspects. The number of samples necessary to adequately delineate the quality and quantity of the soil material depends largely on the variability of the material in question. At a minimum, each and every soil phase must have one soil sample site. Each inclusion must also be sampled and reported separately.

If no topsoil is present, as in a previously disturbed site or when the substitute topsoil is equal to or more suitable than the existing topsoil, the operator is required to fully characterize the suitability of all potential substitute materials. Due to the potential high variability of physicochemical characteristics in potential substitute topsoil materials, an extensive sampling regime is required. Sampling frequency usually consists of three noncomposite sample locations with individual samples taken at 0-15 cm, 15-30 cm and every 30 cm thereafter to the depth of removal. The Division encourages the operator to meet with the Division as early in the permitting stage as possible to establish the appropriate sampling frequency.

The applicant may wish to sample adjacent areas where future disturbance is anticipated. Availability of sufficient baseline soils data expedites processing mine plan modifications. Time delays are inevitably associated with sample collection, seasonal constraints to sampling, lag time associated with laboratory testing, and data reporting.

In all cases, sampling must be performed and reported by depth intervals. Sampling should be done by soil horizon where possible. Where no horizontal differentiation is evident, sample at 15 cm (or less) for the first 30 cm of the soil profile and 25 cm depth intervals thereafter to 100 cm or to bedrock, whichever comes first. The location and the depth must be included with each individual soil sample.

A(3) The tests listed in Table 1 must be done for each depth increment sampled. Suitability limits for evaluating substitute topsoil are listed in Table 2.

A(4) The operator may need to demonstrate the feasibility of the proposed topsoil substitute material by approved field site trials. The design of the trials should consider the following: (1) location of test sites; (2) test for types and rates of soil amendments; (3) a test for optimizing topsoil depth; (4) test for each proposed seed mix; (5) control plots for each test; (6) monitoring schedule (include methods for monitoring); (7) analysis of seedling establishment and mortality; and (8) standard for determining success.

A(5) Data generated during soil sampling, mapping, and analysis must be used to prepare a topsoil and/or isopach map. This isopach map will function as a practical field guide to soil removal. Estimates of the volume of soil to be removed must also be reported within the permit application.

A(6) The applicant must discuss proposed methods and equipment that will be utilized to ensure the proper depth of soil removal. One possible method is to leave small islands of topsoil for verification. Another method is the use of a grid staking system at a spacing of 100 to 200 feet. Each sample point should be identified and data from each point presented in a tabular format.

The topsoil balance sheet, Table 3, should be utilized throughout the life of the project to keep a running total of available soils versus disturbed acreage for the purpose of ensuring that adequate soil is available for reclamation. It is advisable to include this information in the operation's annual report.

B. Topsoil Storage and Protection

The mine plan must include a map showing the location of all topsoil stockpiles in proximity to all operational areas. The applicant must address measures that will be employed to achieve topsoil stockpile protection. These measures must include plans, x-sections, designs and maps of the following:

1) Drainage diversion
2) Earthen berms
3) Topsoil stockpile dimensions (Include volume and maximum slope. Depth and slope must be minimized to the greatest extent practicable to ensure against an anaerobic soil environment)
4) Mulch (type & rate)
5) Biological stabilization (Include rate and mixture. Leguminous vegetation is recommended to enhance soil fertility. The seed mixture should complement postmine reclamation seed mix. Refer to revegetation guidelines)
6) Fertilizer/Amendments (Incorporation of an organic material)
7) Contour furrowing, if appropriate
8) Compaction mitigation

C. Subsoil or Overburden Preparation, Soil Redistribution and Testing

Methods such as scarification of overburden and compacted areas should be addressed in the interest of ensuring good overburden/soil contact thereby preventing potential slippage. The mine plan must also include the depth of soil redistribution, time of revegetation, and a soil sampling program.

The depth of scarification must be determined by the depth of available soil and the total length of the effective root growth. At a minimum, scarification must be at a six inch depth. Soil redistribution should be carried out when the soil is dry. Working on wet soil results in excessively compacted soil. Detail the specific equipment that will be used for topsoil redistribution and seedbed preparation.

The application must address the expected depth of soil redistribution. The suitable depth(s) of topsoil redistribution shall be determined by the quality and depth of overburden, effective length of vegetative root growth, volume of available topsoil, previous topsoil depth and geomorphological features (i.e., slope, surface drainage patterns, etc.). If redistribution will not be uniform over the disturbed area, a map depicting the aerial extent of each varying distribution depth and a discussion of the rationale must be provided.

The length of time between topsoil redistribution and revegetation must be kept to a minimum. Other soil stabilization techniques should be implemented to control erosion if reseeding operations will not be implemented within one month of topsoil redistribution. Contour furrowing should be implemented in all areas where the slope exceeds 6 percent. Seedbed preparation plans must include equipment, man-hours, and techniques utilized for each specific revegetation zone.

The applicant must include a soil sampling program to be undertaken after topsoil redistribution. The purpose of this plan is to identify soil fertility problems and to provide a basis for determining necessary soil amendments. At a minimum the following parameters should be analyzed for each soil sample: electrical conductivity; texture; pH; available phosphorus; and potassium. Other parameters may be required for analysis depending upon the specific materials involved. Refer to Table 1 for suggested methods of analysis and to section A(2) for sampling methodology. The sampling scheme should be based on previous analysis, affected soil series type, postmining land use and the postmining vegetation ecosystem. A discussion of implements to be used to apply soil nutrients, if required, should be included.

OVERBURDEN GUIDELINES FOR UNDERGROUND COAL MINES

D. Baseline Data Needs

Typical information and efforts necessary to identify and characterize the overburden include: (1) proper sampling methodology; (2) a physical and chemical profile; and (3) determining the acid-forming or toxic-forming potential.

D(1) Overburden Sampling

The objective of a premining overburden sampling program is to locate and identify areas of overburden that may cause problems during final reclamation, and operate in conjunction with determining the existence of aquifers. Due to anomalous physical or chemical characteristics, the drilling program should be designed to maximize information available and yield the most information possible. The drilling program should be designed around a grid that provides information for the entire permit area.

If data collected during the drilling program identifies areas of toxic- or acid-forming overburden, then additional drilling may be required to identify the lateral extent of the toxic material.

D(2) Analytical Procedures

Table 6 lists the recommended lab methods for analysis of the parameters of greatest concern. These methods are recommended for the sake of standardizing the methods and creating data that is repeatable. If other methods are proposed, they must be approved by the Division prior to use.

Table 2 lists the criteria and parameters for overburden evaluation in the vegetative root zone.

D(3) Acid Base Potential

The acid base potential must be quantified for all underground development waste and overburden materials. The acid base potential is determined by calculating the difference between the neutralizing potential (NP) and the acid potential (AP). Both the neutralizing and the acid potential should be determined as prescribed in Table 6, for total nonsulfate sulfur (AP) and carbonates (NP). The acid potential should be reported as % S and the neutralizing potential as % $CaCO_3$.

The AP and NP must first be converted to tons $CaCO_3$/1,000 tons overburden material.

1. AP = % S x (31.24) = tons $CaCO_3$/1,000 tons material.

2. NP = % $CaCO_3$ X 10 = tons $CaCO_3$/1,000 tons material.

3. ABP = NP - AP

The results of the evaluations should be integrated into the mine plan so that the applicant can demonstrate their capability to assure that all coal and toxic- and/or acid-forming material is disposed of in a manner that will prevent environmental degradation. A reclamation plan shall be formulated, using the overburden analysis, demonstrating that toxic- and/or acid-forming overburden material will not prevent surface reclamation and revegetation or the degradation of the quantity and quality of surface and ground water.

E. Backfilling and Grading

A plan describing the timing of backfilling and grading must be included in the permit application package (PAP). Slope evaluations are needed for both premining and proposed postmining surfaces. This may be accomplished by presenting topography maps for both premining and postmining surfaces. All overburden must be accounted for in a mass balance. The contour interval should accurately depict the premining topography in a useful manner. All topographic and hydrologic (natural depressions, springs, etc.) anomalies should be discussed and identified. Slope data should include minimum slopes, maximum slopes, means and the percentage of each slope for both premining and postmining surfaces.

All calculations, geotechnical information, topography and cross sections (scale 1" = 200'-400' horizontal, 1" = 10' vertical) of the regraded material must be included in the grading plan.

This plan shall include a detailed narrative of the overburden, preparation and/or placement. The placement of the overburden material must be conducted in a manner which minimizes erosion and prepares the surface to minimize slippage of the redistributed topsoil. All equipment to be used and hazardous steep slopes should be identified. If an unstable condition is encountered, operation plans other than general parallel to the contour must be implemented.

The Division recommends a total cover depth of four feet or more of nontoxic material must be placed over all coal and acid- and/or toxic-forming material. The location of each disposal site, affiliated stream channel and slope(s) should be delineated on a topographic map. If a compaction layer is used, then identification of this material including the permeability rates and the bulk density along with design and operational plans for this activity should be presented. If neutralization of the problem material is desired, the applicant must describe the degree of neutralization, the neutralizing material, the NP of the material, amount required, placement, equipment and procedures to insure the neutralizing process.

All regraded material must topographically conform to the relative environmental conditions. The regraded site should be the approximate premining topography. The overburden and spoil shall be graded to the most moderate slope possible, eliminating and/or reducing all highwalls. Under conditions of thick overburden, all overburden and spoil material must be regraded to the lowest practicable stable grade. If areas of both thick and thin overburden exist, then plans could be included to haul excess overburden from thick overburden areas to areas of thin overburden, thereby achieving an ecologically sound land use approved by the Division, compatible with prevailing land use in unmined areas surrounding the mine plan area. Under conditions of thick overburden, all excess material not required to achieve the approximate original contours must be disposed of onsite. In underground mining operations excess waste rock may be placed back into underground workings. MSHA regulations should be complied with prior to disposal of excess waste underground. All overburden must be accounted for in a mass balance. The mass balance can be determined using the formula:

$$MB = CF(OB \times SF) - OB$$

Factors:

OB: volume of overburden in bank cubic yards
SF: well factor, expressed as ratio of MS/ML
MS is weight per cubic yard of material in place, and
ML is weight per cubic yard of loose material
CF: compaction factor, expressed as ratio of ML/MC
MC is weight per cubic yard of compacted material

See Tables 4 and 5 for examples.

When possible, a check of the weight, swell and compaction of the material should be determined. The operator should commit to periodically review these factors and submit revisions to the final topography when a significant change is determined.

The disposal site must be able to maintain the hydrologic balance. All surface and subsurface drainage shall be compatible with the natural surroundings. All potential seeps and springs must be identified on postmining topography maps. The Division recommends developing plans for leaving or providing micro-relief to reduce runoff and maintain available water supply to the vegetation. Area of overburden removal, placement and equipment to be used should be included.

OVERBURDEN GUIDELINES FOR SURFACE COAL MINES

D. Geologic Maps and Baseline Data Needs

Typical information and efforts necessary to identify and characterize the geologic resources include: (1) lithologic and geophysical logs; (2) proper sampling methodology; (3) drilling methods; (4) proper sampling plan; (5) sample preparation; (6) a physical and chemical profile; and (7) determining the acid-forming and toxic-forming potential.

D(1) Lithologic and Geophysical Logs

All boreholes must have a legible, detailed lithologic log that includes depth intervals and description of rock properties including grain size, shape and sorting; megascopic identification of dominant, subordinate and accessory minerals; rock type and color; matrix cement for sandstones and siltstones and the texture and bedding of claystones and shales. A geologist shall supervise sample collection and derive lithologic logs.

Geophysical logs should be submitted in a legible form for all boreholes. For geologic cross sections, logs should be spaced at 1,000 foot intervals. Additional logs may be required on a site specific basis. Composite borehole logs developed from driller logs and geophysical interpretations should be submitted. All interpretations from geophysical logs without an attendant lithologic log should be noted as a geophysical log interpretation only. If only one geophysical log is used for interpretation, it should be noted as such and used only as extrapolation between points with adequate logs. Logs with an excess of 50 percent off-scale are not acceptable for interpretation. All new boreholes should provide the information outlined in items (a) through (f):

(a) Scale of 1 inch per 10 feet.

(b) A suite of at least three geophysical logs (e.g., gamma and electric).

(c) Complete headers.

(d) "0" points and scales for each curve.

(e) Density log should have a caliper for interpretation.

(f) Sufficient deflection to visually identify all lithotypes represented.

The operator shall submit cross sections describing the inclusions of piezometric surface and positions of all strata above, between, and immediately below the coal deposit. Cross section orientations should be such that one set is parallel to the strike and one set parallel to the dip of the coal bed. All cross sections should have corresponding strata at the intersects, complete legends, corresponding elevations at common points and consistent scales. The drill hole identification and depth used for diagram development should be delineated. All cross sections must be certified by a professional geologist or engineer. The sequence, location and extent of coal to be mined should also be diagramed.

D(2) Overburden Sampling

The objective of a premining overburden sampling program is to locate and identify areas of overburden that may cause problems during final reclamation, and operate in conjunction with determining the existence of aquifers. Due to anomalous physical or chemical characteristics, the drilling program should be designed to maximize information available and yield the most information possible.

The drilling program should be designed in a two stage approach. The initial phase is exploratory work and should provide, at a minimum, four holes per section. If possible, the drill pattern should be designed around a grid that provides information for the entire permit area.

Complex geochemical and stratigraphic conditions necessitate more intensive sampling. Phase two development stage should include additional drill hole data to be provided on a grid pattern of 16 holes per section. These data must be provided at least one year in advance of the initiation of the mining operation. If data collected during the two phase drill program identifies areas of toxic overburden, then additional drilling may be required to identify the lateral extent of the toxic material.

D(3) Drilling Methods

A drilling program should be submitted to the Division for approval prior to any drilling. Care should be taken if drilling fluids are used, as many fluids contain salts and alkaloids that can contaminate overburden samples. Joint lubricants can also contaminate samples. Many compounds have been

found to contain zinc, molybdenum, copper and lead. The type of drilling fluid and joint lubricant used should be recorded. If overburden samples have high levels of metals or salts, the drilling practices may be contaminating the samples. If the records of the drilling fluid and joint lubricant are available, it may be possible to determine the extent of contamination.

D(4) Sampling Depth Intervals

All overburden, along with any thin or rider seams of coal that will be disposed of as spoil must be sampled. The samples are to be taken from the surface to a depth of the first geologic stratum below the lowest coal seam to be mined. Sampling intervals must begin at a corresponding depth where the soil sampling ended. Lithologic units that are less than two feet thick should be composited with adjacent material into two foot thick intervals, unless lithologic characteristics indicate that the unit warrants sampling as a separate interval. The intervals extending two feet above and below all coal seams should be sampled separately.

When core drilling is used, a composite from each lithologic unit or 10 foot section of core (whichever is smallest) must be collected for analysis. If rotary cuttings are collected, then a composite of each five foot depth interval (5'-10', 10'-15') shall be collected for analysis.

D(5) Sample Preparation

The samples should be divided into two parts with the operator retaining one subsample for future reference. At least two quart samples should be obtained to insure adequate material to conduct the required analysis. Samples should be air dried and placed in clean polyethylene bags and stored in a cool dry place until analyses are conducted.

The use of fines obtained during drilling are not acceptable for analysis. The entire sample from both core and cutting samples must be used. The samples should be air dried, then ground until the sample passes a 10 mesh sieve. After drying and grinding, samples should be split by passing the entire sample through a splitter until the two subsamples are homogeneous.

D(6) Analytical Procedures

Table 6 lists the recommended lab methods for analysis of the parameters of greatest concern. These methods are recommended for the sake of standardizing the methods and creating data that is repeatable. If other methods are proposed, they must be approved by the Division prior to use.

Table 2 lists the criteria and parameters for overburden evaluation in the vegetative root zone.

D(7) Acid Base Potential

Refer to discussion presented in D(3) of the Underground Coal Mine Overburden Guidelines in this report.

E. Backfilling and Grading

A plan describing the timing of backfilling and grading must be included in the PAP. In strip mine operations, all backfilling and grading should be accomplished within 180 days following the coal removal. The number of spoil ridges behind the working pit must be identified. Four spoil ridges, including the spoil from the active pit is the maximum number allowable.

Slope evaluations are needed for both premining and proposed postmining surfaces. This may be accomplished by presenting topography maps for both premining and postmining surfaces. Slope data should include minimum slopes, maximum slopes, means and the percentage of each slope for both premining and postmining surfaces.

All calculations, geotechnical information, topography and cross sections (scale 1" = 200'-400' horizontal, 1" = 10' vertical) of the regraded material must be included in the grading plan. The contour interval should accurately depict the premining topography in a useful manner. All topographic and hydrologic (natural depressions, springs, etc.) anomalies should be discussed and identified. The plan shall include a detailed narrative of the overburden, preparation and/or placement. The placement of the overburden material must be conducted in a manner which minimizes erosion and prepares the surface to minimize slippage of the redistributed topsoil. All equipment to be used and hazardous steep slopes should be identified. If an unstable condition is encountered, operation plans other than general parallel to the contour must be implemented.

The Division recommends a total cover depth of four feet or more of nontoxic materials to be placed over all coal and acid- and/or toxic-forming materials. The location of each disposal site, affiliated stream channel and slope(s) must be delineated on a topographic map. If a compaction layer is used, then identification of this material including the permeability rates and the bulk density along with design and operational plans for this activity should be presented. If neutralization of the problem material is desired, the applicant must describe the degree of neutralization, the neutralizing material, the NP of the material, amount required, placement, equipment and procedures to insure the neutralizing process.

All regraded material must topographically conform to the relative environmental conditions. The regraded site should be the approximate premining topography, not exceeding the premining grade. The overburden and spoil shall be graded to the most moderate slope possible, eliminating or reducing all highwalls. Under conditions of thick overburden, all overburden and spoil material must be regraded to the lowest practicable stable grade. If areas of both thick and thin overburden exist, then plans could be included to haul excess overburden from thick overburden areas to areas of thin overburden in order to prevent large depressions from being formed, and thereby achieving an ecologically sound land use approved by the Division, compatible with prevailing land use in unmined areas surrounding the mine plan area. Under conditions of thick overburden, all excess material not required to achieve the approximate original contours must be disposed of onsite. All overburden must be accounted for in a mass balance. The mass balance can be determined using the formula:

$$MB = CF(OB \times SF) - (OB + C)$$

Factors:

OB: volume of overburden in bank cubic yards

C: volume of coal in bank cubic yards

SF: swell factor, expressed as ratio of MS/ML
- MS is weight per cubic yard of material in place, and
- ML is weight per cubic yard of loose material

CF: compaction factor, expressed as ratio of ML/MC
- MC is weight per cubic yard of compacted material

See Tables 4 and 5 for examples.

When possible, a check of the weight, swell and compaction of the material should be determined. The operator should commit to periodically review these factors and submit revisions to the final topography when a significant change is determined.

The disposal site must be able to maintain the hydrologic balance. All surface and subsurface drainage shall be compatible to the natural surroundings. All potential seeps and springs must be identified on postmining topography maps. The Division recommends developing plans for leaving or providing micro-relief to reduce runoff and maintain available water supply to the vegetation. Area of overburden removal and placement and equipment to be used should be included.

Table 1. Analytical Methods for Baseline Soils Data

Test to be Performed	Reported As	Suggested Methods[1]
Soil Color	Hue Value/Chroma	Munsell notation
Soil texture	% sand, silt, clay	Hydrometer method. Black et al. 1965. Methods of soil analysis. ASA Mono No. 9, Part 1, method 43-5, pages 562-566.
pH	standard units	ASA Mono. No. 9, part c (2 ed). 1982. Method 10-3.2, page 171. pH performed on saturation paste, method 10-2.3.1, page 169.
Organic Carbon	%	ASA Mono No. 9, Part 2, 1982 (2 ed). Method 29-5.3. pages 571-573.
Saturation Percentage	%	SP = 100 (total wt of water)/(wt of oven-dry soil). Wts of water and soil known when making a saturated paste.
Alkalinity	meq/ liter	Std. Methods for Examination of waters and waste water, 15 ed., 1980, Method 403.4. Bromocresol green-method red indicator.
Electrical Conductivity	mmhos/cm @ 25°C	ASA Mono. No. 9, Part 2 1982, (2 ed). Method 10-3.3, pages 172-173. Use saturation paste extract.

Table 1. (continued)

Test to be Performed	Reported As	Suggested Methods[1]
$CaCO_3$	%	ASA Mono. No. 9, Part 2, 1982 (2 ed). Method 11-2.4, pages 188-191.
Soluble Potassium, Magnesium, Calcium & Sodium	meq/l	ASA Mono. No. 9, Part 2, (2 ed), 1982. Method 10-3.4. pages 173-174.
Sodium Adsorption Ratio[2]	SAR calculated from soluble Ca, Mg & Na (meq/l)	$\frac{[Na^+]}{([Ca^{2+} + Mg^{2+}]/2)^{0.5}}$
Total N	%	ASA Mono. No. 9, Part 2 (2 ed), 1982. Method 31-3, pages 610-616.
Available Phosphorus	mg/Kg	ASA Mono. No. 9, Part 2, (2 ed), 1982. Method 24-5.4, pages 421-422.
Available Water Capacity	in/in	USDA SCS Soil Survey Investigation Report No. 1, Method 4C1, page 24. Report bulk density along with results.
Rock Fragments	% Volume	USDA SCS Soil Survey Investigation Report No. 1, Method 3B, page 18.

[1]These are suggested methods, other equivalent methods may be used if described and can be justified prior to sampling.

[2]If samples have a SAR greater than 12 for clay textured soils or greater than 15 for sandy textured soils, then exchangeable sodium percentage should be analyzed.

Table 2. Overburden Evaluation for Vegetative Root Zone*

Parameters	Good	Fair	Poor	Unacceptable
pH	6.1-8.2	5.1 to 6.1 8.2 to 8.4	4.5 to 5.0 8.5 to 9.0	less than 4.5 greater than 9.0
Ec mmhos/cm 25°C	0 to 2	2 to 8	8 to 15	greater than 15
Saturation %	25%-80%		less than 25% greater than 80%	
Texture	sl, l, sil, scl, vfsl, fsl	c, sicl, sc ls, lfs	sic, s, sc, c, cos, fs, vfs	g, vcos
SAR	0-4	5-10	10-12 Fine Texture 10-15 Coarse Texture	12 Fine Texture 15 Coarse Texture
Selenium	less than 0.1 mg/Kg			greater than 0.1 mg/Kg
Boron	less than 5.0 mg/Kg			greater than 5.0 mg/Kg
Acid/Base Potential	greater than -5 tons $CaCO_3$ 1,000 tons material			Less than -5 tons $CaCO_3$ 1,000 tons material
% Coal fines	Undetermined at this time			
Available water capacity (in/in)	greater than 0.10	0.05-0.10	less than 0.05	
Rock Fragments (% volumes)				
3 inches	0-15	15-25	25-30	greater than 30
3-10 inches	0-15	15-25	25-30	greater than 30
10 inches	0-3	3-7	7-10	greater than 10

* Many native species have their roots in soils that are determined unsuitable by these values. Occasionally soil materials rated good by these standards have poor vegetation success. Therefore plant growth trails may be required where reestablishment of native species is desirable.

Table 3. Soil Tabulation Chart

Area Affected (in mining sequence)	Area 1	2	3	etc.
Acreage of Area				
Depth of Topsoil Removal (inches)				
Depth of Proposed Topsoil Replacement				
Estimate of Salvageable Topsoil (yd^3 or ac-ft)				
Volume Actually Salvaged (yd^3 or ac-ft)				
Volume Required for Reclamation (yd^3 or ac-ft)				
Surplus or Deficit Volume (yd^3 or ac-ft)				
Storage Location & Capacity				
Running Total (all stockpiles) (yd^3 or ac-ft)				
Short-term				
Long-term				

*Long Term Stockpile is defined to be in existence for greater than one year.

Table 4. Overburden Balance Sheet[1]

Date	Removal Method	Area (AC)	Location[2]	Depth of Removal: Overburden (ft)	Depth of Removal: Coal (ft)	Estimation of: Overburden (BCY)	Estimation of: Coal (BCY)	Swell Factor	Volume Overburden Removed (LCY)	Compaction Factor	Mass Balance (CCY)	Destination[3]
1984	Truck & Shovel	105	Map ID #	30	12	5,081,995	2,032,798	1.33	6,759,053	0.89	-1,099,236	Map ID #
1985	Scraper	70	Map ID #	60	10	6,775,993	1,129,332	1.41	9,554,150	0.91	788,952	Map ID #

[1]Mass Balance = CF(OB x SF) - (OB + C); refer to section E.
[2]Area of removal, Pit #, Cut #, should be clearly shown on a mining sequence map.
[3]Backfill location and/or stockpile location.

Table 5. Overburden Stockpile Data

Stockpile Location	Area (Acres)	Maximum Capacity (LCY)	Maximum Height (ft)	Slope (h:v)	Long term*	Short term**
Map ID #	10	550,000	40	3:1	2 year	
Map ID #	2	50,000	17	3:1		.5 year
Map ID #	60	300,000	26	3:1	2 year	

*Long term stockpile is defined to be in existence for greater than one year.
**If short term, how long will the stockpile exist?

Table 6. Recommended Laboratory Methods

Parameters	Reported As	Suggested Methods
pH		ASA Mono. No. 9, Part 2, (2 ed), 1982. Method 10-3.2, page 171. Perform pH on saturated paste.
Electrical Conductivity (EC)	mmhos/cm 25°C	ASA Mono. No. 9, Part 2 (2 ed), 1982. Method 10-3.3, pages 172-173.
Saturation Percentage	%	SP = 100 (total wt of water)/(wt of oven-dry soil). Wts of water and soil known when making a saturated paste.
Particle Size Analysis (texture)	% sand, silt, clay	Hydrometer method. Black et al. 1965. Methods of soil analysis. ASA Mono No. 9, Part 1, method 43-5, pages 562-566.
Soluble Ca, Mg and Na	me1/l	ASA Mono. No. 9, Part 2, (2 ed), 1982. Method 10-3.4. pages 173-174.
Sodium Adsorption Ratio	SAR calculated from soluble Ca, Mg & Na	$\frac{[Na^+]}{([Ca^{2+} + Mg^{2+}]/2)^{0.5}}$
Selenium	mg/Kg	Extraction by ASA Mono. No. 9, Part 2 (1 ed), 1965. Method 80-3.2, page 1122. Analyze by Hydride generation for AA or ICP. ASA Mono. No. 9, Part 2 (2 ed), 1982. Method 3-5.5, pages 59-61.

Table 6. (continued)

Parameters	Reported As	Suggested Methods
Total N	%	ASA Mono. No. 9, Part 2 (2 ed), 1982. Method 31-3, pages 610-616.
Nitrate-N	mg/Kg	ASA Mono No. 9, Part 2 (2 ed), 1982. Methods 33-4.1, pages 649-658 (steam dist.); 33-8.3, pages 679-682 (colorimetric) or Sims J. R., and G. D. Jackson, 1977. Soil Sci. Soc. Am. Proc. 35:603-607.
Boron	mg/Kg	ASA Mono No. 9, Part 2 (2 ed), 1982. Method 25-9.1, page 443 for extraction and Method 25-5, pages 435-436 for analysis.
Maximum Acid Potential	%	US EPA. 1978. EPA - 600/2-78-054. Method 3.2.6, page 60.
Neutralization Potential	%	US EPA. 1978. EPA - 600/2-28-054. Method 3.2.3, page 47.
Organic Carbon	%	ASA Mono No. 9, Part 2 (2 ed), 1982. Method 29-3.5.3, pages 571-573.
Exchangeable Sodium*		ASA Mono No. 9, Part 2 (2 ed), 1982. Method 13-4.3.4, page 239, using Flame Emission. Using extractates in method 8-3, page 152.

Table 6. (continued)

Parameters	Reported As	Suggested Methods
Available Water Capacity	in/in	USDA SCS Soil Survey Investigation Report No. 1, Method 4C1, page 24. Report bulk density along with results.
Rock Fragments	% Volume	USDA SCS Soil Survey Investigation Report No. 1, Method 3B, Page 18.

Acid/Base Account AB = Total Neutralizing Potential minus Total Acid Potential.

*If samples have a SAR greater than 12 for clay textured soils or greater than 15 for sandy textured soils, then exchangeable sodium % should be analyzed.

jbe
A:\TOPSOIL

APPENDIX 12-7-1

WATER QUALITY DATA

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
7/21/95
STATE OF UTAH

Monitor Point: B-1

Parameters		Units	14-Jun-78	09-Aug-78	11-Oct-78	13-Dec-78	15-Dec-78	17-Apr-79	13-Jun-79
		Sample Date							
TEMPERATURE (FIELD)		C	10.0	12.5	3.0	0.0	1.0	4.5	14.0
TOTAL DISSOLVED SOLIDS		MG/L	465	538	548	685	599	775	413
TOTAL SUSPENDED SOLIDS		MG/L	33	3	1	34	36	7750	43
SODIUM		MG/L			60.2	105.0	73.3	50.6	41.8
POTASSIUM		MG/L	1.66	2.11	2.15	2.03	1.61	3.01	1.60
CALCIUM		MG/L	49.6	46.0		69.6	64.0	42.4	56.0
MAGNESIUM		MG/L	34.06		45.10	46.06	52.80	25.92	37.20
SULFATE		MG/L	82.0	174.0	169.1	216.0	230.0	514.0	103.0
CHLORIDE		MG/L	70	22	22	22	16	12	10
CARBONATE		MG/L CO3	-0.01						
BICARBONATE		MG/L HCO3	305.0	329.0	353.8	404.9	341.6	256.2	319.6
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	7.8	7.2	7.1	7.1	8.2	7.3	8.4
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	655	825	840	1020	890	1190	640
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	0.02		0.02	0.22	0.03	0.12	0.06
NITRITE AS N		MG/L	-0.01		-0.01	-0.01			
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L	0.21	0.43	0.24	0.20	0.23	0.23	0.21
OIL & GREASE		MG/L	-1.0	1.8	2.2	-1.0	8.4	-1.0	-1.0
TOTAL ALKALINITY AS CACO3		MG/L							262
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	0.004	-0.001	0.002	-0.001	-0.001	-0.001	-0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.07	0.13	0.09	0.06	0.05	0.30	0.13
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001		-0.001	-0.001	-0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	0.002	0.015	0.004	0.005	0.004	0.008	0.002
IRON	Dissolved	MG/L							
	Total	MG/L	0.84	0.06	0.02	0.02	0.42	246.00	0.22
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.022	0.002	0.018	0.014	0.017	0.378	0.030
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	0.003	0.020
ZINC	Dissolved	MG/L							
	Total	MG/L	0.015	0.029	0.007	-0.001	0.001	0.036	0.050
TOC		MG/L	17	9	18	15	15	4	
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	16.0	2.5	2.0	ice	2.5	51.3	45.0

Negative Values indicate < values

Monitor Point: B-1

Parameters		Sample Date / Units	08-Aug-79	30-Oct-79	26-Dec-79	13-Feb-80	17-Apr-80	05-Jun-80	07-Aug-80
TEMPERATURE (FIELD)		C	24.0	5.0	1.0	0.3	3.0	15.0	21.0
TOTAL DISSOLVED SOLIDS		MG/L	612	559	690	630	631	385	570
TOTAL SUSPENDED SOLIDS		MG/L	970	32	1	16	28	96	6
SODIUM		MG/L	71.5	76.4	81.5	62.0	107.0	39.3	75.8
POTASSIUM		MG/L	3.90	3.86	2.17	3.75	2.24	1.49	2.19
CALCIUM		MG/L	124.0	72.0	84.0	67.2	68.0	50.4	54.5
MAGNESIUM		MG/L	7.20	34.80	55.20	49.92	31.20	30.72	52.00
SULFATE		MG/L	190.0	190.0	240.0	217.0	236.0	75.0	200.0
CHLORIDE		MG/L	26	26	24	34	24	7	30
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	314.8	307.4	402.6	348.9	319.6	263.5	312.3
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.8	7.8	9.1	9.0	8.8	7.4	8.1
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	950	900	1060	1150	750	550	900
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	0.02	0.06	0.02	0.06	0.16	0.04	-0.01
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L		0.09	0.21	0.30	1.72	0.15	0.24
FLORIDE		MG/L	0.42	0.26	1.55	0.74	0.20	0.29	0.24
OIL & GREASE		MG/L	-1.0	3.8	1.8	1.4	7.6	3.6	1.0
TOTAL ALKALINITY AS CACO3		MG/L	258	252	330	286	262	258	260
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	0.004	0.003	-0.001	0.002	0.001	0.001	0.002
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.22	0.25	0.07	0.22	0.26	0.01	0.06
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	0.003	0.002	0.002	0.001	-0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	0.021	0.004	0.004	-0.001	0.010	-0.010	0.010
IRON	Dissolved	MG/L	0.46						
	Total	MG/L	35.90	0.26	0.10	0.29	70.40	2.69	0.04
LEAD	Dissolved	MG/L							
	Total	MG/L	0.003	0.006	-0.001	-0.001	-0.001	0.001	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.690	0.016	0.013	0.030	1.150	0.060	0.002
MERCURY	Dissolved	MG/L							
	Total	MG/L		-0.0002	-0.0002				
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	0.002	0.001	0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.034	0.006	0.006	0.020	0.010	0.013	0.002
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	13.1	4.5	1.8	3.6	14.0	85.0	6.0

Negative Values indicate < values

Monitor Point: B-1

Parameters		Units	28-Oct-80	29-Dec-80	04-Feb-81	07-Apr-81	23-Jun-81	27-Jul-81	29-Oct-81
		Sample Date							
TEMPERATURE (FIELD)		C	2.0	0.0	0.0	4.0	23.0	15.0	7.0
TOTAL DISSOLVED SOLIDS		MG/L	585	590	688	396	510	591	481
TOTAL SUSPENDED SOLIDS		MG/L	62	16	7	16	11	3	439
SODIUM		MG/L	85.0	88.0	142.0	48.4	73.0	88.0	58.0
POTASSIUM		MG/L	1.93	1.50	2.00	3.55	7.20	2.37	2.30
CALCIUM		MG/L	45.6	72.0	48.0	58.0	40.8	47.2	48.0
MAGNESIUM		MG/L	55.68	36.40	41.76	28.80	41.76	50.40	44.64
SULFATE		MG/L	192.0	204.0	214.0	124.0	196.0	21.0	141.0
CHLORIDE		MG/L	21	13	36	16	4	36	19
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	373.1	375.8	412.4	226.9	225.5	297.7	320.7
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	7.6	7.6	7.6	8.1	8.5	8.6	8.3
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	485	504	510	365	700	740	600
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.01
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.12	0.13	0.03	0.07	0.23	0.19	0.30
FLORIDE		MG/L	0.25	0.16	0.39	0.22	0.24	0.25	0.27
OIL & GREASE		MG/L	5.6	0.6	0.6	0.6	1.2	0.6	0.4
TOTAL ALKALINITY AS CACO3		MG/L	306	328	358	204	242	284	279
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	0.002	0.003	0.014	0.125	0.004	0.005
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.09	0.06	0.07	0.09	0.06	0.09	0.11
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.002	-0.001	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	0.022	-0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	0.010	0.010	0.010	0.006	0.230	0.020	0.022
IRON	Dissolved	MG/L	0.01		0.02				
	Total	MG/L	1.23	1.36	0.12	16.20	0.11	0.07	1.18
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.002	-0.001	-0.001	0.006	-0.001	-0.001	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.010	0.025	0.010	0.650	0.010	0.010	0.015
MERCURY	Dissolved	MG/L							
	Total	MG/L	-0.0010		-0.0020				
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	0.003	0.002	0.001	-0.001	0.004	-0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.004	0.006	0.007	0.135	0.015	0.020	0.022
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	6.0	23.0		12.0	6.5	4.6	10.0

Negative Values indicate < values

Monitor Point: B-1

Parameters		Units	03-Dec-81	16-Feb-82	14-Apr-82	14-Jun-82	03-Aug-82	07-Oct-82	21-Dec-82
		Sample Date							
TEMPERATURE (FIELD)		C	1.0	1.0	7.0	9.0	17.0	8.0	0.0
TOTAL DISSOLVED SOLIDS		MG/L	698	662	1196	420	520	497	599
TOTAL SUSPENDED SOLIDS		MG/L	24	11	30	27	1	61	39
SODIUM		MG/L	81.5	84.0	40.5	46.0	83.0	64.5	82.0
POTASSIUM		MG/L	11.90	1.72	2.75	1.50	2.00	1.82	1.90
CALCIUM		MG/L	75.0	73.5	2.6	59.0	56.6	57.6	67.2
MAGNESIUM		MG/L	53.00	54.00	55.00	57.10	51.30	42.72	48.48
SULFATE		MG/L	248.0	236.0	720.0	98.0	147.0	120.0	150.0
CHLORIDE		MG/L	25	25	11	13	21	18	28
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	379.4	375.0	222.7	332.2	351.0	372.7	423.8
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	7.9	7.9	7.7	8.2	8.3	8.3	7.9
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	505	645	514	618	802	502	677
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	0.58	0.14	0.17	0.06	-0.01	-0.01	0.27
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.53	0.50	0.10	0.06	0.09	0.19	0.16
FLORIDE		MG/L	0.22	0.19	0.15	0.18	0.25	0.20	0.24
OIL & GREASE		MG/L	0.2	-1.0	-1.0	-0.1	-0.1	-0.1	-0.1
TOTAL ALKALINITY AS CACO3		MG/L	359	307	181	278	288	310	347
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.062	-0.001	-0.001	-0.001	-0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.09	0.05	0.35	0.10	0.11	1.09	1.09
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.062	-0.001	-0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	0.100	0.010	0.090	0.020	0.010	0.020	0.030
IRON	Dissolved	MG/L							
	Total	MG/L	0.20	0.25	43.30	0.37	0.14	1.25	0.57
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001	0.050	0.003	0.008	0.002	-0.001	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.020	0.020	1.730	0.025	0.055	0.040	0.035
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.003	-0.001	-0.001	-0.001	-0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.014	0.011	0.205	0.045	0.020	0.015	0.015
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	1.6		13.8		4.6		

