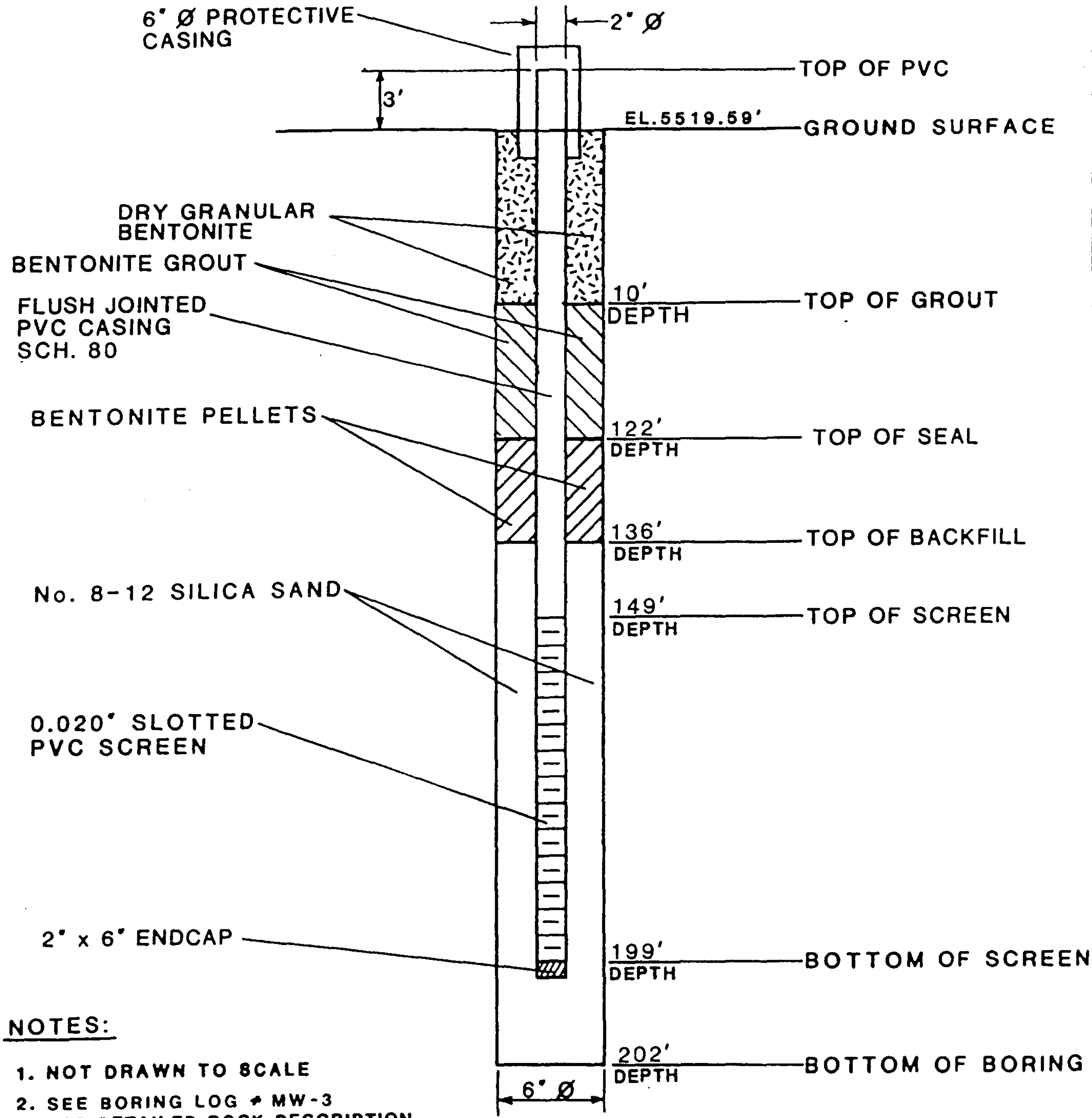
STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	CLIENT GALATIC SERVICES INC. PROJECT QUARTZ MOUNTAIN PROJECT No. 11806.07 DATE 11/2/87	WELL No. MW-3 BY D. GIBBS

WELL LOCATION N 242,069.200 E 1,928,119.720

MONITORING WELL DETAILS

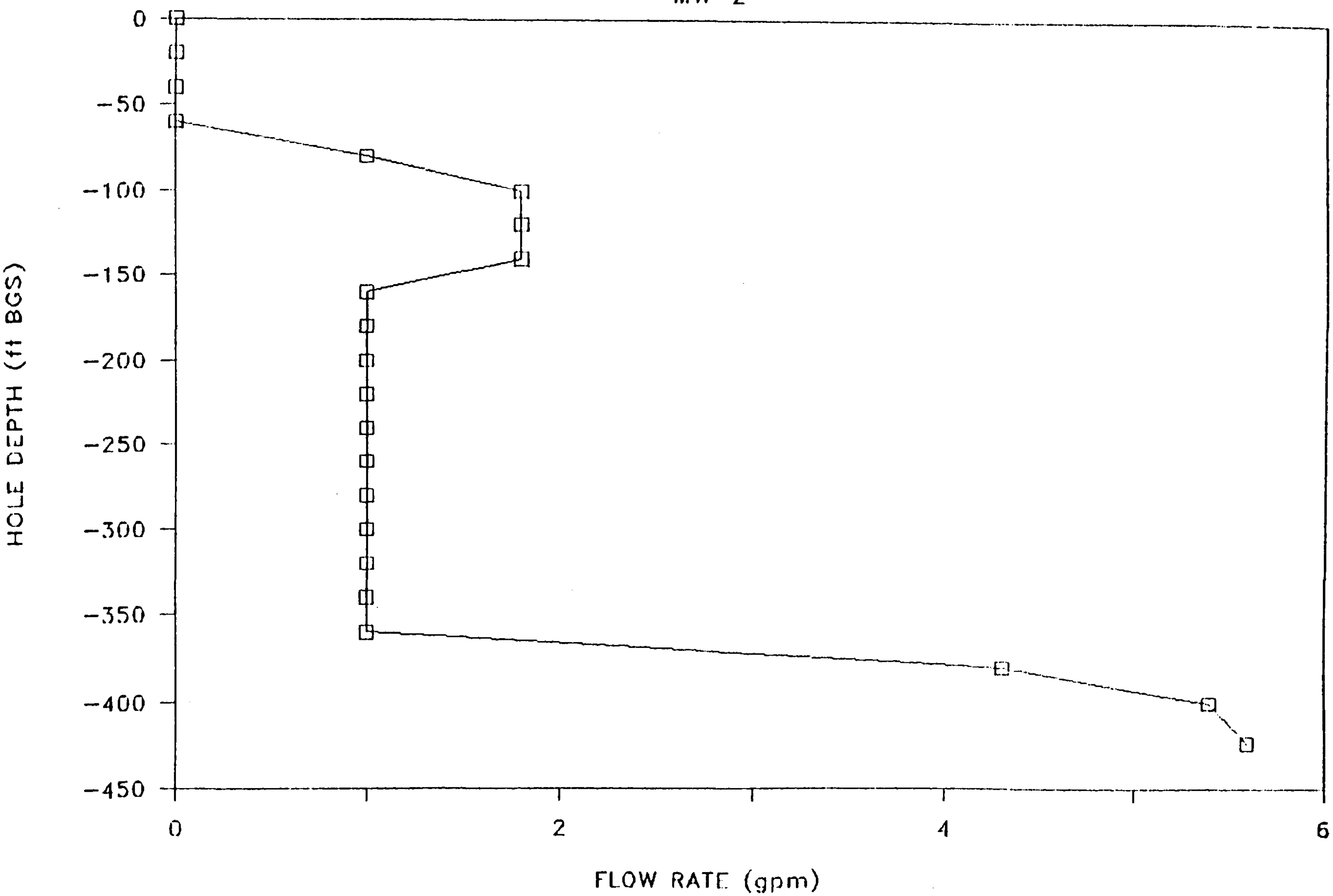


NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG # MW-3 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE

DISCHARGE DATA

MW-2



STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT	GALATIC RESOURCES INC.
PROJECT	QUARTZ MOUNTAIN
PROJECT No.	11806
DATE DRILLED	11/4/87
DRILLER	ROGER CHANCELLOR
BOREHOLE No.	MW-5
SHEET	1 OF 1
INSPECTOR	F.M.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES SURFACE ELEVATION

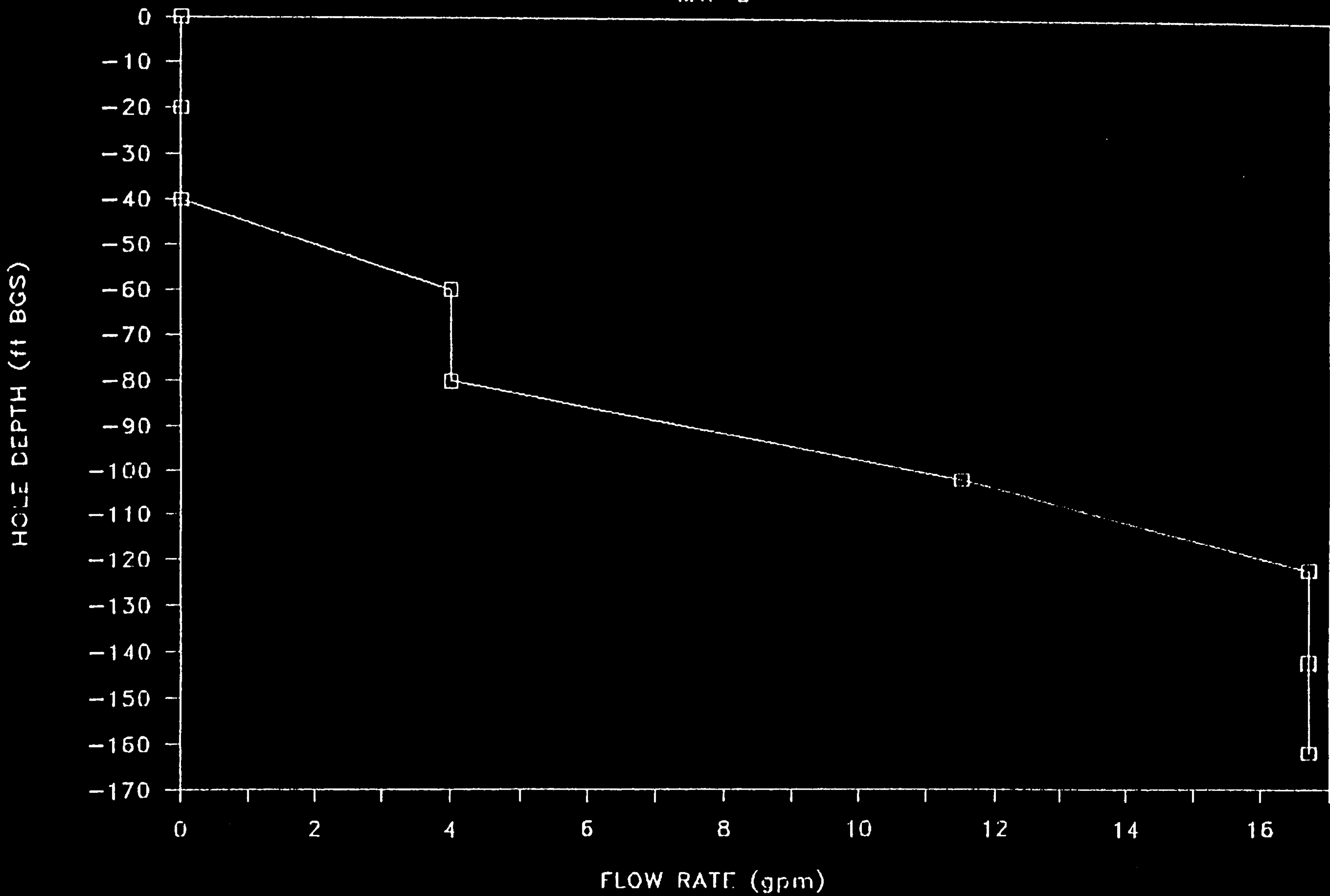
DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
(0–10)	TOPSOIL, DARK BROWN, SILTY, WEATHERED RHYOLITE	
25		
		(40) <1
50		
		(60) 4
75	ALTERED RHYOLITE WITH QUARTZITE	
100		(102) 11.5
		(122) 16.5
125		
150	(150)	
	ALTERED ROCK WITH HIGH CLAY CONTENT ? RHYOLITE ?	
	BOTTOM OF BORING AT 162'	
175		
200		

NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 10 FT. TO 162 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 40 FT.
4. SEE MW-5 FOR COMPLETION DETAILS.