Negative Values indicate < values

Monitor Point: B-1

Parameters		Units	Sample Date 24-Feb-83	21-Apr-83	28-Jun-83	17-Aug-83	17-Oct-83
TEMPERATURE (FIELD)		C	1.0	3.0	14.0	16.0	6.0
TOTAL DISSOLVED SOLIDS		MG/L	612	687	466	486	600
TOTAL SUSPENDED SOLIDS		MG/L	23	22	7	46	7
SODIUM		MG/L	58.5	79.0	48.0	59.0	70.3
POTASSIUM		MG/L	1.75	2.40	2.25	2.50	2.10
CALCIUM		MG/L	65.6	60.0	56.0	41.6	55.2
MAGNESIUM		MG/L	49.64	43.20	42.24	52.80	52.32
SULFATE		MG/L	200.0	190.0	116.0	144.0	202.0
CHLORIDE		MG/L	8	27	22	30	34
CARBONATE		MG/L CO3					
BICARBONATE		MG/L HCO3	367.8	229.4	317.2	317.2	232.0
HYDROXIDE (OH)		MG/L					
PH (LAB)		S.U.	7.7	7.2	7.0	6.8	7.9
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	698	626	504	847	891
AMMONIA AS N		MG/L					
NITRATE AS N		MG/L	0.06	0.25	0.06	0.05	-0.01
NITRITE AS N		MG/L					
PHOSPHATE AS PO4		MG/L	0.18	0.10	0.20	0.14	0.02
FLORIDE		MG/L	0.19	0.28	0.21	0.19	0.28
OIL & GREASE		MG/L	-0.2	-0.2	0.8	-0.2	-0.2
TOTAL ALKALINITY AS CACO3		MG/L	318	270	260	260	272
TOTAL HARDNESS AS CACO3		MG/L					
ARSENIC	Dissolved	MG/L					
	Total	MG/L	-0.001	0.023	0.020	0.018	-0.001
BARIUM	Dissolved	MG/L					
	Total	MG/L	0.10	0.67	0.65	0.63	0.18
CADMIUM	Dissolved	MG/L					
	Total	MG/L	-0.001	0.002	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L					
	Total	MG/L	-0.001	0.028	0.006	0.010	-0.001
COPPER	Dissolved	MG/L					
	Total	MG/L	0.030	0.150	0.010	0.010	0.060
IRON	Dissolved	MG/L					
	Total	MG/L	0.56	29.00	28.60	0.36	0.43
LEAD	Dissolved	MG/L					
	Total	MG/L	-0.001	0.027	0.002	0.002	-0.001
MANGANESE	Dissolved	MG/L					
	Total	MG/L	0.040	1.410	0.027	0.028	0.010
MERCURY	Dissolved	MG/L					
	Total	MG/L					
SELENIUM	Dissolved	MG/L					
	Total	MG/L	-0.001	0.003	0.002	-0.001	-0.001
ZINC	Dissolved	MG/L					
	Total	MG/L	0.015	0.165	0.149	0.150	0.015
TOC		MG/L					
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)					
FLOW		CFS	1.3	27.5	27.4	12.8	8.3

Negative Values indicate < values

Monitor Point: B-2

Parameters		Units	Sample Date 04/13/77	05/09/77	06/01/77	07/06/77	08/03/77	09/08/77	10/12/77
TEMPERATURE (FIELD)		C	11.0	19.0	18.0	19.0	24.0	12.0	12.0
TOTAL DISSOLVED SOLIDS		MG/L	720	800	810	490	695	820	700
TOTAL SUSPENDED SOLIDS		MG/L	37	20	5	7	7	8	30
SODIUM		MG/L	88.4	95.0	102.9	77.8	96.9	85.3	91.8
POTASSIUM		MG/L	2.95	2.49	3.33	2.90	3.99	6.70	4.19
CALCIUM		MG/L	50.4	19.2	46.4	53.6	58.4	80.0	60.0
MAGNESIUM		MG/L	46.56	75.36	56.64	32.64	56.64	72.00	63.84
SULFATE		MG/L	210	254	271	172	290	396	274
CHLORIDE		MG/L	22	28	28	18	30	34	28
CARBONATE		MG/L CO3	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
BICARBONATE		MG/L HCO3	307.4	331.8	307.4	283.0	314.8	292.8	366.0
HYDROXIDE (OH)		MG/L	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
PH (LAB)		S.U.	8.4	8.2	8.4	8.2	8.3	7.9	
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	1090	1210	1220	760	1065	1270	1083
AMMONIA AS N		MG/L	0.10	0.15	0.12	0.25	0.15	0.25	0.30
NITRATE AS N		MG/L	0.06	0.05	0.10	0.07	0.02	0.04	0.05
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.06	0.05	0.04	1.03	0.08	0.10	0.03
FLORIDE		MG/L	0.34	0.46	0.35	0.33	0.36	0.45	0.33
OIL & GREASE		MG/L	-1.0	-1.0		-1.0		5.9	
TOTAL ALKALINITY AS CACO3		MG/L	252	272	252	232	256	240	300
TOTAL HARDNESS AS CACO3		MG/L	320	362	352	270	382	500	416
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.17	0.01	0.01	0.01	0.05	0.02	0.07
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001			-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L				0.006		0.016	
IRON	Dissolved	MG/L							
	Total	MG/L	0.12	0.13	0.11	0.02	0.21	0.18	0.18
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.072	0.028	0.021	0.003	0.006	0.005	0.006
MERCURY	Dissolved	MG/L							
	Total	MG/L	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.016	0.004	0.005	0.012	0.014	0.064	0.010
TOC		MG/L	10	11	6	8	32	4	2
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	1.5	1.2	3.5	0.3	0.1	0.2	0.1

Negative Values indicate < values

Monitor Point: B-2

Parameters		Units / Sample Date	11/09/77	12/14/77	01/11/78	02/08/78	03/08/78	05/10/78	06/14/78
TEMPERATURE (FIELD)		C	0.5	1.0	0.2		1.0	7.0	10.0
TOTAL DISSOLVED SOLIDS		MG/L	910	872	808		610	404	410
TOTAL SUSPENDED SOLIDS		MG/L	29	21	15		356	443	57
SODIUM		MG/L	115.0	91.0	79.0		90.0	55.0	
POTASSIUM		MG/L	7.23	4.03	6.59		6.16	1.70	
CALCIUM		MG/L	84.8	100.0	90.4		60.8	50.4	
MAGNESIUM		MG/L	78.72	74.40	72.90		45.60	32.16	
SULFATE		MG/L	380	360	320		200	88	
CHLORIDE		MG/L	34	36	34		30	24	20
CARBONATE		MG/L CO3	-0.01	-0.01	-0.01		7.20	-0.01	
BICARBONATE		MG/L HCO3	434.3	422.1	408.9		339.2	300.1	
HYDROXIDE (OH)		MG/L	-0.01	-0.01	-0.01		-0.01	-0.01	
PH (LAB)		S.U.	8.1	8.2	8.2		8.1	7.3	9.2
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	1397	1350	1242		940	615	650
AMMONIA AS N		MG/L	0.10	0.20	0.10		-0.01	0.10	
NITRATE AS N		MG/L	0.02	0.02	0.02		0.06	0.18	
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.03	0.05	0.06		0.05	0.04	
FLORIDE		MG/L	0.43	0.40	0.44		0.24	0.25	
OIL & GREASE		MG/L	1.5		3.4		2.3		-1.0
TOTAL ALKALINITY AS CACO3		MG/L	356	346	336		290	246	
TOTAL HARDNESS AS CACO3		MG/L	540	560	530		342	280	
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-1.001		-0.001	-0.001	
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.06	0.01	0.07		0.14	0.06	
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001		-0.001	-0.001	
CHROMIUM	Dissolved	MG/L							
	Total	MG/L			-0.001				
COPPER	Dissolved	MG/L							
	Total	MG/L	-0.001		0.014				
IRON	Dissolved	MG/L							
	Total	MG/L	0.21	0.34	0.30		0.56	0.04	0.26
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001		-0.001		
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.061	0.132	0.145		0.230	0.007	
MERCURY	Dissolved	MG/L							
	Total	MG/L	-0.0002	-0.0002	-0.0002		-0.0002	-0.0002	
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001		-0.001	-0.001	
ZINC	Dissolved	MG/L							
	Total	MG/L	0.003	0.036	0.025		0.036	0.012	
TOC		MG/L	2	2	2		5	25	
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	0.0	0.2	dry	2.0	32.0	31.0	

Negative Values indicate < values

Monitor Point: B-2

Parameters		Units	Sample Date 08/09/78	10/11/78	11/12/78	12/13/78	12/15/78	04/17/79	06/13/79
TEMPERATURE (FIELD)		C	15.0	6.0	5.0	0.0	1.0	7.0	12.0
TOTAL DISSOLVED SOLIDS		MG/L	566	566	410	640	599	776	410
TOTAL SUSPENDED SOLIDS		MG/L	2	8	2070	1	38	8770	24
SODIUM		MG/L			50.0	84.2	73.3	61.0	41.2
POTASSIUM		MG/L			1.92	2.56		3.15	1.61
CALCIUM		MG/L			48.8	70.4		48.0	50.0
MAGNESIUM		MG/L			30.24	52.32		29.28	42.00
SULFATE		MG/L	194	193	94	210		466	110
CHLORIDE		MG/L	26	24	18	24		16	12
CARBONATE		MG/L CO3			7.20				
BICARBONATE		MG/L HCO3			275.7	402.9		280.6	309.9
HYDROXIDE (OH)		MG/L			-0.01				
PH (LAB)		S.U.	7.9	7.3	8.3	6.9		7.5	8.6
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	795	920	630	990		1190	630
AMMONIA AS N		MG/L			0.25				
NITRATE AS N		MG/L			0.52	0.02		0.11	0.04
NITRITE AS N		MG/L				-0.01			
PHOSPHATE AS PO4		MG/L			0.09				
FLORIDE		MG/L			0.23	0.23		0.24	0.20
OIL & GREASE		MG/L	1.4	2.0	33.0	-1.0		1.8	1.0
TOTAL ALKALINITY AS CACO3		MG/L			238				254
TOTAL HARDNESS AS CACO3		MG/L			248				
ARSENIC	Dissolved	MG/L							
	Total	MG/L			0.003	-0.001		-0.001	-0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L			0.03	0.07		0.35	0.12
CADMIUM	Dissolved	MG/L							
	Total	MG/L			-0.001	-0.001		-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L			-0.001	-0.001		-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L			0.006	0.002		0.004	-0.001
IRON	Dissolved	MG/L							
	Total	MG/L	0.12	0.13	0.01	0.03		227.00	0.18
LEAD	Dissolved	MG/L							
	Total	MG/L			-0.001	-0.001		-0.001	0.002
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.013	0.026	0.011	0.041		0.794	0.026
MERCURY	Dissolved	MG/L							
	Total	MG/L			-0.0002				
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001		0.020	0.002
ZINC	Dissolved	MG/L							
	Total	MG/L			0.007	-0.001		0.031	0.038
TOC		MG/L			37	18		1	
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	1.7	2.0	49.0	Ice	0.0	57.0	68.0

Negative Values indicate < values

Monitor Point: B-2

Parameters		Units	08/08/79	10/30/79	12/26/79	02/13/80	04/17/80	06/05/80	08/07/80
		Sample Date							
TEMPERATURE (FIELD)		C	21.0	6.0	0.5	0.5	3.0	11.5	20.0
TOTAL DISSOLVED SOLIDS		MG/L	856	568	680	635	670	362	560
TOTAL SUSPENDED SOLIDS		MG/L	5660	24	1	1	1518	136	3
SODIUM		MG/L	58.5	74.0	84.0	81.0	115.0	37.8	70.8
POTASSIUM		MG/L	4.66	4.91	2.63	4.88	2.40	1.44	2.38
CALCIUM		MG/L	116.0	48.0	84.0	71.2	56.0	55.2	51.0
MAGNESIUM		MG/L	7.66	51.60	55.20	48.48	44.40	31.68	52.00
SULFATE		MG/L	170	212	290	223	285	76	220
CHLORIDE		MG/L	22	28	28	28	24	12	28
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	295.2	297.7	376.3	353.8	334.3	307.4	286.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	7.8	8.0	9.4	8.8	8.8	9.2	8.4
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	1300	640	1060	1360	490	560	10
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	0.17	0.16	-0.01	0.02	0.16	0.15	-0.01
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L		0.14	0.02	0.16	0.72	0.20	0.17
FLORIDE		MG/L	0.71	0.26	0.23	0.37	0.23	0.28	0.25
OIL & GREASE		MG/L	-1.0	4.4	-1.0	2.0	6.4	1.2	0.2
TOTAL ALKALINITY AS CACO3		MG/L	242	244	306	290	274	280	230
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	-1.001	0.002	0.001	0.003	0.001	0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.32	0.36	0.05	0.31	0.17	0.02	0.08
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	0.002	0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	0.006	0.004	0.004	-0.001	0.010	-0.010	0.040
IRON	Dissolved	MG/L	0.56						
	Total	MG/L	332.00	0.13	0.14	0.14	32.60	2.61	0.07
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	0.002	-0.002
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.007	0.036	0.043	0.130	0.680	0.070	0.003
MERCURY	Dissolved	MG/L							
	Total	MG/L		-0.0002	-0.0002				
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	0.001	0.001	0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.009	0.006	0.007	0.016	0.020	0.010	0.005
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	8.6	0.7	3.0	Ice	24.0	56.1	6.0

Negative Values indicate < values

Monitor Point: B-2

Parameters		Units	10/28/80	12/29/80	02/04/81	04/07/81	06/23/81	08/27/81	10/29/81
		Sample Date							
TEMPERATURE (FIELD)		C	2.0	0.0	1.0	4.0	22.0	15.0	7.0
TOTAL DISSOLVED SOLIDS		MG/L	580	840	700	346	506	695	453
TOTAL SUSPENDED SOLIDS		MG/L	28	14	13	2946	15	1	102
SODIUM		MG/L	86.0	73.4	125.0	42.3	79.0	86.0	63.0
POTASSIUM		MG/L	2.19	1.95	2.40	3.90	2.34	2.95	2.80
CALCIUM		MG/L	46.6	50.0	49.6	48.0	34.4	39.2	44.0
MAGNESIUM		MG/L	56.16	48.00	52.32	25.92	48.16	57.60	47.04
SULFATE		MG/L	204	231	223	92	189	226	150
CHLORIDE		MG/L	22	11	40	16	22	41	20
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	361.1	358.6	407.5	216.4	286.0	276.2	322.9
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	7.9	7.6	7.6	8.1	8.7	8.7	8.3
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	890	503	522	326	660	700	615
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	1.02
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.10	0.12	0.06	10.00	0.22	0.29	0.20
FLORIDE		MG/L	0.24	0.15	0.29	0.23	0.25	0.26	0.23
OIL & GREASE		MG/L	1.0	1.0	-0.0	1.4	1.2	0.2	1.3
TOTAL ALKALINITY AS CACO3		MG/L	296	322	354	202	230	248	277
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	0.002	0.002	0.016	0.050	0.004	0.004
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.06	0.14	0.07	0.06	0.07	0.10	0.10
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	0.002	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	0.027	-0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	-0.001	0.010	0.010	0.090	0.040	0.010	0.009
IRON	Dissolved	MG/L	0.02		0.02				
	Total	MG/L	0.54	0.49	0.14	19.70	0.28	0.11	0.12
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.002	-0.001	-0.001	0.013	-0.001	-0.001	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.030	0.070	0.040	1.010	0.020	0.020	0.022
MERCURY	Dissolved	MG/L							
	Total	MG/L	-0.0002		-0.0002				
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	0.020	0.002	0.001	-0.001	0.004	-0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.003	0.006	0.007	0.145	0.009	0.010	0.015
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	6.0			31.0		1.3	

Negative Values indicate < values

Monitor Point: B-2

Parameters		Units / Sample Date	12/03/81	02/15/82	04/14/82	06/14/82	08/03/82	10/07/82	12/21/82
TEMPERATURE (FIELD)		C	1.0		5.0	13.0	19.0	6.0	0.0
TOTAL DISSOLVED SOLIDS		MG/L	683		798	395	493	495	535
TOTAL SUSPENDED SOLIDS		MG/L	130		536	28	5	46	34
SODIUM		MG/L	52.5		42.0	46.5	71.0	65.5	61.5
POTASSIUM		MG/L	5.60		3.08	1.55	2.20	2.86	2.00
CALCIUM		MG/L	70.0		155.0	56.5	55.9	49.6	55.6
MAGNESIUM		MG/L	54.00		43.00	56.20	36.10	45.60	52.82
SULFATE		MG/L	265		415	74	144	140	174
CHLORIDE		MG/L	25		12	10	17	11	27
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	326.3		251.6	311.4	332.3	355.4	420.9
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	7.9		7.9	8.3	8.4	8.5	8.1
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	50		520	609	753	634	663
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	0.53		0.17	0.16	-0.01	-0.01	-0.01
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.62		1.24	0.06	0.08	0.13	0.13
FLORIDE		MG/L	0.25		0.17	0.18	0.24	0.20	0.25
OIL & GREASE		MG/L	-0.0		2.6	-0.1	-0.1	-0.1	-0.1
TOTAL ALKALINITY AS CACO3		MG/L	317		206	304	276	291	345
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001		0.030	0.003	-0.001	-0.001	-0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.06		0.25	0.10	0.10	0.11	0.06
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001		-0.001	-0.001	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001		0.037	-0.001	-0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	0.010		0.100	0.010	-0.001	0.020	0.020
IRON	Dissolved	MG/L							
	Total	MG/L	0.13		24.50	0.30	0.06	0.54	0.32
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001		0.002	-0.001	-0.001	-0.001	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.040		0.900	0.025	0.015	0.040	0.040
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001		0.002	-0.001	-0.001	-0.001	-0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.023		0.106	0.015	0.010	0.005	0.013
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS		0.0		39.0			

Negative Values indicate < values

Monitor Point: B-2

Parameters		Units / Sample Date	02/28/83	04/29/83	06/28/83	08/17/83	10/18/83
TEMPERATURE (FIELD)		C	1.0	3.0	14.0	19.0	6.0
TOTAL DISSOLVED SOLIDS		MG/L	600	540	480	490	595
TOTAL SUSPENDED SOLIDS		MG/L	45	4310	68	28	6
SODIUM		MG/L	79.5	74.0	57.0	63.0	75.8
POTASSIUM		MG/L	1.92	2.30	2.50	2.40	2.30
CALCIUM		MG/L	53.6	56.6	49.6	49.0	51.2
MAGNESIUM		MG/L	55.20	45.12	42.24	46.08	63.10
SULFATE		MG/L	210	188	119	146	213
CHLORIDE		MG/L	3	29	24	32	32
CARBONATE		MG/L CO3					
BICARBONATE		MG/L HCO3	376.2	317.2	328.1	305.0	307.4
HYDROXIDE (OH)		MG/L					
PH (LAB)		S.U.	7.9	7.6	7.5	7.6	7.7
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	650	661	519	788	901
AMMONIA AS N		MG/L					
NITRATE AS N		MG/L	-0.03	0.27	0.02	0.04	-0.01
NITRITE AS N		MG/L					
PHOSPHATE AS PO4		MG/L	0.20	0.90	0.14	0.13	-0.01
FLORIDE		MG/L	0.19	0.26	0.22	0.19	0.25
OIL & GREASE		MG/L	-0.2	-0.2	1.0	0.2	-0.2
TOTAL ALKALINITY AS CACO3		MG/L	304	260	270	250	252
TOTAL HARDNESS AS CACO3		MG/L					
ARSENIC	Dissolved	MG/L					
	Total	MG/L	-0.001	0.024	0.019	0.016	-0.001
BARIUM	Dissolved	MG/L					
	Total	MG/L	0.10	0.74	0.75	0.72	0.11
CADMIUM	Dissolved	MG/L					
	Total	MG/L	-0.001	0.002	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L					
	Total	MG/L	-0.001	0.033	0.006	0.011	-0.001
COPPER	Dissolved	MG/L					
	Total	MG/L	0.050	0.110	0.020	0.012	0.040
IRON	Dissolved	MG/L					
	Total	MG/L	0.61	33.70	31.50	0.43	0.21
LEAD	Dissolved	MG/L					
	Total	MG/L	-0.001	0.030	0.004	-0.001	-0.001
MANGANESE	Dissolved	MG/L					
	Total	MG/L	0.060	1.400	0.002	0.040	0.020
MERCURY	Dissolved	MG/L					
	Total	MG/L					
SELENIUM	Dissolved	MG/L					
	Total	MG/L	-0.001	1.002	0.001	-0.001	-0.001
ZINC	Dissolved	MG/L					
	Total	MG/L	0.013	0.175	0.166	0.166	0.019
TOC		MG/L					
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)					
FLOW		CFS	2.8		30.6	20.2	6.0

Negative Values indicate < values

Monitor Point: B-3

Parameters		Units	Sample Date 08/07/80	10/28/80	12/29/80	02/04/81	04/07/81	06/23/81	08/27/81
TEMPERATURE (FIELD)		C	19.0	3.0	2.0	1.0	4.0	18.0	15.0
TOTAL DISSOLVED SOLIDS		MG/L	540	570	510	695	345	455	560
TOTAL SUSPENDED SOLIDS		MG/L	1	31	32	4	2728	21	6
SODIUM		MG/L	76.5	81.0	35.0	117.0	41.0	64.0	85.0
POTASSIUM		MG/L	2.43	2.14	2.10	2.45	4.02	2.46	2.90
CALCIUM		MG/L	47.5	46.0	64.0	52.0	49.2	33.1	40.0
MAGNESIUM		MG/L	49.30	52.30	57.60	56.64	24.18	44.16	51.92
SULFATE		MG/L	200.0	192.0	206.0	223.0	93.0	166.0	228.0
CHLORIDE		MG/L	34	22	12	40	20	22	40
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	283.5	368.7	217.7	409.9	226.9	261.1	261.1
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.6	7.9	7.6	7.6	8.0	8.7	8.7
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	850	670	505	521	315	670	695
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.34
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.04	0.12	0.13	0.06	1.20	0.24	0.30
FLORIDE		MG/L	0.24	0.23	0.15	0.30	0.22	0.26	0.26
OIL & GREASE		MG/L	0.4	4.4	1.4	-0.0	1.4	1.4	0.2
TOTAL ALKALINITY AS CACO3		MG/L	229	294	296	352	186	230	236
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	0.001	-0.001	0.002	0.002	0.020	0.020	0.005
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.07	0.07	0.07	0.07	0.06	0.06	0.10
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	0.002	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	0.005	-0.001	-0.001	0.040	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	0.110	0.010	0.020	0.010	0.060	0.010	0.020
IRON	Dissolved	MG/L		0.69		0.04			
	Total	MG/L	0.60	0.92	0.68	0.12	27.00	0.12	0.18
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.002	0.005	-0.001	-0.001	0.013	-0.001	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.004	0.030	0.036	0.030	1.220	0.010	0.010
MERCURY	Dissolved	MG/L							
	Total	MG/L		-0.0002		-0.0002			
SELENIUM	Dissolved	MG/L							
	Total	MG/L	0.001	-0.001	0.002	0.001	0.001	-0.001	0.004
ZINC	Dissolved	MG/L							
	Total	MG/L	0.002	0.010	0.012	0.007	0.175	0.019	0.010
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	16.8	1.6	2.7		11.0	3.0	

Negative Values indicate < values

Monitor Point: B-3

Parameters		Units	Sample Date 06/13/79	08/08/79	10/30/79	12/26/79	02/13/80	04/17/80	06/05/80
TEMPERATURE (FIELD)		C	12.5	21.0	6.5	0.5		3.0	11.0
TOTAL DISSOLVED SOLIDS		MG/L	380	968	562	652		720	360
TOTAL SUSPENDED SOLIDS		MG/L	26	797	24	1		1356	96
SODIUM		MG/L	45.0	64.8	70.0	84.0		139.0	37.5
POTASSIUM		MG/L	1.62	6.42	6.28	2.62		2.52	1.45
CALCIUM		MG/L	52.0	11.2	54.0	76.0		68.0	50.4
MAGNESIUM		MG/L	37.20	7.20	34.80	56.20		33.60	32.64
SULFATE		MG/L	85.0	240.0	207.0	245.0		250.0	70.5
CHLORIDE		MG/L	20	28	30	24		66	14
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	309.9	202.5	292.8	366.0		324.5	217.7
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.6	7.7	8.0	9.6		8.8	9.5
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	590	1500		1000		560	550
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	-0.01	0.29	0.30	-0.01		0.20	0.02
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L			0.12	0.10		0.56	0.15
FLORIDE		MG/L	0.21	0.54	0.27	0.26		0.22	0.27
OIL & GREASE		MG/L	-1.0	-1.0	-1.0	-1.0		106.0	3.6
TOTAL ALKALINITY AS CAC03		MG/L	254	166	240	300		266	252
TOTAL HARDNESS AS CAC03		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	0.003	0.002	-0.001		0.002	-0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.11	0.86	0.88	0.05		0.16	0.05
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001		-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	0.002	-0.001	-0.001		0.002	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	-0.001	0.016	0.003	0.003		0.020	-0.010
IRON	Dissolved	MG/L		0.88					
	Total	MG/L	0.16	131.00	0.13	0.16		28.30	2.71
LEAD	Dissolved	MG/L							
	Total	MG/L	0.002	-0.001	-0.001	-0.001		-0.001	0.004
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.026	0.301	0.023	0.034		0.520	0.090
MERCURY	Dissolved	MG/L							
	Total	MG/L			-0.0002	-0.0002			
SELENIUM	Dissolved	MG/L							
	Total	MG/L	0.002	-0.001	-0.001	-0.001		0.001	0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.120	0.016	0.006	0.003		0.020	0.010
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	51.0	8.5	1.4	2.6	0.0	25.0	85.0

Negative Values indicate < values

Iron TOTAL

Mang TOTAL

Monitor Point: B-3

Parameters		Units / Sample Date	04/13/77	06/14/78	08/09/78	10/11/78	12/13/78	12/15/78	04/17/79
TEMPERATURE (FIELD)		C	13.0	10.0	15.0	6.0	0.0	1.0	7.0
TOTAL DISSOLVED SOLIDS		MG/L	700	378	577	575	612	685	790
TOTAL SUSPENDED SOLIDS		MG/L	5	55	4	2	25	56	955
SODIUM		MG/L	83.7	51.0		81.5	77.0	79.6	50.9
POTASSIUM		MG/L	3.13	1.72		2.68	2.52	2.72	2.97
CALCIUM		MG/L	43.2	44.0			66.6	72.8	55.2
MAGNESIUM		MG/L	50.90	34.08		45.10	46.08	52.80	25.92
SULFATE		MG/L	210.0	84.0	196.0	196.0	196.0	246.0	510.0
CHLORIDE		MG/L	24	20		24	22	14	12
CARBONATE		MG/L CO3	-0.01	-0.01					
BICARBONATE		MG/L HCO3	292.8	292.8		331.8	390.4	346.5	387.9
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.7	7.5	8.0	7.4	7.1	8.4	7.5
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	1050	625	845	870	940	1050	1210
AMMONIA AS N		MG/L	0.20						
NITRATE AS N		MG/L	0.02	0.06		0.03	0.02	0.03	0.23
NITRITE AS N		MG/L		-0.01		-0.01	-0.01		
PHOSPHATE AS PO4		MG/L	0.06						
FLORIDE		MG/L	0.32	0.21		0.26	0.23	0.26	0.24
OIL & GREASE		MG/L	-1.0	-1.0	1.2	1.4	1.2		1.2
TOTAL ALKALINITY AS CAC03		MG/L	240						
TOTAL HARDNESS AS CAC03		MG/L	320						
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	0.003	-0.001	-0.001	-0.001	-0.001	-0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.14	0.66		0.09	0.08	0.06	0.26
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001		-0.001	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001		-0.001	-0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L		-0.001		0.004	0.001	0.001	0.005
IRON	Dissolved	MG/L							
	Total	MG/L	0.25	0.84	0.13	0.08	0.02	0.48	235.00
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001		-0.001	-0.001	-0.001	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.021	0.021	0.013	0.020	0.034	0.043	0.039
MERCURY	Dissolved	MG/L							
	Total	MG/L	-0.0002						
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.020
ZINC	Dissolved	MG/L							
	Total	MG/L	0.019	0.016		0.006	0.002	-0.001	0.019
TOC		MG/L	9	18	12	11	12	8	2
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	0.2	34.0	2.0	3.5	Ice	1.1	44.6

Negative Values indicate < values

B-3 TDS TSS PH

Monitor Point: B-3

Parameters		Units / Sample Date	10/29/81	12/03/81	02/15/82	04/14/82	06/14/82	08/03/82	10/07/82
TEMPERATURE (FIELD)		C	7.0	1.0	frozen	4.0	13.0	19.0	6.0
TOTAL DISSOLVED SOLIDS		MG/L	520	698		510	470	525	492
TOTAL SUSPENDED SOLIDS		MG/L	65	17		807	31	1	27
SODIUM		MG/L	62.0	105.0		41.0	45.5	68.0	67.0
POTASSIUM		MG/L	2.50	1.20		2.65	1.55	2.20	2.06
CALCIUM		MG/L	43.2	65.0		60.0	60.5	68.4	45.8
MAGNESIUM		MG/L	46.26	56.50		30.00	37.60	37.20	45.60
SULFATE		MG/L	147.0	234.0		196.0	136.0	160.0	140.0
CHLORIDE		MG/L	18	27		12	14	22	9
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	322.3	427.0		260.0	322.3	332.6	352.2
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.1	7.5		7.9	8.5	8.5	8.5
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	485	483		535	611	590	699
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	-0.01	0.63		0.18	0.11	-0.01	-0.01
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.20	0.95		0.76	0.06	0.07	0.13
FLORIDE		MG/L	0.23	0.26		0.16	0.17	0.24	0.20
OIL & GREASE		MG/L	3.4	0.2		4.0	-0.1	-0.1	1.0
TOTAL ALKALINITY AS CACO3		MG/L	276	396		213	264	273	289
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	0.006	-0.001		0.023	-0.001	-0.001	-0.001
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.07	0.08		0.14	0.10	0.05	0.08
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001		-0.001	-0.001	-0.001	-0.001
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001		0.032	-0.001	-0.001	-0.001
COPPER	Dissolved	MG/L							
	Total	MG/L	0.013	0.010		0.100	-0.010	0.013	0.010
IRON	Dissolved	MG/L							
	Total	MG/L	0.19	0.15		20.50	0.42	0.13	0.46
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001		0.002	0.005	0.002	-0.001
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.012	0.040		0.200	0.035	0.020	0.035
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001		0.002	-0.001	-0.001	-0.001
ZINC	Dissolved	MG/L							
	Total	MG/L	0.011	0.028		0.095	0.015	0.010	0.015
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS			0.0				

Negative Values indicate < values

Monitor Point: B-3

Parameters		Units / Sample Date	12/21/82	02/24/83	04/21/83	06/28/83	08/17/83	10/18/83	03/30/85
TEMPERATURE (FIELD)		C	1.0	1.0	4.0	14.0	20.0	9.0	0.9
TOTAL DISSOLVED SOLIDS		MG/L	590	585	566	458	470	610	665
TOTAL SUSPENDED SOLIDS		MG/L	42	43	4105	56	36	6	1420
SODIUM		MG/L	81.0	81.0	79.0	50.0	55.0	76.4	96.0
POTASSIUM		MG/L	2.10	1.94	2.50	2.60	2.50	2.40	3.00
CALCIUM		MG/L	65.6	56.8	56.8	48.0	42.4	101.6	77.0
MAGNESIUM		MG/L	41.48	48.96	44.64	44.16	41.03	23.04	56.00
SULFATE		MG/L	155.0	195.0	190.0	119.0	140.0	216.0	237.0
CHLORIDE		MG/L	27	6	29	24	28	34	40
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	405.0	371.6	328.9	314.8	297.7	217.6	285.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.3	8.1	8.1	7.8	7.7	7.7	8.2
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	687	675	636	523	781	876	
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L	-0.01	0.05	0.27	0.02	0.06	-0.01	
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L	0.09	0.20	1.00	0.15	0.14	0.05	
FLORIDE		MG/L	0.25	0.19	0.26	0.22	0.18	0.24	
OIL & GREASE		MG/L	-0.1	-0.2	-0.2	0.6	-0.2	-0.2	-1.0
TOTAL ALKALINITY AS CACO3		MG/L	320	305	268	258	244	244	
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.026	0.025	0.026	-0.001	
BARIUM	Dissolved	MG/L							
	Total	MG/L	0.06	0.10	0.75	0.79	0.78	0.11	
CADMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.002	-0.001	-0.001	-0.001	
CHROMIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.033	0.005	0.011	-0.001	
COPPER	Dissolved	MG/L							
	Total	MG/L	0.010	0.060	0.110	0.020	0.060	0.040	
IRON	Dissolved	MG/L							
	Total	MG/L	0.48	0.65	34.50	35.60	0.43	0.30	12.50
LEAD	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.030	0.104	-0.001	-0.001	
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.035	0.045	1.560	0.025	0.030	0.020	
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L	-0.001	-0.001	0.003	0.002	0.002	-0.001	
ZINC	Dissolved	MG/L							
	Total	MG/L	0.003	0.013	0.200	0.219	0.199	0.011	
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS			60.0		18.4	6.0	19.2

Negative Values indicate < values

Monitor Point: B-3

Parameters		Units	Sample Date 06/15/85	09/30/85	11/30/85	04/03/86	06/17/86	09/23/86	10/15/86
TEMPERATURE (FIELD)		C	14.0	6.0	4.0	1.0	4.0	12.0	
TOTAL DISSOLVED SOLIDS		MG/L	470	628	674	466	514	606	756
TOTAL SUSPENDED SOLIDS		MG/L	32	280	12	616	470	316	121
SODIUM		MG/L	56.0	89.0	101.0	59.0	59.0	84.0	4.8
POTASSIUM		MG/L	2.00	3.00	2.00	2.00	2.00	3.00	0.06
CALCIUM		MG/L	44.0	11.5	65.0	51.0	51.0	57.0	3.1
MAGNESIUM		MG/L	48.00	62.00	66.00	36.00	36.00	0.22	5.19
SULFATE		MG/L	140.0	261.0	259.0	128.0	144.0	22.0	6.2
CHLORIDE		MG/L	20	36	37	21	20	31	1
CARBONATE		MG/L CO3							0.00
BICARBONATE		MG/L HCO3	241.0	206.0	286.0	0.0	305.0	334.0	5.9
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.2	8.0	8.2	8.4	8.1	8.2	8.2
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C							1150
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							0.01
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-1.0	0.0	1.0	-1.0	-5.0	-0.5	-5.0
TOTAL ALKALINITY AS CACO3		MG/L							295
TOTAL HARDNESS AS CACO3		MG/L							414
ARSENIC	Dissolved	MG/L							
	Total	MG/L							
BARIUM	Dissolved	MG/L							
	Total	MG/L							
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	0.26	2.81	0.40	13.90	0.94	7.46	3.30
LEAD	Dissolved	MG/L							
	Total	MG/L							
MANGANESE	Dissolved	MG/L							
	Total	MG/L							0.080
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L							
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	13.8	1.3	0.2	2081.0	2700.0	1080.0	

Negative Values indicate < values

Monitor Point: B-3

Parameters		Units / Sample Date	11/20/86	03/26/87	04/15/87	05/22/87	07/28/87	10/13/87	10/29/87
TEMPERATURE (FIELD)		C	3.0	1.0		5.0	11.0	10.0	
TOTAL DISSOLVED SOLIDS		MG/L	778	680	666	437	624	588	588
TOTAL SUSPENDED SOLIDS		MG/L	121	424	424	67	34	104	104
SODIUM		MG/L	111.0	90.0	3.9	56.0	84.0	85.0	3.7
POTASSIUM		MG/L	3.00	3.00	0.07	1.00	3.00	3.00	0.07
CALCIUM		MG/L	62.0	64.0	3.2	46.0	39.0	50.0	2.5
MAGNESIUM		MG/L	0.06	54.00	4.43	40.00	52.00	51.00	4.17
SULFATE		MG/L	297.0	243.0		121.0	210.0	216.0	4.5
CHLORIDE		MG/L	46	36	1	18	35	33	0
CARBONATE		MG/L CO3			0.06				0.06
BICARBONATE		MG/L HCO3	361.0	354.0	5.8	315.0	258.0	303.0	5.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.1	8.3	8.4	8.1	7.8	8.4	8.4
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C			1023				
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-0.5	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
TOTAL ALKALINITY AS CACO3		MG/L			295				253
TOTAL HARDNESS AS CACO3		MG/L			382				333
ARSENIC	Dissolved	MG/L							
	Total	MG/L							
BARIUM	Dissolved	MG/L							
	Total	MG/L							
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	3.30	12.50	12.50	1.84	0.77	1.39	1.39
LEAD	Dissolved	MG/L							
	Total	MG/L							
MANGANESE	Dissolved	MG/L							
	Total	MG/L							
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L							
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	1289.0	497.0		1575.0	670.0	1215.0	

Negative Values Indicate < values

Monitor Point: B-3

Parameters		Units / Sample Date	03/24/88	05/18/88	09/30/88	12/08/88	12/29/88	03/15/89	04/05/89
TEMPERATURE (FIELD)		C	1.0	3.0	6.0	2.0		2.0	
TOTAL DISSOLVED SOLIDS		MG/L	361	368	432	783	783	759	758
TOTAL SUSPENDED SOLIDS		MG/L	532	488	0	9	9	224	224
SODIUM		MG/L	50.0	40.0	92.3	101.0	101.0	106.0	106.0
POTASSIUM		MG/L	4.00	2.00	2.91	5.00	5.00	3.00	3.00
CALCIUM		MG/L	43.0	51.0	46.1	119.0	119.0	69.0	69.0
MAGNESIUM		MG/L	28.00	33.00	306.90	41.00	41.00	59.00	59.00
SULFATE		MG/L	107.0	81.0	252.0	285.0	285.0	303.0	303.0
CHLORIDE		MG/L					40	44	44
CARBONATE		MG/L CO3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BICARBONATE		MG/L HCO3					392.0	353.0	353.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	7.8	8.1	7.9	8.1		8.1	8.3
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	600	620	990	600		990	1016
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-5.0	-5.0	late	-5.0	-5.0	-5.0	-5.0
TOTAL ALKALINITY AS CACO3		MG/L							
TOTAL HARDNESS AS CACO3		MG/L					467	418	418
ARSENIC	Dissolved	MG/L							
	Total	MG/L					-0.005		
BARIUM	Dissolved	MG/L							
	Total	MG/L					-0.50		
CADMIUM	Dissolved	MG/L							
	Total	MG/L					-0.002		
CHROMIUM	Dissolved	MG/L							
	Total	MG/L					-0.020		
COPPER	Dissolved	MG/L							
	Total	MG/L					-0.010		
IRON	Dissolved	MG/L							
	Total	MG/L	13.20	0.85	0.10	0.10	0.07	227.00	2.27
LEAD	Dissolved	MG/L							
	Total	MG/L					-0.020		
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.380	0.400	0.010	0.010	0.010	0.060	0.060
MERCURY	Dissolved	MG/L							
	Total	MG/L					-0.0010		
SELENIUM	Dissolved	MG/L							
	Total	MG/L					-0.005		
ZINC	Dissolved	MG/L							
	Total	MG/L					-0.010		
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	2.8	3.8	1.2	1.1		2.3	

Negative Values indicate < values

Monitor Point: B-3

Parameters		Units	05/26/89	08/22/89	09/25/89	10/18/89	02/28/90	03/13/90	05/30/90
		Sample Date	05/26/89	08/22/89	09/25/89	10/18/89	02/28/90	03/13/90	05/30/90
TEMPERATURE (FIELD)		C	6.0	5.0		2.0	1.0		3.0
TOTAL DISSOLVED SOLIDS		MG/L	553	644	644	750	735	735	604
TOTAL SUSPENDED SOLIDS		MG/L	5	3524	3524	1	116	116	19
SODIUM		MG/L	82.0	12.0	12.0	103.0	88.4	88.4	91.3
POTASSIUM		MG/L	2.00	0.00	0.00	4.46	4.11	4.11	2.50
CALCIUM		MG/L	18.0	61.9	61.9	159.2	92.6	92.6	40.2
MAGNESIUM		MG/L	67.00	43.96	43.96	6.32	54.37	54.37	58.70
SULFATE		MG/L	211.0	229.4	229.4	268.9	273.2	273.2	210.3
CHLORIDE		MG/L	28	40	40	44	89	89	34
CARBONATE		MG/L CO3	11.00	4.81	4.81	12.74	0.00	0.00	18.30
BICARBONATE		MG/L HCO3	273.0	315.0	311.5	324.0	312.3	312.3	302.9
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.1	8.0	8.5	8.4	7.9	8.3	8.1
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	900	910	1075	1200	990	1191	1100
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L			-0.01				
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-5.0	3.0	3.0	-5.0	-5.0	-5.0	-5.0
TOTAL ALKALINITY AS CAC03		MG/L			253			256	
TOTAL HARDNESS AS CAC03		MG/L	319	335	335	423	455	455	341
ARSENIC	Dissolved	MG/L							
	Total	MG/L							
BARIUM	Dissolved	MG/L							
	Total	MG/L							
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L			0.020				
IRON	Dissolved	MG/L							
	Total	MG/L	0.03	5.74	5.74	0.11	0.27	0.27	0.30
LEAD	Dissolved	MG/L							
	Total	MG/L							
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.010	0.930	0.930	0.010	0.060	0.060	0.010
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L			0.040				
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	1.2	0.7		0.3	0.6		2.4

Negative Values indicate < values

Monitor Point: B-3

Parameters		Units / Sample Date	06/14/90	09/29/90	10/23/90	11/26/90	12/20/90	12/22/90	03/13/91
TEMPERATURE (FIELD)		C		6.0		2.0			2.0
TOTAL DISSOLVED SOLIDS		MG/L	604	527	527	844		870	948
TOTAL SUSPENDED SOLIDS		MG/L	19	166	166	21		21	66
SODIUM		MG/L	91.9	75.7	75.7	111.0		111.0	182.0
POTASSIUM		MG/L	2.50	3.79	3.79	4.16		4.16	4.06
CALCIUM		MG/L	40.2	54.6	54.6	58.4		58.4	63.5
MAGNESIUM		MG/L	56.70	38.20	38.20	73.40		73.40	61.30
SULFATE		MG/L	210.9	207.0	207.0	333.0		333.0	282.0
CHLORIDE		MG/L	34	4	4	55		55	84
CARBONATE		MG/L CO3	18.30	0.00	0.00	8.10		8.10	0.00
BICARBONATE		MG/L HCO3	302.9	292.0	292.0	401.0		401.0	513.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.4	8.1	8.3	8.1		8.4	8.0
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	964	840	947	1290		1300	890
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-5.0	-5.0	-5.0	-5.0		-5.0	-5.0
TOTAL ALKALINITY AS CACO3		MG/L	279		239			342	
TOTAL HARDNESS AS CACO3		MG/L	341	293	293	522		522	411
ARSENIC	Dissolved	MG/L							
	Total	MG/L					0.001		
BARIUM	Dissolved	MG/L							
	Total	MG/L					0.12		
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	0.30	4.46	4.46	0.21	0.21		1.32
LEAD	Dissolved	MG/L							
	Total	MG/L					0.004		
MANGANESE	Dissolved	MG/L							
	Total	MG/L		0.070	0.070	0.010			0.010
MERCURY	Dissolved	MG/L							
	Total	MG/L					0.0003		
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L					0.020		
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS		0.2		1.2			1.2

Negative Values indicate < values

Monitor Point: B-3

Parameters		Units	04/05/91	05/26/91	09/23/91	10/21/91	11/22/91	03/04/92	04/14/92
		Sample Date							
TEMPERATURE (FIELD)		C		4.0	9.0		1.0	2.0	
TOTAL DISSOLVED SOLIDS		MG/L	928	466	100	947	1070	280	280
TOTAL SUSPENDED SOLIDS		MG/L	66	43	6	6	9	740	740
SODIUM		MG/L	182.0	76.0	255.0	255.0	292.0	50.0	50.0
POTASSIUM		MG/L	4.06	2.03	1.17	1.17	5.92	5.51	5.51
CALCIUM		MG/L	63.5	44.2	21.1	21.1	21.1	29.9	29.9
MAGNESIUM		MG/L	61.30	36.70	55.10	55.10	62.50	16.20	16.20
SULFATE		MG/L	262.0	145.0	230.0	230.0	254.0	59.7	59.7
CHLORIDE		MG/L	84	22	81	81	92	18	18
CARBONATE		MG/L CO3	0.00	0.00	11.10	11.10	0.00	0.00	0.00
BICARBONATE		MG/L HCO3	513.0	320.0	596.0	596.0	669.0	205.0	205.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.2	8.2	8.0	8.5	8.0	7.9	7.7
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	1510	1010	510	1560	1640	450	454
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-5.0	-5.0	-5.0	-5.0	-5.0	-0.0	-0.0
TOTAL ALKALINITY AS CACO3		MG/L	421			507			168
TOTAL HARDNESS AS CACO3		MG/L	411	289	279	279	309	141	141
ARSENIC	Dissolved	MG/L							
	Total	MG/L							
BARIUM	Dissolved	MG/L							
	Total	MG/L							
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	1.32	1.66	0.14	0.14	0.71	15.60	15.60
LEAD	Dissolved	MG/L							
	Total	MG/L							
MANGANESE	Dissolved	MG/L							
	Total	MG/L		0.020	0.010		0.030	0.400	0.400
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L							
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS		3.7	0.8		1.3	1.2	

Negative Values indicate < values

Monitor Point: B-27

Parameters		Units	Sample Date 03/03/85	06/15/85	09/30/85	11/30/85	04/03/86	06/17/86	09/23/86
TEMPERATURE (FIELD)		C	1.0	13.0	6.8	4.0	2.0	4.0	11.0
TOTAL DISSOLVED SOLIDS		MG/L	690	462	640	672	474	530	598
TOTAL SUSPENDED SOLIDS		MG/L	1220	46	-2	6	578	48	68
SODIUM		MG/L	99.0	58.0	101.0	104.0	59.0	59.0	86.0
POTASSIUM		MG/L	2.60	2.00	3.00	2.00	2.00	2.00	2.00
CALCIUM		MG/L	63.0	46.0	54.0	65.0	64.0	61.0	57.0
MAGNESIUM		MG/L	54.00	49.00	65.00	68.00	38.00	40.00	0.06
SULFATE		MG/L	237.0	140.0	253.0	257.0	126.0	146.0	229.0
CHLORIDE		MG/L	46	21	37	36	23	21	31
CARBONATE		MG/L CO3							
BICARBONATE		MG/L HCO3	283.0	243.0	282.0	292.0	0.0	303.0	333.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.4	8.2	8.2	8.2	8.0	8.2	8.5
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C							
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-1.0	-1.0	0.0	1.0	1.0	-5.0	-0.5
TOTAL ALKALINITY AS CACO3		MG/L							
TOTAL HARDNESS AS CACO3		MG/L							
ARSENIC	Dissolved	MG/L							
	Total	MG/L							
BARIUM	Dissolved	MG/L							
	Total	MG/L							
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	11.00	0.42	0.10	0.41	11.00	0.87	2.28
LEAD	Dissolved	MG/L							
	Total	MG/L							
MANGANESE	Dissolved	MG/L							
	Total	MG/L							
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L							
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	17.6	13.5	1.1	0.3	1840.0	2340.0	990.0

Negative Values indicate < values

B-27 TDS TSS PH Fe TOTAL

Monitor Point: B-27

Parameters		Units	11/20/86	12/15/86	03/26/87	04/15/87	05/22/87	07/28/87	10/13/87
		Sample Date							
TEMPERATURE (FIELD)		C	2.0		1.0		5.0	11.0	9.0
TOTAL DISSOLVED SOLIDS		MG/L	772	762	658	663	437	541	591
TOTAL SUSPENDED SOLIDS		MG/L	118	118	136	136	86	24	38
SODIUM		MG/L	111.0	111.0	88.0	88.0	58.0	78.0	86.0
POTASSIUM		MG/L	3.00	3.00	3.00	3.00	1.00	3.00	3.00
CALCIUM		MG/L	60.0	60.0	65.0	65.0	35.0	41.0	50.0
MAGNESIUM		MG/L	0.09	65.00	55.00	55.00	45.00	53.00	51.00
SULFATE		MG/L	296.0	296.0	241.0	241.0	122	206.0	218.0
CHLORIDE		MG/L	46	46	36	36	19	27	33
CARBONATE		MG/L CO3		0.00		5.00			
BICARBONATE		MG/L HCO3	365.0	365.0	346.0	346.0	315.0	288.0	296.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.1	8.3	8.3	8.4	8.1	8.1	7.9
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C		1150		1032			
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L		-0.01					
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-0.5	-5.0	-0.5	-5.0	-5.0	-5.0	-5.0
TOTAL ALKALINITY AS CACO3		MG/L		299		294			
TOTAL HARDNESS AS CACO3		MG/L		417		386			
ARSENIC	Dissolved	MG/L							
	Total	MG/L							
BARIUM	Dissolved	MG/L							
	Total	MG/L							
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	3.76	3.76	5.67	5.67	2.09	0.51	1.20
LEAD	Dissolved	MG/L							
	Total	MG/L							
MANGANESE	Dissolved	MG/L							
	Total	MG/L		0.090					
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L							
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	1240.0		460.0		1330.0	510.0	900.0

Negative Values indicate < values

B-27 TDS Mn TOTAL

Monitor Point: B-27

Parameters		Units / Sample Date	10/29/87	03/24/88	05/18/88	09/30/88	12/08/88	12/29/88	03/15/89
TEMPERATURE (FIELD)		C		1.0	3.0	6.0	1.0		2.0
TOTAL DISSOLVED SOLIDS		MG/L	591	351	360	404	793	793	754
TOTAL SUSPENDED SOLIDS		MG/L	38	443	700	-0	12	12	288
SODIUM		MG/L	86.0	48.0	41.0	93.1	100.0	100.0	104.0
POTASSIUM		MG/L	3.00	3.00	2.00	2.96	4.00	4.00	3.00
CALCIUM		MG/L	50.0	42.0	33.0	46.5	66.0	66.0	71.0
MAGNESIUM		MG/L	51.00	28.00	44.00	309.50	62.00	62.00	59.00
SULFATE		MG/L	218.0	107.0	81.0	253.0	310.0	310.0	305.0
CHLORIDE		MG/L	33					41	41
CARBONATE		MG/L CO3	5.00	0.00	0.00	0.00	0.00	0.00	6.00
BICARBONATE		MG/L HCO3	296.0					389.0	338.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.4	8.0	8.2	8.0	7.9		8.0
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C		600	600	990	490		900
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-5.0	-5.0	-5.0	late	-5.0	-5.0	-5.0
TOTAL ALKALINITY AS CAC03		MG/L	251						
TOTAL HARDNESS AS CAC03		MG/L	336					470	418
ARSENIC	Dissolved	MG/L							
	Total	MG/L						-0.005	
BARIUM	Dissolved	MG/L							
	Total	MG/L						-0.50	
CADMIUM	Dissolved	MG/L							
	Total	MG/L						-0.002	
CHROMIUM	Dissolved	MG/L							
	Total	MG/L						-0.020	
COPPER	Dissolved	MG/L							
	Total	MG/L						-0.010	
IRON	Dissolved	MG/L							
	Total	MG/L	1.20	12.70	1.03	0.03	0.17	0.01	0.28
LEAD	Dissolved	MG/L							
	Total	MG/L						-0.020	
MANGANESE	Dissolved	MG/L							
	Total	MG/L		0.370	0.460	0.010	0.010	0.010	
MERCURY	Dissolved	MG/L							
	Total	MG/L						-0.0010	
SELENIUM	Dissolved	MG/L							
	Total	MG/L						-0.005	
ZINC	Dissolved	MG/L							
	Total	MG/L						-0.010	
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS		2.3	3.5	1.1	1.0		2.4

Negative Values indicate < values

Monitor Point: B-27

Parameters		Units / Sample Date	04/05/89	05/26/89	08/22/89	09/25/89	10/18/89	02/28/90	03/13/90
TEMPERATURE (FIELD)		C		6.0	5.0		2.0	0.0	
TOTAL DISSOLVED SOLIDS		MG/L	754	556	636	613	752	735	735
TOTAL SUSPENDED SOLIDS		MG/L	286	-0	472	472	1	114	114
SODIUM		MG/L	104.0	87.0	12.0	12.0	104.5	87.0	87.0
POTASSIUM		MG/L	3.00	1.90	0.00	0.00	4.51	4.06	4.06
CALCIUM		MG/L	71.0	19.0	65.1	65.1	66.5	88.4	88.4
MAGNESIUM		MG/L	59.00	64.00	39.84	39.84	63.56	56.42	56.42
SULFATE		MG/L	305.0	209.0	228.0	228.0	266.0	275.3	275.3
CHLORIDE		MG/L	41	32	39	39	49	71	71
CARBONATE		MG/L CO3	6.00	9.00	11.52	11.52	0.00	2.29	2.29
BICARBONATE		MG/L HCO3	338.0	278.0	285.8	285.8	362.8	307.6	307.6
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.4	8.6	8.1	8.6	8.2	8.1	8.4
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	1013	880	990	1011	1200	1400	1190
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L				-0.01			
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
TOTAL ALKALINITY AS CAC03		MG/L		242	254	253	297	256	256
TOTAL HARDNESS AS CAC03		MG/L	418	307	325	325	427	453	453
ARSENIC	Dissolved	MG/L							
	Total	MG/L							
BARIUM	Dissolved	MG/L							
	Total	MG/L							
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	0.28	0.09	2.73	2.73	0.06	0.79	0.27
LEAD	Dissolved	MG/L							
	Total	MG/L							
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.010	0.010	0.010	0.160	0.160	0.010	0.060
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L				0.020			
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS		1.1	0.8		0.3	0.6	

Negative Values Indicate < values

Monitor Point: B-27

Parameters		Units	05/30/90	06/14/90	09/29/90	10/23/90	11/26/90	12/20/90	03/13/91
		Sample Date							
TEMPERATURE (FIELD)		C	3.0		6.0		1.0		1.0
TOTAL DISSOLVED SOLIDS		MG/L	542	566	568	568	820	844	935
TOTAL SUSPENDED SOLIDS		MG/L	22	22	164	164	31	31	63
SODIUM		MG/L	86.4	86.4	76.3	76.3	109.0		181.0
POTASSIUM		MG/L	2.60	2.60	3.88	3.88	4.12	4.12	4.06
CALCIUM		MG/L	44.2	44.2	56.2	56.2	84.3	84.3	68.2
MAGNESIUM		MG/L	48.96	48.90	44.00	44.00	80.70	80.70	59.40
SULFATE		MG/L	206.4	206.4	207.0	207.0	316.0	316.0	261.0
CHLORIDE		MG/L	34	34	36	36	53	53	52
CARBONATE		MG/L CO3	18.30	18.30	0.00	0.00	6.10	6.10	0.00
BICARBONATE		MG/L HCO3	256.3	256.3	292.0	292.0	384.0	384.0	526.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.0	8.4	8.0	8.2	8.0	8.3	7.9
CONDUCTIVITY (LAB)		UMHOS/COM @ 25 C	1000	962	940	946	1190	1290	790
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
TOTAL ALKALINITY AS CAC03		MG/L	241	241	239	239	326	326	431
TOTAL HARDNESS AS CAC03		MG/L	311	311	321	321	542	542	413
ARSENIC	Dissolved	MG/L							
	Total	MG/L						0.001	
BARIUM	Dissolved	MG/L							
	Total	MG/L						0.33	
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L						0.160	
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	0.27	0.31	0.31	3.43	0.97	0.97	1.30
LEAD	Dissolved	MG/L							
	Total	MG/L						0.010	
MANGANESE	Dissolved	MG/L							
	Total	MG/L	0.060	0.020	0.020	0.070	0.030	0.030	0.010
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L						0.020	
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS	2.2		0.2		0.9		1.2

Negative Values indicate < values

B-27 TDS

Monitor Point: B-27

Parameters		Units	04/04/91	05/26/91	09/23/91	10/21/91	11/22/91	03/03/92	04/14/92
		Sample Date	04/04/91	05/26/91	09/23/91	10/21/91	11/22/91	03/03/92	04/14/92
TEMPERATURE (FIELD)		C		4.0	9.0		1.0	3.0	
TOTAL DISSOLVED SOLIDS		MG/L	935	502	958	956	1080	275	275
TOTAL SUSPENDED SOLIDS		MG/L	63	39	13	13	6	820	820
SODIUM		MG/L	181.0	75.5	283.0	283.0	294.0	45.1	45.1
POTASSIUM		MG/L	4.06	2.02	0.78	0.78	5.86	5.59	5.59
CALCIUM		MG/L	68.2	52.7	20.9	20.9	28.2	35.3	35.3
MAGNESIUM		MG/L	59.40	35.40	55.70	55.70	58.40	15.90	15.90
SULFATE		MG/L	281.0	157.0	229.0	229.0	256.0	51.4	51.4
CHLORIDE		MG/L	82	22	80	80	93	20	20
CARBONATE		MG/L CO3	0.00	0.00	12.90	12.90	0.00	0.00	0.00
BICARBONATE		MG/L HCO3	528.0	312.0	597.0	597.0	659.0	207.0	207.0
HYDROXIDE (OH)		MG/L							
PH (LAB)		S.U.	8.1	8.0	7.9	8.5	7.9	7.5	7.4
CONDUCTIVITY (LAB)		UMHOS/CCM @ 25 C	1510	970	450	1540	1411	400	421
AMMONIA AS N		MG/L							
NITRATE AS N		MG/L							0.35
NITRITE AS N		MG/L							
PHOSPHATE AS PO4		MG/L							
FLORIDE		MG/L							
OIL & GREASE		MG/L	-5.0	-5.0	-5.0	-5.0	-5.0	-0.0	-0.0
TOTAL ALKALINITY AS CACO3		MG/L	431	256	510	510	564	170	170
TOTAL HARDNESS AS CACO3		MG/L	414	277	281	281	305	153	153
ARSENIC	Dissolved	MG/L							
	Total	MG/L							
BARIUM	Dissolved	MG/L							
	Total	MG/L							
CADMIUM	Dissolved	MG/L							
	Total	MG/L							
CHROMIUM	Dissolved	MG/L							
	Total	MG/L							
COPPER	Dissolved	MG/L							
	Total	MG/L							
IRON	Dissolved	MG/L							
	Total	MG/L	1.30	1.72	0.11	0.11	0.07	12.00	12.00
LEAD	Dissolved	MG/L							
	Total	MG/L							
MANGANESE	Dissolved	MG/L							
	Total	MG/L		0.020	0.010		0.013	0.040	0.400
MERCURY	Dissolved	MG/L							
	Total	MG/L							
SELENIUM	Dissolved	MG/L							
	Total	MG/L							
ZINC	Dissolved	MG/L							
	Total	MG/L							
TOC		MG/L							
STATIC WATER LEVEL (FIELD)		(ELEV. FT.)							
FLOW		CFS		2.9	0.7		1.3	1.0	

Negative Values indicate < values

APPENDIX 12-7-2
HYDROLOGY CALCULATIONS

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
10/31/95
STATE OF UTAH

OPERATIONS HYDROLOGY PARAMETERS:

WATERSHED AREA:

W.S.	AREA SQ. FT.	AREA Ac
POND 1	530,290	12.2
POND 002	130,200	3.0
TRAP 1	127,013.6	2.9
TRAP 2	42,268.1	0.93
TRAP 3	121,000	2.8
UD-5	20,910	0.48
UD-6	54,450	1.25
TRAP 4	126,545.0	2.9
UD-1	2,077,611.8	47.7
UD-2	421,547.6	9.7
UD-3	2,613.4	0.1
UD-4	46,610	1.07
TOTAL CONTAINMENT BERM	118,920	2.73

HYDRAULIC LENGTH:

W.S.	LENGTH (FT)
POND 1	1230
POND 002	980
TRAP 1	780
TRAP 2	980
TRAP 3	1190
UD-5	240
UD-6	410
TRAP 4	700
UD-1	2900
UD-2	1725
UD-3	200
UD-4	790
TOTAL CONTAINMENT BERM	850

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AVERAGE W.S. SLOPE:

W.S.	ELEVATIONS (FT) MAX	MIN	CL_{25}	CL_{50}	CL_{75}	AWS
			6500	6720	6750	
POND 1	7180	6273	560	190	20	33%
POND 002	6190	6153	425	250	260	6.6%
TRAP 1	6360	6250	320	170	50	12%
			6210	6250	6250	
TRAP 2	6262	6196	20	25	40	3%
TRAP 3	6207	6153	325	300	280	10.1%
UD-5	6164	6156	310	310	260	6.8%
UD-6	6165	6142	75	380	360	8.6%
TRAP 4	6298	6266	150	200	330	3%
UD-1	7847	6222	2060	1320	650	79%
			6300	[illegible]	[illegible]	
UD-2	6650	6180	800	480	340	45%
UD-4	6210	6120	50	575	520	55%
UD-3	6208	6130	20	15	10	7%
TOTAL CONTAINMENT BERM	6210	6120	500	350	200	31.4%

CURVE NUMBERS:

W.S.	AVERAGE C.N.	
POND 1	85	WORK AREA + UNDISTURBED AREA ABOVE WORK AREA
TRAP 1	85	ROAD + RECLAIMED PAD AREA
TRAP 2	85	ROAD + RECLAIMED PAD AREA
TRAP 3	90	DISTURBED PAD AREA
UD-5	75	UNDISTURBED - TOPSOIL
UD-6	75	UNDISTURBED - TOPSOIL
TRAP 4	90	STOCK PILE AREA
UD-1	75	UNDISTURBED - SOME BEDROCK
UD-2	75	UNDISTURBED - SOME BEDROCK
UD-3	80	UNDISTURBED - SOME GRAVEL ROAD.
POND 002	90	DISTURBED AREA
TOTAL CONTAINMENT BERM	75	UNDISTURBED - TOPSOIL
UD-4	75	UNDISTURBED - TOPSOIL

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PRECIPITATION DEPTH:

DURATION + RETURN PERIODS	DEPTH (in)
5yr - 24hr	1.55
10yr - 6hr	1.4
10yr - 24hr	1.9
25yr - 6hr	1.6
25yr - 24hr	2.3
100yr - 6hr	2.0

REF: MILLER, ET. AL., 1973.

TIME OF CONCENTRATION:

W.S.	HYD. LENGTH (FT)	CN	AWC (%)	LAG TIME (hr)	Tc (hrs)
POND 1	1280	85	33	0.06	0.10
POND 002	980	90	6.6	0.085	0.142
TRAP 1	780	85	12	0.06	0.11
TRAP 2	980	85	3	0.15	0.26
TRAP 3	1190	90	10.1	0.081	0.134
UD-5	240	75	6.8	0.05	0.08
UD-6	410	75	8.6	0.06	0.10
TRAP 4	700	90	3	0.10	0.16
UD-1	2900	75	79	0.10	[illegible]
UD-2	1725	75	45	0.09	[illegible]
UD-3	200	80	7	0.03	0.06
TOTAL CONTAINMENT BERM	850	75	31.4	0.06	0.10
UD-4	790	75	55.0	0.04	0.07

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EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENRATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Pond 1 - 25yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 12.20 acres
Depth = 2.30 inches	CN = 85.00
Duration = 24.00 hrs	Time conc.= 0.100 hrs

OUTPUT SUMMARY

Runoff depth	1.02136	inches	
Initial abstr	0.35294	inches	
Peak flow =	13.01	cfs	(1.05738 iph)
at time	12.013	hrs	

REVISED 9/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

POND-002

INPUT FOR: Willow Creek - WC-002 - 10yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 2.99 acres
Depth = 1.90 inches	CN = 90.00
Duration = 24.00 hrs	Time conc.= 0.142 hrs

OUTPUT SUMMARY

Runoff depth	1.00934	inches		
Initial abstr	0.22222	inches		
Peak flow =	0.73	cfs	(0.24239	iph)
at time	10.016	hrs		

POND-002

INPUT FOR: Willow Creek - WC-002 - 25yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 2.99 acres
Depth = 1.60 inches	CN = 90.00
Duration = 6.00 hrs	Time conc.= 0.142 hrs

OUTPUT SUMMARY

Runoff depth	0.76270	inches		
Initial abstr	0.22222	inches		
Peak flow =	2.08	cfs	(0.69034	iph)
at time	2.518	hrs		

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EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENRATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 1 - 25yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 2.90 acres
Depth = 2.30 inches	CN = 85.00
Duration = 24.00 hrs	Time conc.= 0.110 hrs

OUTPUT SUMMARY

Runoff depth	1.02136	inches	
Initial abstr	0.35294	inches	
Peak flow =	3.07	cfs	(1.04820 iph)
at time	12.012	hrs	

REVISED 9/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENRATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 2 - 25yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 0.98 acres
Depth = 2.30 inches	CN = 85.00
Duration = 24.00 hrs	Time conc.= 0.260 hrs

OUTPUT SUMMARY

Runoff depth	1.02136	inches	
Initial abstr	0.35294	inches	
Peak flow =	0.93	cfs	(0.94026 iph)
at time	12.064	hrs	

REVISED 7/95

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EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 3 - 10yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 2.78 acres
Depth = 1.90 inches	CN = 90.00
Duration = 24.00 hrs	Time conc.= 0.134 hrs

OUTPUT SUMMARY

Runoff depth	1.00934	inches	
Initial abstr	0.22222	inches	
Peak flow =	2.79	cfs	(0.99491 iph)
at time	12.024	hrs	

INPUT FOR: Willow Creek - Trap 3 - 25yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 2.78 acres
Depth = 1.60 inches	CN = 90.00
Duration = 6.00 hrs	Time conc.= 0.134 hrs

OUTPUT SUMMARY

Runoff depth	0.76270	inches	
Initial abstr	0.22222	inches	
Peak flow =	1.95	cfs	(0.69485 iph)
at time	2.519	hrs	

REVISED 9/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENRATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 4 - 25yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 2.90 acres
Depth = 2.30 inches	CN = 90.00
Duration = 24.00 hrs	Time conc.= 0.160 hrs

OUTPUT SUMMARY

Runoff depth	1.35381	inches	
Initial abstr	0.22222	inches	
Peak flow =	3.79	cfs	(1.29558 iph)
at time	12.011	hrs	

Revised 9/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Total Containment Berm - 10yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 1.73 acres
Depth = 1.90 inches	CN = 75.00
Duration = 24.00 hrs	Time conc.= 0.058 hrs

OUTPUT SUMMARY

Runoff depth	0.33309	inches	
Initial abstr	0.66667	inches	
Peak flow =	0.64	cfs	(0.36879 iph)
at time	12.010	hrs	

INPUT FOR: Willow Creek - Total Containment Berm - 25yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 1.73 acres
Depth = 1.60 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.058 hrs

OUTPUT SUMMARY

Runoff depth	0.20417	inches	
Initial abstr	0.66667	inches	
Peak flow =	0.27	cfs	(0.15576 iph)
at time	2.513	hrs	

ADDED 9/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Total Containment Berm - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 1.73 acres
Depth = 1.40 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.058 hrs

OUTPUT SUMMARY

Runoff depth	0.13224	inches		
Initial abstr	0.66667	inches		
Peak flow =	0.14	cfs	(0.07746	iph)
at time	2.521	hrs		

INPUT FOR: Willow Creek - Total Containment Berm - 100yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 1.73 acres
Depth = 2.00 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.058 hrs

OUTPUT SUMMARY

Runoff depth	0.38095	inches		
Initial abstr	0.66667	inches		
Peak flow =	0.60	cfs	(0.34186	iph)
at time	2.513	hrs		

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POND + TRAP REQUIRED RUNOFF VOLUMES:

W.S.	RUNOFF DEPTH (IN)	DRAINAGE AREA (AC)	RUNOFF VOLUME (AC-FT)	
POND 1	1.02	12.2	1.25	25YR-24hr
POND 002	1.01	3.0	0.25	10YR-24hr
TRAP 1	1.02	2.9	0.25	25YR-24hr
TRAP 2	1.02	0.93	0.08	25YR-24hr
TRAP 3	1.01	2.8	0.23	10yr-24hr
TRAP 4	1.35	2.9	0.33	25yr-24hr
TOTAL CONTAINMENT BERM	0.33	1.7	0.05	10YR-24hr
TOTAL CONTAINMENT BERM	0.38 (100YR-6HR)	1.7	0.05	100YR-6HR

POND + TRAP SEDIMENT STORAGE VOLUME:

W.S.	DISTURBED AREA (AC)	SEDIMENT YIELD FACTOR	3 YR SEDIMENT STORAGE VOL. (AC-FT)	3 MO SED VOLUME (AC-FT)
POND 1	9.19	* 0.1 AC-FT/AC DIST	0.92	0.03
POND 002	2.4	* 0.1 "	0.24	0.02
TRAP 1	1.88	** 0.05 "	0.09	0.01
TRAP 2	0.93	** 0.05 "	0.05	0.005
TRAP 3	2.0	* 0.1 "	0.20	0.02
TRAP 4	2.9	* 0.1 AC-FT/AC DIST	0.29	0.02
TOTAL CONTAINMENT BERM	1.5	** 0.05 "	0.08	0.01

* ENTIRE AREA DISTURBED

** MIXTURE OF DISTURBED + UNDISTURBED.

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DESIGN CAPACITY:

STRUCTURE	SEDIMENT STORAGE (AC-FT)		RUNOFF STORAGE (AC-FT)	
POND 1	0.40	(~15mo.)	1.25	(25yr, 24-hr)
POND 002	0.01	(1.5 mo.)	0.25	(10-yr, 24-HR)
TRAP 1**	0.03	(9 mo.)	0.25	(25-yr, 24-hr)
TRAP 2**	0.01	(6 mo.)	0.08	(25-yr, 24-hr)
TRAP 3**	0.04	(6 mo.)	0.23	(10-yr, 24-hr)
TRAP 4**	0.02	(3 mo.)	0.33	(25yr, 24-hr)
TOTAL CONTAINMENT BERM	0.16	(~72 mo.)	0.05	(10-YR, 24-HR)

** NEEDS TO BE CLEANED-OUT & ENLARGED TO MEET CAPACITY. SEE PLANS.

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REVISED 6/95

SEDIMENT POND FOR REFUSE AREA:

POND TO BE DESIGNED AS A TOTAL CONTAINMENT STRUCTURE.

THIS POND IS TO BE CONSTRUCTED AS PART OF THE FIRST REFUSE EXCAVATION. THIS WILL BE AN INCISED POND WITHIN THE REFUSE + PAD FILL MATERIAL. FOR THE FIRST PHASE OF REFUSE REMOVAL, THE POND WILL COLLECT RUNOFF FROM THE SLOPED REFUSE PILE (FIG 1). AS THE REFUSE PILE IS EXCAVATED TO PAD LEVEL OR SLIGHTLY SLOPING INTO THE HIGH WALL, DRAINAGE WILL NO LONGER FLOW TO THE POND. INSTEAD, THE REFUSE EXCAVATION WILL ACT AS THE POND. THIS WILL CONTINUE THRU THE REMAINDER OF THE PROJECT (SEE FIG 2+3)

UPON COMPLETION OF THE REFUSE EXCAVATION IMPOUNDMENT OF RUNOFF WILL OCCUR AGAINST THE HIGHWALL. BASED ON THE VOLUME OF THE PRE-AML EXCAVATION, BEFORE IT WAS FILLED W/ REFUSE, THE EXCAVATION WILL BE ABLE HOLD 15.7 AC-FT OF RUNOFF + SEDIMENT.

THE 100 YR-24 HR STORM WOULD YIELD 1.89 AC-FT OF RUNOFF; THEREFORE, THIS CONFIGURATION IS EXPECTED TO BE ABLE TO HANDLE THE RUNOFF + SEDIMENT VOLUMES FOR MANY YEARS.