DRILLING DISCHARGE DATA

MW-5



STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers

CLIENT	GALATIC RESOURCES INC.
PROJECT	QUARTZ MOUNTAIN
PROJECT No.	11606
DATE DRILLED	10/26/87
DRILLER	ROGER CHANCELLOR

BOREHOLE No.	MW-6
SHEET	2 OF 2
INSPECTOR	D.G.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES

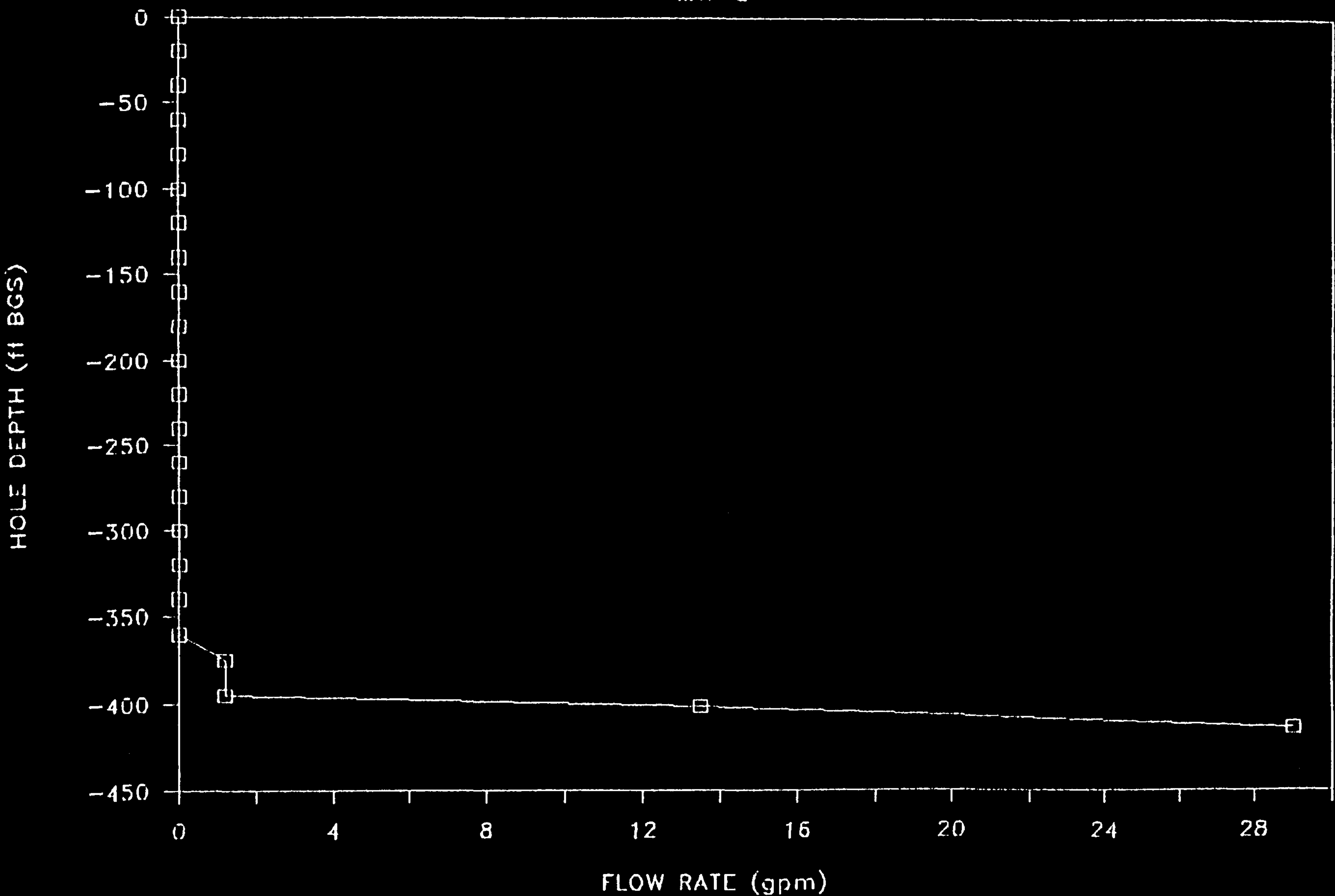
SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
225		
250		
275		
300		
325		
350		
375		(375) 1
	(385)	
400	RED/BROWN ALTERED BASALT WITH CLAY	(401) 13.5
	(405)	
	EXTENSIVE UNCONSOLIDATED, ROUNDED PARTICLES, GRAVEL SIZES	(413) 29
	BOTTOM OF BORING AT 413'	

(SEE NOTES ON SHEET 1)

DRILLING DISCHARGE DATA

MW-6



STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC RESOURCES INC.
PROJECT QUARTZ MOUNTAIN
PROJECT No. 11806
DATE DRILLED 12/1/87
DRILLER ROGER CHANCELLOR

BOREHOLE No. MW-7
SHEET 2 OF 2
INSPECTOR D.G.

LOCATION QUARTZ MOUNTAIN, OREGON
COORDINATES
SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
	(343)	
350	VERY HARD, DARK GREY, CRYSTALLINE, ANGULAR BASALT	
400	(410)	(400) *100 GALLONS
450	RED/BROWN ALTERED BASALT WITH CLAY MATRIX (460)	
	RED/BROWN VERY ALTERED BASALT AND HEAVY CLAY	
500	BOTTOM OF BORING AT 500'	

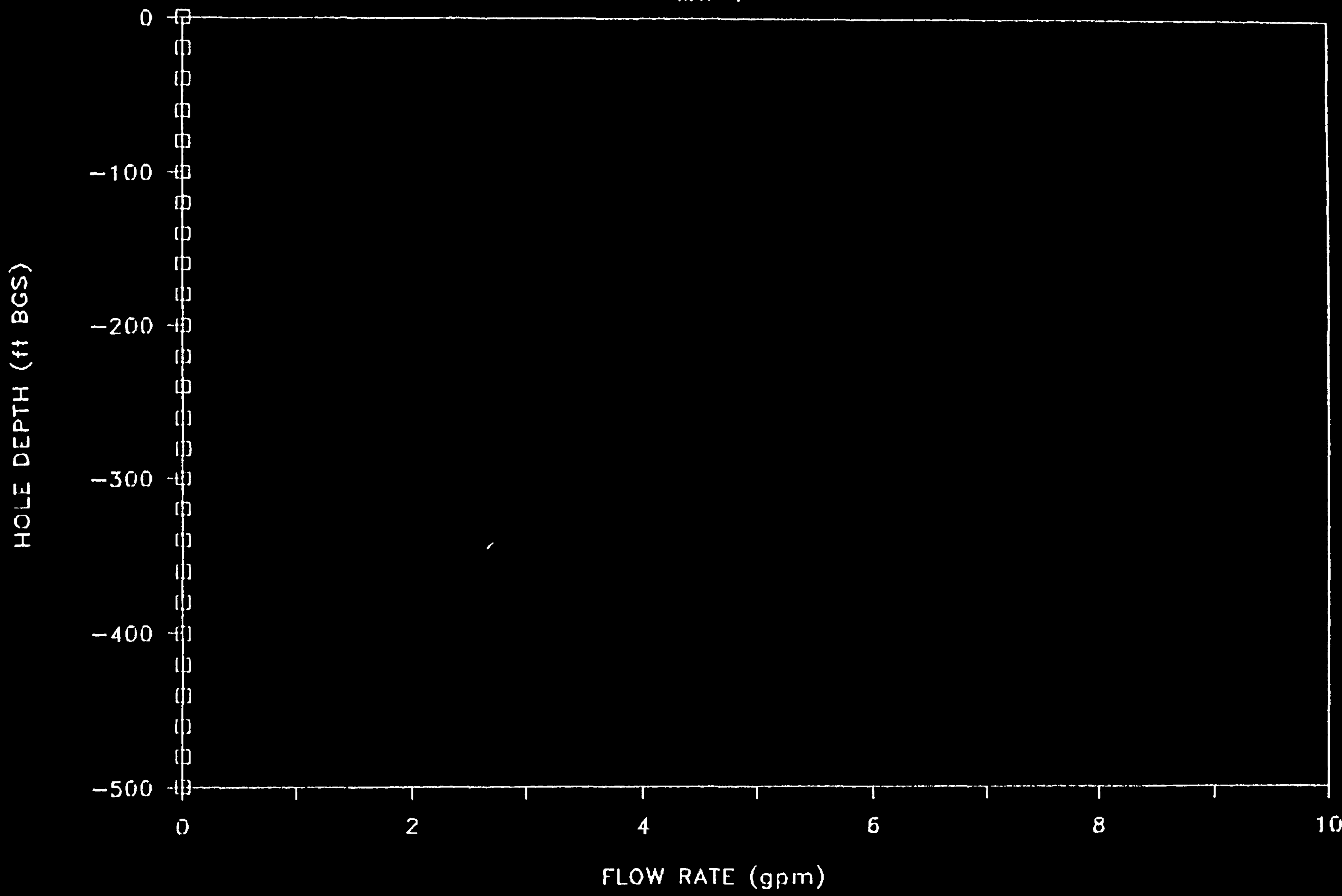
NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 5 FT. TO 500 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 100 FT.
4. SEE MW-7 FOR COMPLETION DETAILS

* WATER DISCHARGED AT BEGINNING OF DRILLING DAY

DRILLING DISCHARGE DATA

MW-7



STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers

CLIENT	GALATIC RESOURCES INC.
PROJECT	QUARTZ MOUNTAIN
PROJECT No.	11806
DATE DRILLED	11/30/87
DRILLER	ROGER CHANCELLOR
BOREHOLE No.	MW-9
SHEET	2 OF 2
INSPECTOR	D.G.