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FIG. 1

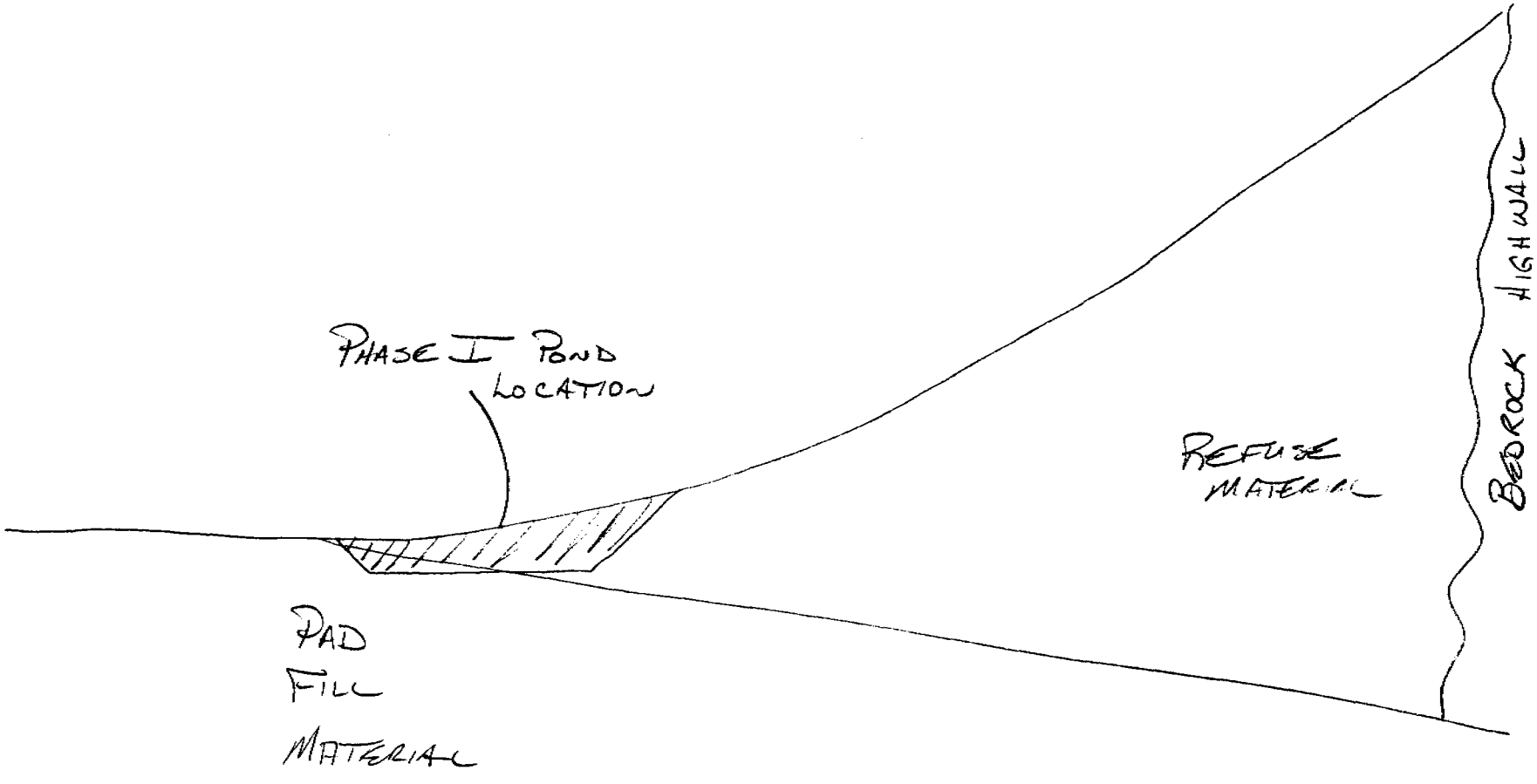

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FIG. 2

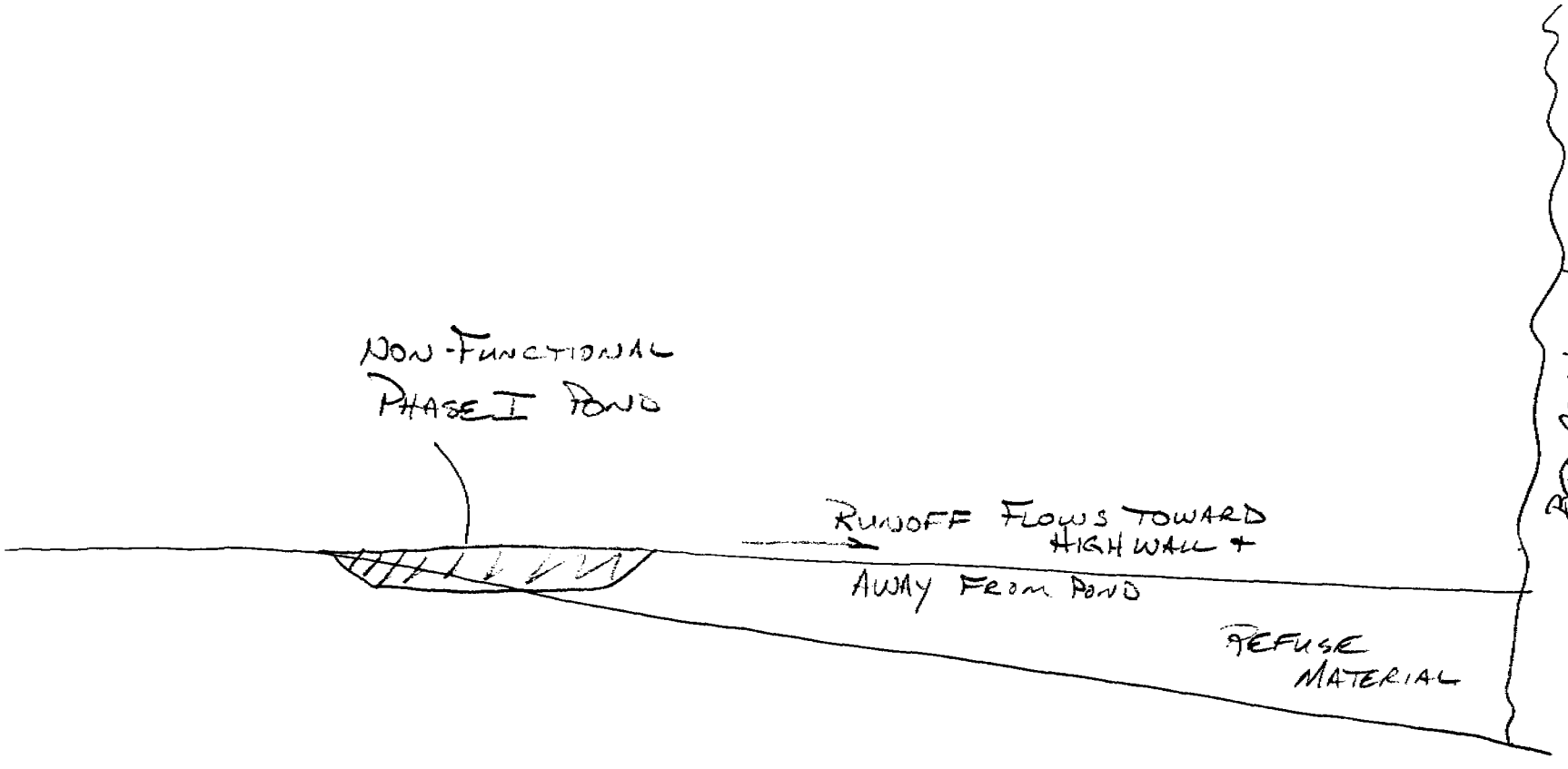

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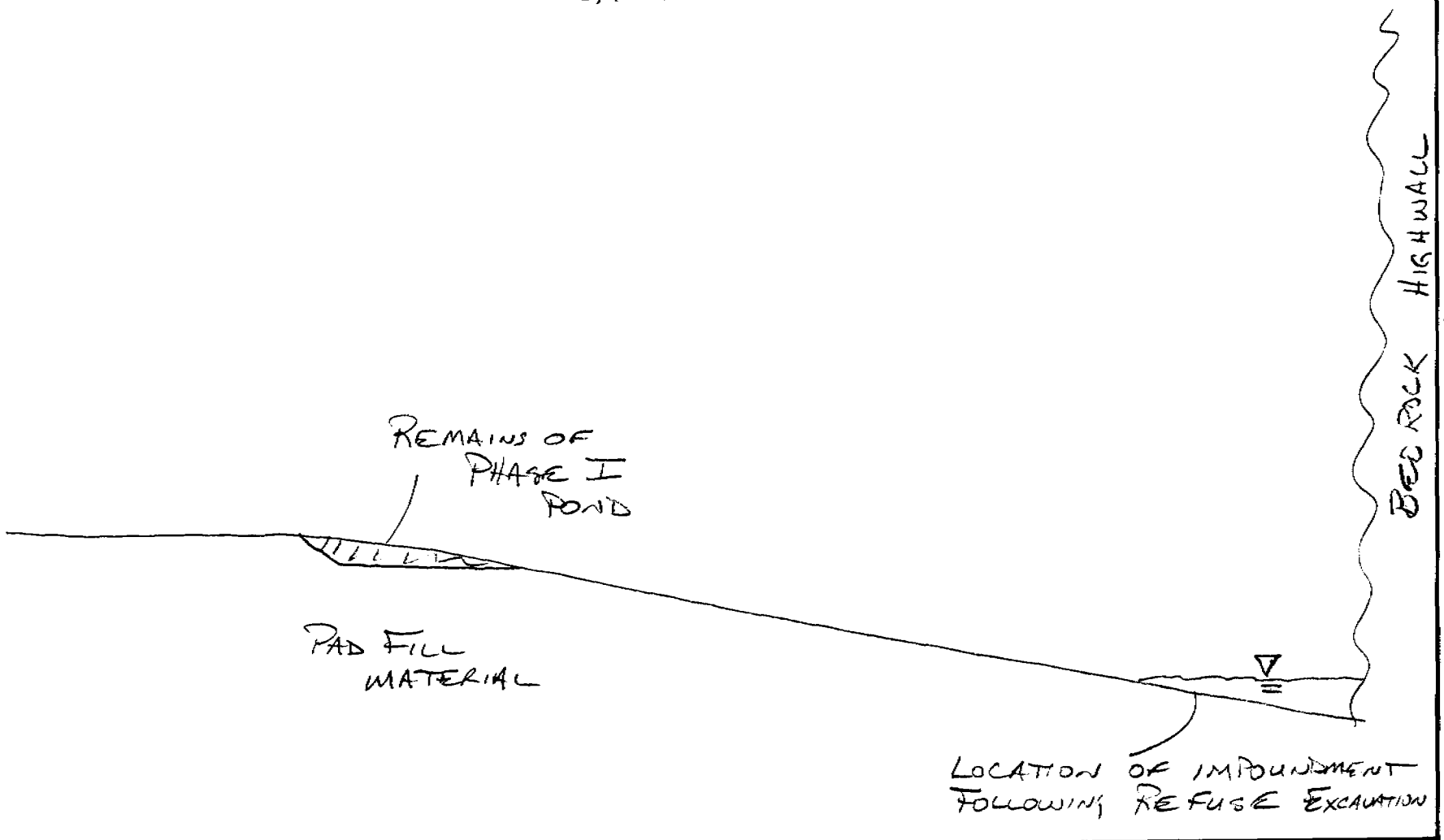
FIG. 3



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PREAML EXCAVATION VOLUME

ELEVATION	AREA	AVG AREA	VOLUME (AC-FT)	TOTAL VOLUME
6266.1	0			
		665	0.01	0.01
6266.6	1330			
		2,070	0.07	0.08
6268	2810			
		3,900	0.18	0.26
6270	4990			
		21,233	4.87	5.13
6280	37475			
		76,758	10.57	15.70 AC-FT
6286	116040			

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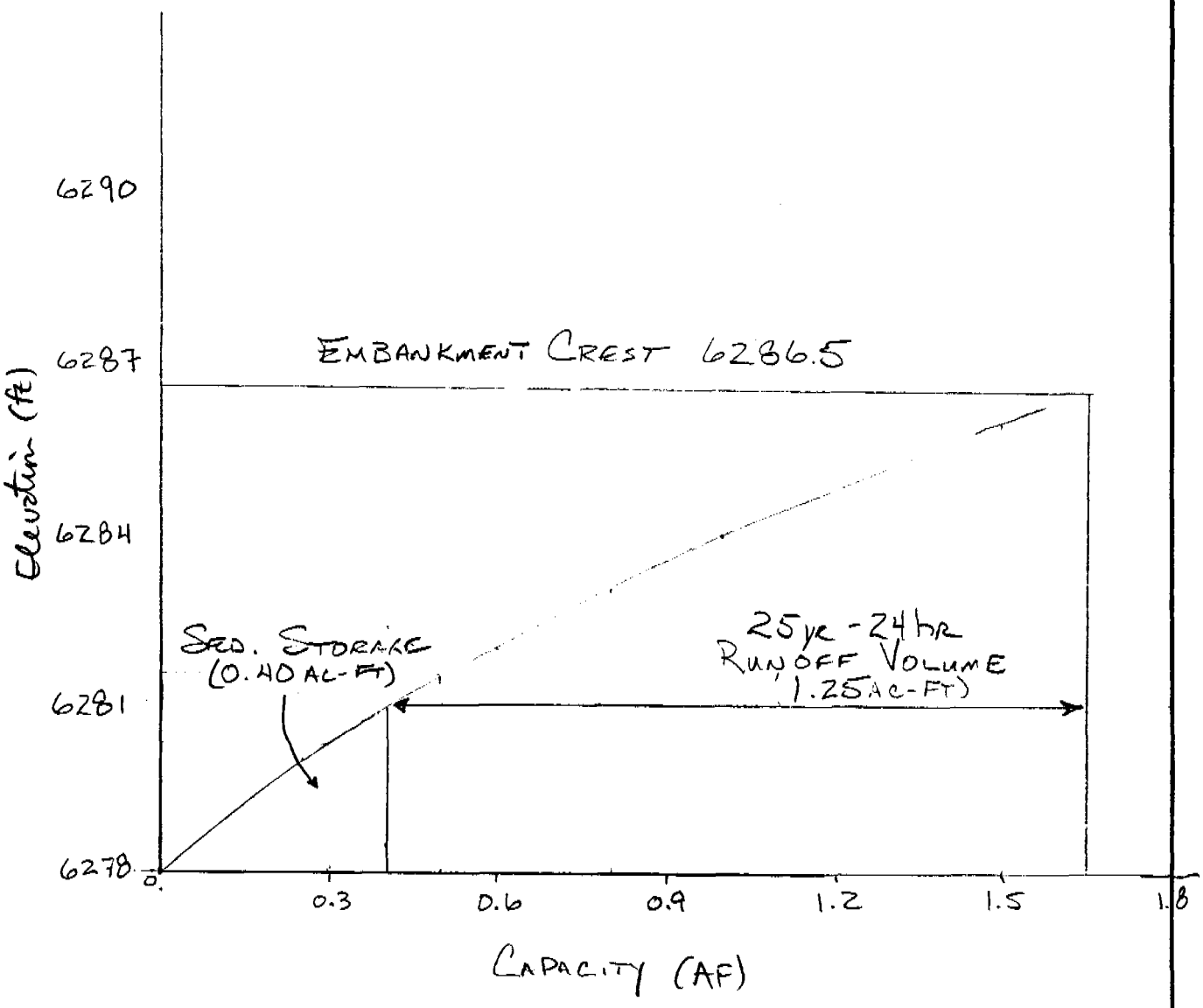
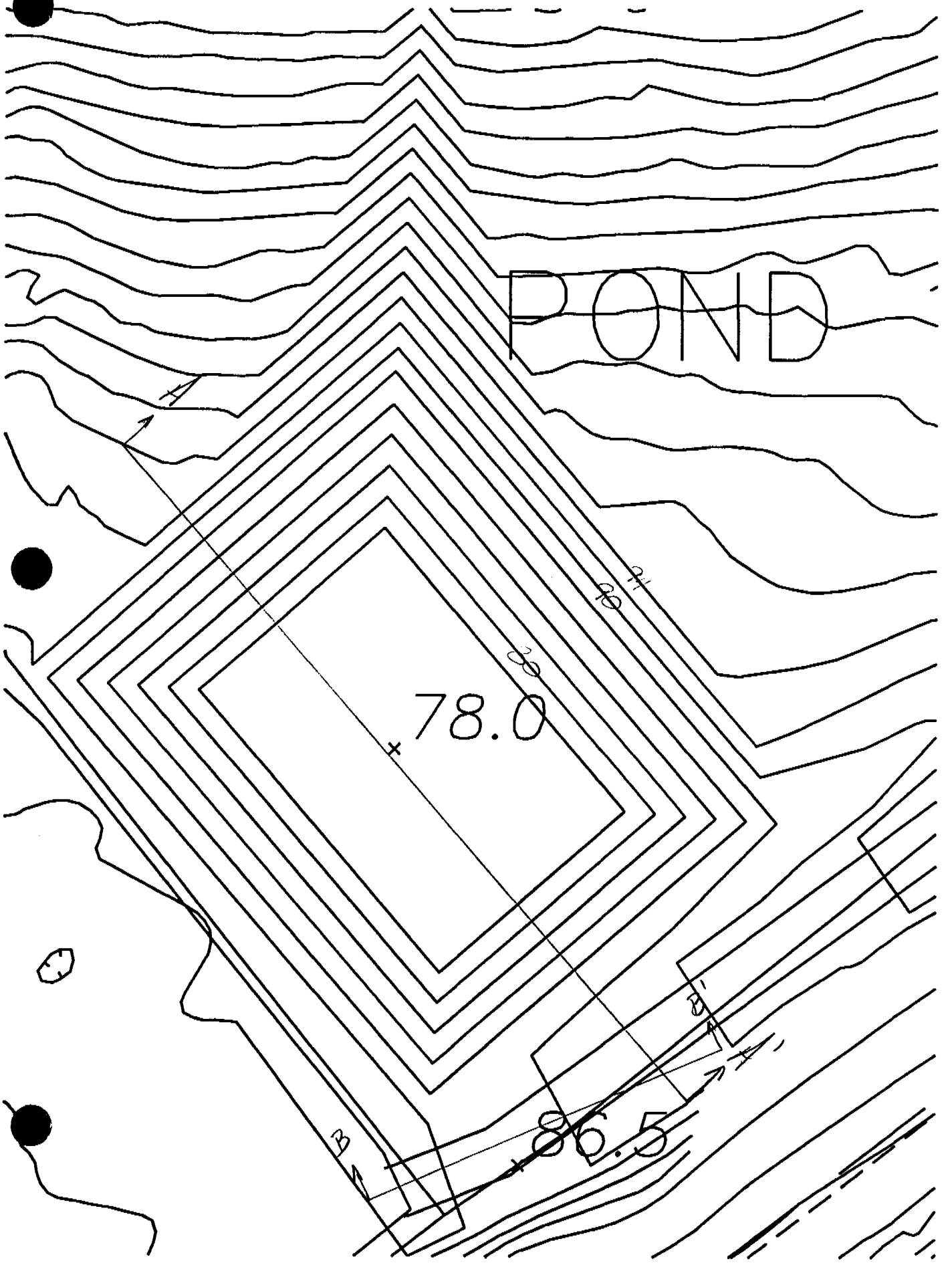
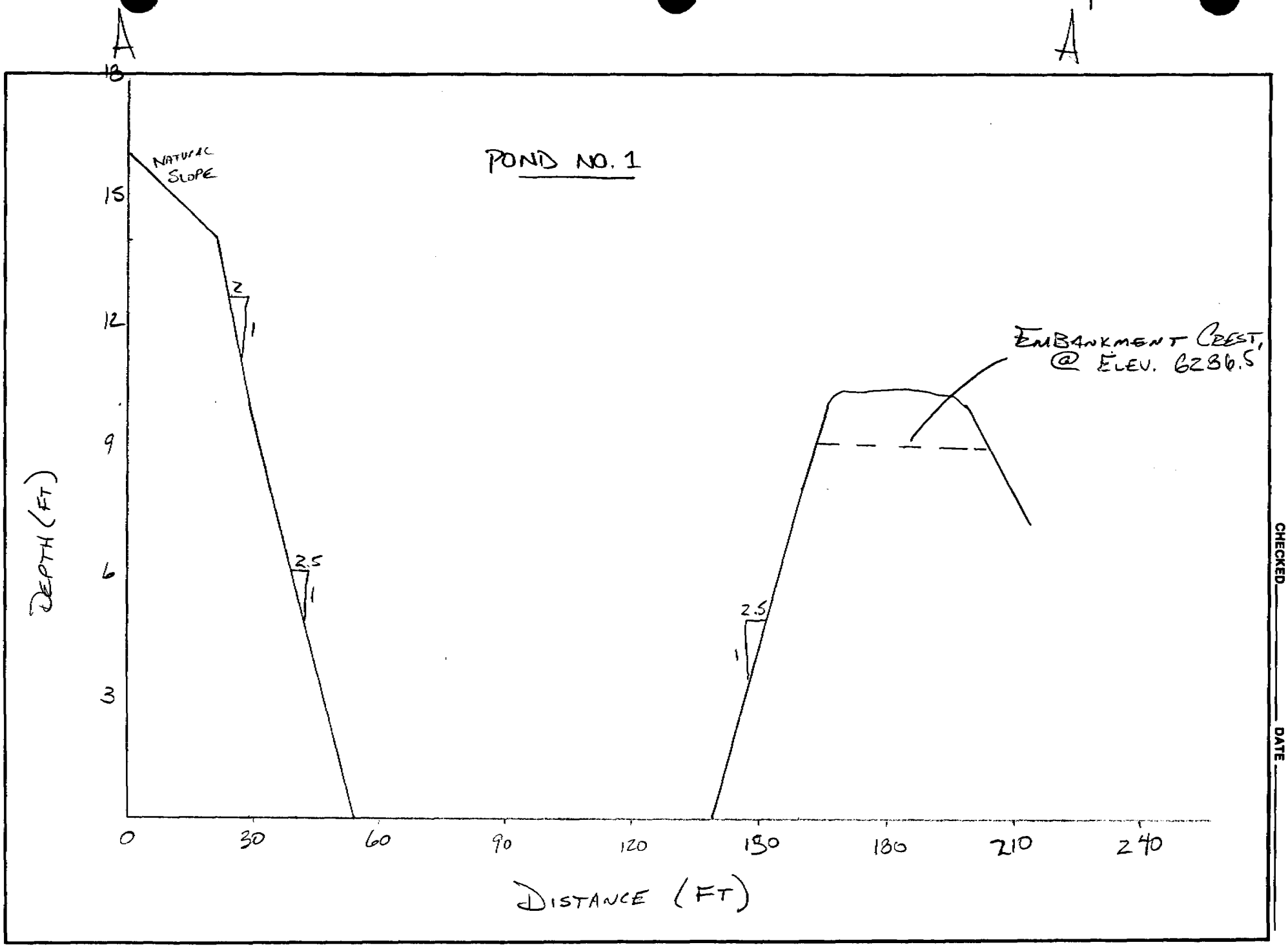
POND 1 CAPACITY

6278	4840					
		5602	2	11204	11204	0.25
6280	6365					
		7227	2	14454	25658	0.6
6282	8090					
		9050	2	18100	43758	1.0
6284	10010					
		11070	2	22140	65898	1.5
6286	12130					



Pond 1
1"=30'





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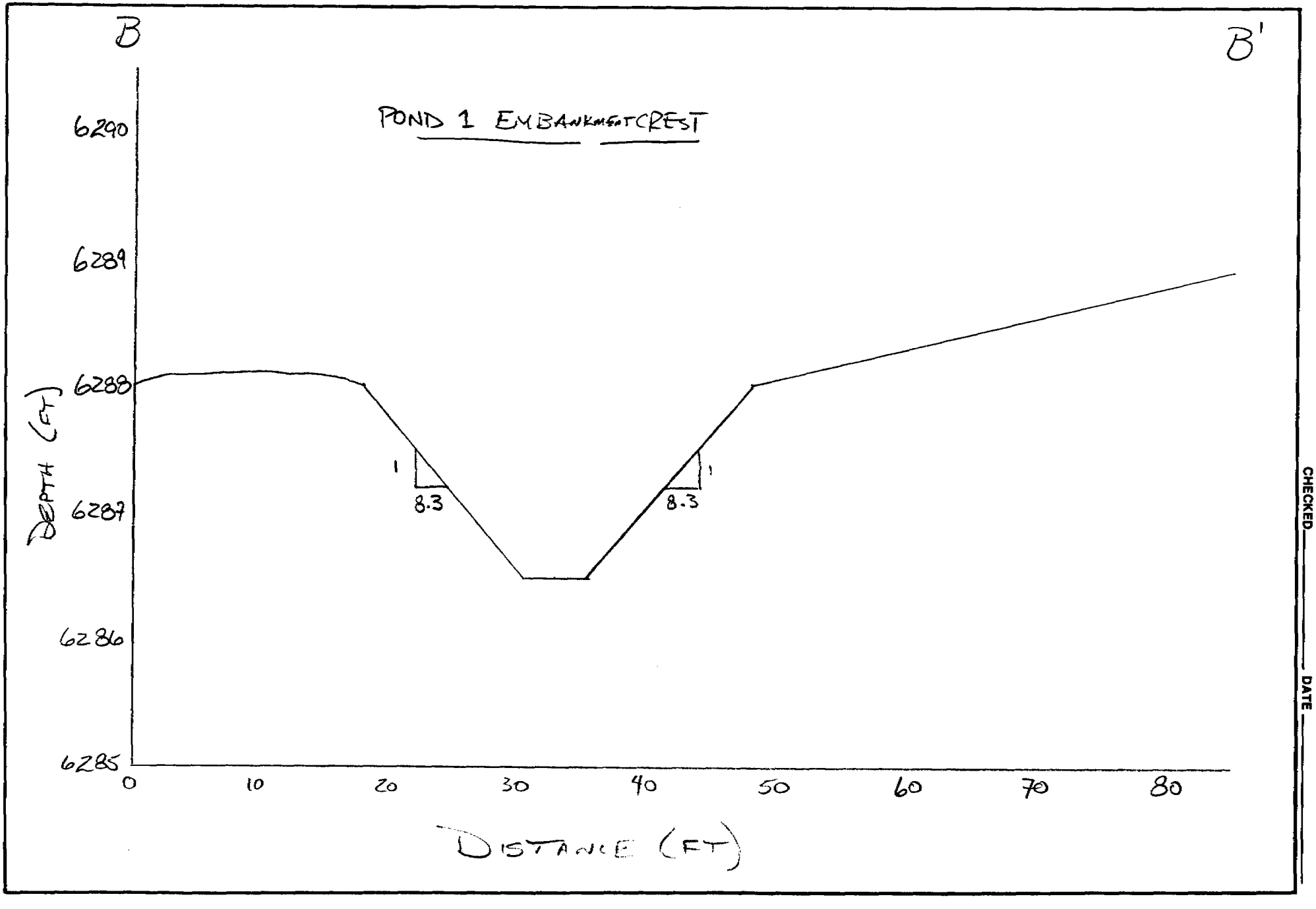

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COMPUTED AM DATE 9/21/95
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POND 002 CALCULATIONS WERE PERFOMED BY TERRAMATRIX AND ARE PRESENTED IN APPENDIX 12-7-4.

ADDED 9/95

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PROJECT UC0446-01 PAGE ____ OF ____
COMPUTED TJS DATE 9/27/95
CHECKED ____ DATE ____

SEDIMENT TRAP OPERATION:

THE SEDIMENT TRAPS PROPOSED FOR THE WILLOW CREEK SITE WILL CONSIST OF A COMBINATION OF TOTAL CONTAINMENT STRUCTURES & STRUCTURES WITH OPEN CHANNEL SPILLWAYS. EACH TRAP WILL CONSIST OF A DEPRESSION FOR WATER & SEDIMENT COLLECTION. THE DEPRESSION WILL PROVIDE SEDIMENT STORAGE AND A STILLING POOL FOR RUNOFF WATER.

THE TRAPS 1, 2, + 4 WILL BE CONSTRUCTED AS TOTAL CONTAINMENT TRAPS. DUE TO THE LIMITED LIFE OF THE REFUSE REMOVAL PROJECT + THE DURATION OF TRAP USE, THEY WILL BE DESIGNED TO CONTAIN THE 25YR - 24HR STORM EVENT W/ NO SPILLWAY. THEY WILL ALSO HAVE A SEDIMENT STORAGE VOLUME W/ A LIFE OF AT LEAST 4 MO.

TRAP 3 WILL BE CONSTRUCTED TO CONTAIN THE 10YR - 24HR RUNOFF VOLUME + A SEDIMENT VOLUME, AT LEAST 4MO. LIFE, WITH A SPILLWAY CAPABLE OF HANDLING THE 25YR - 6HR EVENT.

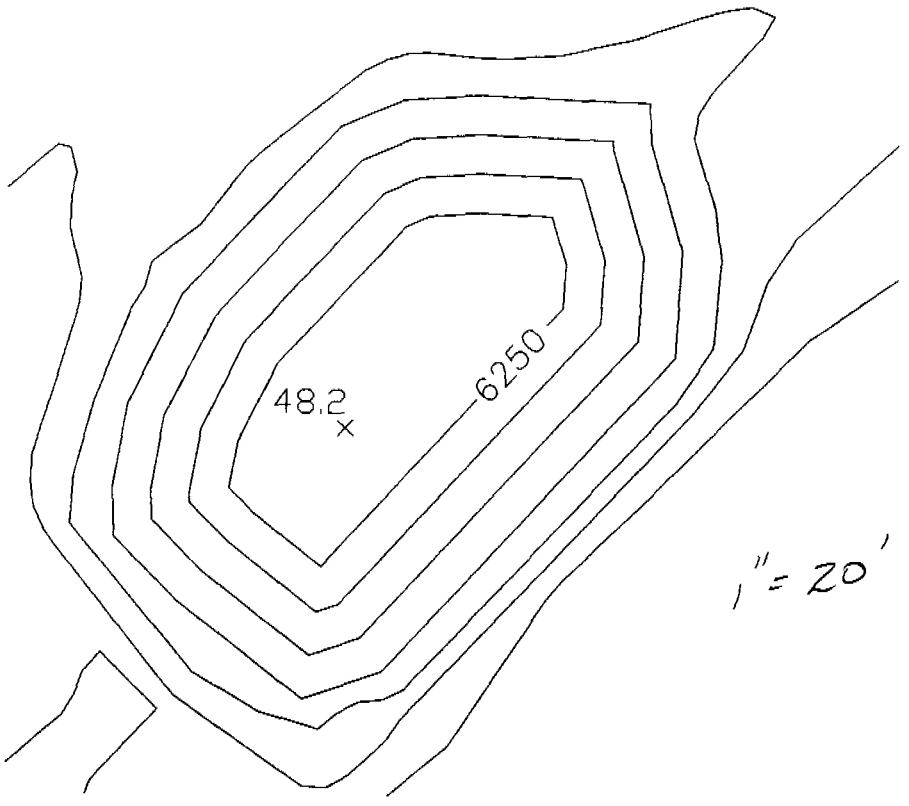
THE TOTAL CONTAINMENT BERM BELOW THE TOPSOIL STOCKPILE WILL BE CAPABLE OF CONTAINING AT LEAST THE 10YR - 24HR RUNOFF VOLUME PLUS SEDIMENT STORAGE. NO SPILLWAY STRUCTURE IS INCLUDED IN THE BERM.

REVISED 9/95

TRAP CAPACITY

ELEV.	AREA (FT²)	AVG AREA (FT²)	INC. VOLUM (FT³)	CUMM. VOLUME (AC-FT)
6248.2	0	331	596	0.01
6250	662	903	1806	0.06
6252	1144	1439	2877	0.12
6254	1733	2082	4164	0.22
6256	2431	2839	5679	0.35
6258	3248			

GREATER THAN 0.28 AC-FT OK!



TRAP-1

REVISED 9/95

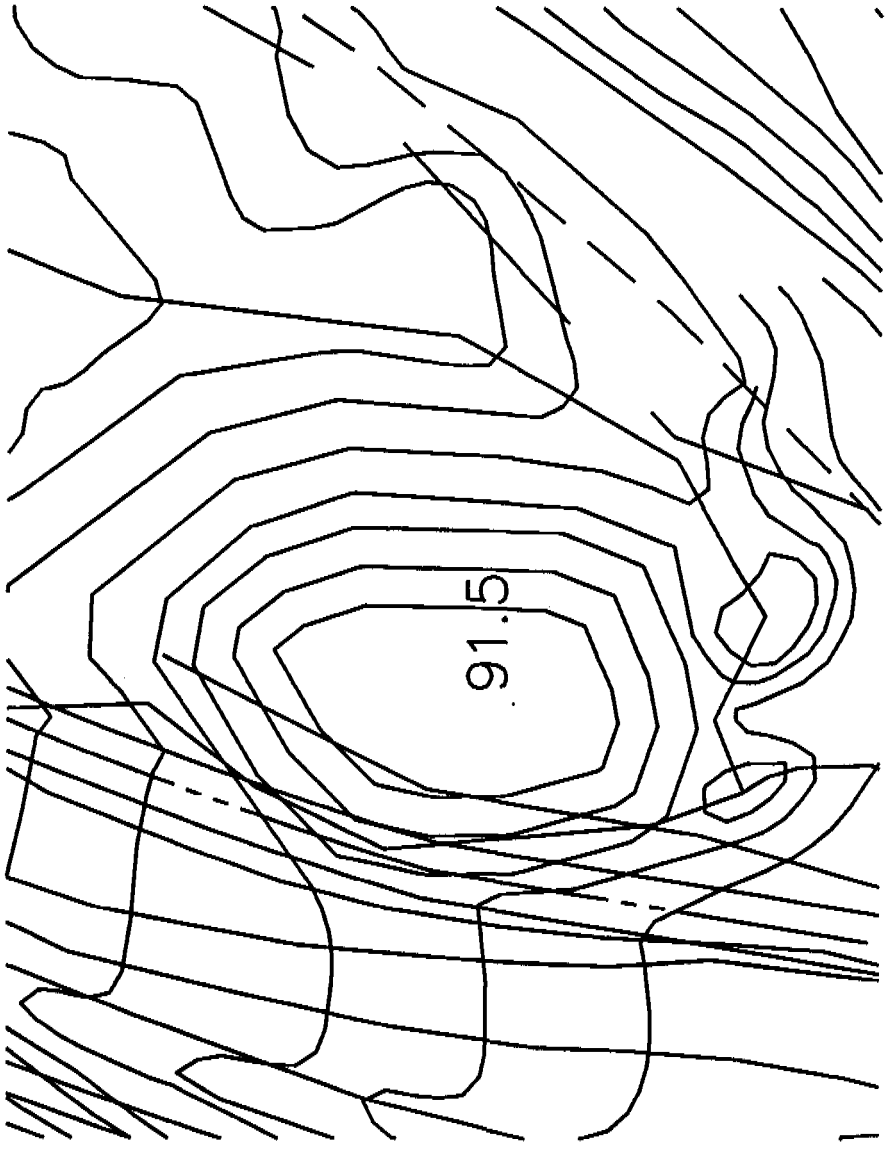
TRAP CAPACITY

ELEV.	AREA (FT^2)	AVG. AREA (FT^2)	INC VOL. (FT^3)	ACC. VOLUME (AC-FT)
6091.5	0			
		274	137	0.01
6092	548			
		755	1511	0.03
6094	963			
		1222	2444	0.09
6096	1481			

EQUAL TO OR GREATER THAN 0.09 OK!

TRAP 2 1" = 20'

REVISED TOPO



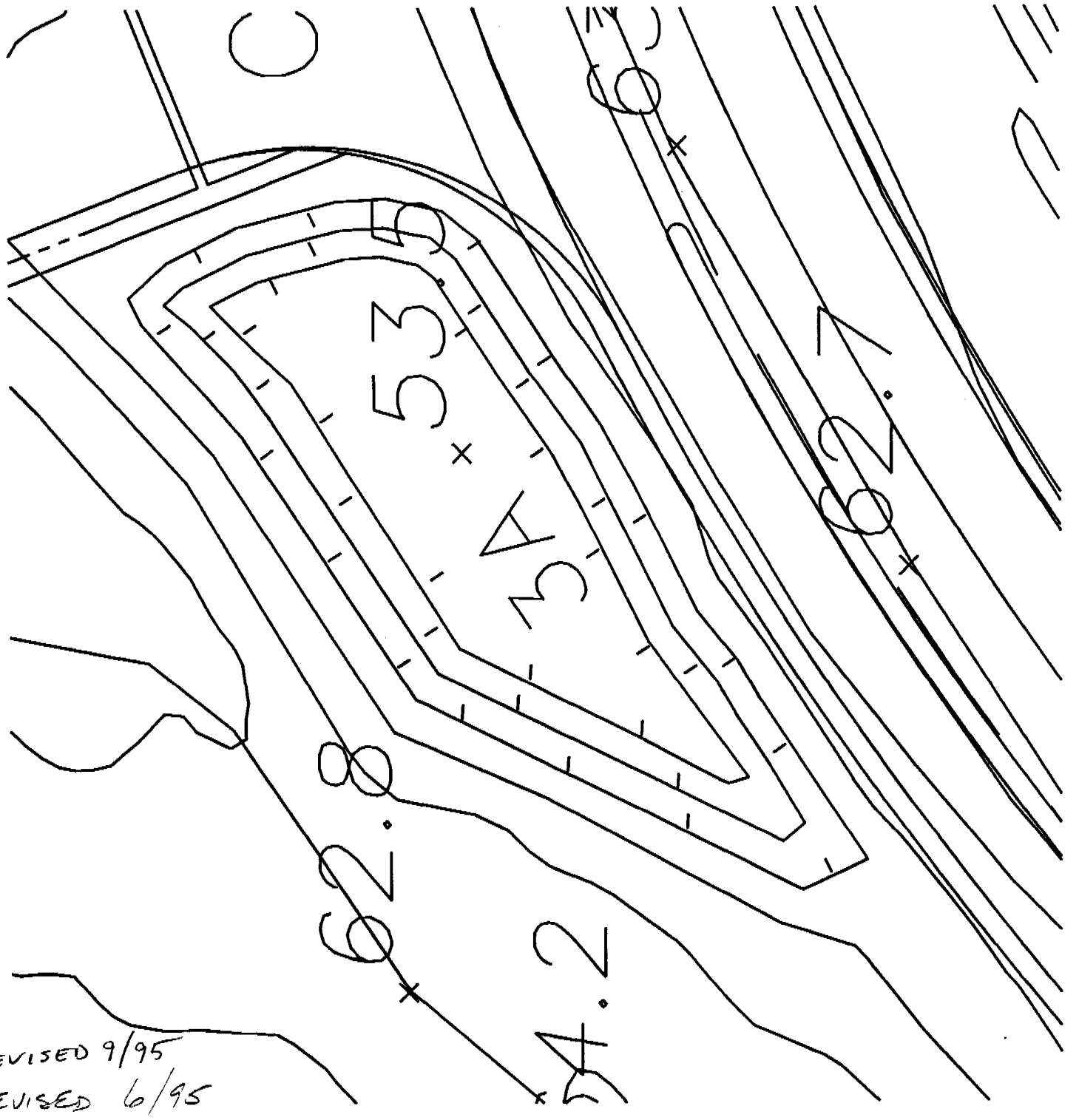
REVISED 6/95

TRAP ELEV.	CAPACITY AREA (FT²)	AVG AREA (FT²)	VOLUME (FT³)	CUMM VOL. (AC-FT)
6053.5	0	921	461	0.01
6054.0	1842	2355	4709	0.12
6056.0	2867	3477	6954	0.23
6058.0	4087			

GREATER THAN 0.27 OK!

REVISED TOPO

TRAP 3 1" = 20'



REVISED 9/95
REVISED 6/95

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 3

Comment: Spillway Structure - 25yr-6hr Event

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	1.95 cfs

Computed Results:

Depth.....	0.13 ft
Velocity.....	2.78 fps
Flow Area.....	0.70 sf
Flow Top Width...	5.53 ft
Wetted Perimeter.	5.60 ft
Critical Depth...	0.16 ft
Critical Slope...	0.0249 ft/ft
Froude Number....	1.37 (flow is Supercritical)

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REVISED 9/95

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 3 Outlet Channe

Comment: Minimum Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	1.95 cfs

Computed Results:

Depth.....	0.76 ft
Velocity.....	1.70 fps
Flow Area.....	1.15 sf
Flow Top Width...	3.03 ft
Wetted Perimeter.	3.39 ft
Critical Depth...	0.57 ft
Critical Slope...	0.0232 ft/ft
Froude Number....	0.49 (flow is Subcritical)

Open Channel Flow Module, Version 3.2 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

ADDED 12/25

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 3 Outlet Channe

Comment: Maximum Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035 * D50-6-INCH RIPRAP
Channel Slope....	0.5000 ft/ft
Discharge.....	1.95 cfs

Computed Results:

Depth.....	0.34 ft
Velocity.....	8.52 fps
Flow Area.....	0.23 sf
Flow Top Width...	1.35 ft
Wetted Perimeter.	1.51 ft
Critical Depth...	0.57 ft
Critical Slope...	0.0315 ft/ft
Froude Number....	3.65 (flow is Supercritical)

Open Channel Flow Module, Version 3.2 (c) 1990
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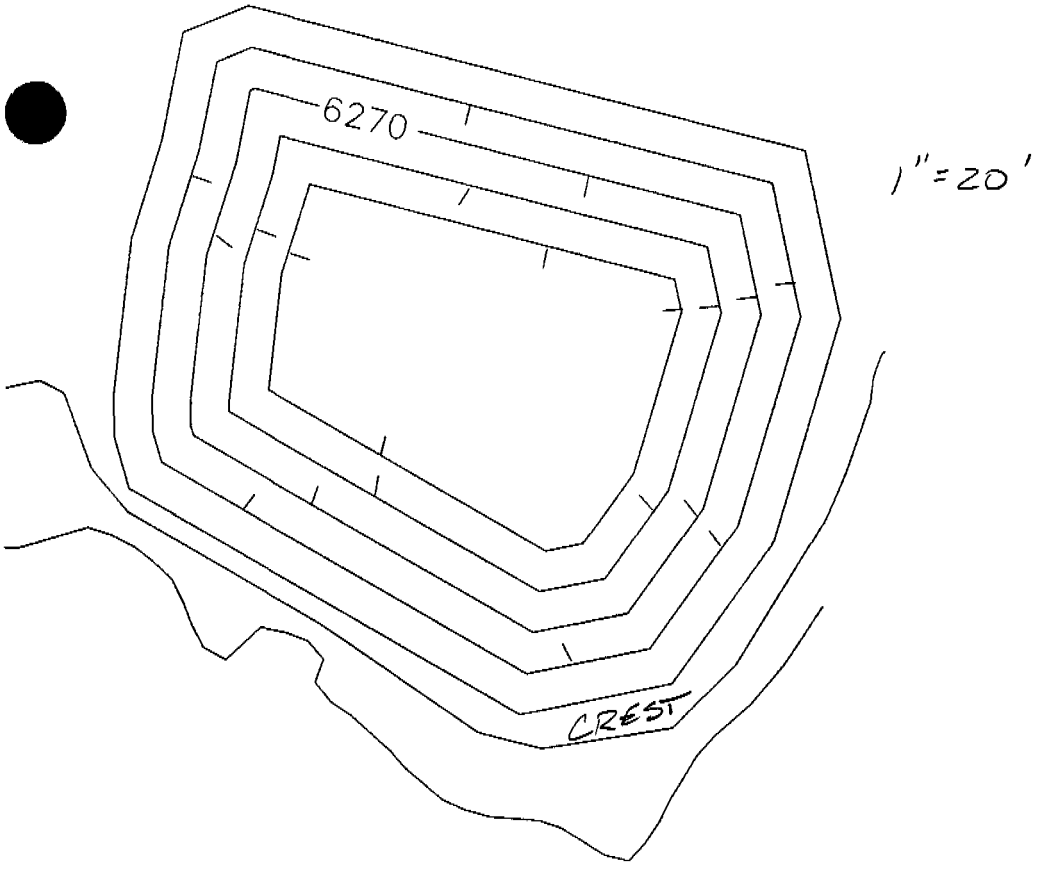
ADDED 10/95

TRAP CAPACITY

ELEV.	AREA (FT^2)	AVG AREA (FT^2)	INC. VOLUME (FT^3)	CUMM. VOLUME (AC-FT)
6265.5	0			
		520	260	0.01
6266	1040			
		1324	2647	0.07
6268	1607			
		1947	3893	0.16
6270	2286			
		2681	5361	0.28
6272	3075			
		3522	7044	0.44
6274	3969			

GREATER THAN 0.35 OK!



TRAP-4

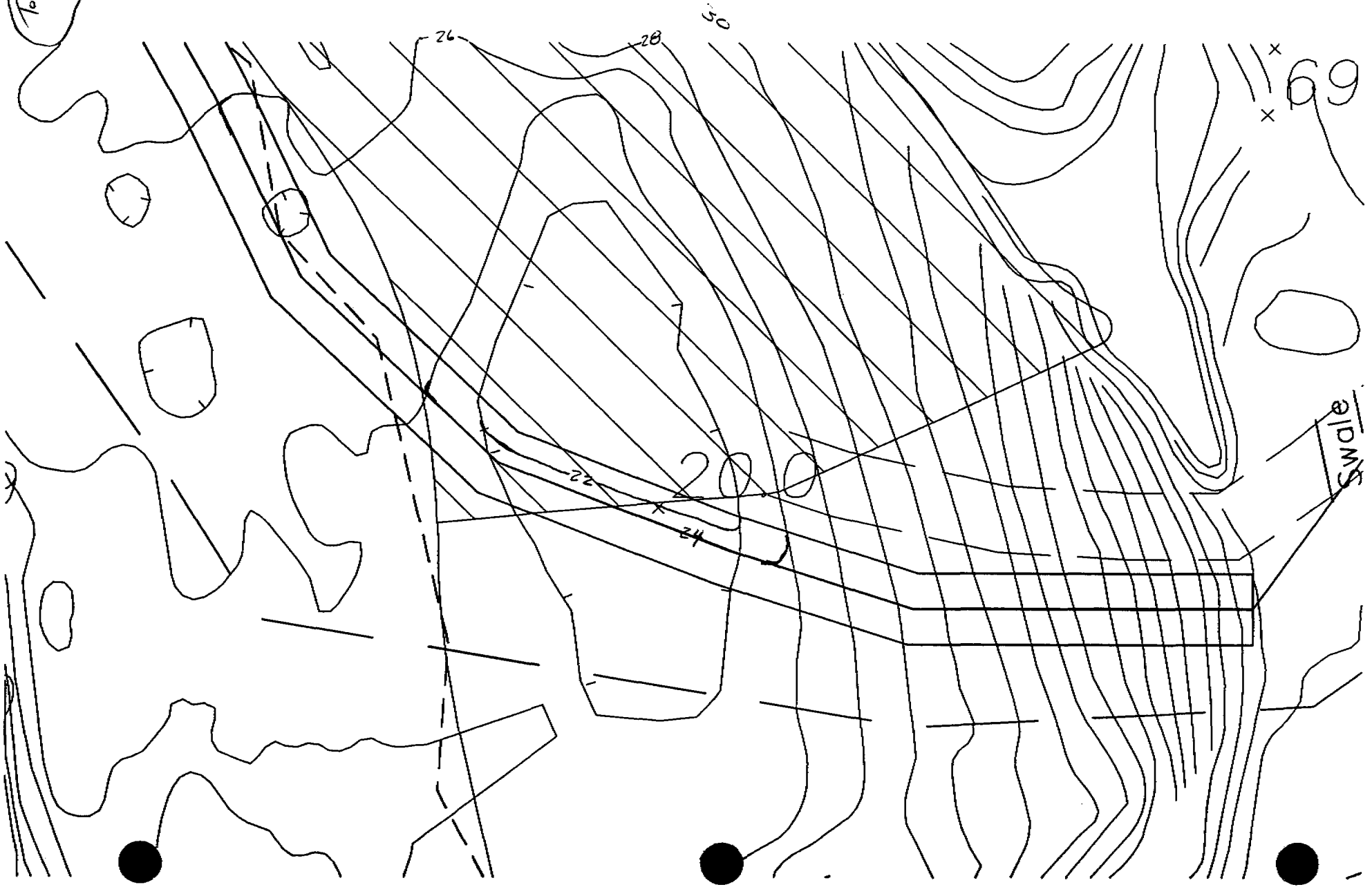
REVISED 9/95

TOTAL CONTAINMENT BERM

ELEV.	AREA (FT²)	ΔVOL (FT³)	CUM. VOL (FT³)	CUM. VOL (AF)
6120	0			
6122	2,580	2,580		
6124	4,752	7,332	2,580	
			9,912 →	0.23 AF

1" = 30'

REVISED 9/95



DIVERSION DITCHES

UNDISTURBED AREA DITCHES

UNDISTURBED AREA DITCHES CONVEY RUNOFF AROUND THE DISTURBED AREAS. THESE CONSIST OF UD-1, UD-2 + UD-3 FOR THE DRAINAGES ABOVE THE REFUSE REMOVAL ACCESS ROAD. UD-4 WILL DIVERT DRAINAGE FROM RUNNING ON TO THE TOPSOIL STOCKPILE. HOWEVER, DUE TO LIMITED DRAINAGE AREA + DIFFICULTY CONVEYING FLOW AROUND DISTURBED AREA DRAINAGE WILL BE COLLECTED IN TOTAL CONTAINMENT BERM. UD-5 + UD-6 WILL CONSIST OF A SWALE - DITCH COMBINATION TO TAKE UNDISTURBED DRAINAGE OFF ROAD + PREVENT RUNOFF FROM FLOWING INTO TOPSOIL STORAGE AREA.
THE 10YR - 6HR DESIGN WILL BE USED.

DISTURBED AREA DITCHES

DISTURBED AREA RUNOFF WILL BE CONVEYED BY DITCHES + SWALES TO THE SEDIMENT PONDS + TRAPS. RUNOFF FROM THE REFUSE REMOVAL ACCESS ROAD + THE TOPSOIL STOCKPILE ACCESS ROAD WILL BE CONVEYED BY SWALE + DITCH COMBINATIONS TO TRAPS 1, 2, 3, + 4.
THE 10YR - 6HR PEAK FLOW WILL BE USED TO DESIGN THE DITCHES

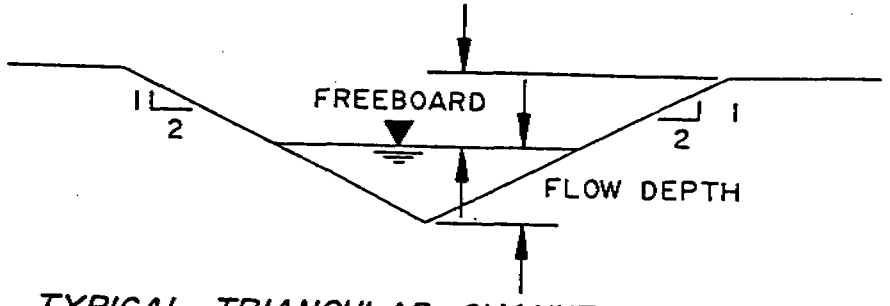
UNDISTURBED AREA CULVERTS

UNDISTURBED AREA DRAINAGE FROM ABOVE THE ACCESS ROAD WILL BE CONVEYED THROUGH THE DISTURBED AREA USING CMP CULVERTS. THE LOCATIONS OF THESE PIPES ARE: JUST BELOW TRAP 4 FOR UC-1 + ABOVE TRAP 2 FOR UC-2

UNDISTURBED
CHANNEL DESIGN

U.S.	Channel Shape	Design Flow (CFS)	Manning's n	Bottom Width (FT)	Min. Slope (%)	Max. Flow Depth	Min. Velocity (FPS)	Max. Slope (%)	Min. Flow Depth (FT)	Max.*** Velocity (FPS)	Freeboard (FT)	Min. Channel Depth (FT)
UD-1 (Upper)	TRI	2.55	0.03	Ø	1.4	0.69	2.68	4.6	0.55	4.18	0.31	1.0
UD-1* (Lower)	TRAP	2.55										
UD-2 (Upper)	TRI	0.55	0.03	Ø	3.2	0.33	2.49	12.0	0.26	4.08	0.67	1.0
UD-2 (Lower)	TRI	0.55	0.035**	Ø	10.0	0.28	3.40	500	0.21	6.21	0.72	1.0
UD-3	TRI	0.02	0.03	Ø	10.0	0.08	1.66	50.0	0.06	3.04	0.42	0.5
UD-4	TRI	0.08	0.03	Ø	1.75	0.18	1.22	20.0	0.11	3.05	0.32	0.5
UD-5	SWALE	0.03	0.03	10	0.5	0.02	0.27	2.0	0.01	0.41	0.48	0.5
UD-5	TRI	0.03	0.03	Ø	2.0	0.12	1.01	20.0	0.08	2.39	0.38	0.5
UD-6	SWALE	0.08	0.03	10	0.5	0.04	0.38	2.0	0.03	0.59	0.46	0.5
UD-6	TRI	0.08	0.03	Ø	2.0	0.18	1.29	10.0	0.13	2.35	0.32	0.5

* EXISTING GABION DROP STRUCTURE INSTALLED AS PART OF AML REC. ACTIVITIES
** ASSUMES A D_{50} 6-INCH RIPRAP.
*** FLOW VELOCITES LESS THAN 5 FPS DO NOT REQUIRE RIPRAP



TYPICAL TRIANGULAR CHANNEL SECTION
NOT TO SCALE

REVISED 10/95
REVISED 9/95

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PROJECT UC0446-01 PAGE ___ OF ___
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EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - UD-1 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 47.70 acres
Depth = 1.40 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.160 hrs

OUTPUT SUMMARY

Runoff depth	0.13224	inches	
Initial abstr	0.66667	inches	
Peak flow =	2.55	cfs	(0.05300 iph)
at time	2.603	hrs	

INPUT FOR: Willow Creek - UD-2 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 9.70 acres
Depth = 1.40 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.140 hrs

OUTPUT SUMMARY

Runoff depth	0.13224	inches	
Initial abstr	0.66667	inches	
Peak flow =	0.55	cfs	(0.05659 iph)
at time	2.576	hrs	

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - UD-3 -10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 0.10 acres
Depth = 1.40 inches	CN = 80.00
Duration = 6.00 hrs	Time conc.= 0.060 hrs

OUTPUT SUMMARY

Runoff depth	0.23824	inches	
Initial abstr	0.50000	inches	
Peak flow =	0.02	cfs	(0.20631 iph)
at time	2.512	hrs	

INPUT FOR: Willow Creek - UD-4 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 1.07 acres
Depth = 1.40 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.070 hrs

OUTPUT SUMMARY

Runoff depth	0.13224	inches	
Initial abstr	0.66667	inches	
Peak flow =	0.08	cfs	(0.07372 iph)
at time	2.529	hrs	

REVISED 10/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - UD-5 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 0.48 acres
Depth = 1.40 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.080 hrs

OUTPUT SUMMARY

Runoff depth	0.13224	inches		
Initial abstr	0.66667	inches		
Peak flow =	0.03	cfs	(0.07058	iph)
at time	2.528	hrs		

INPUT FOR: Willow Creek - UD-6 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 1.25 acres
Depth = 1.40 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.100 hrs

OUTPUT SUMMARY

Runoff depth	0.13224	inches		
Initial abstr	0.66667	inches		
Peak flow =	0.08	cfs	(0.06547	iph)
at time	2.547	hrs		

REVISED 10/95

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UD-1

Comment: Willow Creek UD-1 - Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0140 ft/ft
Discharge.....	2.55 cfs

Computed Results:

Depth.....	0.69 ft
Velocity.....	2.68 fps
Flow Area.....	0.95 sf
Flow Top Width...	2.76 ft
Wetted Perimeter.	3.09 ft
Critical Depth...	0.63 ft
Critical Slope...	0.0224 ft/ft
Froude Number....	0.80 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UD-1

Comment: Willow Creek UD-1 - Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0460 ft/ft
Discharge.....	2.55 cfs

Computed Results:

Depth.....	0.55 ft
Velocity.....	4.18 fps
Flow Area.....	0.61 sf
Flow Top Width...	2.21 ft
Wetted Perimeter.	2.47 ft
Critical Depth...	0.63 ft
Critical Slope...	0.0224 ft/ft
Froude Number....	1.40 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UUD-2-min

Comment: Willow Creek - Upper UD-2 - Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0320 ft/ft
Discharge.....	0.55 cfs

Computed Results:

Depth.....	0.33 ft
Velocity.....	2.49 fps
Flow Area.....	0.22 sf
Flow Top Width...	1.33 ft
Wetted Perimeter.	1.49 ft
Critical Depth...	0.34 ft
Critical Slope...	0.0274 ft/ft
Froude Number....	1.07 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UUD-2-max

Comment: Willow Creek - Upper UD-2 - Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1200 ft/ft
Discharge.....	0.55 cfs

Computed Results:

Depth.....	0.26 ft
Velocity.....	4.08 fps
Flow Area.....	0.13 sf
Flow Top Width...	1.04 ft
Wetted Perimeter.	1.16 ft
Critical Depth...	0.34 ft
Critical Slope...	0.0274 ft/ft
Froude Number....	2.00 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: LUD-2-min

Comment: Willow Creek - Lower UD-2 - Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.1000 ft/ft
Discharge.....	0.55 cfs

Computed Results:

Depth.....	0.28 ft
Velocity.....	3.40 fps
Flow Area.....	0.16 sf
Flow Top Width...	1.14 ft
Wetted Perimeter.	1.27 ft
Critical Depth...	0.34 ft
Critical Slope...	0.0373 ft/ft
Froude Number....	1.59 (flow is Supercritical)

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Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: LUD-2-max

Comment: Willow Creek - Lower UD-2 - Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.5000 ft/ft
Discharge.....	0.55 cfs

Computed Results:

Depth.....	0.21 ft
Velocity.....	6.21 fps
Flow Area.....	0.09 sf
Flow Top Width...	0.84 ft
Wetted Perimeter.	0.94 ft
Critical Depth...	0.34 ft
Critical Slope...	0.0373 ft/ft
Froude Number....	3.37 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UD-3

Comment: Willow Creek - UD-3 - Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1000 ft/ft
Discharge.....	0.02 cfs

Computed Results:

Depth.....	0.08 ft
Velocity.....	1.66 fps
Flow Area.....	0.01 sf
Flow Top Width...	0.31 ft
Wetted Perimeter.	0.35 ft
Critical Depth...	0.09 ft
Critical Slope...	0.0427 ft/ft
Froude Number....	1.49 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: UD-3

Comment: Willow Creek - UD-3 - Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.5000 ft/ft
Discharge.....	0.02 cfs

Computed Results:

Depth.....	0.06 ft
Velocity.....	3.04 fps
Flow Area.....	0.01 sf
Flow Top Width...	0.23 ft
Wetted Perimeter.	0.26 ft
Critical Depth...	0.09 ft
Critical Slope...	0.0427 ft/ft
Froude Number....	3.17 (flow is Supercritical)

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Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek UD-4

Comment: Minimum Channel Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0175 ft/ft
Discharge.....	0.08 cfs

Computed Results:

Depth.....	0.18 ft
Velocity.....	1.22 fps
Flow Area.....	0.07 sf
Flow Top Width...	0.72 ft
Wetted Perimeter.	0.81 ft
Critical Depth...	0.16 ft
Critical Slope...	0.0355 ft/ft
Froude Number....	0.72 (flow is Subcritical)

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REVISED 10/95

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek UD-4

Comment: Maximum Channel Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.2000 ft/ft
Discharge.....	0.08 cfs

Computed Results:

Depth.....	0.11 ft
Velocity.....	3.05 fps
Flow Area.....	0.03 sf
Flow Top Width...	0.46 ft
Wetted Perimeter.	0.51 ft
Critical Depth...	0.16 ft
Critical Slope...	0.0355 ft/ft
Froude Number....	2.25 (flow is Supercritical)

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Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek UD-5

Comment: Ditch Section - Minimum Channel Slope Sect.

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	0.03 cfs

Computed Results:

Depth.....	0.12 ft
Velocity.....	1.01 fps
Flow Area.....	0.03 sf
Flow Top Width...	0.49 ft
Wetted Perimeter.	0.55 ft
Critical Depth...	0.11 ft
Critical Slope...	0.0404 ft/ft
Froude Number....	0.72 (flow is Subcritical)

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Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek UD-5

Comment: Ditch Section - Maximum Channel Slope Sect.

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.2000 ft/ft
Discharge.....	0.03 cfs

Computed Results:

Depth.....	0.08 ft
Velocity.....	2.39 fps
Flow Area.....	0.01 sf
Flow Top Width...	0.32 ft
Wetted Perimeter.	0.35 ft
Critical Depth...	0.11 ft
Critical Slope...	0.0404 ft/ft
Froude Number....	2.12 (flow is Supercritical)

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Revised 10/95

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek - UD-5

Comment: Swale Section - Minimum Slope Section

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	0.03 cfs

Computed Results:

Depth.....	0.02 ft
Velocity.....	0.27 fps
Flow Area.....	0.11 sf
Flow Top Width...	5.43 ft
Wetted Perimeter.	5.44 ft
Critical Depth...	0.01 ft
Critical Slope...	0.0607 ft/ft
Froude Number....	0.32 (flow is Subcritical)

Open Channel Flow Module, Version 3.2 (c) 1990
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REVISED 10/95

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek - UD-5

Comment: Swale Section - Maximum Slope Section

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	0.03 cfs

Computed Results:

Depth.....	0.01 ft
Velocity.....	0.41 fps
Flow Area.....	0.07 sf
Flow Top Width...	5.29 ft
Wetted Perimeter.	5.29 ft
Critical Depth...	0.01 ft
Critical Slope...	0.0607 ft/ft
Froude Number....	0.61 (flow is Subcritical)

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REVISED 10/95

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek - UD-6

Comment: Ditch Section - Minimum Channel Slope Sect.

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	0.08 cfs

Computed Results:

Depth.....	0.18 ft
Velocity.....	1.29 fps
Flow Area.....	0.06 sf
Flow Top Width...	0.70 ft
Wetted Perimeter.	0.79 ft
Critical Depth...	0.16 ft
Critical Slope...	0.0355 ft/ft
Froude Number....	0.76 (flow is Subcritical)

Open Channel Flow Module, Version 3.2 (c) 1990
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REVISED 10/95

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek - UD-6

Comment: Ditch Section - Maximum Channel Slope Sect.

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1000 ft/ft
Discharge.....	0.08 cfs

Computed Results:

Depth.....	0.13 ft
Velocity.....	2.35 fps
Flow Area.....	0.03 sf
Flow Top Width...	0.52 ft
Wetted Perimeter.	0.58 ft
Critical Depth...	0.16 ft
Critical Slope...	0.0355 ft/ft
Froude Number....	1.63 (flow is Supercritical)

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REVISED 10/95

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek - UD-6

Comment: Swale Section - Minimum Slope Section

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	0.08 cfs

Computed Results:

Depth.....	0.04 ft
Velocity.....	0.38 fps
Flow Area.....	0.21 sf
Flow Top Width...	5.78 ft
Wetted Perimeter.	5.78 ft
Critical Depth...	0.02 ft
Critical Slope...	0.0492 ft/ft
Froude Number....	0.35 (flow is Subcritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Willow Creek - UD-6

Comment: Swale Section - Maximum Slope Section

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	0.08 cfs

Computed Results:

Depth.....	0.03 ft
Velocity.....	0.59 fps
Flow Area.....	0.14 sf
Flow Top Width...	5.51 ft
Wetted Perimeter.	5.52 ft
Critical Depth...	0.02 ft
Critical Slope...	0.0492 ft/ft
Froude Number....	0.67 (flow is Subcritical)

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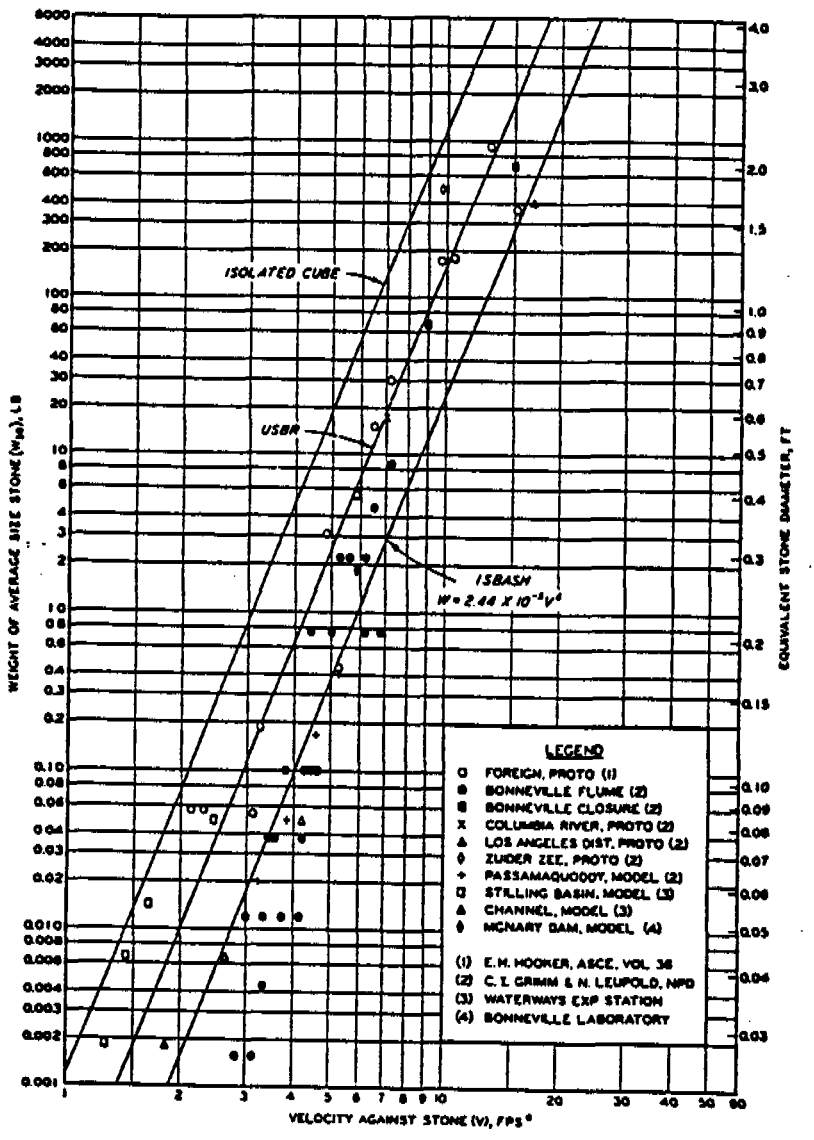
REVISED 10/95



NOTE: SPECIFIC WEIGHT OF ROCK = 165 LB/CU FT.
*FOR STONE PROTECTION BELOW ENERGY DISSIPATORS USE AS AVERAGE VELOCITY ACROSS END SILL

VELOCITY VS STONE WEIGHT

SEE TEXT PAGE 36

Plate 29

FROM: U.S. ARMY CORPS OF ENGINEERS. 1970. HYDRAULIC DESIGN OF FLOOD CONTROL CHANNELS. EM 1110-2-1601. WASHINGTON, D.C.

DISTURBED CHANNEL DESIGN

W.S.	CHANNEL SHAPE	DESIGN FLOW (CFS)	MANNING'S n	BOTTOM WIDTH (FT)	MIN. SLOPE (%)	MAX. FLOW DEPTH (FT)	MIN. VELOCITY (FPS)	MAX. SLOPE (%)	MIN. FLOW DEPTH (FT)	MAX. VELOCITY (FPS)	FREEBOARD (FT)	MIN. CHANNEL DEPTH (FT)
TRAP 1	SWALE	1.02	0.03	5	0.5	0.17	0.91	2.0	0.11	1.46	0.33	0.5
TRAP 1	DITCH	1.02	0.03	Ø	5.0	0.39	3.43	33.0	0.29	6.20*	0.61	1.0
TRAP 2	SWALE	0.28	0.03	5	0.5	0.03	0.60	2.0	0.05	0.94	0.42	0.5
TRAP 2	DITCH	0.28	0.03	Ø	5.0	0.24	2.48	12.0	0.20	3.45	0.76	1.0
TRAP 3	SWALE	1.54	0.03	5	0.5	0.21	1.04	2.0	0.14	1.67	0.29	0.5
TRAP 3	DITCH	1.54	0.03	Ø	3.0	050	3.14	3.0	0.41	4.54	0.5	1.0
TRAP 4	SWALE	1.57	0.03	5	0.5	0.21	1.04	2.0	0.14	1.68	0.29	0.5
TRAP 4	DITCH	1.57	0.03	Ø	5.0	0.45	3.82	20.0	0.37	5.73*	0.55	1.0

* STEEP SECTIONS TO BE RIPRAPPED W/ D_{50} 6-INCH MATERIALS ADEQUATE TO WITHSTAND A VELOCITY OF 8.5 FPS. (SEE ATTACHED FIGURE).

EARTHFAX ENGINEERING, INC.
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PROJECT UCD446-01 PAGE ___ OF ___
COMPUTED TJS DATE 9/27/95
CHECKED ___ DATE ___

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 1 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 2.90 acres
Depth = 1.40 inches	CN = 85.00
Duration = 6.00 hrs	Time conc.= 0.110 hrs

OUTPUT SUMMARY

Runoff depth	0.38991	inches		
Initial abstr	0.35294	inches		
Peak flow =	1.02	cfs	(0.34884	iph)
at time	2.523	hrs		

ADDED 9/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 2 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 0.98 acres
Depth = 1.40 inches	CN = 85.00
Duration = 6.00 hrs	Time conc.= 0.260 hrs

OUTPUT SUMMARY

Runoff depth	0.38991	inches	
Initial abstr	0.35294	inches	
Peak flow =	0.28	cfs	(0.28676 iph)
at time	2.600	hrs	

ADDED 9/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 3 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 2.78 acres
Depth = 1.40 inches	CN = 90.00
Duration = 6.00 hrs	Time conc.= 0.134 hrs

OUTPUT SUMMARY

Runoff depth	0.60604	inches	
Initial abstr	0.22222	inches	
Peak flow =	1.54	cfs	(0.55094 iph)
at time	2.519	hrs	

ADDED 9/95

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENRATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 4 - 10yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type `b' - 6 Hr	Area = 2.90 acres
Depth = 1.40 inches	CN = 90.00
Duration = 6.00 hrs	Time conc.= 0.160 hrs

OUTPUT SUMMARY

Runoff depth	0.60604	inches	
Initial abstr	0.22222	inches	
Peak flow =	1.57	cfs	(0.53821 iph)
at time	2.539	hrs	

Revised 9/95

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 1

Comment: Swale Section - Minimum Slope

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	1.02 cfs

Computed Results:

Depth.....	0.17 ft
Velocity.....	0.91 fps
Flow Area.....	1.12 sf
Flow Top Width...	8.34 ft
Wetted Perimeter.	8.36 ft
Critical Depth...	0.10 ft
Critical Slope...	0.0297 ft/ft
Froude Number....	0.44 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 1

Comment: Swale Section - Maximum Slope

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	1.02 cfs

Computed Results:

Depth.....	0.11 ft
Velocity.....	1.46 fps
Flow Area.....	0.70 sf
Flow Top Width...	7.27 ft
Wetted Perimeter.	7.28 ft
Critical Depth...	0.10 ft
Critical Slope...	0.0297 ft/ft
Froude Number....	0.83 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 1

Comment: Ditch Section - Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	1.02 cfs

Computed Results:

Depth.....	0.39 ft
Velocity.....	3.43 fps
Flow Area.....	0.30 sf
Flow Top Width...	1.54 ft
Wetted Perimeter.	1.72 ft
Critical Depth...	0.44 ft
Critical Slope...	0.0253 ft/ft
Froude Number....	1.38 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 1

Comment: Ditch Section - Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.3300 ft/ft
Discharge.....	1.02 cfs

Computed Results:

Depth.....	0.29 ft
Velocity.....	6.20 fps
Flow Area.....	0.16 sf
Flow Top Width...	1.15 ft
Wetted Perimeter.	1.28 ft
Critical Depth...	0.44 ft
Critical Slope...	0.0344 ft/ft
Froude Number....	2.89 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 2

Comment: Swale Section - Minimum Slope

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	0.28 cfs

Computed Results:

Depth.....	0.08 ft
Velocity.....	0.60 fps
Flow Area.....	0.47 sf
Flow Top Width...	6.61 ft
Wetted Perimeter.	6.62 ft
Critical Depth...	0.04 ft
Critical Slope...	0.0380 ft/ft
Froude Number....	0.40 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 2

Comment: Swale Section - Maximum Slope

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	0.28 cfs

Computed Results:

Depth.....	0.05 ft
Velocity.....	0.94 fps
Flow Area.....	0.30 sf
Flow Top Width...	6.08 ft
Wetted Perimeter.	6.08 ft
Critical Depth...	0.04 ft
Critical Slope...	0.0380 ft/ft
Froude Number....	0.75 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 2

Comment: Ditch Section - Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	0.28 cfs

Computed Results:

Depth.....	0.24 ft
Velocity.....	2.48 fps
Flow Area.....	0.11 sf
Flow Top Width...	0.95 ft
Wetted Perimeter.	1.06 ft
Critical Depth...	0.26 ft
Critical Slope...	0.0300 ft/ft
Froude Number....	1.27 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 2

Comment: Ditch Section - Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1200 ft/ft
Discharge.....	0.28 cfs

Computed Results:

Depth.....	0.20 ft
Velocity.....	3.45 fps
Flow Area.....	0.08 sf
Flow Top Width...	0.81 ft
Wetted Perimeter.	0.90 ft
Critical Depth...	0.26 ft
Critical Slope...	0.0300 ft/ft
Froude Number....	1.91 (flow is Supercritical)

Open Channel Flow Module, Version 3.16 (c) 1990
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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 3

Comment: Swale Section - Minimum Slope

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	1.54 cfs

Computed Results:

Depth.....	0.21 ft
Velocity.....	1.04 fps
Flow Area.....	1.48 sf
Flow Top Width...	9.19 ft
Wetted Perimeter.	9.21 ft
Critical Depth...	0.13 ft
Critical Slope...	0.0276 ft/ft
Froude Number....	0.45 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 3

Comment: Swale Section - Maximum Slope

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	1.54 cfs

Computed Results:

Depth.....	0.14 ft
Velocity.....	1.67 fps
Flow Area.....	0.92 sf
Flow Top Width...	7.86 ft
Wetted Perimeter.	7.88 ft
Critical Depth...	0.13 ft
Critical Slope...	0.0276 ft/ft
Froude Number....	0.86 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 3