LOCATION QUARTZ MOUNTAIN, OREGON

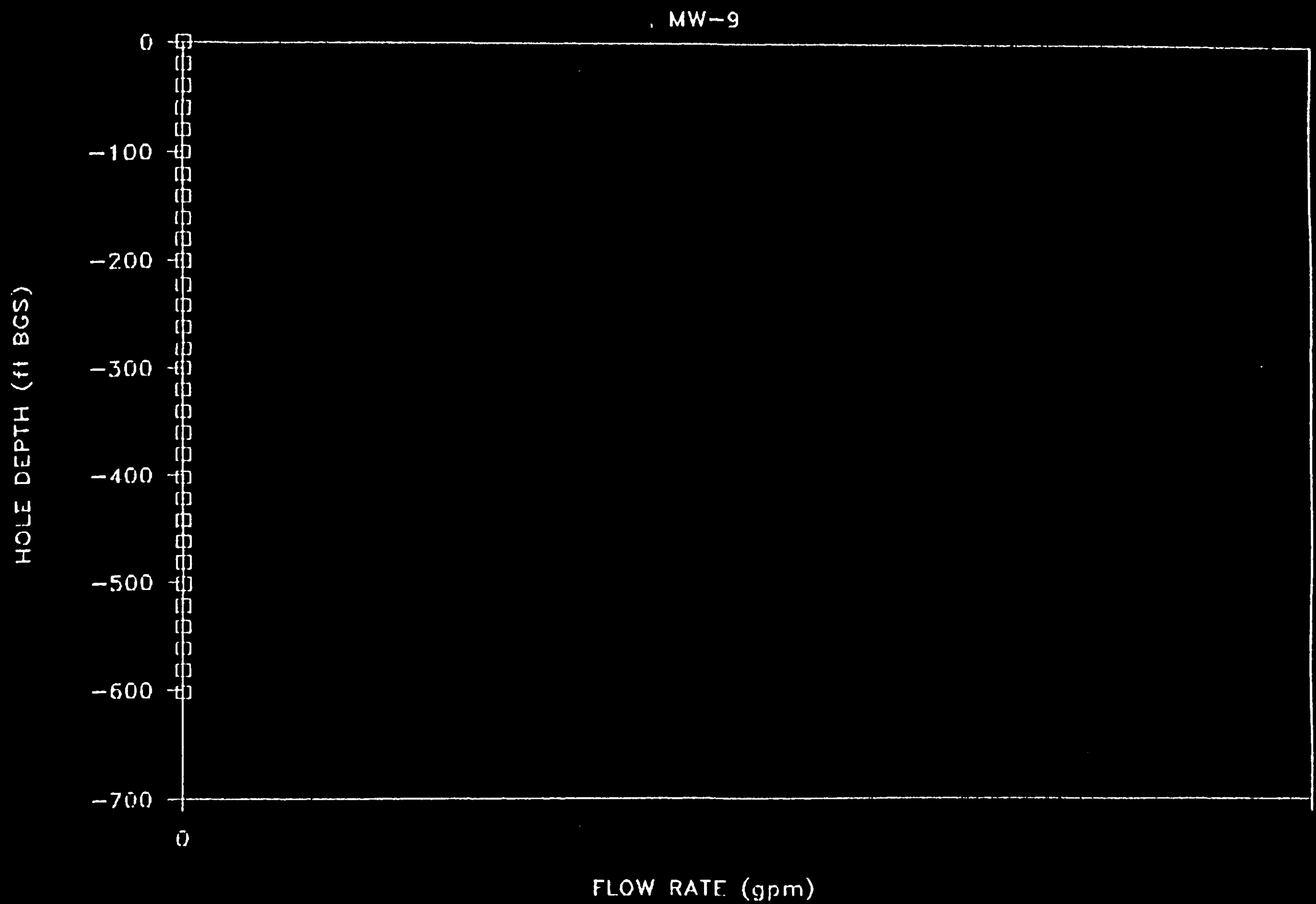
COORDINATES SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
	(385)	
400	SLIGHTLY ALTERED, PINK & BROWN, HARD, ANGULAR RHYOLITE (422)	
450		BORING PRODUCED NO WATER DURING DRILLING
500	UNIFORM GREY, HARD, ANGULAR RHYOLITE	
550		
600	BOTTOM OF BORING AT 602'	

NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 10 FT. TO 602 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT
4. SEE MW-9 FOR COMPLETION DETAILS.

DRILLING DISCHARGE DATA



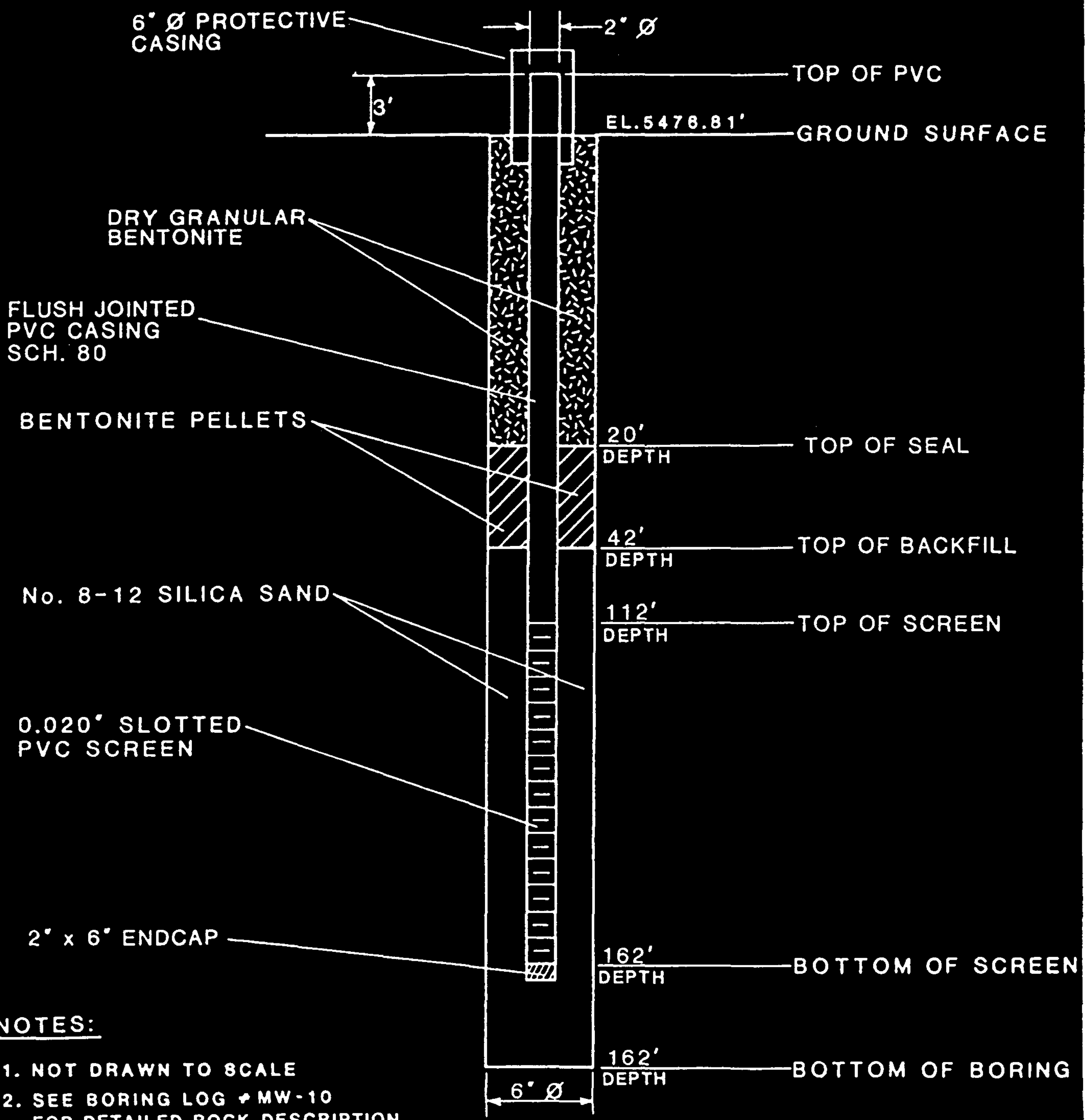
STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC SERVICES INC.
PROJECT QUARTZ MOUNTAIN
PROJECT No. 11806.07
DATE 12/21/87

WELL No. MW-10
BY D. GIBBS

WELL LOCATION N 240,739.829 E 1,919,889.523

MONITORING WELL DETAILS



NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG # MW-10 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC RESOURCES INC.
PROJECT QUARTZ MOUNTAIN
PROJECT No. 11806
DATE DRILLED 12/7/87
DRILLER ROGER CHANCELLOR

BOREHOLE No. MW-11
SHEET 1 OF 2
INSPECTOR D.G.

LOCATION QUARTZ MOUNTAIN, OREGON
COORDINATES
SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
(20)	GREY, ANGULAR, HARD RHYOLITE	
50	WHITE/PINK/GREY, MINERALIZED RHYOLITE	
(100)		
100 – (142)	HIGHLY ALTERED RHYOLITE, HIGH CLAY CONTENT	
150 – (175)	GREY ANGULAR, HARD RHYOLITE	
200 – 250 – (295)	DARK GREY TO ORANGE, VERY ALTERED ? RHYOLITE ? WITH HIGH CLAY CONTENT-THIN LAYERED CLAYS OF VARIOUS COLORS	(202) <1
300 (310)	ORANGE CLAY AND INTERFLOW MATERIAL	(302) <1
(324)	GREY/BROWN CLAYS	
	LAYERS OF RED/BROWN CLAYS, INTERFLOW MATERIALS	

NOTES:

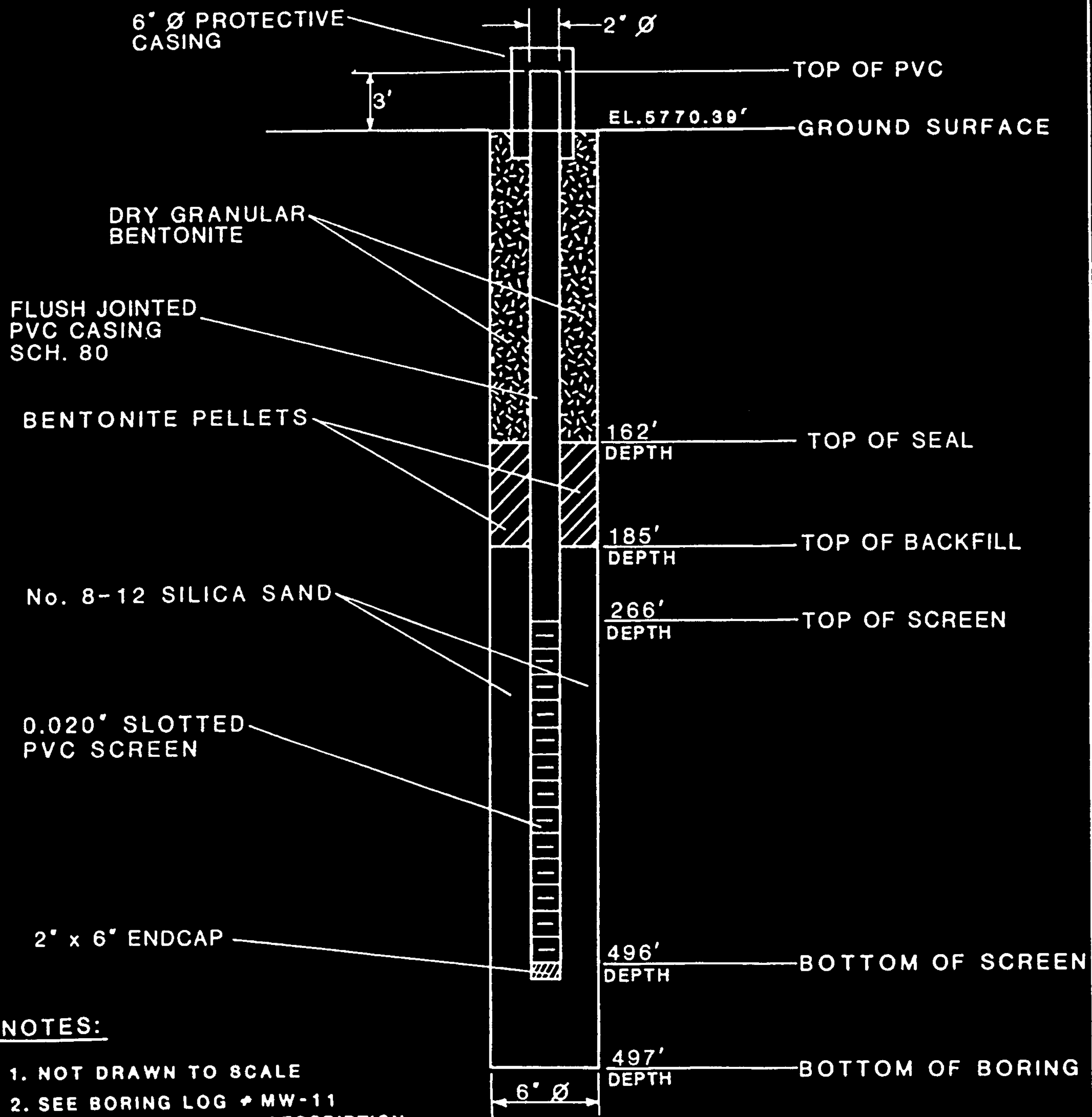
1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 5 FT. TO 497 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 202 FT.
4. SEE MW-11 FOR COMPLETION DETAILS

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC SERVICES INC.		WELL No. MW-11
PROJECT QUARTZ MOUNTAIN		
PROJECT No. 11806.07		BY D. GIBBS
DATE 11/20/87		

WELL LOCATION N 241,272.766 E 1,921,498.029

MONITORING WELL DETAILS



NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG # MW-11 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC RESOURCES INC.		BOREHOLE No. MW-12
PROJECT QUARTZ MOUNTAIN		SHEET 1 OF 2
PROJECT No. 11806		
DATE DRILLED 10/24/87		INSPECTOR D.G.
DRILLER ROGER CHANCELLOR		

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES — SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
(15)	TOPSOIL, RHYOLITE/BASALT MIX, VERY FRACTURED	
(70)	GREY, MEDIUM, ANGULAR RHYOLITE	
(105)	RED TO GREY ALTERED BASALT/RHYOLITE MIX, SOME CLAY	
(150)	HIGHLY ALTERED BASALTS & RHYOLITES ? INTERBEDDED WITH HIGH CLAY CONTENTS GRADES TO MAINLY ALTERED BASALT WITH DEPTH	
	BLACK, ANGULAR, VESICULAR, BASALT, NO CLAY, SOME QUARTZITE	

Depth scale: 25, 50, 75, 100, 125, 150, 175

NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 10 FT. TO 382 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 302 FT.
4. SEE MW-12 FOR COMPLETION DETAILS

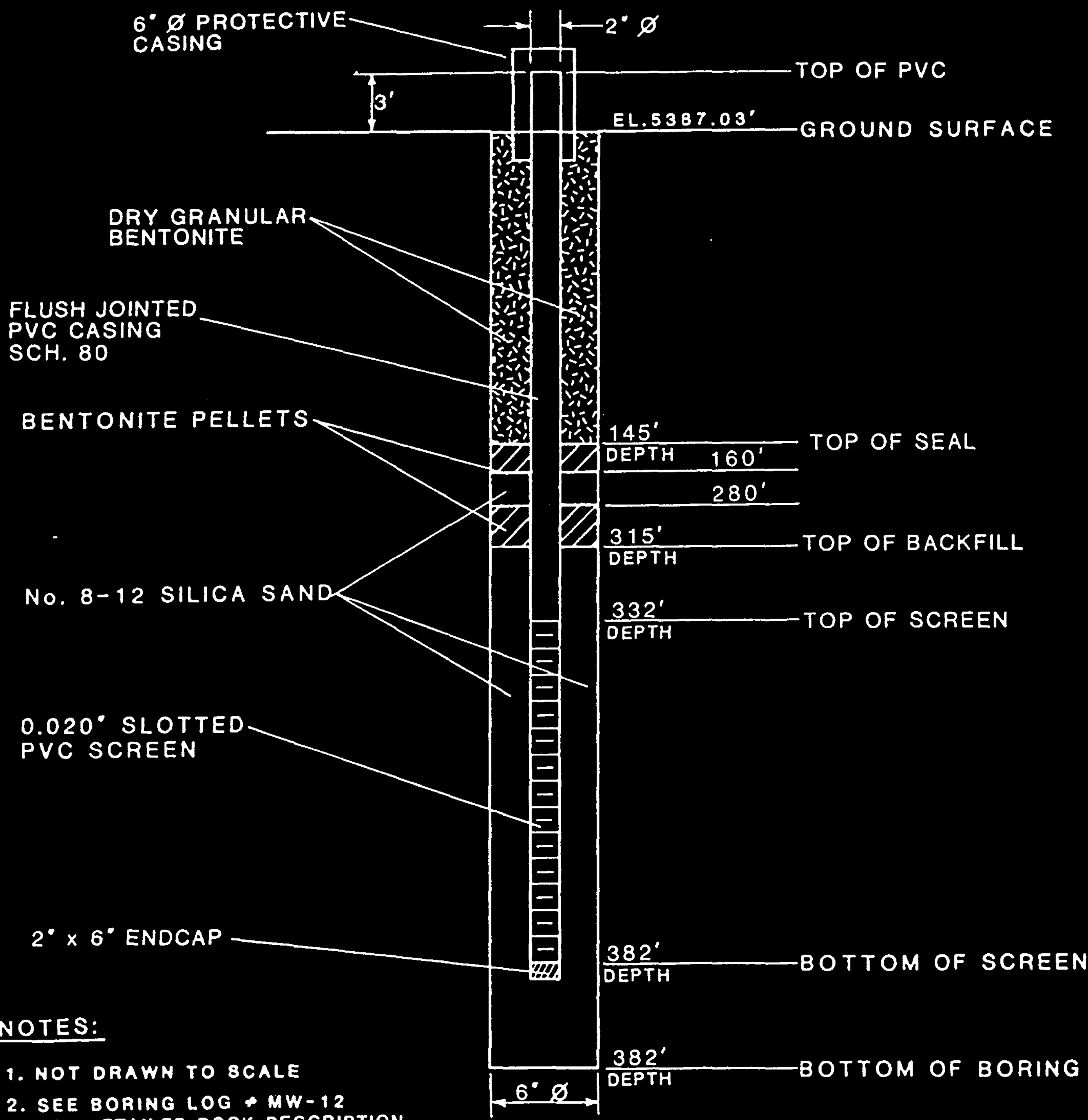
*WATER DISCHARGED AT BEGINNING OF DRILLING DAY.

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC SERVICES INC.		WELL No. MW-12
PROJECT QUARTZ MOUNTAIN		
PROJECT No. 11808.07		BY D. GIBBS
DATE 11/30/87		

WELL LOCATION N 245,653.489 E 1,919,307.369

MONITORING WELL DETAILS



NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG # MW-12 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE

STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers

CLIENT	GALATIC RESOURCES INC.
PROJECT	QUARTZ MOUNTAIN
PROJECT No.	11806
DATE DRILLED	10/25/87
DRILLER	ROGER CHANCELLOR
BOREHOLE No.	MW-13
SHEET	1 OF 2
INSPECTOR	D.G.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES

SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
50	LAYERED THICK GREY, ANGULAR, HARD, VESICULAR BASALT AND THIN RED/BROWN CLAYS (82)	
100	RED/BROWN ALTERED BASALTS IN CLAY MATRIX (102)	
	(111) RED/BROWN ALTERED BASALT WITH SOME CLAY	
	(124) BROWN CLAY LAYER	
150	LAYERED RED/BROWN, ANGULAR, ALTERED BASALTS AND THIN CLAYS (150)	
	(162) BROWN CLAY LAYER	
	LAYERED ALTERED ANGULAR BASALTS & CLAYS (190)	
200	RED/BROWN CLAY (220)	(220) 0.5
250	RED/BROWN ALTERED BASALT WITH CLAYS AND INTERFLOW MATERIALS (270)	
300	LAYERED ALTERED BASALT BECOMES MORE GREY AND HARDER WITH DEPTH AND THIN CLAY LAYERS	
350		

NOTES:

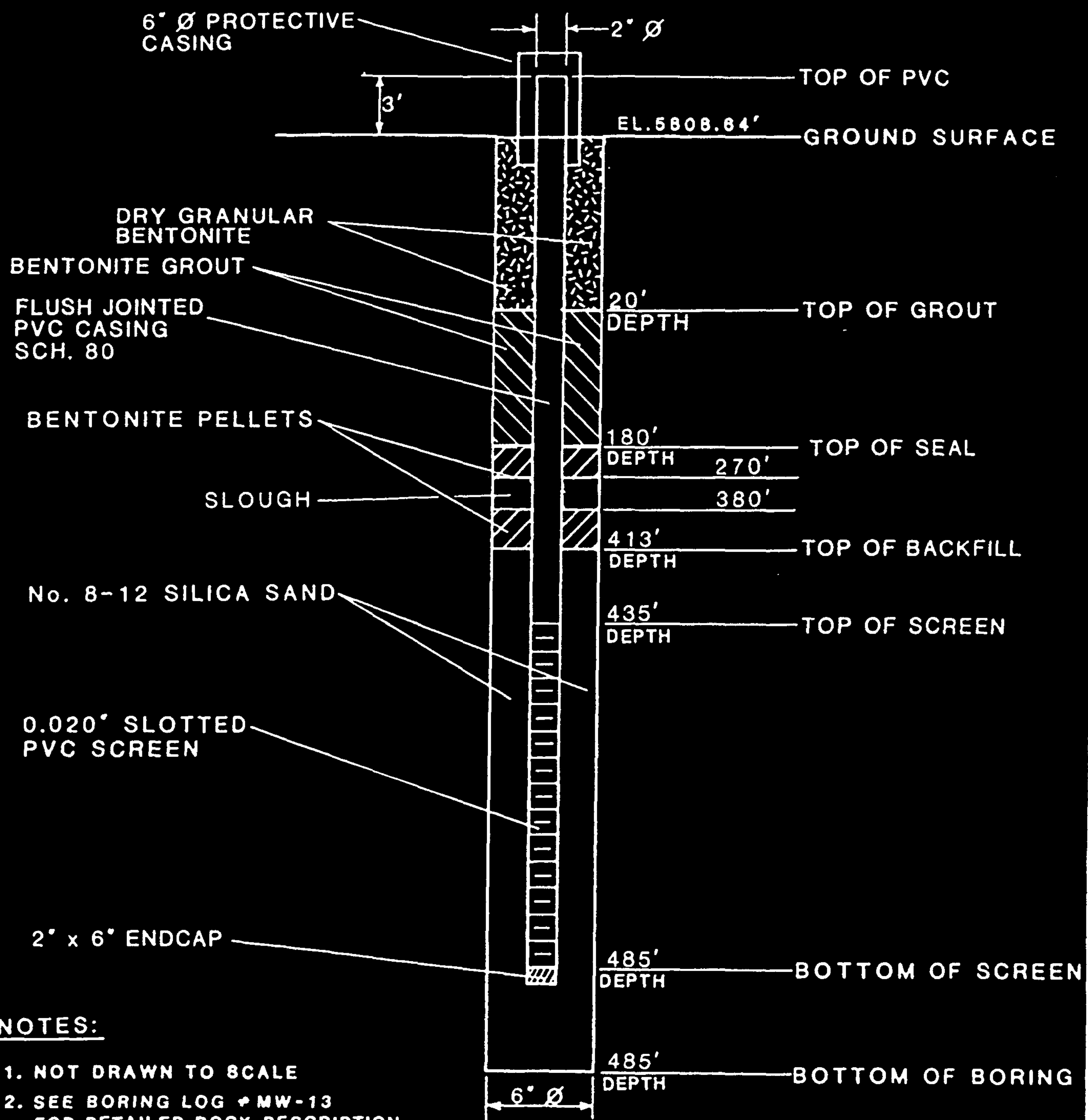
1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 10 FT. TO 485 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 220 FT.
4. SEE MW-13 FOR COMPLETION DETAILS

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC SERVICES INC.	WELL No.	
PROJECT QUARTZ MOUNTAIN	MW-13	
PROJECT No. 11806.07	BY	
DATE 10/25/87	D. GIBBS	

WELL LOCATION N 244,110.021 E 1,927,431.440

MONITORING WELL DETAILS



NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG #MW-13 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC RESOURCES INC.		BOREHOLE No. MW-14
PROJECT QUARTZ MOUNTAIN		SHEET 1 OF 2
PROJECT No. 11806		
DATE DRILLED 10/22/87		INSPECTOR D.G.
DRILLER ROGER CHANCELLOR		

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES | SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
	RED/BROWN, HARD, ANGULAR, VESICULAR, WEATHERED BASALT	
25	(31)	
	ALTERED BASALT WITH CLAY MATRIX, VARIOUS COLORS	
	(47)	
50	BROWN TO GREY SOFT CLAY	
	(65)	
	(70) ALTERED BASALT WITH CLAY MATRIX, VARIOUS COLORS	
75	GREY, SLIGHTLY ALTERED BASALT, SOME CLAY	
100	(102)	
	INTERBEDDED LAYERS OF ALTERED BASALTS & THICK, HEAVY CLAYS, VARIOUS COLORS	
125		
150		
175		

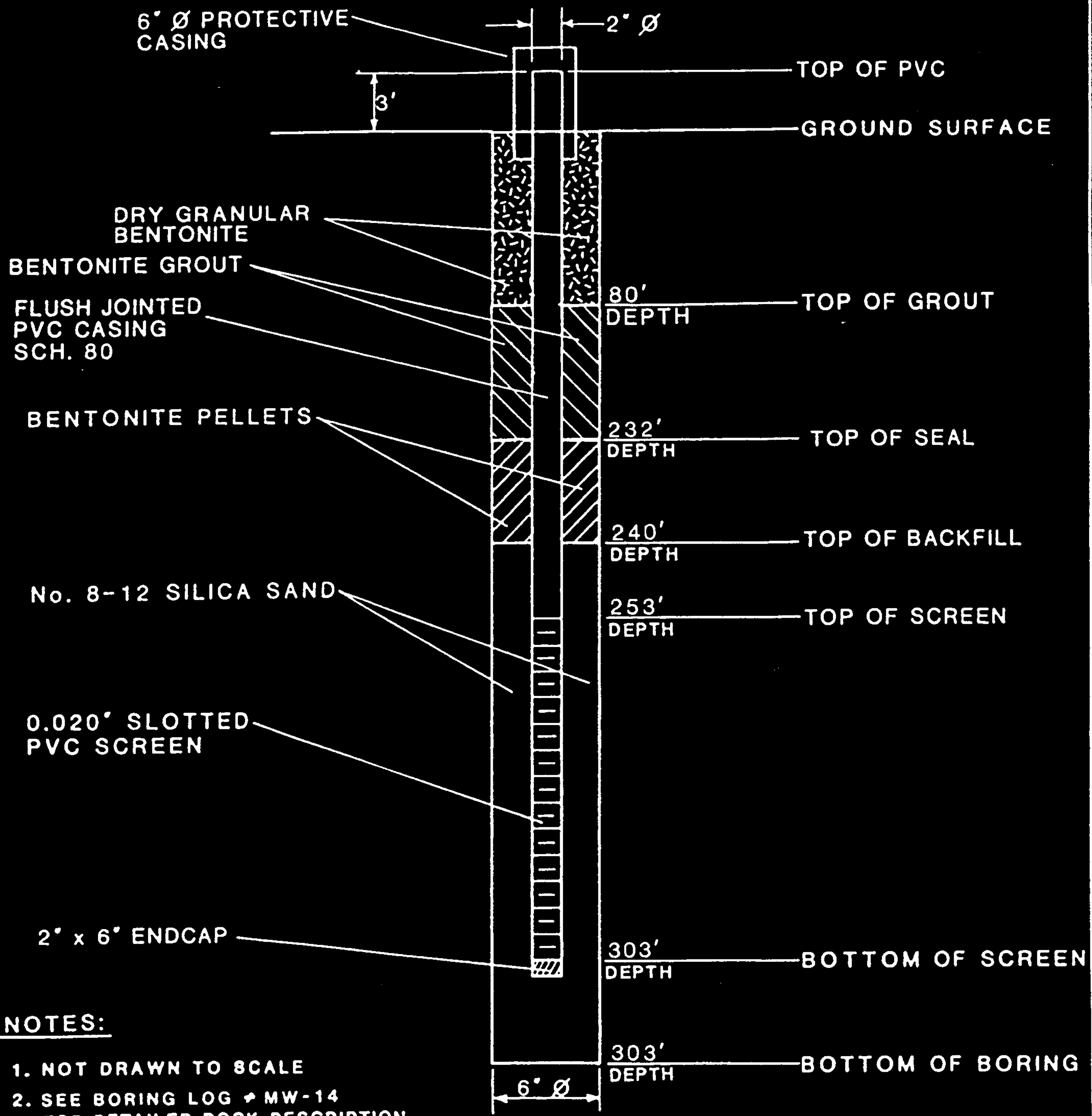
NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 10 FT. TO 303 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 184 FT.
4. SEE MW-14 FOR COMPLETION DETAILS

STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	CLIENT GALATIC SERVICES INC.	WELL No.
	PROJECT QUARTZ MOUNTAIN	MW-14
	PROJECT No. 11806.07	BY
	DATE 10/22/87	D. GIBBS

WELL LOCATION

MONITORING WELL DETAILS



NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG # MW-14 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC RESOURCES INC.	BOREHOLE No. MW-15
PROJECT QUARTZ MOUNTAIN	SHEET 1 OF 2
PROJECT No. 11806	
DATE DRILLED 10/18/87	INSPECTOR
DRILLER ROGER CHANCELLOR	D.G.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
	(11) TAN, ROUNDED SILTY GRAVEL	
50	HIGHLY ALTERED, PINK/WHITE/RED HARD RHYOLITE HIGHLY MINERALIZED (90)	
100	(100) LAYERED COMPETENT & ALTERED RHYOLITE	
	HIGHLY ALTERED, PINK/WHITE/RED HARD RHYOLITE HIGHLY MINERALIZED (141)	
150		
200	GREY, HARD, ANGULAR RHYOLITE, LESS ALTERATION WITH DEPTH	
250	(275)	
300	GREY, VERY HARD, ANGULAR RHYOLITE ABUNDANT PYRITE MINERALIZATION	(322) 0.2
350		
400		

NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 10 FT. TO 605 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 322 FT.
4. SEE MW-15 FOR COMPLETION DETAILS

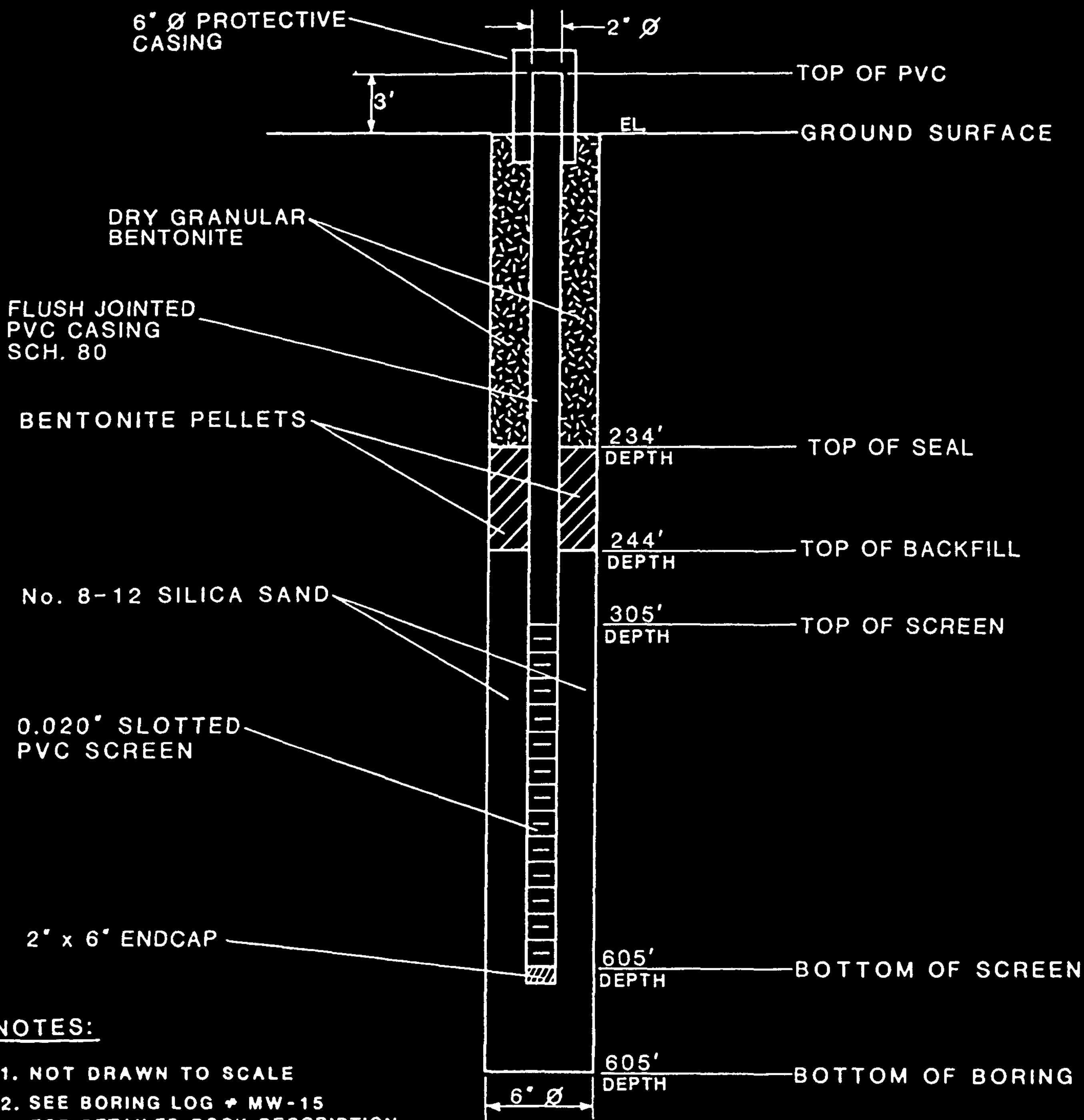
STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers

CLIENT GALATIC SERVICES INC.		WELL No. MW-15
PROJECT QUARTZ MOUNTAIN		
PROJECT No. 11606.07		BY D. GIBBS
DATE 11/9/87		

WELL LOCATION

MONITORING WELL DETAILS



NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG # MW-15 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE

STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers

CLIENT	GALATIC RESOURCES INC.
PROJECT	QUARTZ MOUNTAIN
PROJECT No.	11606
DATE DRILLED	10/16/87
DRILLER	ROGER CHANCELLOR
BOREHOLE No.	MW-16
SHEET	1 OF 1
INSPECTOR	D.G.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES

SURFACE ELEVATION

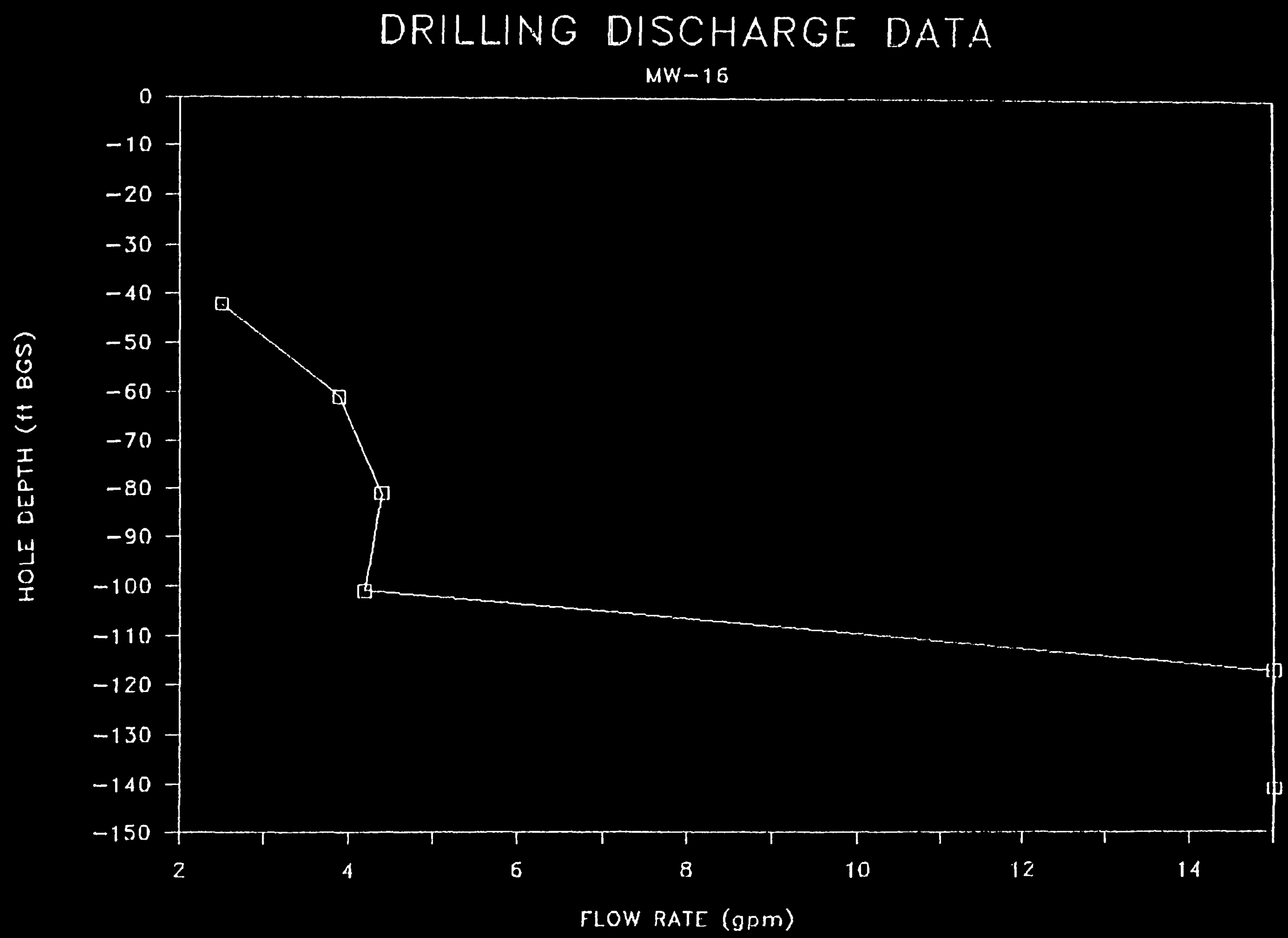
DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
	TOPSOIL, DARK BROWN SILTY CLAY (8)	
	RED/BROWN CLAYEY GRAVELS (23)	
25		
	RED/BROWN ALTERED BASALT	(42) 2.5
50	(57)	
		(61) 4
75		
		(81) 4.5
100	DARK GREY, HARD, ANGULAR, CRYSTALLINE BASALT SLIGHTLY FRACTURED	(101) 4
		(121) * 15
125		
		(141) ** 15
	BOTTOM OF BORING AT 141'	
150		
175		
200		

NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 10 FT. TO 141 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 42 FT.
4. SEE MW-16 FOR COMPLETION DETAILS

** ARTESIAN TO 15' AGL. Q 2.5 GPM AT 3' AGL.

* SIGNIFICANT INCREASE AT 116'

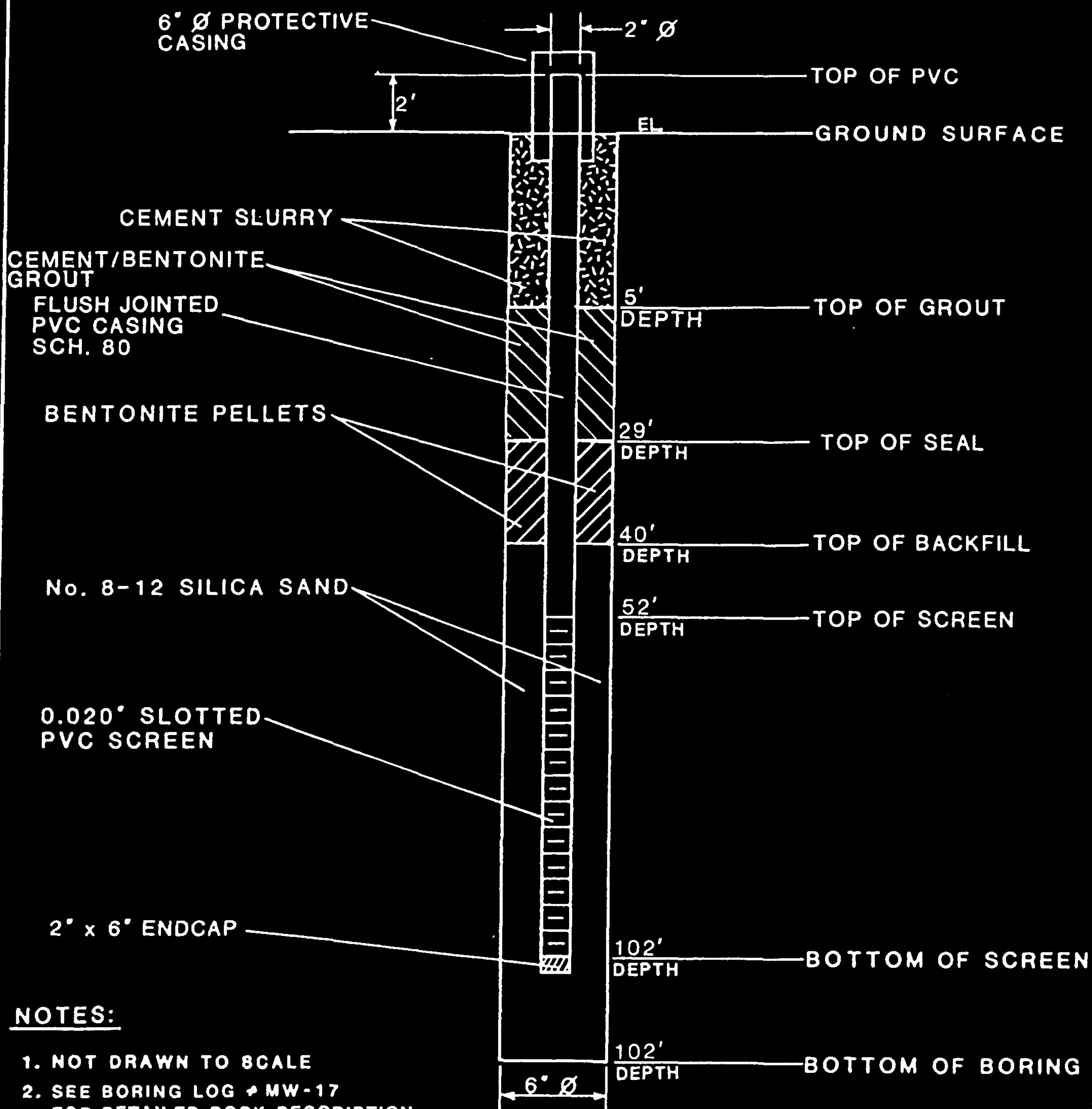

DRILLING DISCHARGE DATA
MW-16
HOLE DEPTH (ft BGS)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
2
4
6
8
10
12
14
FLOW RATE (gpm)