Comment: Ditch Section - Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0800 ft/ft
Discharge.....	1.54 cfs

Computed Results:

Depth.....	0.41 ft
Velocity.....	4.54 fps
Flow Area.....	0.34 sf
Flow Top Width...	1.65 ft
Wetted Perimeter.	1.84 ft
Critical Depth...	0.52 ft
Critical Slope...	0.0239 ft/ft
Froude Number....	1.76 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 3

Comment: Ditch Section - Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0300 ft/ft
Discharge.....	1.54 cfs

Computed Results:

Depth.....	0.50 ft
Velocity.....	3.14 fps
Flow Area.....	0.49 sf
Flow Top Width...	1.98 ft
Wetted Perimeter.	2.21 ft
Critical Depth...	0.52 ft
Critical Slope...	0.0239 ft/ft
Froude Number....	1.11 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 4

Comment: Swale Section - Minimum Slope

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	1.57 cfs

Computed Results:

Depth.....	0.21 ft
Velocity.....	1.04 fps
Flow Area.....	1.50 sf
Flow Top Width...	9.23 ft
Wetted Perimeter.	9.25 ft
Critical Depth...	0.13 ft
Critical Slope...	0.0275 ft/ft
Froude Number....	0.46 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 4

Comment: Swale Section - Maximum Slope

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	1.57 cfs

Computed Results:

Depth.....	0.14 ft
Velocity.....	1.68 fps
Flow Area.....	0.93 sf
Flow Top Width...	7.89 ft
Wetted Perimeter.	7.91 ft
Critical Depth...	0.13 ft
Critical Slope...	0.0275 ft/ft
Froude Number....	0.86 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 4

Comment: Ditch Section - Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	1.57 cfs

Computed Results:

Depth.....	0.45 ft
Velocity.....	3.82 fps
Flow Area.....	0.41 sf
Flow Top Width...	1.81 ft
Wetted Perimeter.	2.03 ft
Critical Depth...	0.52 ft
Critical Slope...	0.0238 ft/ft
Froude Number....	1.41 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 4

Comment: Ditch Section - Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.2000 ft/ft
Discharge.....	1.57 cfs

Computed Results:

Depth.....	0.37 ft
Velocity.....	5.73 fps
Flow Area.....	0.27 sf
Flow Top Width...	1.48 ft
Wetted Perimeter.	1.66 ft
Critical Depth...	0.52 ft
Critical Slope...	0.0325 ft/ft
Froude Number....	2.35 (flow is Supercritical)

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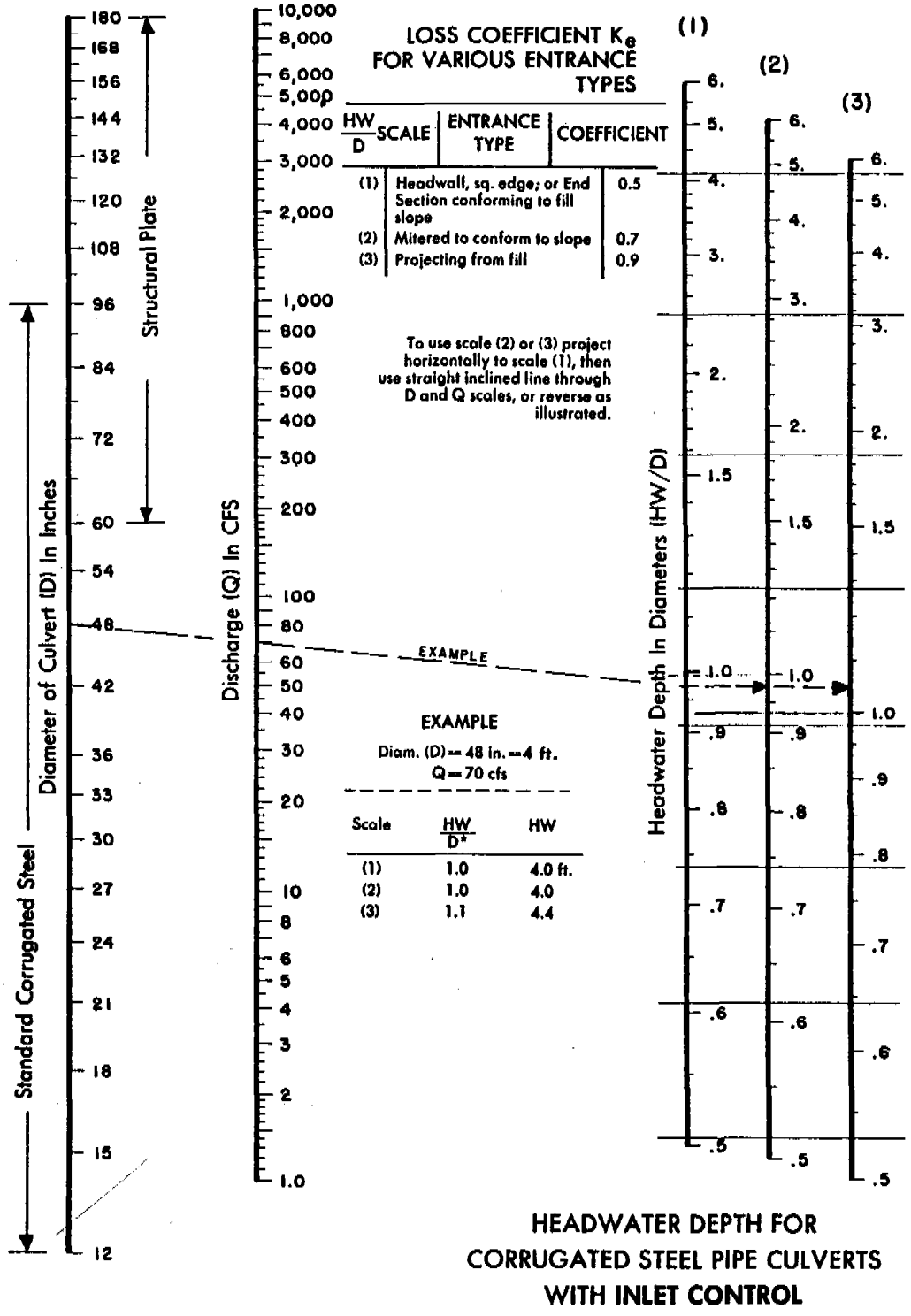
ENGINEERS / SCIENTISTS

PROJECT UC-412-31 PAGE ____ OF ____
COMPUTED AM DATE 9/21/95
CHECKED ____ DATE ____

A 18" CMP CULVERT WILL BE INSTALLED WHERE UD-1 WILL TRAVEL BENEATH THE ROAD.

THE DESIGN FLOW OF 2.55 CFS WAS USED WITH THE INLET CONTROL NOMOGRAPH (SEE PAGE ATTACHED) TO DETERMINE A RECOMENDED DIAMETER OF 15".

AN 18" CMP CULVERT WILL BE UTILIZED TO ENSURE ADEQUATE CAPACITY & TO AID MAINTENANCE EFFORTS.



HEADWATER DEPTH FOR CORRUGATED STEEL PIPE CULVERTS WITH INLET CONTROL

Fig. 4-18. ***Inlet control*** **nomograph for corrugated steel** ***pipe*** **culverts. The manufacturers recommend keeping** ***HW/D*** **to a maximum of 1.5 and preferably to no more than 1.0.**

RECLAMATION HYDROLOGY IMPLEMENTATION:

IF IT IS DETERMINED THAT THE SITE WILL NOT BE USED FOR FUTURE MINING, THE SITE WILL BE RECLAIMED IN A PHASED MANNER.

PHASE I

DURING PHASE I RECLAMATION, THE FOLLOWING WORK WILL BE UNDERTAKEN:

- TRAILER/OFFICE WILL BE DEMOLISED
- CONCRETE PAD WILL BE REMOVED & EITHER BURIED IN PIT OR HAULED TO APPROVED LANDFILL.
- UPPER PAD AREA ROUGH GRADED, SEDIMENT POND FOR UPPER AREA CONSTRUCTED, TOPSOILED, SEEDED, & MULCHED.

THE LOWER PORTION OF THE SITE WILL REMAIN AS ACCESS TO THE UPPER PAD WILL BE NECESSARY FOR FUTURE MAINTENANCE & FINAL RECLAMATION OF THE SEDIMENT POND.

PHASE II

ONCE THE UPPER PAD IS RECLAIMED SUFFICIENTLY TO ALLOW REMOVAL OF THE SEDIMENT POND, THE SECOND PHASE OF RECLAMATION WILL BE UNDERTAKEN. THE FOLLOWING WORK WILL BE UNDERTAKEN:

- UPPER AREA SEDIMENT POND REMOVED & SITE RECLAIMED.
- MIDDLE AREA ROAD & SEDIMENT CONTROLS REGRADED, RIPPED, & RECLAIMED.
- CULVERT @ STREAM CROSSING REMOVED & CHANNEL RESTORED & PROTECTED.

- LOWER PAD AREA REGRADED, RIPPED, + RECLAIMED
- TOPSOIL STORAGE AREA RECLAIMED.

IF POSSIBLE SOME OF THE PHASE II WORK MAY BE CONDUCTED AS PART OF PHASE I. HOWEVER, ACCESS TO THE UPPER PAD AREA MUST BE MAINTAINED UNTIL THE POND CAN BE REMOVED

BASED ON THIS RECLAMATION SCHEDULE, THE RECLAMATION HYDROLOGY HAS BEEN CALCULATED FOR THE FINAL SITE CONFIGURATION. HOWEVER, THE PHASED RECLAMATION CANBE IMPLEMENTED USING THIS RUNOFF CONTROL PLAN.

FOR PHASE I, ONLY THE UPPER PAD WILL BE AFFECTED. THIS WILL RESULT IN POND 1, TRAP 4, + UD-1 BEING REPLACED W/ THE REC. POND. THE REMAINING OPERATIONS STRUCTURES WILL REMAIN IN PLACE UNTIL PHASE II.

FOR PHASE II, THE REC POND, UD-2, UD-3, TRAP 1, + TRAP 2 WILL BE REMOVED DURING RECLAMATION ACTIVITIES. TRAPS 3, UD-4, UD-5, UD AND THE TOTAL CONTAINMENT BERM WILL REMAIN IN PLACE. THE ACCESS ROAD TO THE UPPER PAD WILL BE TREATED AS A SMALL EXEMPTION AREA AS THERE IS NO WAY TO CONVEY RUNOFF TO A POND. THIS AREA WILL BE MULCHED + ALTERNATIVE MEASURES SUCH AS STRAWBALE DIKES, SILT FENCES, ETC. WILL BE USED TO AID IN CONTROLLING EROSION.

PHASE III

ONCE THE AREAS DRAINING TO TRAP 3 AND THE TOTAL CONTAINMENT BERM ARE ADEQUATELY RECLAIMED, THESE TRAPS WILL BE REMOVED + THE SITES REGRADED, TOPSOILED, AND RESEEDED + MULCHED.

REVISED 9/95

RECLAMATION HYDROLOGY INPUTS

WATERSHED AREAS:

W.S.	AREA SQ.FT.	AREA AC
TRAP 3	131,334	3.02
POND 002	119,092	2.73
TOTAL CONTAINMENT BERM	174,269	4.00
RECLAMATION POND	2,763,262	63.44

HYDRAULIC LENGTH:

W.S.	LENGTH (FT)
TRAP 3	950
POND 002	1110
TOTAL CONTAINMENT BERM	780
RECLAMATION POND	3000

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AVERAGE WATERSHED SLOPE:

W.S.	ELEVATION (FT) MAX	MIN	CONTOUR LENGTHS 25	50	75	AWS (%)
TRAP 3	6201	6156	230	290	140	6
POND 002	6207	6156	110	260	200	6
TOTAL CONTAINMENT BERM	6210	6121	500	790	526	23
REC. POND	7847	6222	2310	1340	680	64

CURVE NUMBER:

W.S.	AVERAGE CN
TRAP 3	80
POND 002	80
TOTAL CONTAINMENT BERM	75
RECLAMATION POND	80

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TIME OF CONCENTRATION:

W.S.	HYD. LENGTH (FT)	CN	AVG (%)	LAG TIME (HR)	Tc (HRS)
TRAP 3	950	30	6	0.12	0.21
POND 002	1110	30	6	0.14	0.24
TOTAL CONTAINMENT BERM	730	75	23	0.06	0.11
REC. POND	5000	30	64	0.10	0.16

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EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Reclamation Pond - 10yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 63.44 acres
Depth = 1.90 inches	CN = 80.00
Duration = 24.00 hrs	Time conc.= 0.160 hrs

OUTPUT SUMMARY

Runoff depth	0.50256	inches	
Initial abstr	0.50000	inches	
Peak flow =	31.84	cfs	(0.49769 iph)
at time	12.032	hrs	

INPUT FOR: Willow Creek - Reclamation Pond - 25yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 63.44 acres
Depth = 1.60 inches	CN = 80.00
Duration = 6.00 hrs	Time conc.= 0.160 hrs

OUTPUT SUMMARY

Runoff depth	0.33611	inches	
Initial abstr	0.50000	inches	
Peak flow =	16.65	cfs	(0.26028 iph)
at time	2.560	hrs	

/

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Willow Creek - Trap 3X - 5yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 3.02 acres
Depth = 1.55 inches	CN = 80.00
Duration = 24.00 hrs	Time conc.= 0.210 hrs

OUTPUT SUMMARY

Runoff depth	0.31056	inches	
Initial abstr	0.50000	inches	
Peak flow =	0.84	cfs	(0.27659 iph)
at time	12.068	hrs	

INPUT FOR: Willow Creek - Trap 3X - 25yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 3.02 acres
Depth = 1.60 inches	CN = 80.00
Duration = 6.00 hrs	Time conc.= 0.210 hrs

OUTPUT SUMMARY

Runoff depth	0.33611	inches	
Initial abstr	0.50000	inches	
Peak flow =	0.73	cfs	(0.23888 iph)
at time	2.576	hrs	

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/

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

POND 002

INPUT FOR: Willow Creek - ~~Trap 3B~~ - 5yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 2.73 acres
Depth = 1.55 inches	CN = 80.00
Duration = 24.00 hrs	Time conc.= 0.240 hrs

OUTPUT SUMMARY

Runoff depth	0.31056	inches	
Initial abstr	0.50000	inches	
Peak flow =	0.73	cfs	(0.26557 iph)
at time	12.096	hrs	

POND 002

INPUT FOR: Willow Creek - ~~Trap 3B~~ - 25yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 2.73 acres
Depth = 1.60 inches	CN = 80.00
Duration = 6.00 hrs	Time conc.= 0.240 hrs

OUTPUT SUMMARY

Runoff depth	0.33611	inches	
Initial abstr	0.50000	inches	
Peak flow =	0.63	cfs	(0.22803 iph)
at time	2.624	hrs	

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/

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HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

TOTAL CONTAINMENT BERM

INPUT FOR: Willow Creek - ~~Trap 4~~ - 5yr-24hr

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 4.00 acres
Depth = 1.55 inches	CN = 75.00
Duration = 24.00 hrs	Time conc.= 0.110 hrs

OUTPUT SUMMARY

Runoff depth	0.18505	inches	
Initial abstr	0.66667	inches	
Peak flow =	0.69	cfs	(0.16984 iph)
at time	12.027	hrs	

TOTAL CONTAINMENT BERM

INPUT FOR: Willow Creek - ~~Trap 4~~ - 25yr-6hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 4.00 acres
Depth = 1.60 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.110 hrs

OUTPUT SUMMARY

Runoff depth	0.20417	inches	
Initial abstr	0.66667	inches	
Peak flow =	0.54	cfs	(0.13447 iph)
at time	2.537	hrs	

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POND & TRAP REQUIRED RUNOFF VOLUMES:

W.S.	RUNOFF DEPTH (IN)	DRAINAGE AREA (AC)	RUNOFF VOLUME (AC-FT)
RECLAMATION POND	0.50	63.44	2.64
TRAP 3	0.31	3.02	0.08
POND 002	0.31	2.73	0.07
TOTAL RECLAMATION BERM	0.13	4.00	0.06

POND & TRAP SEDIMENT STORAGE VOLUME:

	SEDIMENT STORAGE VOLUME
[illegible]	0.60
TRAP 3A	0.14
TRAP 3B	0.05
TRAP 4	0.04

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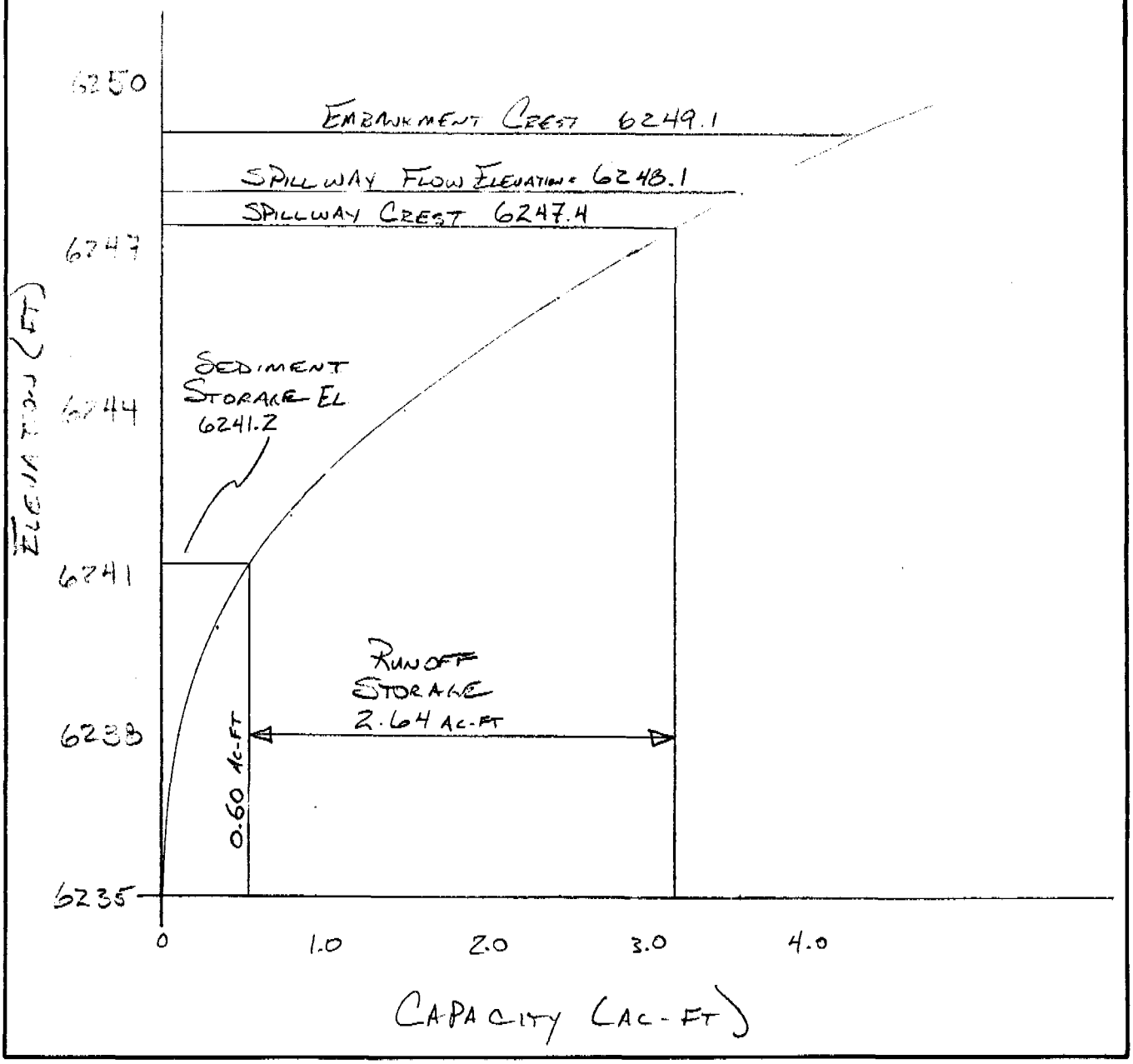
ELEVATION (FT)	AREA (FT²)	AVG. AREA (FT²)	C.I. (FT)	VOLUME (AC-FT)	TOTAL VOLUME
35	0				
		316	1	0.01	0.01
36	631				
		1783	2	0.08	0.09
38	2935				
		5336	2	0.25	0.34
40	7836				
		10034	2	0.46	0.80
42	12232				
		14896	2	0.68	1.48
44	17559				
		20,587	2	0.95	2.43
46	23615				
		26583	2	1.22	3.65
48	29550				



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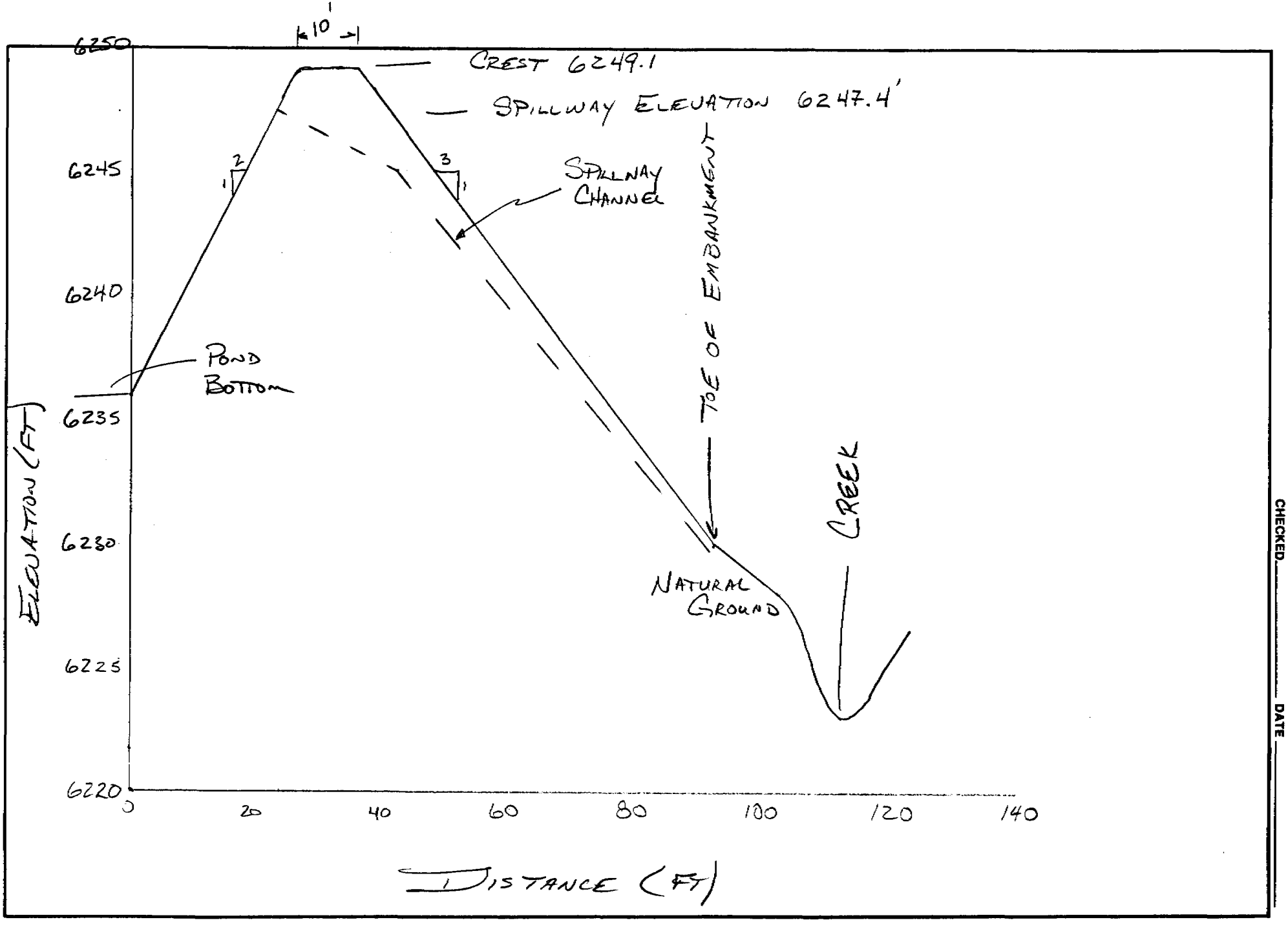

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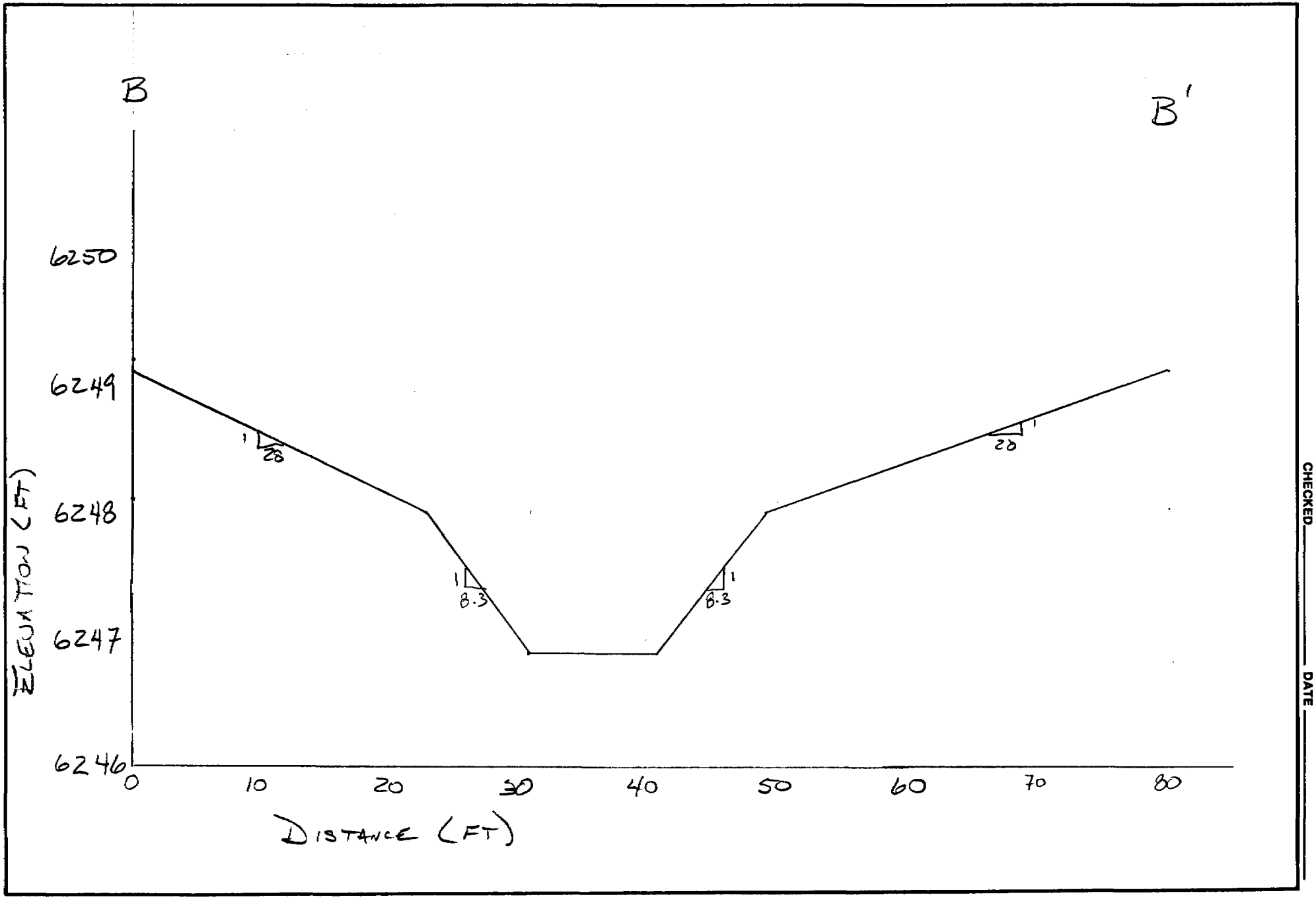

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Rec. Pond

Comment: Spillway Structure - 25yr-6hr

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	16.65 cfs

Computed Results:

Depth.....	0.69 ft
Velocity.....	2.02 fps
Flow Area.....	8.26 sf
Flow Top Width...	18.85 ft
Wetted Perimeter.	18.92 ft
Critical Depth...	0.50 ft
Critical Slope...	0.0190 ft/ft
Froude Number....	0.54 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Rec. Pond

Comment: Spillway Structure - Steep - 25yr-6hr

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.3300 ft/ft
Discharge.....	16.65 cfs

Computed Results:

Depth.....	0.30 ft
Velocity.....	10.01 fps
Flow Area.....	1.66 sf
Flow Top Width...	6.19 ft
Wetted Perimeter.	6.33 ft
Critical Depth...	0.64 ft
Critical Slope...	0.0232 ft/ft
Froude Number....	3.40 (flow is Supercritical)

Open Channel Flow Module, Version 3.2 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

TRAP CAPACITIES:

TRAP 3

TOTAL VOLUME: 0.28 AC-FT

REQUIRED VOLS:

SED	0.20
RUNOFF	0.08
	0.28

OK

POND 002

TOTAL VOLUME: 0.26 AC-FT

REQUIRED VOLS:

SED.	0.19
RUNOFF	0.07
	0.26

OK

TOTAL CONTAINMENT BERM

TOTAL VOLUME: 0.13

REQUIRED VOLS:

SED.	0.07
RUNOFF	0.06
	0.13

OK

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Rec Trap 3

Comment: Spillway Structure - 25yr-6hr

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	0.73 cfs

Computed Results:

Depth.....	0.07 ft
Velocity.....	1.91 fps
Flow Area.....	0.38 sf
Flow Top Width...	5.30 ft
Wetted Perimeter.	5.33 ft
Critical Depth...	0.09 ft
Critical Slope...	0.0303 ft/ft
Froude Number....	1.25 (flow is Supercritical)

Open Channel Flow Module, Version 3.16 (c) 1990
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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Pond 002

Comment: Spillway Structure - 25 yr-6hr

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	0.63 cfs

Computed Results:

Depth.....	0.07 ft
Velocity.....	1.81 fps
Flow Area.....	0.35 sf
Flow Top Width...	5.27 ft
Wetted Perimeter.	5.30 ft
Critical Depth...	0.08 ft
Critical Slope...	0.0313 ft/ft
Froude Number....	1.24 (flow is Supercritical)

Open Channel Flow Module, Version 3.16 (c) 1990
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BERM CAPACITY EVALUATION

- TRAP 1 BERM
  - 4-5 FT HIGH
  - 2.5H:1V SIDE SLOPE
  - 1-1.5 FT TOP WIDTH
  - SLOPE: 0.005 FT/FT TO 0.10 FT/FT
  - PEAK FLOW FOR DESIGN: 3.07 CFS (25YR-24HR EVENT)
  - SEE OUTPUT - MAX. DEPTH OK
    - MAX. VEL. < 5 FPS OK
- TRAP 2 BERM
  - 1.5 FT HIGH
  - 2.5H:1V SIDESLOPE
  - SLOPE 0.01 FT/FT TO 0.1 FT/FT
  - PEAKFLOW FOR DESIGN: 0.93 CFS (25YR-24HR EVENT)
  - SEE OUTPUT
    - MAX. DEPTH OK
    - MAX. VEL. < 5 FPS OK

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 1 Berm

Comment: Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.50:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	3.07 cfs

Computed Results:

Depth.....	0.57 ft MAX. DEPTH < 4 FT OK
Velocity.....	1.50 fps
Flow Area.....	2.05 sf
Flow Top Width...	7.15 ft
Wetted Perimeter.	7.29 ft
Critical Depth...	0.43 ft
Critical Slope...	0.0224 ft/ft
Froude Number....	0.49 (flow is Subcritical)

Open Channel Flow Module, Version 3.2 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 1 Berm

Comment: Maximum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.50:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1000 ft/ft
Discharge.....	3.07 cfs

Computed Results:

Depth.....	0.33 ft
Velocity.....	4.62 fps MAX. VELOCITY ~ 5 FPS
Flow Area.....	0.67 sf
Flow Top Width...	4.08 ft
Wetted Perimeter.	4.16 ft
Critical Depth...	0.43 ft
Critical Slope...	0.0224 ft/ft
Froude Number....	2.01 (flow is Supercritical)

Open Channel Flow Module, Version 3.2 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 2 Berm

Comment: Minimum Slope

Solve For Depth

Given Input Data:

Left Side Slope..	2.50:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0100 ft/ft
Discharge.....	0.93 cfs

Computed Results:

Depth.....	0.32 ft MAX. DEPTH < 1.5FT
Velocity.....	1.44 fps
Flow Area.....	0.64 sf
Flow Top Width...	4.01 ft
Wetted Perimeter.	4.09 ft
Critical Depth...	0.27 ft
Critical Slope...	0.0263 ft/ft
Froude Number....	0.64 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Trap 2 Berm

Comment: Maximum Slope

Solve For Depth

Given Input Data:

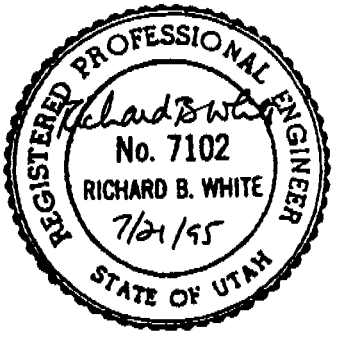
Left Side Slope..	2.50:1 (H:V)
Right Side Slope.	10.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1000 ft/ft
Discharge.....	0.93 cfs

Computed Results:

Depth.....	0.21 ft
Velocity.....	3.42 fps MAX. VELOCITY < 5 FPS
Flow Area.....	0.27 sf
Flow Top Width...	2.61 ft
Wetted Perimeter.	2.66 ft
Critical Depth...	0.27 ft
Critical Slope...	0.0263 ft/ft
Froude Number....	1.87 (flow is Supercritical)

APPENDIX 12-7-3

UPDES PERMIT



Permit No. UTG040000
Minor Industrial

STATE OF UTAH
DIVISION OF WATER QUALITY
DEPARTMENT OF ENVIRONMENTAL QUALITY
SALT LAKE CITY, UTAH

AUTHORIZATION TO DISCHARGE UNDER THE

UTAH POLLUTANT DISCHARGE ELIMINATION SYSTEM (UPDES)

GENERAL PERMIT FOR COAL MINING

In compliance with provisions of the Utah *Water Quality Act, Title 19, Chapter 5, Utah Code Annotated ("UCA") 1953, as amended* (the *"Act"*),

Cyprus Plateau - Blackhawk Project, located approximately three miles east of the Pacificorp Carbon Plant on State Highway 33, as identified in the Notice of Intent, application UTG040016, is authorized to discharge to Willow Creek, a tributary of the Price River, in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on July 1, 1993.

This general permit and the authorization to discharge shall expire at midnight, April 30, 1998.

Signed this 29th day of June, 1993.

Authorized Permitting Official
Executive Secretary
Utah Water Quality Board

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I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Definitions.

1. The "30-day (and monthly) average" is the arithmetic average of all samples collected during a consecutive 30-day period or calendar month, whichever is applicable. The calendar month shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms.

2. The "7-day (and weekly) average" is the arithmetic average of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. The 7-day and weekly averages are applicable only to those effluent characteristics for which there are 7-day average effluent limitations. The calendar week which begins on Sunday and ends on Saturday, shall be used for purposes of reporting self- monitoring data on discharge monitoring report forms. Weekly averages shall be calculated for all calendar weeks with Saturdays in the month. If a calendar week overlaps two months (i.e., the Sunday is in one month and the Saturday in the following month), the weekly average calculated for that calendar week shall be included in the data for the month that contains the Saturday.

3. "Daily Maximum" ("Daily Max.") is the maximum value allowable in any single sample or instantaneous measurement.

4. "Composite samples" shall be flow proportioned. The composite sample shall, as a minimum, contain at least four (4) samples collected over the composite sample period. Unless otherwise specified, the time between the collection of the first sample and the last sample shall not be less than six (6) hours nor more than 24 hours. Acceptable methods for preparation of composite samples are as follows:

   a. Constant time interval between samples, sample volume proportional to flow rate at time of sampling;

   b. Constant time interval between samples, sample volume proportional to total flow (volume) since last sample. For the first sample, the flow rate at the time the sample was collected may be used;

   c. Constant sample volume, time interval between samples proportional to flow (i.e., sample taken every "X" gallons of flow); and,

   d. Continuous collection of sample, with sample collection rate proportional to flow rate.

5. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

6. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

7. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

8. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

9. "Executive Secretary" means Executive Secretary of the Utah Water Quality Board.

10. "EPA" means the United States Environmental Protection Agency.

11. "Act" means the "*Utah Water Quality Act*".

12. "Best Management Practices" ("*BMPs*") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. *BMPs* also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

13. "*CWA*" means *Federal Water Pollution Control Act*, as amended, by *The Clean Water Act of 1987*.

14. "Point Source" means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharges.