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC SERVICES INC.	WELL No. MW-17
PROJECT QUARTZ MOUNTAIN	
PROJECT No. 11806.07	BY M. GALLOWAY
DATE 10/14/87	

WELL LOCATION

MONITORING WELL DETAILS



NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG # MW-17 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE

STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers

CLIENT GALATIC RESOURCES INC.
PROJECT QUARTZ MOUNTAIN
PROJECT No. 11806
DATE DRILLED 10/13/87
DRILLER ROGER CHANCELLOR

BOREHOLE No. MW-18
SHEET 1 OF 1
INSPECTOR M.G.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES

SURFACE ELEVATION

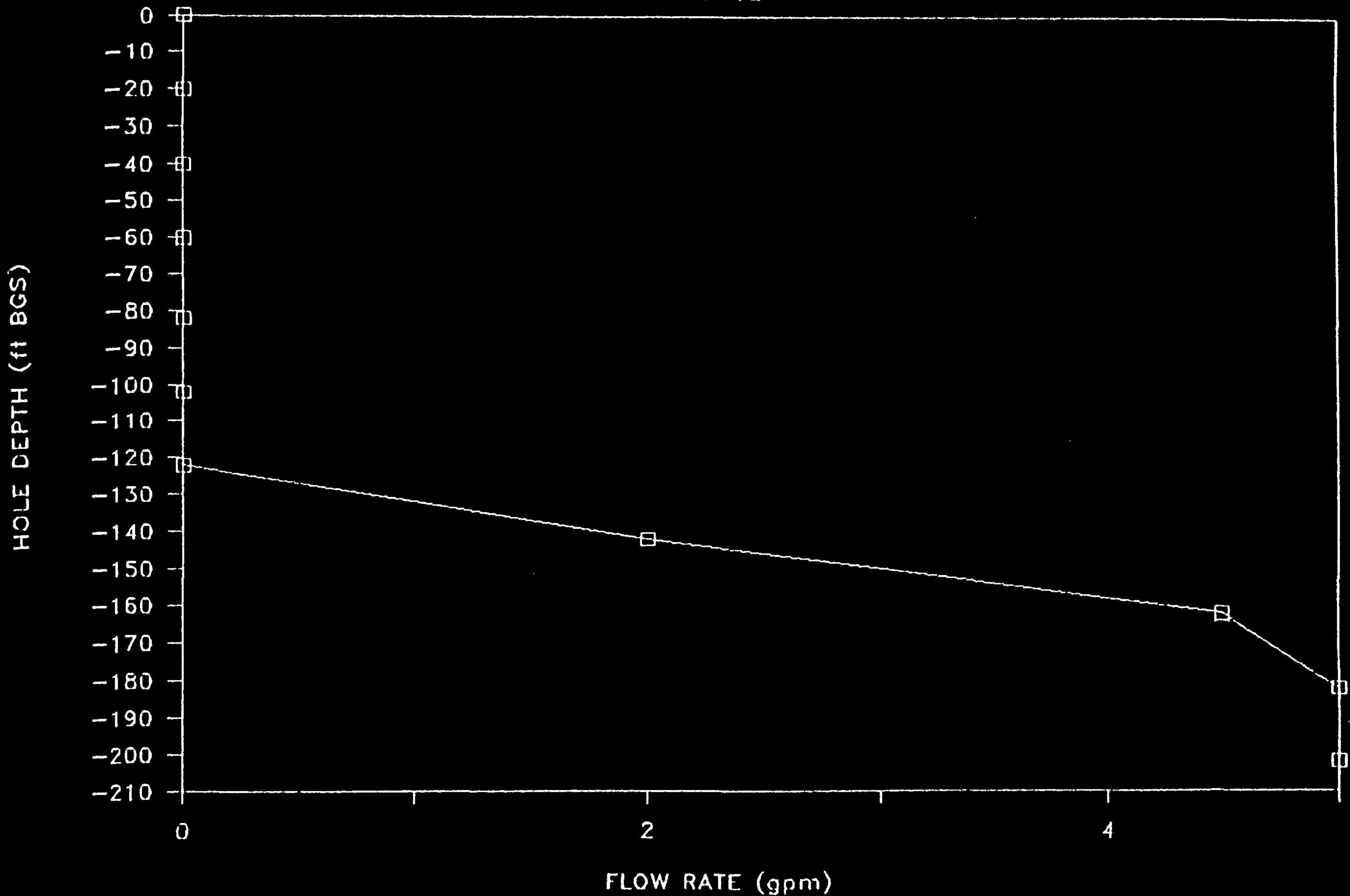
DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
(10)	TOPSOIL/FILL	
25, 50 (64)	RED/BROWN ALTERED BASALT, SOME CLAY, VARIOUS COLORS	
75, 100, 125, 150 (154)	RED TO DARK GREY ALTERED BASALT	(142) 2
(170)	LIGHT BROWN, SOFT BASALT WITH SOME CLAY	(162) 4.5
175, 200	GREY RHYOLITE	(182) 5; (202) 5
	BOTTOM OF BORING AT 202'	

NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT
2. WATER CIRCULATED FROM 10' TO 202' TO ENHANCE REMOVAL OF CUTTINGS
3. WATER FIRST ENCOUNTERED AT 142'
4. SEE MW-18 FOR COMPLETION DETAILS