15. "Significant spills" includes, but is not limited to: releases of oil or hazardous substances in excess of reportable quantities under *Section 311* of the *Clean Water Act* (see *40 CFR 110.10* and *40 CFR 117.21*) or *Section 102* of *CERCLA* (see *40 CFR 302.4*).

16. "Storm water" means storm water runoff, snow melt runoff, and surface runoff and drainage.

17. "Waste pile" means any noncontainerized accumulation of solid, nonflowing waste that is used for treatment or storage.

18. "10-year, 24-hour precipitation event" means the maximum 24-hour precipitation event with a probable reoccurrence interval of once in 10 years. This information is available in *Weather Bureau Technical Paper No. 40*, May 1961 and *NOAA Atlas 2*, 1973 for the 11 Western States, and may be obtained from the National Climatic Center of the Environmental Data Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

19. The term "coal preparation plant" means a facility where coal is crushed, screened, sized, cleaned, dried, or otherwise prepared and loaded for transit to a consuming facility.

20. The term "coal preparation plant associated areas" means the coal preparation plant yards, immediate access roads, <u>coal refuse piles</u>, and <u>coal storage piles</u> and <u>facilities</u>.

21. "Alkaline mine drainage" means mine drainage which before any treatment has a pH equal to or greater than 6.0 and total iron concentration less than 10 mg/l.

22. The term "settleable solids" is that matter measured by the volumetric method specified below:

Fill an Imhoff cone to the one-liter mark with a thoroughly mixed sample. Allow to settle undisturbed for 45 minutes. Gently stir along the inside surface of the cone with a stirring rod. Allow to settle undisturbed for 15 minutes longer. Record the volume of settled material in the cone as milliliters per liter. Where a separation of settleable and floating material occurs, do not include the floating material in the reading.

B. Criteria for Inclusion in the General Permit for Coal Mining

This General permit shall apply only to the discharge of treated wastewater from:

Coal mining operations either new or existing in Utah which include or will include in part or in a whole alkaline mine water drainage, storm water runoff from coal preparation plant associated areas, active mining areas, and post mining areas until the performance bond is released. The total amount of total dissolved solids discharged from all mine water and decant operations is limited to one ton per day.

C. Notice of Intent for a General Permit for Coal Mining

Any facility which desires a general permit for coal mining and meets the requirements of Part I.B. can be issued a general permit by submitting a notice of intent (NOI) to the Division of Water Quality and EPA at the addresses listed on page 10 of this permit.

The NOI shall include:

a. A completed Environmental Protection Agency Application (EPA Form 3510-1) or equivalent information.

b. Location and identification number (such as 001, 002, etc.) of each existing discharge and/or proposed discharge point(s). This includes the latitude and longitude to the nearest 15 seconds and the name of the receiving water(s).

c. A description of the source of the wastewater for each discharge point.

d. A description of the treatment given or proposed for the wastewater at each discharge point and if necessary a justification of why no treatment is required.

e. Flow characteristics for each discharge point such as whether flow is or will be continuous or intermittent and indicate projected and/or actual average and maximum flows in gpd.

f. Data for each discharge point for the following parameters:

1) Biochemical oxygen demand (BOD_5)
2) Chemical oxygen demand (COD)
3) Total organic carbon (TOC)
4) Total suspended solids (TSS)
5) Flow
6) Ammonia (as N)

7) Oil and grease
8) Temperature
9) pH
10) Total dissolved solids (TDS)
11) Total iron and metals, cyanide, phenols located in Table III UAC R317-8-3.12
12) Date and time of sampling for each parameter
13) Date and time of analysis for each parameter
14) Utah certified laboratory which has completed the analysis for each parameter

If no data is available, indicate why the data is not available.
The Executive Secretary may waive the reporting requirements for any of these pollutants and parameters if the applicant submits a request for such a waiver before or with the NOI which demonstrates that information adequate to support issuance of the permit can be obtained through less stringent reporting requirements.

g. For each discharge point the presence or absence of any toxic and/or priority pollutants as listed by EPA in *40 CFR Part 403*.

h. Best management practice plan or sediment runoff control plan approved by the Division of Oil, Gas and Mining.

D Description of Discharge Point(s).

The authorization to discharge provided under this permit is limited to those outfalls specifically designated below as discharge locations. Discharges at any location not authorized under a UPDES permit is a violation of the *Act* and may be subject to penalties under the *Act*. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge may be subject to criminal penalties as provided under the *Act*.

Outfall Number	Location of Discharge Point(s)
001	Sediment trap located near the temporary office trailer site Latitude 39° 43' 15" and Longitude 110° 51' 30"
002	Sediment trap at Willow Creek portal area Latitude 39° 43' 45" and Longitude 110° 44' 00"
003	Sediment trap at the Willow Creek old fan area Latitude 39° 44' 00" and Longitude 110° 50' 45"

E. Narrative Standard.

It shall be unlawful, and a violation of this permit, for the permittee to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum or other nuisances such as color, odor or taste, or conditions which produce undesirable aquatic life or which produces objectionable tastes in edible aquatic organisms; or concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish

or other desirable aquatic life, or undesirable human health effects, as determined by bioassay or other tests performed in accordance with standard procedures.

F. Specific Limitations and Self-monitoring Requirements.

1. Effective immediately and lasting the duration of this permit, the permittee is authorized to discharge from Outfall __. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations a/ Average 30-Day	Average 7-Day	Daily Maximum	Monitoring Requirements Measurement Frequency	Sample Type
Flow, gpd	NA	NA	NA	Monthly	Measured b/
Oil & Grease, mg/L	NA	NA	10	Monthly	Grab
Total Suspended Solids, mg/L	25	35	70	Monthly	Grab e/
Total Iron, mg/l	NA	NA	1.0 c/	Monthly	Grab e/
Total Dissolved Solids lbs/day	NA	NA	d/	Monthly	Grab e/

The pH shall not be less than 6.5 standard units nor greater than 9.0 standard units in any sample and shall be monitored monthly by a grab sample.

There shall be no visible sheen or floating solids or visible foam in other than trace amounts.

There shall be no discharge of sanitary wastes or any process water from coal preparation plants.

N.A. - Not Applicable.

a/ See Definitions, *Part I.A* for definition of terms.

b/ For intermittent discharge, the duration of the discharge shall be reported along with the flow.

c/ Values up to 2 mg/l may be approved where the permittee provides sufficient information that water quality standards will not be violated.

d/ The total amount of total dissolved solids (TDS) discharged from all mine water and decant operations is limited to one ton (2000 pounds) per day.

e/ These samples may also be a composite sample.

2. Samples taken in compliance with the monitoring requirements specified above shall be taken from the effluent before mixing with any receiving water.

3. Any overflow, increase in volume of a discharge or discharge from a bypass system caused by precipitation within any 24-hour period less than or equal to the 10-year, 24-hour precipitation event (or snowmelt of equivalent volume) at all surface runoff pond (outfalls) may comply with the following limitation instead of the total suspended solids limitations contained in Part I.F.1:

Effluent Characteristics	Daily Maximum
Settleable Solids	0.5 mL/L

In addition to the monitoring requirements specified under Part I.F.1, all effluent samples collected during storm water discharge events shall also be analyzed for settleable solids. Such analyses shall be conducted on either grab or composite samples.

4. Any overflow, increase in volume of a discharge or discharge from a bypass system caused by precipitation within any 24-hour period greater than the 10-year, 24-hour precipitation event (or snowmelt of equivalent volume) at all surface runoff pond outfalls may comply with the following limitations instead of the otherwise applicable limitations:

   The pH shall not be less than 6.5 standard units nor greater than 9.0 standard units. However, as stated under Part I.F.3, all effluent samples collected at all surface runoff pond outfalls during storm water discharge events shall be analyzed for settleable solids and the parameters identified under Part I.F.1.

5. The operator shall have the burden of proof that the discharge or increase in discharge was caused by the applicable precipitation event described in Parts I.F.3. and F.4. The alternate limitation in Parts I.F.4. and F.5. shall not apply to treatment systems that treat underground mine water only.

6. Best Management Practices.

   a. The company shall implement and maintain best management practices for the control of road salt storage for areas discharging to waters of the State. This shall include enclosure or coverage to prevent exposure to precipitation, except exposure resulting from adding or removing materials from the pile. Dischargers shall demonstrate compliance with the enclosure provision as expeditiously as practicable, but in no event later than October 1, 1995.

   b. The facility must minimize the discharge of salt by using the largest practicable amount of saline water for process and dust control. After April 30, 1994 there shall be no use of gypsum for rock dusting unless the permittee provides sufficient information to the Executive Secretary such that approval is granted based upon the Colorado River Basin Salinity Control Forum Policies and the fact that it will not significantly increase total dissolved solids concentrations.

   c. Sediment and Erosion Control. Within six months of permit issuance, the permittee shall develop a stormwater pollution prevention plan which identifies areas which, due to topography, road construction with waste materials, other activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to limit erosion. (The general permit for storm water discharges associated with industrial activity contains information for developing a satisfactory plan).

   d. Management of Runoff. The stormwater pollution prevention plan shall be implemented as soon as practical but no later than one year after permit issuance. Appropriate measures for small areas may include: silt fences, sediment traps, vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration deicers, and wet detention/retention devices.

e. Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the stormwater pollution prevention plan, but in no case less than once a year. Such evaluations shall provide:

(1) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed.

(2) Based on the results of the inspection, the description of potential pollutant sources identified in the plan and pollution prevention measures and controls identified in the plan shall be revised as appropriate within two weeks of such inspection and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than twelve weeks after the inspection.

(3) A report summarizing the scope of the inspection, personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken shall be made and retained as part of the storm water pollution prevention plan for at least one year after coverage under this permit terminates. The report shall identify any incidents of non-compliance. Where a report does not identify any incidents of non-compliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with *Part IV.G Signatory Requirements* of this permit.

(4) Where annual site inspections are shown in the plan to be impractical for inactive mining sites due to the remote location and inaccessibility of the site, site inspections required under this part shall be conducted at appropriate intervals specified in the plan, but, in no case less than once in three years.

f. Consistency with other plans. Plans may reflect requirements for *Spill Prevention Control and Countermeasure ("SPCC")* plans developed for the facility under *Section 311* of the *CWA* or *Best Management Practices ("BMP")* otherwise required by this permit for the facility as long as such requirement is incorporated into the plan.

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under *Part I* shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge. Sludge samples shall be collected at a location representative of the quality of sludge immediately prior to the use-disposal practice.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under *Utah Administrative Code ("UAC") R317-2-10*, unless other test procedures have been specified in this permit.

C. Penalties for Tampering. The *Act* provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results. Monitoring results obtained during the previous month shall be summarized and reported monthly on a Discharge Monitoring Report Form (EPA No. 3320-1), postmarked no later than the 28th day of the month following the completed reporting period. The first report is due on August 28, 1993. If no discharge occurs during the reporting period, "no discharge" shall be reported. Legible copies of these, and all other reports required herein, shall be signed and certified in accordance with the requirements of *Signatory Requirements (see Part IV.G)*, and submitted to the Director, Division of Water Quality and to EPA at the following addresses:

original to: Department of Environmental Quality
Division of Water Quality
288 North 1460 West
PO Box 144870
Salt Lake City, Utah 84114-4870

copy to: United States Environmental Protection Agency Region VIII
Denver Place
999 18th Street, Suite 500
Denver, Colorado 80202-2466
Attention: Water Management Division
Compliance Branch (8WM-C)

E. Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee. If the permittee monitors any parameter more frequently than required by this permit, using test procedures approved under *UAC R317-2-10* or as otherwise specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated. Only those parameters required by the permit need to be reported.

G. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

H. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Executive Secretary at any time. A copy of this UPDES permit must be maintained on site during the duration of activity at the permitted location.

I. Twenty-four Hour Notice of Noncompliance Reporting.

1. The permittee shall (orally) report any noncompliance which may seriously endanger health or environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of circumstances. The report shall be made to the Division of Water Quality, (801) 538-6146, or 24 hour answering service (801) 536-4123.

2. The following occurrences of noncompliance shall be reported by telephone (801) 536-4123 as soon as possible but no later than 24 hours from the time the permittee becomes aware of the circumstances:

   a. Any noncompliance which may endanger health or the environment;

   b. Any unanticipated bypass which exceeds any effluent limitation in the permit (See *Part III.G, Bypass of Treatment Facilities.)*;

   c. Any upset which exceeds any effluent limitation in the permit (See *Part III.H, Upset Conditions.*); or,

   d. Violation of a maximum daily discharge limitation for any of the pollutants listed in the permit.

3. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

e. Steps taken, if any, to mitigate the adverse impacts on the environment and human health during the noncompliance period.

4. The Executive Secretary may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Division of Water Quality, (801) 538-6146.

5. Reports shall be submitted to the addresses in *Part II.D, Reporting of Monitoring Results.*

J. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for *Part II.D* are submitted. The reports shall contain the information listed in *Part II.I.3.*

K. Inspection and Entry. The permittee shall allow the Executive Secretary, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the *Act*, any substances or parameters at any location.

III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions. The *Act* provides that any person who violates a permit condition implementing provisions of the *Act* is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions of the Act is subject to a fine not exceeding $25,000 per day of violation; Any person convicted under *UCA 19-5-115(2)* a second time shall be punished by a fine not exceeding $50,000 per day. Except as provided at *Part III.G, Bypass of Treatment Facilities* and *Part III.H, Upset Conditions*, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

F. Removed Substances. Collected screening, grit, solids, sludges, or other pollutants removed in the course of treatment shall be buried or disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard. Sludge/digester supernatant and filter backwash shall not directly enter either the final effluent or waters of the state by any other direct route.

G. Bypass of Treatment Facilities.

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs 2 and 3 of this section. Return of removed substances, as described in *Part III.F*, to the discharge stream shall not be considered a bypass under the provisions of this paragraph.

2. Notice:

   a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten (10) days before the date of the bypass.

b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required under *Part II.I, Twenty-four Hour Reporting*.

3. Prohibition of bypass.

a. Bypass is prohibited and the Executive Secretary may take enforcement action against a permittee for a bypass, unless:

(1) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage ;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

(3) The permittee submitted notices as required under paragraph 2 of this section.

b. The Executive Secretary may approve an anticipated bypass, after considering its adverse effects, if the Executive Secretary determines that it will meet the three conditions listed above in paragraph 3.a of this section.

H. Upset Conditions.

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of paragraph 2. of this section are met. Executive Secretary's administrative determination regarding a claim of upset cannot be judiciously challenged by the permittee until such time as an action is initiated for noncompliance.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

a. An upset occurred and that the permittee can identify the cause(s) of the upset;

b. The permitted facility was at the time being properly operated;

c. The permittee submitted notice of the upset as required under *Part II.I, Twenty-four Hour Notice of Noncompliance Reporting*; and,

d. The permittee complied with any remedial measures required under *Part III.D, Duty to Mitigate*.

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

I. Toxic Pollutants. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of *The Water Quality Act of 1987* for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

J. Changes in Discharge of Toxic Substances. Notification shall be provided to the Executive Secretary as soon as the permittee knows of, or has reason to believe:

1. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   a. One hundred micrograms per liter (100 ug/L);

   b. Two hundred micrograms per liter (200 ug/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/L) for 2,4-dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

   c. Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with *UAC R317-8-3.4(7)* or (10); or,

   d. The level established by the Executive Secretary in accordance with *UAC R317-8-4.2(6).*

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   a. Five hundred micrograms per liter (500 ug/L);

   b. One milligram per liter (1 mg/L) for antimony:

   c. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with *UAC R317-8-3.4(9)*; or,

   d. The level established by the Executive Secretary in accordance with *UAC R317-8-4.2(6).*

K. Industrial Pretreatment. Any wastewaters discharged to the sanitary sewer, either as a direct discharge or as a hauled waste, are subject to Federal, State and local pretreatment regulations. Pursuant to Section 307 of *The Water Quality Act of 1987*, the permittee shall comply with all applicable federal General Pretreatment Regulations promulgated at *40 CFR 403*, the State Pretreatment Requirements at *UAC R317-8-8*, and any specific local discharge limitations developed by the Publicly Owned Treatment Works (POTW) accepting the wastewaters.

In addition, in accordance with *40 CFR 403.12(p)(1)*, the permittee must notify the POTW, the EPA Regional Waste Management Director, and the State hazardous waste authorities, in writing, if they discharge any substance into a POTW which if otherwise disposed of would be considered a hazardous waste under *40 CFR 261*. This notification must include the name of the hazardous waste, the EPA hazardous waste number, and the type of discharge (continuous or batch).

IV. GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Executive Secretary as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when the alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are not subject to effluent limitations in the permit. In addition, if there are any planned substantial changes to the permittee's existing sludge facilities or their manner of operation or to current sludge management practices of storage and disposal, the permittee shall give notice to the Executive Secretary of any planned changes at least 30 days prior to their implementation.

B. Anticipated Noncompliance. The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall apply for and obtain a new permit. The application shall be submitted at least 60 days before the expiration date of this permit. The application shall be submitted at least 180 days before the expiration date if an individual permit is necessary.

E. Duty to Provide Information. The permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by this permit.

F. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Executive Secretary, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Executive Secretary shall be signed and certified.

1. All permit applications shall be signed by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Executive Secretary, and,

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager,

superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph *IV.G.2* is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph *IV.G.2* must be submitted to the Executive Secretary prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports. The *Act* provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000.00 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential under *UAC R317-8-3.2*, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of Executive Secretary. As required by the *Act*, permit applications, permits and effluent data shall not be considered confidential.

J. Oil and Hazardous Substance Liability. Nothing in this permit shall be construed to preclude the permittee of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under the *Act*.

K. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability. The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers. This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Executive Secretary at least 20 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Executive Secretary does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

N. State Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by *UCA 19-5-117.*

O. Water Quality-Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. Water Quality Standards for the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. A final wasteload allocation is developed and approved by the State and/or EPA for incorporation in this permit.

3. A revision to the current Water Quality Management Plan is approved and adopted which calls for different effluent limitations than contained in this permit.

P. Toxicity Limitation-Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include whole effluent toxicity (WET) testing, a WET limitation, a compliance schedule, a compliance date, additional or modified numerical limitations, or any other conditions related to the control of toxicants if toxicity is detected during the life of this permit.

Q. Storm Water-Reopener Provision. At any time during the duration (life) of this permit, this permit may be reopened and modified (following proper administrative procedures) as per *UAC R317.8*, to include, any applicable storm water provisions and requirements, a storm water pollution prevention plan, a compliance schedule, a compliance date, monitoring and/or reporting requirements, or any other conditions related to the control of storm water discharges to "waters-of-State".

P:CYPRUS.PER

APPENDIX 12-7-4

TERRAMATRIX HYDROLOGY CALCULATIONS

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT _____ PAGE _____ OF _____
COMPUTED _____ DATE _____
CHECKED _____ DATE _____

TERRA MATRIX

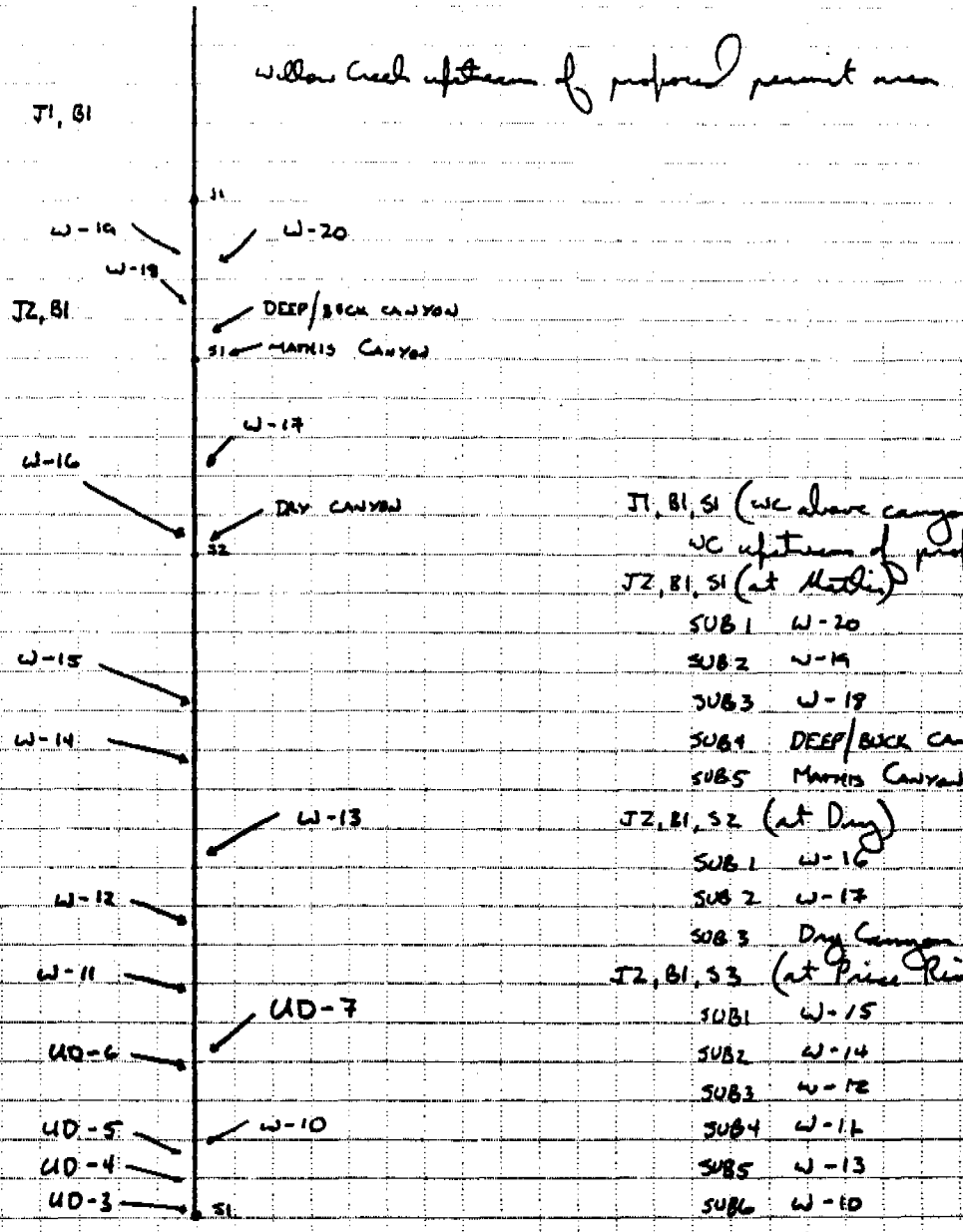
CULVERT SIZING
CALCULATIONS

TerraMatrix
Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774018
Steamboat Springs, Colorado 80477

Project Name: Willow Creek - Channel Relocation
Project Number: 866 Sheet ___ Of ___
Prepared By: JCW Date: 4/28/95
Checked By: ___ Date: ___

STORM MODELING (flow chart)

WILLOW CREEK CULVERT DESIGN CALCULATIONS



J1, B1, S1 (WC above canyon)
WC upstream of proposed permit
J2, B1, S1 (at Mathis)
SUB1 W-20
SUB2 W-19
SUB3 W-18
SUB4 DEEP/BUCK CANYON
SUB5 MATHIS CANYON
J2, B1, S2 (at Dry)
SUB1 W-16
SUB2 W-17
SUB3 Dry Canyon
J2, B1, S3 (at Prince Rim)
SUB1 W-15
SUB2 W-14
SUB3 W-12
SUB4 W-11
SUB5 W-13
SUB6 W-10
SUB7 UD7
SUB8 UD6
SUB9 UD5
SUB10 UD4
SUB11 UD3

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

WILLOW CREEK PEAK FLOW MODELING

by

Name: jcw

Company Name: ACZ, INC.
File Name: C:\SEDCAD3\NEW\WILLOWCR

Date: 04-27-1995

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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\NEW\WILLOWCR User: jcw
Date: 04-27-1995 Time: 23:20:53
Willow Creek Peak Flow Modeling
Storm: 2.08 inches, 100 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
2	1	1	1	8	10400.69	1.15	3.22	0.90	0.896	0.327
2	1	2	1	8	10606.81	3.58	5.68	0.52	0.518	0.384
2	1	3	1	8	14807.15	3.11	5.29	0.78	0.777	0.378

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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\NEW\WILLOWCR User: jcw
Date: 04-27-1995 Time: 23:20:53
Willow Creek Peak Flow Modeling
Storm: 2.08 inches, 100 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	35611.00	63	M	4.570	0.000	0.000	7.0	358.88	679.92
		Type: Null			Label: WC above canyon					
111	Structure	35611.00							358.88	
111	Total IN/OUT	35611.00							358.88	686.92
211	1	180.00	71	M	0.183	0.670	0.311	0.0	4.48	24.27
211	2	180.00	73	M	0.116	0.608	0.308	0.0	5.35	55.35
211	3	230.00	72	M	0.104	0.270	0.320	0.0	6.26	62.60
211	4	1840.00	69	M	2.675	0.441	0.312	0.1	37.72	88.00
211	5	2340.00	68	M	2.369	0.000	0.000	0.0	43.27	104.52
		Type: Null			Label: WC at Mathis					
	Structure	4770.00							455.96	
211	Total IN/OUT	40381.00							455.96	786.79
111 to 211 Routing						0.896	0.327			
212	1	680.00	71	M	0.225	0.367	0.375	0.0	16.91	83.74
212	2	880.00	72	M	0.347	0.153	0.374	0.0	23.96	104.05
212	3	2440.00	69	M	1.383	0.000	0.000	0.0	50.02	135.52
		Type: Null			Label: WC at Dry					
212	Structure	4000.00							546.84	
212	Total IN/OUT	44381.00							546.84	815.47
211 to 212 Routing						0.518	0.384			
213	1	77.00	74	M	0.096	0.770	0.377	0.0	2.49	26.49
213	2	780.00	74	M	0.659	0.662	0.378	0.0	25.21	90.03
213	3	245.00	76	M	0.290	0.563	0.378	0.0	9.30	54.04
213	4	75.00	74	M	0.086	0.434	0.384	0.0	2.42	25.80
213	5	290.00	72	M	0.201	0.706	0.370	0.0	7.89	43.82
213	6	630.00	71	M	0.356	0.332	0.375	0.0	15.66	62.02
213	7	425.00	70	M	0.529	0.388	0.379	0.0	9.61	34.09
213	8	149.00	76	M	0.222	0.380	0.380	0.0	5.66	36.92
	9	48.00	77	M	0.103	0.342	0.372	0.0	1.97	22.10
	10	81.00	75	M	0.245	0.261	0.356	0.0	2.84	17.03
	11	20.00	74	M	0.081	0.258	0.347	0.0	0.65	6.88
		Type: Null			Label: WC at Price River					
213	Structure	2820.00							630.54	
213	Total IN/OUT	47201.00							630.54	814.73

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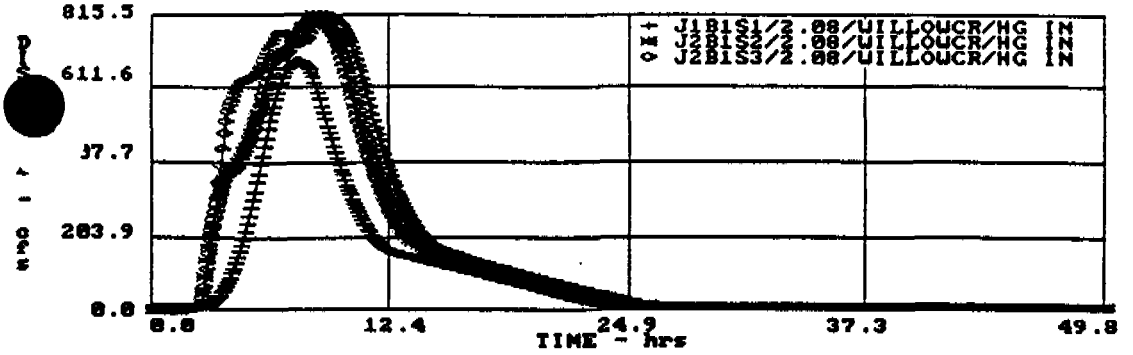
Company Name: ACZ, INC.
Filename: C:\SEDCAD3\NEW\WILLOWCR User: jcw
Date: 04-27-1995 Time: 23:20:53
Willow Creek Peak Flow Modeling
Storm: 2.08 inches, 100 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
2	1	1	1	-a	5	3100.00	21.94	4.68	0.18	0.183		
2	1	1	1	-1	8	6800.26	0.88	2.82	0.67		0.670	0.311
2	1	1	2	-a	5	2400.00	32.50	5.70	0.12	0.116		
2	1	1	2	-1	8	6000.21	0.83	2.74	0.61		0.608	0.308
2	1	1	3	-a	5	2500.00	44.40	6.66	0.10	0.104		
2	1	1	3	-1	8	2950.15	1.02	3.03	0.27		0.270	0.320
2	1	1	4	-a	5	25608.00	7.07	2.66	2.68	2.675		
		1	4	-1	8	4500.18	0.89	2.83	0.44		0.441	0.312
2	1	1	5	-a	5	23126.00	7.35	2.71	2.37	2.369		
2	1	2	1	-a	5	4700.00	33.62	5.80	0.23	0.225		
2	1	2	1	-1	8	6802.94	2.94	5.14	0.37		0.367	0.375
2	1	2	2	-a	5	6300.00	25.40	5.04	0.35	0.347		
2	1	2	2	-1	8	2801.14	2.86	5.07	0.15		0.153	0.374
2	1	2	3	-a	5	17794.00	12.76	3.57	1.38	1.383		
2	1	3	1	-a	5	2500.00	51.60	7.18	0.10	0.096		
2	1	3	1	-1	8	14506.67	3.03	5.23	0.77		0.770	0.377
2	1	3	2	-a	5	10200.00	18.43	4.29	0.66	0.659		
2	1	3	2	-1	8	12706.30	3.15	5.32	0.66		0.662	0.378
2	1	3	3	-1	8	10805.35	3.15	5.32	0.56		0.563	0.378
2	1	3	4	-1	8	8905.75	3.60	5.69	0.43		0.434	0.384
		3	5	-a	5	4350.00	35.86	5.99	0.20	0.201		
2	1	3	5	-1	8	12304.16	2.60	4.84	0.71		0.706	0.370
2	1	3	6	-a	5	6900.00	28.99	5.38	0.36	0.356		

2	1	3	6	-1	8	6152.63	2.93	5.13	0.33	0.332	0.375
2	1	3	7	-1	8	7503.84	3.20	5.37	0.39	0.388	0.379
		3	8	-1	8	7403.89	3.24	5.40	0.38	0.380	0.380
		3	9	-1	8	6152.35	2.76	4.99	0.34	0.342	0.372
2	1	3	10	-1	8	4000.80	2.00	4.24	0.26	0.261	0.356
2	1	3	11	-1	8	3600.50	1.67	3.87	0.26	0.258	0.347

SEDCAD+ Hydrograph/Sedimentgraph Plot Program



Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:

Comment: Willow Creek Culvert at Mine Access Road

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0280 ft/ft
Manning's n.....	0.015
Discharge.....	815.00 cfs

Computed Results:

Full Flow Diameter.....	6.67 ft
Full Flow Depth.....	6.67 ft
Velocity.....	23.31 fps
Flow Area.....	34.96 sf
Critical Depth....	6.51 ft
Percent Full.....	100.00 %
Full Capacity.....	815.00 cfs
QMAX @.94D.....	876.70 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:

Comment: Willow Creek Culvert at Mine Access Road

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	8.00 ft
Slope.....	0.0280 ft/ft
Manning's n.....	0.015
Discharge.....	1322.71 cfs

Computed Results:

Full Flow Capacity.....	1322.71 cfs
Full Flow Depth.....	8.00 ft
Velocity.....	26.31 fps
Flow Area.....	50.27 sf
Critical Depth....	7.83 ft
Percent Full.....	100.00 %
Full Capacity.....	1322.71 cfs
QMAX @.94D.....	1422.84 cfs
Froude Number.....	FULL

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT _____ PAGE _____ OF _____
COMPUTED _____ DATE _____
CHECKED _____ DATE _____

TERRA MATRIX

SEDIMENT POND
NC-002
CALCULATIONS

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

WILLOW CREEK MINE: SEDIMENT POND 002

by

Name: jcw

Company Name: ACZ, INC.
File Name: C:\SEDCAD3\WC\POND2V1

Date: 09-18-1995

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V1 User: jcw
Date: 09-18-1995 Time: 09:10:23
Willow Creek Mine: Sediment Pond 002
Storm: 2.06 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr .

GENERAL INPUT TABLE

Specific Gravity: 2.50
Submerged Bulk Specific Gravity: 1.25

Particle Size Distribution(s):

Size (mm)	psd-1 % Finer
0.2500	100.00
0.1000	50.00
0.0500	35.00
0.0100	19.00
0.0050	15.00
0.0010	6.00
0.0001	0.00

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	8	121.00	0.41	1.92	0.02		
			2	8	45.00	0.56	2.24	0.01	0.023	0.270
2	1	1	1	8	31.03	47.80	20.74	0.00	0.000	0.462

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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V1 User: jcw
Date: 09-18-1995 Time: 09:10:23
Willow Creek Mine: Sediment Pond 002
Storm: 2.06 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	0.50	90	M	0.068	0.000	0.000	0.0	0.05	0.58
		Type: Null			Label: at DD-26_c2 outflow					
111	Structure	0.50							0.05	
111	Total IN/OUT	0.50							0.05	0.58
112	1	0.44	90	M	0.035	0.000	0.000	0.0	0.04	0.51
		Type: Null			Label: at DC-12 inflow					
112	Structure	0.44							0.09	
112	Total IN/OUT	0.94							0.09	1.10
111 to 112 Routing						0.023	0.270			
121	1	0.54	90	M	0.061	0.000	0.000	0.0	0.05	0.63
121	2	0.20	90	M	0.014	0.000	0.000	0.0	0.02	0.23
		Type: Null			Label: at DD-27 inflow					
121	Structure	0.74							0.07	
121	Total IN/OUT	0.74							0.07	0.86
211	1	0.08	99	M	0.000	0.000	0.000	0.0	0.01	0.13
		Type: Pond			Label: Sediment Pond 002					
211	Structure	0.08							0.17	
211	Total IN	1.76							0.17	2.09
211	Total OUT								0.17	0.09
112 to 211 Routing						0.000	0.462			

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Sedimentology-

SED: Sediment
SCp: Peak Sediment Concentration
SSp: Peak Settleable Concentration
24VW: Volume Weighted Average Settleable Concentration - Peak 24 hours

24AA: Arithmetic Average Settleable Concentration - Peak 24 hours

	TBS	SWS	K	L (ft)	S (%)	CP	Tt (hrs)	PS #	SED (tons)	SCp (mg/l)	SSp (ml/l)	24VW (ml/l)	24AA (ml/l)
R	111	1	0.22	25.0	4.0	1.050	0.000	1	0.8				
				Type: Null		Label: at DD-26_c2 outflow							
	111 Structure								0.8				
	111 Total IN/OUT								0.8	23317	14.80	8.15	1.85
R	112	1	0.22	51.0	1.3	1.050	0.000	1	0.4				
				Type: Null		Label: at DC-12 inflow							
	112 Structure								1.2				
	112 Total IN/OUT								1.2	17990	11.42	6.47	1.50
	111 to 112 Routing						0.023						
R	121	1	0.22	25.0	4.0	1.050	0.000	1	0.9				
R	121	2	0.22	28.0	0.5	1.050	0.000	1	0.1				
				Type: Null		Label: at DD-27 inflow							
	121 Structure								1.0				
	121 Total IN/OUT								1.0	18476	11.73	6.88	1.67
R	211	1	0.31	10.0	33.0	0.890	0.000	1	1.1				
				Type: Pond		Label: Sediment Pond 002							
	211 Structure								3.2				
	211 Total IN								3.2	24852	15.78	9.45	1.79
	211 Total OUT								0.3	1440	0.00	0.00	0.00
	112 to 211 Routing						0.000						

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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V1 User: jcw
Date: 09-18-1995 Time: 09:10:23
Willow Creek Mine: Sediment Pond 002
Storm: 2.06 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

==========
DETAILED SUBWATERSHED INPUT/OUTPUT TABLE
==========

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V1 User: jcw
Date: 09-18-1995 Time: 09:10:23
Willow Creek Mine: Sediment Pond 002
Storm: 2.06 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J2, B1, S1
Sediment Pond 002

Drainage Area from J2, B1, S1, SWS(s)1: 0.1 acres
Total Contributing Drainage Area: 1.8 acres

DISCHARGE OPTIONS:

	Perf. Riser	Emergency Spillway
Riser Diameter (in)	12.0	----
Riser Height (ft)	8.50	----
Barrel Diameter (in)	10.0	----
Barrel Length (ft)	50.00	----
Barrel Slope (%)	1.00	----
Manning's n of Pipe	0.015	----
Spillway Elevation	6156.5	----
Lowest Elevation of Holes	6153.0	----
# of Holes/Elevation	1	----
Entrance Loss Coefficient	----	----
Tailwater Depth (ft)	----	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	6156.5
Crest Length (ft)	----	10.0
Z:1 (Left and Right)	-- --	3 3
Bottom Width (ft)	----	4.0

POND RESULTS:

Sediment Storage* (ac-ft)	Permanent Pool (ac-ft)	Dead Space (%)	Sediment Algorithm
0.00	0.11	20.00	CSTRS

*Sediment Capacity based on Average Annual R of 11.0 for 3.0 year(s)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)	Sediment (tons)	Peak Sediment Concentration (mg/l)	Peak Settleable Concentration (ml/l)	24VW (ml/l)	24AA (ml/l)
IN	0.17	2.09	3.2	24852	15.78	9.45	1.79
OUT	0.17	0.09	0.3	1440	0.00	0.00	0.00

Peak Elevation	Trap Efficiency (%)	Hydrograph Detention Time (hrs)
6155.4	91.65	10.11

Dewatering Time (Max. Perf. Riser Elev to Lowest Orifice): 1.0 days

****

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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V1 User: jcw
Date: 09-18-1995 Time: 09:10:23
Willow Creek Mine: Sediment Pond 002
Storm: 2.06 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J2, B1, S1
Sediment Pond 002

Drainage Area from J2, B1, S1, SWS(s)1: 0.1 acres
Total Contributing Drainage Area: 1.8 acres

SW#1: Perforated Riser
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6148.00	0.00	0.01	0.00		
6148.00	0.00	0.01	0.00		
6148.25	0.00	0.01	0.00	0.00	Top of Sediment Storage (0 Stage)
6148.50	0.25	0.01	0.00	0.00	
6149.00	0.75	0.01	0.01	0.00	
6149.50	1.25	0.02	0.02	0.00	
6150.00	1.75	0.02	0.03	0.00	
6150.50	2.25	0.02	0.04	0.00	
6151.00	2.75	0.02	0.05	0.00	
6151.50	3.25	0.03	0.06	0.00	
6152.00	3.75	0.03	0.08	0.00	
6152.50	4.25	0.03	0.09	0.00	
6153.00	4.75	0.03	0.11	0.00	Low Orifice of SW#1
6153.50	5.25	0.04	0.13	0.04	
6154.00	5.75	0.04	0.15	0.06	
6154.50	6.25	0.04	0.17	0.07	
6155.00	6.75	0.05	0.19	0.08	
6155.41	7.16	0.05	0.21	0.09	Peak Stage
6155.50	7.25	0.05	0.22	0.09	
6156.00	7.75	0.06	0.25	0.10	
6156.50	8.25	0.06	0.28	0.11	Stage of SW#1, SW#2
6157.00	8.75	0.07	0.31	6.78	
6157.05	8.80	0.07	0.31	7.26	
6157.15	8.90	0.07	0.32	8.31	
6157.25	9.00	0.07	0.33	10.53	
6157.35	9.10	0.07	0.34	13.06	
6157.45	9.20	0.07	0.34	15.91	
6157.50	9.25	0.07	0.35	18.67	
6157.95	9.70	0.08	0.38	35.26	
6158.00	9.75	0.08	0.39	40.28	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

WILLOW CREEK MINE: SEDIMENT POND 002 (EMERGENCY SPILLWAY ONLY)

by

Name: jcw

Company Name: ACZ, INC.
File Name: C:\SEDCAD3\WC\POND2V2A

Date: 09-18-1995

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2A User: jcw
Date: 09-18-1995 Time: 09:46:47
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Specific Gravity: 2.50
Submerged Bulk Specific Gravity: 1.25

Particle Size Distribution(s):

Size (mm)	psd-1 % Finer
0.2500	100.00
0.1000	50.00
0.0500	35.00
0.0100	19.00
0.0050	15.00
0.0010	6.00
0.0001	0.00

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	8	121.00	0.41	1.92	0.02		
			2	8	45.00	0.56	2.24	0.01	0.023	0.270
2	1	1	1	8	31.03	47.80	20.74	0.00	0.000	0.462

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2A User: jcw
Date: 09-18-1995 Time: 09:46:47
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	0.50	90	M	0.068	0.000	0.000	0.0	0.06	0.74
		Type: Null			Label: at DD-26_c2 outflow					
111	Structure	0.50							0.06	
111	Total IN/OUT	0.50							0.06	0.74
112	1	0.44	90	M	0.035	0.000	0.000	0.0	0.05	0.65
		Type: Null			Label: at DC-12 inflow					
112	Structure	0.44							0.12	
112	Total IN/OUT	0.94							0.12	1.38
111 to 112 Routing						0.023	0.270			
121	1	0.54	90	M	0.061	0.000	0.000	0.0	0.07	0.80
121	2	0.20	90	M	0.014	0.000	0.000	0.0	0.02	0.29
		Type: Null			Label: at DD-27 inflow					
121	Structure	0.74							0.09	
121	Total IN/OUT	0.74							0.09	1.09
211	1	0.08	99	M	0.000	0.000	0.000	0.0	0.02	0.15
		Type: Pond			Label: Sediment Pond 002					
211	Structure	0.08							0.22	
211	Total IN	1.76							0.22	2.62
211	Total OUT								0.22	2.55
112 to 211 Routing						0.000	0.462			

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Sedimentology-

SED: Sediment
SCp: Peak Sediment Concentration
SSp: Peak Settleable Concentration
24VW: Volume Weighted Average Settleable Concentration - Peak 24 hours

24AA: Arithmetic Average Settleable Concentration - Peak 24 hours

	JBS	SWS	K	L (ft)	S (%)	CP	Tt (hrs)	PS #	SED (tons)	SCp (mg/l)	SSp (ml/l)	24VW (ml/l)	24AA (ml/l)
R	111	1	0.22	25.0	4.0	1.050	0.000	1	1.1				
				Type: Null		Label: at DD-26_c2 outflow							
	111 Structure								1.1				
	111 Total IN/OUT								1.1	23523	14.93	8.30	1.91
R	112	1	0.22	51.0	1.3	1.050	0.000	1	0.5				
				Type: Null		Label: at DC-12 inflow							
	112 Structure								1.6				
	112 Total IN/OUT								1.6	18049	11.46	6.37	1.47
	111 to 112 Routing						0.023						
R	121	1	0.22	25.0	4.0	1.050	0.000	1	1.2				
R	121	2	0.22	28.0	0.5	1.050	0.000	1	0.1				
				Type: Null		Label: at DD-27 inflow							
	121 Structure								1.3				
	121 Total IN/OUT								1.3	18594	11.80	6.86	1.69
R	211	1	0.31	10.0	33.0	0.890	0.000	1	1.3				
				Type: Pond		Label: Sediment Pond 002							
	211 Structure								4.1				
	211 Total IN								4.1	24461	15.53	9.12	1.83
	211 Total OUT								0.3	1604	0.00	0.00	0.00
	112 to 211 Routing						0.000						

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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2A User: jcw
Date: 09-18-1995 Time: 09:46:47
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

==========
DETAILED SUBWATERSHED INPUT/OUTPUT TABLE
==========

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2A User: jcw
Date: 09-18-1995 Time: 09:46:47
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J2, B1, S1
Sediment Pond 002

Drainage Area from J2, B1, S1, SWS(s)1: 0.1 acres
Total Contributing Drainage Area: 1.8 acres

DISCHARGE OPTIONS:

	Drop Inlet	Emergency Spillway
Riser Diameter (in)	12.0	----
Riser Height (ft)	8.50	----
Barrel Diameter (in)	10.0	----
Barrel Length (ft)	50.00	----
Barrel Slope (%)	1.00	----
Manning's n of Pipe	0.015	----
Spillway Elevation	6156.5	----
Lowest Elevation of Holes	----	----
# of Holes/Elevation	----	----
Entrance Loss Coefficient	----	----
Tailwater Depth (ft)	----	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	6156.5
Crest Length (ft)	----	10.0
Z:1 (Left and Right)	-- --	3 3
Bottom Width (ft)	----	4.0

POND RESULTS:

Sediment Storage* (ac-ft)	Permanent Pool (ac-ft)	Dead Space (%)	Sediment Algorithm
0.00	0.28	20.00	CSTRS

*Sediment Capacity based on Average Annual R of 11.0 for 3.0 year(s)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)	Sediment (tons)	Peak Sediment Concentration (mg/l)	Peak Settleable Concentration (ml/l)	24VW (ml/l)	24AA (ml/l)
IN	0.22	2.62	4.1	24461	15.53	9.12	1.83
OUT	0.22	2.55	0.3	1604	0.00	0.00	0.00

Peak Elevation	Trap Efficiency (%)	Hydrograph Detention Time (hrs)
6156.7	92.83	0.06

****

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2A User: jcw
Date: 09-18-1995 Time: 09:46:47
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J2, B1, S1
Sediment Pond 002

Drainage Area from J2, B1, S1, SWS(s)1: 0.1 acres
Total Contributing Drainage Area: 1.8 acres

Elevation	Drop Inlet (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
6148.22	0.0	0.0	0.0
6148.50	0.0	0.0	0.0
6149.00	0.0	0.0	0.0
6149.50	0.0	0.0	0.0
6150.00	0.0	0.0	0.0
6150.50	0.0	0.0	0.0
6151.00	0.0	0.0	0.0
6151.50	0.0	0.0	0.0
6152.00	0.0	0.0	0.0
6152.50	0.0	0.0	0.0
6153.00	0.0	0.0	0.0
6153.50	0.0	0.0	0.0
6154.00	0.0	0.0	0.0
6154.50	0.0	0.0	0.0
6155.00	0.0	0.0	0.0
6155.50	0.0	0.0	0.0
6156.00	0.0	0.0	0.0
6156.50	0.0	0.0	0.0
6157.00	2.7	4.3	7.0
6157.02	2.7	4.4	7.2
6157.12	2.9	5.3	8.2
6157.22	3.2	7.3	10.5
6157.32	3.4	9.6	13.0
6157.42	3.6	12.2	15.8
6157.50	3.8	14.9	18.7
6157.92	4.5	30.7	35.2
6158.00	4.6	35.6	40.3

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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2A User: jcw
Date: 09-18-1995 Time: 09:46:47
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J2, B1, S1
Sediment Pond 002

Drainage Area from J2, B1, S1, SWS(s)1: 0.1 acres
Total Contributing Drainage Area: 1.8 acres

SW#1: Drop Inlet
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6148.00	0.00	0.01	0.00		
6148.00	0.00	0.01	0.00		
6148.22	0.00	0.01	0.00	0.00	Top of Sediment Storage (0 Stage)
6148.50	0.28	0.01	0.00	0.00	
6149.00	0.78	0.01	0.01	0.00	
6149.50	1.28	0.02	0.02	0.00	
6150.00	1.78	0.02	0.03	0.00	
6150.50	2.28	0.02	0.04	0.00	
6151.00	2.78	0.02	0.05	0.00	
6151.50	3.28	0.03	0.06	0.00	
6152.00	3.78	0.03	0.08	0.00	
6152.50	4.28	0.03	0.09	0.00	
6153.00	4.78	0.03	0.11	0.00	
6153.50	5.28	0.04	0.13	0.00	
6154.00	5.78	0.04	0.15	0.00	
6154.50	6.28	0.04	0.17	0.00	
6155.00	6.78	0.05	0.19	0.00	
6155.50	7.28	0.05	0.22	0.00	
6156.00	7.78	0.06	0.25	0.00	
6156.50	8.28	0.06	0.28	0.00	Stage of SW#1, SW#2
6156.68	8.47	0.07	0.29	2.55	Peak Stage
6157.00	8.78	0.07	0.31	6.97	
6157.02	8.80	0.07	0.31	7.16	
6157.12	8.90	0.07	0.32	8.24	
6157.22	9.00	0.07	0.33	10.46	
6157.32	9.10	0.07	0.33	13.00	
6157.42	9.20	0.07	0.34	15.85	
6157.50	9.28	0.07	0.35	18.67	
6157.92	9.70	0.08	0.38	35.21	
6158.00	9.78	0.08	0.39	40.28	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

WILLOW CREEK MINE: SEDIMENT POND 002 (EMERGENCY SPILLWAY ONLY)

by

Name: jcw

Company Name: ACZ, INC.
File Name: C:\SEDCAD3\WC\POND2V2

Date: 09-18-1995

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2 User: jcw
Date: 09-18-1995 Time: 09:42:59
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 1.66 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Specific Gravity: 2.50
Submerged Bulk Specific Gravity: 1.25

Particle Size Distribution(s):

Size (mm)	psd-1 % Finer
0.2500	100.00
0.1000	50.00
0.0500	35.00
0.0100	19.00
0.0050	15.00
0.0010	6.00
0.0001	0.00

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	8	121.00	0.41	1.92	0.02		
			2	8	45.00	0.56	2.24	0.01	0.023	0.270
2	1	1	1	8	31.03	47.80	20.74	0.00	0.000	0.462

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2 User: jcw
Date: 09-18-1995 Time: 09:42:59
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 1.66 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	0.50	90	M	0.068	0.000	0.000	0.0	0.03	0.39
		Type: Null			Label: at DD-26_c2 outflow					
111	Structure	0.50							0.03	
111	Total IN/OUT	0.50							0.03	0.39
112	1	0.44	90	M	0.035	0.000	0.000	0.0	0.03	0.34
		Type: Null			Label: at DC-12 inflow					
112	Structure	0.44							0.06	
112	Total IN/OUT	0.94							0.06	0.73
111 to 112 Routing						0.023	0.270			
121	1	0.54	90	M	0.061	0.000	0.000	0.0	0.04	0.42
121	2	0.20	90	M	0.014	0.000	0.000	0.0	0.01	0.16
		Type: Null			Label: at DD-27 inflow					
121	Structure	0.74							0.05	
121	Total IN/OUT	0.74							0.05	0.58
211	1	0.08	99	M	0.000	0.000	0.000	0.0	0.01	0.10
		Type: Pond			Label: Sediment Pond 002					
211	Structure	0.08							0.12	
211	Total IN	1.76							0.12	1.41
211	Total OUT								0.12	1.34
112 to 211 Routing						0.000	0.462			

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Sedimentology-

SED: Sediment
SCp: Peak Sediment Concentration
SSp: Peak Settleable Concentration
24VW: Volume Weighted Average Settleable Concentration - Peak 24 hours

24AA: Arithmetic Average Settleable Concentration - Peak 24 hours

	JBS	SWS	K	L (ft)	S (%)	CP	Tt (hrs)	PS #	SED (tons)	SCp (mg/l)	SSp (ml/l)	24VW (ml/l)	24AA (ml/l)
R	111	1	0.22	25.0	4.0	1.050	0.000	1	0.5				
				Type: Null		Label: at DD-26_c2 outflow							
	111 Structure								0.5				
	111 Total IN/OUT								0.5	19592	12.44	7.64	1.01
R	112	1	0.22	51.0	1.3	1.050	0.000	1	0.2				
				Type: Null		Label: at DC-12 inflow							
	112 Structure								0.8				
	112 Total IN/OUT								0.8	15027	9.54	5.85	0.77
	111 to 112 Routing						0.023						
R	121	1	0.22	25.0	4.0	1.050	0.000	1	0.6				
R	121	2	0.22	28.0	0.5	1.050	0.000	1	0.0				
				Type: Null		Label: at DD-27 inflow							
	121 Structure								0.6				
	121 Total IN/OUT								0.6	15444	9.80	6.03	0.80
R	211	1	0.31	10.0	33.0	0.890	0.000	1	0.8				
				Type: Pond		Label: Sediment Pond 002							
	211 Structure								2.2				
	211 Total IN								2.2	44230	28.08	8.57	1.69
	211 Total OUT								0.1	729	0.00	0.00	0.00
	112 to 211 Routing						0.000						

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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2 User: jcw
Date: 09-18-1995 Time: 09:42:59
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 1.66 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr .

==========
DETAILED SUBWATERSHED INPUT/OUTPUT TABLE
==========

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2 User: jcw
Date: 09-18-1995 Time: 09:42:59
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 1.66 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J2, B1, S1
Sediment Pond 002

Drainage Area from J2, B1, S1, SWS(s)1: 0.1 acres
Total Contributing Drainage Area: 1.8 acres

DISCHARGE OPTIONS:

	Drop Inlet	Emergency Spillway
Riser Diameter (in)	12.0	----
Riser Height (ft)	8.50	----
Barrel Diameter (in)	10.0	----
Barrel Length (ft)	50.00	----
Barrel Slope (%)	1.00	----
Manning's n of Pipe	0.015	----
Spillway Elevation	6156.5	----
Lowest Elevation of Holes	----	----
# of Holes/Elevation	----	----
Entrance Loss Coefficient	----	----
Tailwater Depth (ft)	----	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	6156.5
Crest Length (ft)	----	10.0
Z:1 (Left and Right)	-- --	3 3
Bottom Width (ft)	----	4.0

POND RESULTS:

Sediment Storage* (ac-ft)	Permanent Pool (ac-ft)	Dead Space (%)	Sediment Algorithm
0.00	0.28	20.00	CSTRS

*Sediment Capacity based on Average Annual R of 11.0 for 3.0 year(s)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)	Sediment (tons)	Peak Sediment Concentration (mg/l)	Peak Settleable Concentration (ml/l)	24VW (ml/l)	24AA (ml/l)
IN	0.12	1.41	2.2	44230	28.08	8.57	1.69
OUT	0.12	1.34	0.1	729	0.00	0.00	0.00

Peak Elevation	Trap Efficiency (%)	Hydrograph Detention Time (hrs)
6156.6	96.67	0.06

****

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2 User: jcw
Date: 09-18-1995 Time: 09:42:59
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 1.66 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J2, B1, S1
Sediment Pond 002

Drainage Area from J2, B1, S1, SWS(s)1: 0.1 acres
Total Contributing Drainage Area: 1.8 acres

Elevation	Drop Inlet (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
6148.24	0.0	0.0	0.0
6148.50	0.0	0.0	0.0
6149.00	0.0	0.0	0.0
6149.50	0.0	0.0	0.0
6150.00	0.0	0.0	0.0
6150.50	0.0	0.0	0.0
6151.00	0.0	0.0	0.0
6151.50	0.0	0.0	0.0
6152.00	0.0	0.0	0.0
6152.50	0.0	0.0	0.0
6153.00	0.0	0.0	0.0
6153.50	0.0	0.0	0.0
6154.00	0.0	0.0	0.0
6154.50	0.0	0.0	0.0
6155.00	0.0	0.0	0.0
6155.50	0.0	0.0	0.0
6156.00	0.0	0.0	0.0
6156.50	0.0	0.0	0.0
6157.00	2.7	4.1	6.8
6157.04	2.8	4.5	7.3
6157.14	3.0	5.3	8.3
6157.24	3.2	7.3	10.5
6157.34	3.4	9.6	13.1
6157.44	3.7	12.2	15.9
6157.50	3.8	14.9	18.7
6157.94	4.5	30.7	35.3
6158.00	4.6	35.6	40.3

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND2V2 User: jcw
Date: 09-18-1995 Time: 09:42:59
Willow Creek Mine: Sediment Pond 002 (Emergency Spillway Only)
Storm: 1.66 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

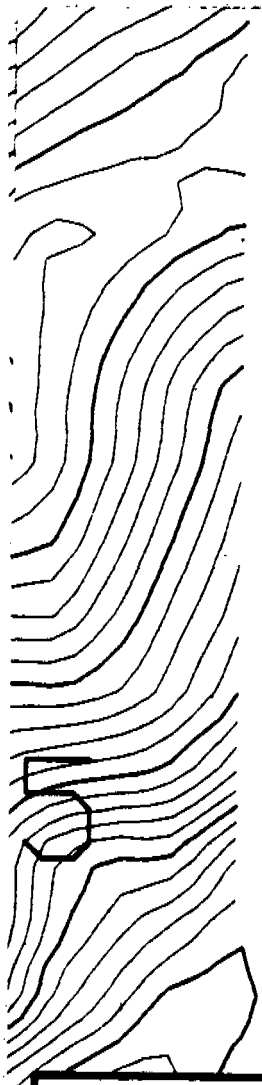
J2, B1, S1
Sediment Pond 002

Drainage Area from J2, B1, S1, SWS(s)1: 0.1 acres
Total Contributing Drainage Area: 1.8 acres

SW#1: Drop Inlet
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6148.00	0.00	0.01	0.00		
6148.00	0.00	0.01	0.00		
6148.24	0.00	0.01	0.00	0.00	Top of Sediment Storage (0 Stage)
6148.50	0.26	0.01	0.00	0.00	
6149.00	0.76	0.01	0.01	0.00	
6149.50	1.26	0.02	0.02	0.00	
6150.00	1.76	0.02	0.03	0.00	
6150.50	2.26	0.02	0.04	0.00	
6151.00	2.76	0.02	0.05	0.00	
6151.50	3.26	0.03	0.06	0.00	
6152.00	3.76	0.03	0.08	0.00	
6152.50	4.26	0.03	0.09	0.00	
6153.00	4.76	0.03	0.11	0.00	
6153.50	5.26	0.04	0.13	0.00	
6154.00	5.76	0.04	0.15	0.00	
6154.50	6.26	0.04	0.17	0.00	
6155.00	6.76	0.05	0.19	0.00	
6155.50	7.26	0.05	0.22	0.00	
6156.00	7.76	0.06	0.25	0.00	
6156.50	8.26	0.06	0.28	0.00	Stage of SW#1, SW#2
6156.60	8.35	0.07	0.28	1.34	Peak Stage
6157.00	8.76	0.07	0.31	6.80	
6157.04	8.80	0.07	0.31	7.25	
6157.14	8.90	0.07	0.32	8.30	
6157.24	9.00	0.07	0.33	10.52	
6157.34	9.10	0.07	0.33	13.05	
6157.44	9.20	0.07	0.34	15.90	
6157.50	9.26	0.07	0.35	18.67	
6157.94	9.70	0.08	0.38	35.25	
6158.00	9.76	0.08	0.39	40.28	

APPENDIX 12-7-5
STATE ENGINEER'S APPROVAL
OF WILLOW CREEK CULVERT



REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
3/13/95
STATE OF UTAH

0' 500'

REVISION	
DATE	BY

Castle Gate Mine

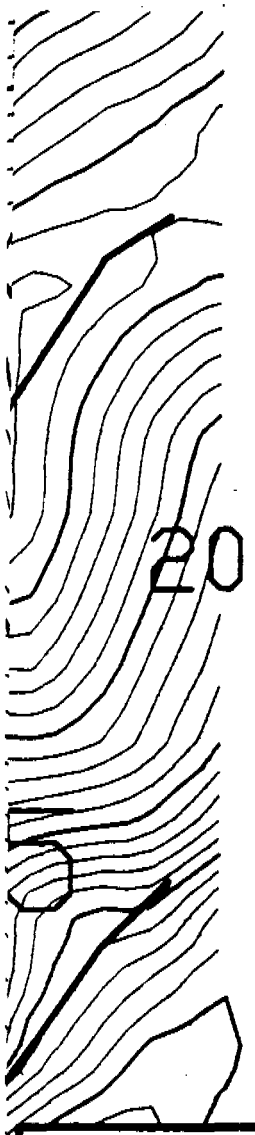
Carbon County, Utah

CASTLE GATE PERMIT BOUNDARY

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: KHB	PROJECT NUMBER: UC-446	SCALE: 1" = 500'
APPROVED BY: TJS	FILE NAME: PERMIT.DWG	EXHIBIT 12-1-1
DATE: MARCH 1995	EarthFax Engineering, Inc.	



72 PATHEAD–CURECANTI FAMILY ASSOCIATION
95 ROCK OUTCROP
107 SHURPERT–WINNETTI COMPLEX
121 TRAVESSILLA–ROCK OUTCROP–GERST COMPLEX
124 UINTA FAMILY–PODO ASSOCIATION

72 SOIL TYPE AND BOUNDARY

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
3/13/95
STATE OF UTAH

0' 500'

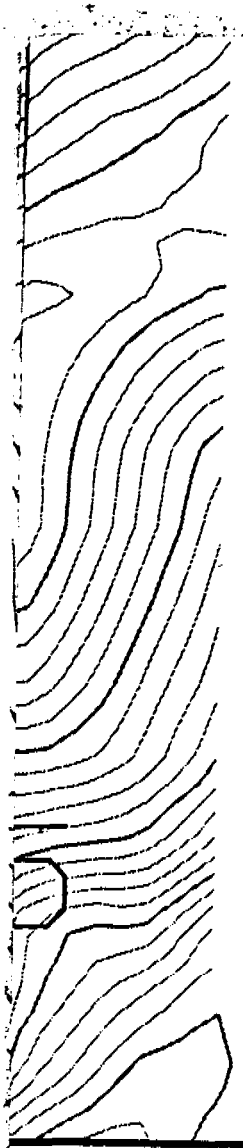
REVISION	
DATE	BY

Castle Gate Mine
Carbon County, Utah

SOILS MAP

Amax Coal Company
Subsidiary of Cyprus Amax Coal Company

DRAWN BY: KHB	PROJECT NUMBER: UC-446	SCALE: 1" = 500'
APPROVED BY: TJS	FILE NAME: SOILS.DWG	EXHIBIT 12-2-1
DATE: MARCH 1995	EarthFax Engineering, Inc.	



REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
3/13/95
STATE OF UTAH

0' 500'

REVISION	
DATE	BY

Castle Gate Mine

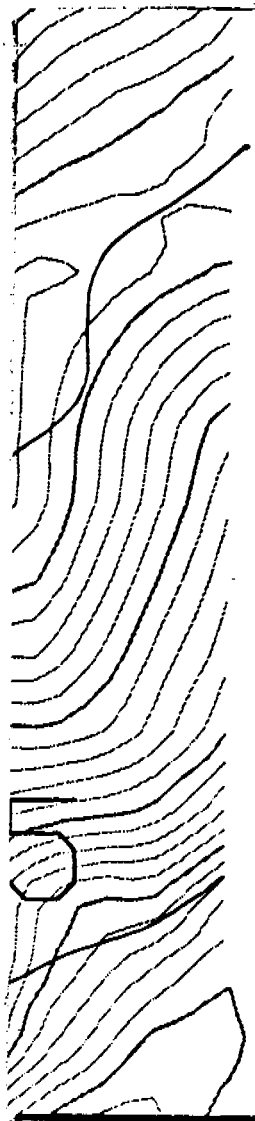
Carbon County, Utah

ELK AND DEER RANGE AND FISH LADDER

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: VSB	PROJECT NUMBER: UC-446	SCALE: 1" = 500'
APPROVED BY: TJS	FILE NAME: WILDLIFE.DWG	EXHIBIT 12-3-1
DATE: MARCH 1995	EarthFax Engineering, Inc.	



D2	DISTURBED BY MINING (POST-1977)
GS	GRASSLAND-SAGEBRUSH
MB	MIXED BRUSH
PJ	PINYON-JUNIPER
RB	RIPARIAN BOTTOM

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
3/13/95
STATE OF UTAH

0' 500'

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DATE	BY

Castle Gate Mine

Carbon County, Utah

PLANT COMMUNITIES AND REFERENCE AREA

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: VSB	PROJECT NUMBER: UC-446	SCALE: 1" = 500'
APPROVED BY: TJS	FILE NAME: VEGETATE.DWG	EXHIBIT 12-3-2
DATE: MARCH 1995	**EarthFax Engineering, Inc.**	

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No. 7102
RICHARD B. WHITE
3/13/95
STATE OF UTAH

0' 1000'

REVISION	
DATE	BY

Castle Gate Mine

Carbon County, Utah

SURFACE OWNERSHIP

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: VSB	PROJECT NUMBER: UC-446	SCALE: 1" = 1000'
APPROVED BY: TJS	FILE NAME: SURFOWN.DWG	EXHIBIT 12-4-1
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No. 7102
RICHARD B. WHITE
3/13/95
STATE OF UTAH

0' 1000'

REVISION	
DATE	BY

Castle Gate Mine

Carbon County, Utah

COAL OWNERSHIP

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: VSB	PROJECT NUMBER: UC-446	SCALE: 1" = 1000'
APPROVED BY: TJS	FILE NAME: COALOWN.DWG	EXHIBIT 12-4-2
DATE: MARCH 1995	EarthFax Engineering, Inc.	

LEGEND

PERMIT BOUNDARY

TRANSMISSION LINES

POWER POLES

STREAM BUFFER ZONE BOUNDARY

DIVERSION CHANNEL LOCATIONS (ARROW SHOWS FLOW DIRECTION)

GRAVEL ROAD

0' 100'

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
10/31/95
STATE OF UTAH

REVISION	
DATE	BY
CT 95	KHB

Castle Gate Mine

Carbon County, Utah

FACILITIES AREA MAP

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

RAWN BY: TJS	PROJECT NUMBER: UC-442-31	SCALE: 1" = 100'
PPROVED BY: TJS	FILE NAME: FACAREA.DWG	EXHIBIT: 12-5-1
ATE: MARCH 1995	EarthFax Engineering, Inc.	

LEGEND

— — — PERMIT BOUNDARY

——— CEMETERY BOUNDARY

- - - - - STREAM BUFFER ZONE BOUNDARY

0' 100'

REVISION	
DATE	BY

Castle Gate Mine

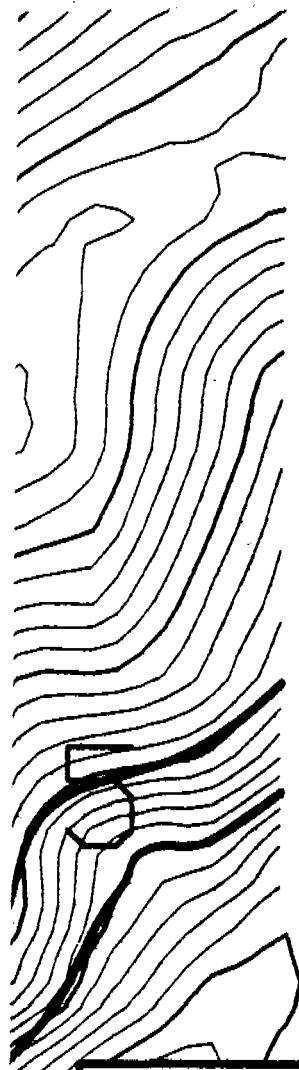
Carbon County, Utah

RECLAMATION TOPOGRAPHY

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY:	PROJECT NUMBER: UC-446-01	SCALE: 1" = 100'
APPROVED BY:	FILE NAME: RECAREA.DWG	EXHIBIT: 12-5-2
DATE: MARCH 1995	EarthFax Engineering, Inc.	



TEST HOLE
FORMATION CONTACT
PERMIT AREA BOUNDARY
CONTOUR INTERVAL = 40 FEET

REGISTERED PROFESSIONAL ENGINEER
Richard B White
No. 7102
RICHARD B. WHITE
7/20/95
STATE OF UTAH

0' 500'

REVISION	
DATE	BY
June 1995	KHB

Castle Gate Mine

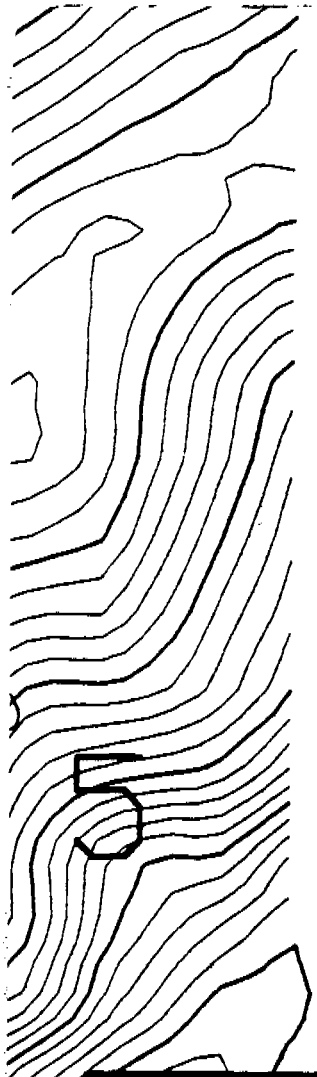
Carbon County, Utah

GEOLOGIC MAP

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: KHB	PROJECT NUMBER: UC-446	SCALE: 1" = 500'
APPROVED BY: TJS	FILE NAME: GEOMAP.DWG	EXHIBIT 12-6-1
DATE: MARCH 1995	EarthFax Engineering, Inc.	



▲ SUBSURFACE MONITORING LOCATION

■ UPDES DISCHARGE POINTS

○ MONITORING WELL LOCATION

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
7/20/95
STATE OF UTAH

0' 500'

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DATE	BY
June 1995	KHB
July 1995	KHB

Castle Gate Mine

Carbon County, Utah

WATER MONITORING STATIONS

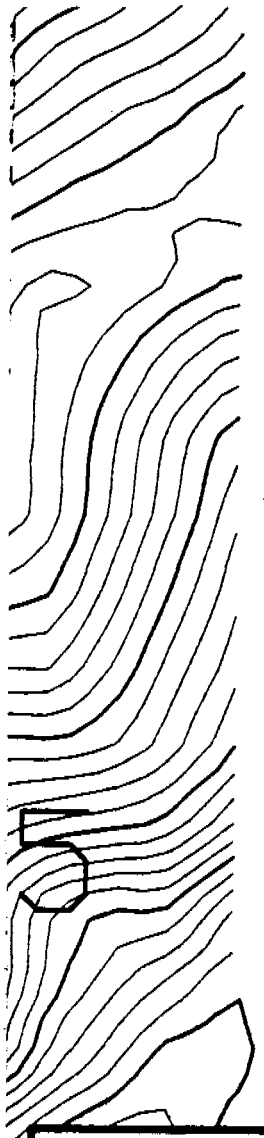
Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: KHB	PROJECT NUMBER: UC-446	SCALE: 1" = 500'
APPROVED BY: RBW	MONITOR.DWG	EXHIBIT: 12-7-1
DATE: MARCH 1995	EarthFax Engineering, Inc.	

GROUNDWATER RIGHT

or SURFACE WATER RIGHT



REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
3/13/95
STATE OF UTAH

0' 500'

REVISION	
DATE	BY

Castle Gate Mine

Carbon County, Utah

WATER RIGHTS MAP

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: KHB	PROJECT NUMBER: UC-446	SCALE: 1" = 500'
APPROVED BY: RBW	FILE NAME: WATRIGHT.DWG	EXHIBIT: 12-7-2
DATE: MARCH 1995	EarthFax Engineering, Inc.	

LEGEND

PERMIT BOUNDARY

WATERSHED BOUNDARY

STREAM BUFFER ZONE BOUNDARY

DIVERSION CHANNEL LOCATIONS

0' 100'

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
10/31/95
STATE OF UTAH

REVISION	
DATE	BY
OCT 95	KHB

Castle Gate Mine

Carbon County, Utah

OPERATIONAL HYDROLOGY PLAN

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: TJS	PROJECT NUMBER: UC-412-31	SCALE: 1" = 100'
APPROVED BY: RBW	FILE NAME: OPHYDRO.DWG	EXHIBIT: 12-7-3
DATE: MARCH 1995	EarthFax Engineering, Inc.	

LEGEND

- PERMIT BOUNDARY
- WATERSHED BOUNDARY
- CEMETERY BOUNDARY
- STREAM BUFFER ZONE BOUNDARY
- SILT FENCE LOCATIONS

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
3/13/95
STATE OF UTAH

0' 100'

REVISION	
DATE	BY

Castle Gate Mine

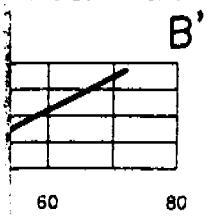
Carbon County, Utah

RECLAMATION HYDROLOGY

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: TJS	PROJECT NUMBER: UC-446-01	SCALE: 1" = 100'
APPROVED BY: TJS	FILE NAME: RECHYDRO.DWG	EXHIBIT: 12-7-4
DATE: MARCH 1995	EarthFax Engineering, Inc.	



B-B'

REGISTERED PROFESSIONAL ENGINEER
Richard B. White
No. 7102
RICHARD B. WHITE
10/4/95
STATE OF UTAH

REVISION	
DATE	BY
10/95	TJS

Castle Gate Mine

Carbon County, Utah

SEDIMENTATION STRUCTURE TOPOGRAPHY AND CROSS SECTIONS

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: KHB	PROJECT NUMBER: UC412-22	SCALE: HORZ: 1" = 30' VERT: 1" = 30'
APPROVED BY: RBW	FILE NAME: SHEET1.DWG	EXHIBIT: 12-7-5 1 OF 2
DATE: JULY 1995	EarthFax Engineering, Inc.	

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No. 7102
RICHARD B. WHITE
10/4/95
STATE OF UTAH

REVISION	
DATE	BY
9/95	TJS

Castle Gate Mine

Carbon County, Utah

SEDIMENTATION STRUCTURE TOPOGRAPHY AND CROSS SECTIONS

Amax Coal Company

Subsidiary of Cyprus Amax Coal Company

DRAWN BY: KHB	PROJECT NUMBER: UC412-22	SCALE: HORZ: 1" = 30' VERT: 1" = 30'
APPROVED BY: RBW	FILE NAME: SHEET2.DWG	EXHIBIT: 12-7-5 2 OF 2
DATE: JULY 1995	EarthFax Engineering, Inc.	