DRILLING DISCHARGE DATA

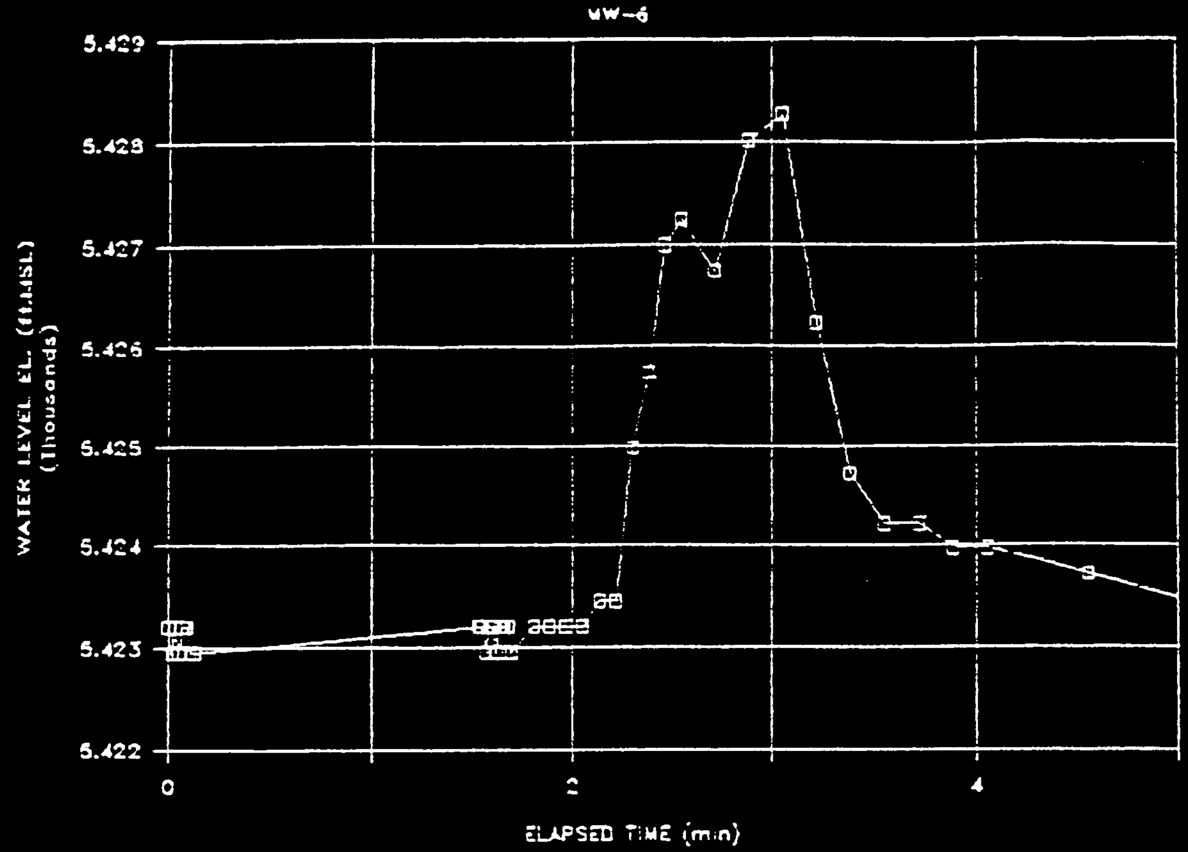
MW-18



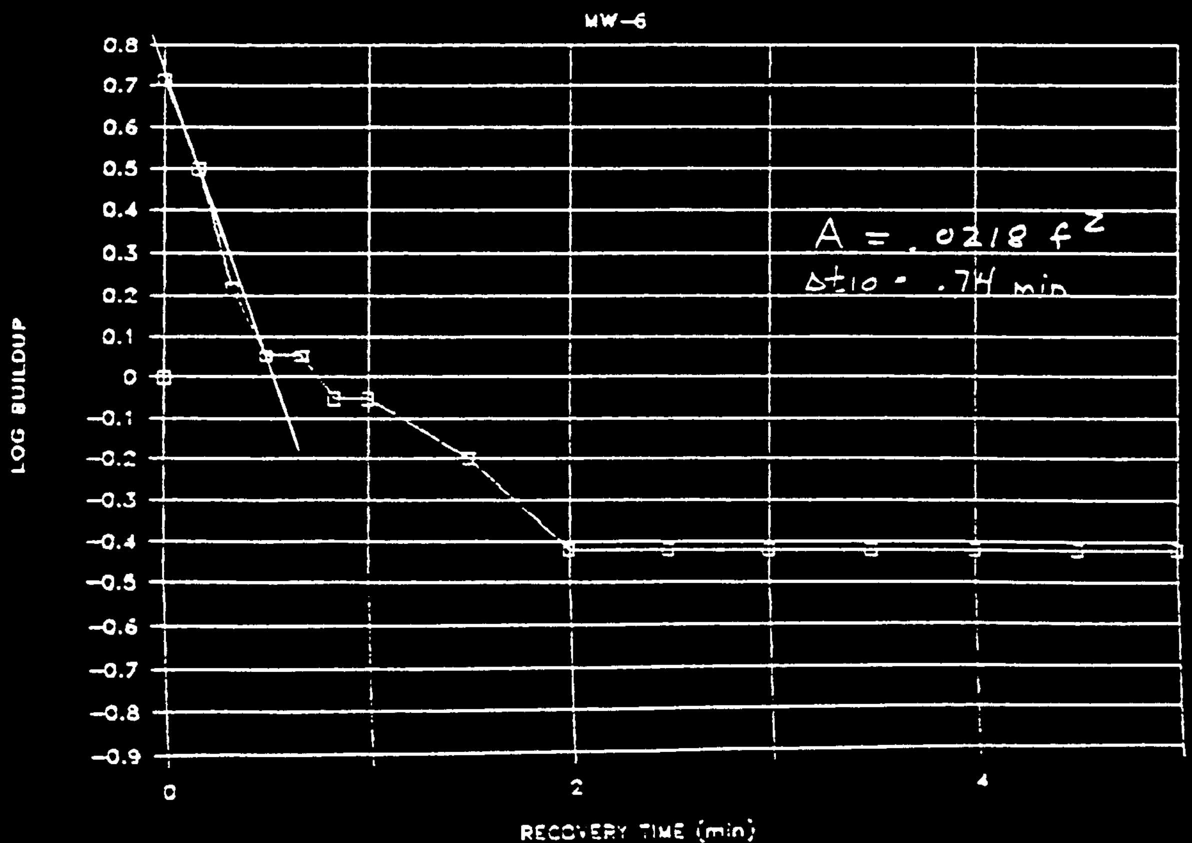
APPENDIX 8.B

MONITOR WELL FALLING HEAD TEST DATA

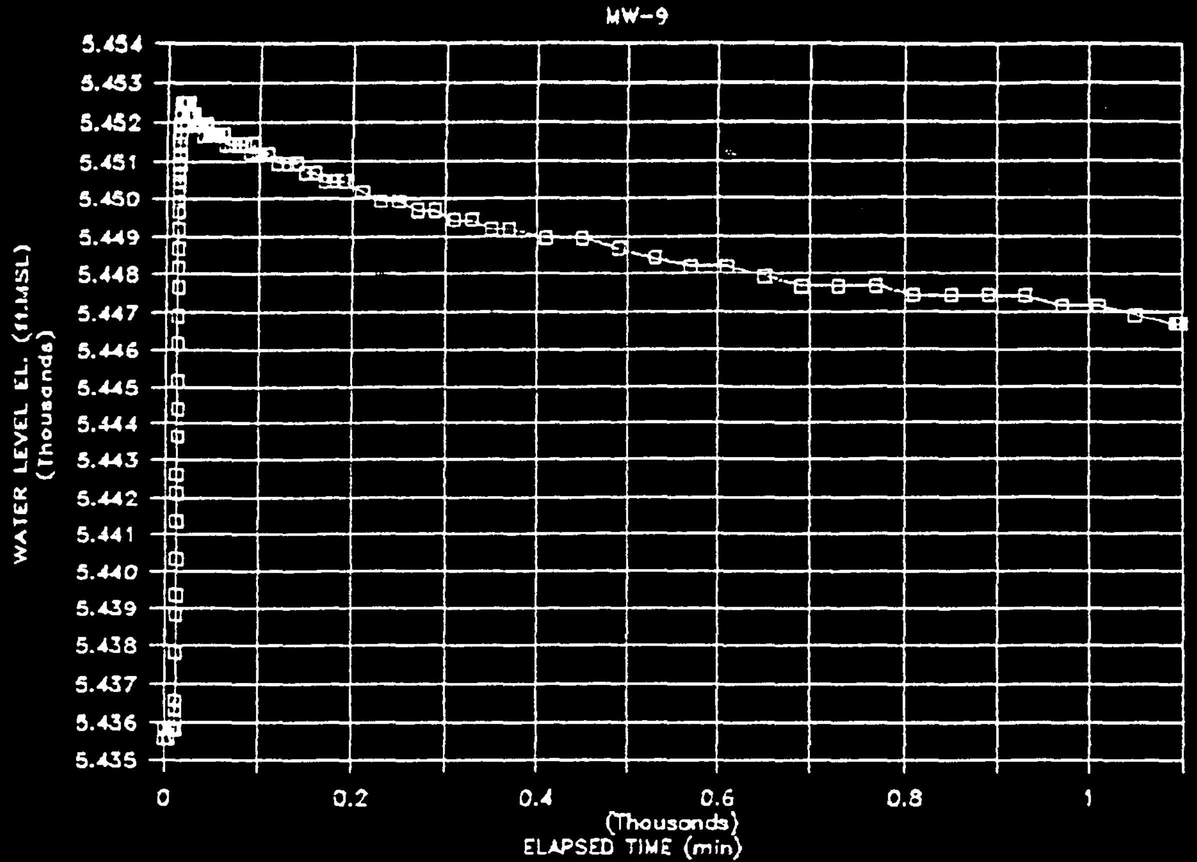
WATER LEVEL HYDROGRAPH: TRANSDUCER DATA



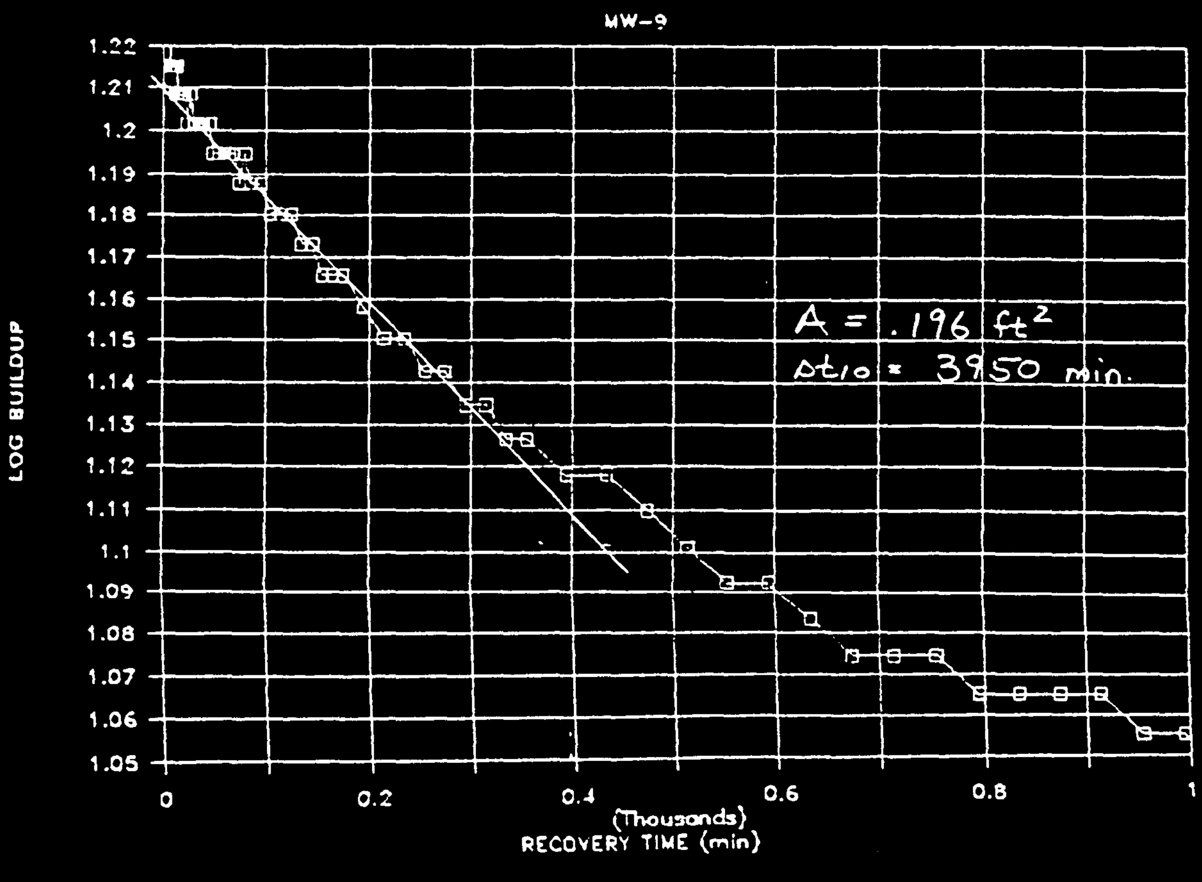
MODIFIED HVORSLEV PLOT: TRANSDUCER DATA



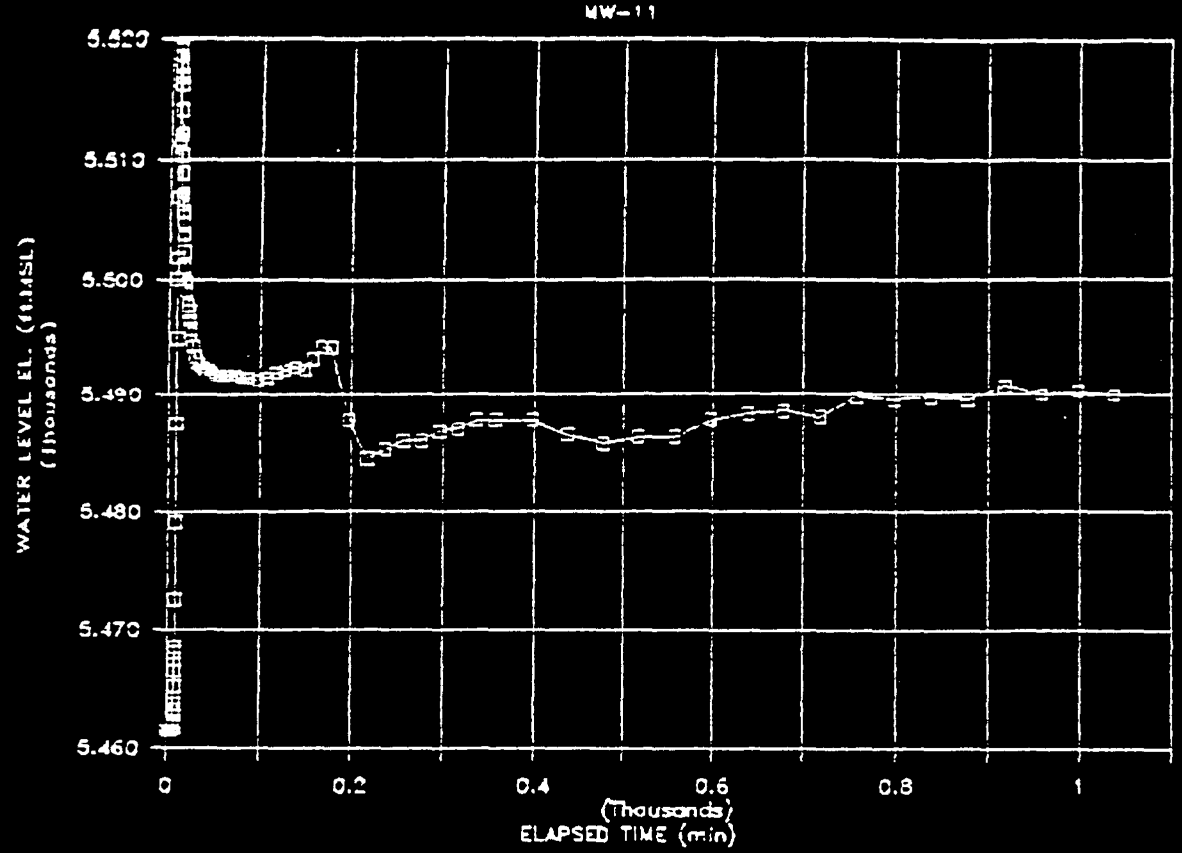
WATER LEVEL HYDROGRAPH: TRANSDUCER DATA



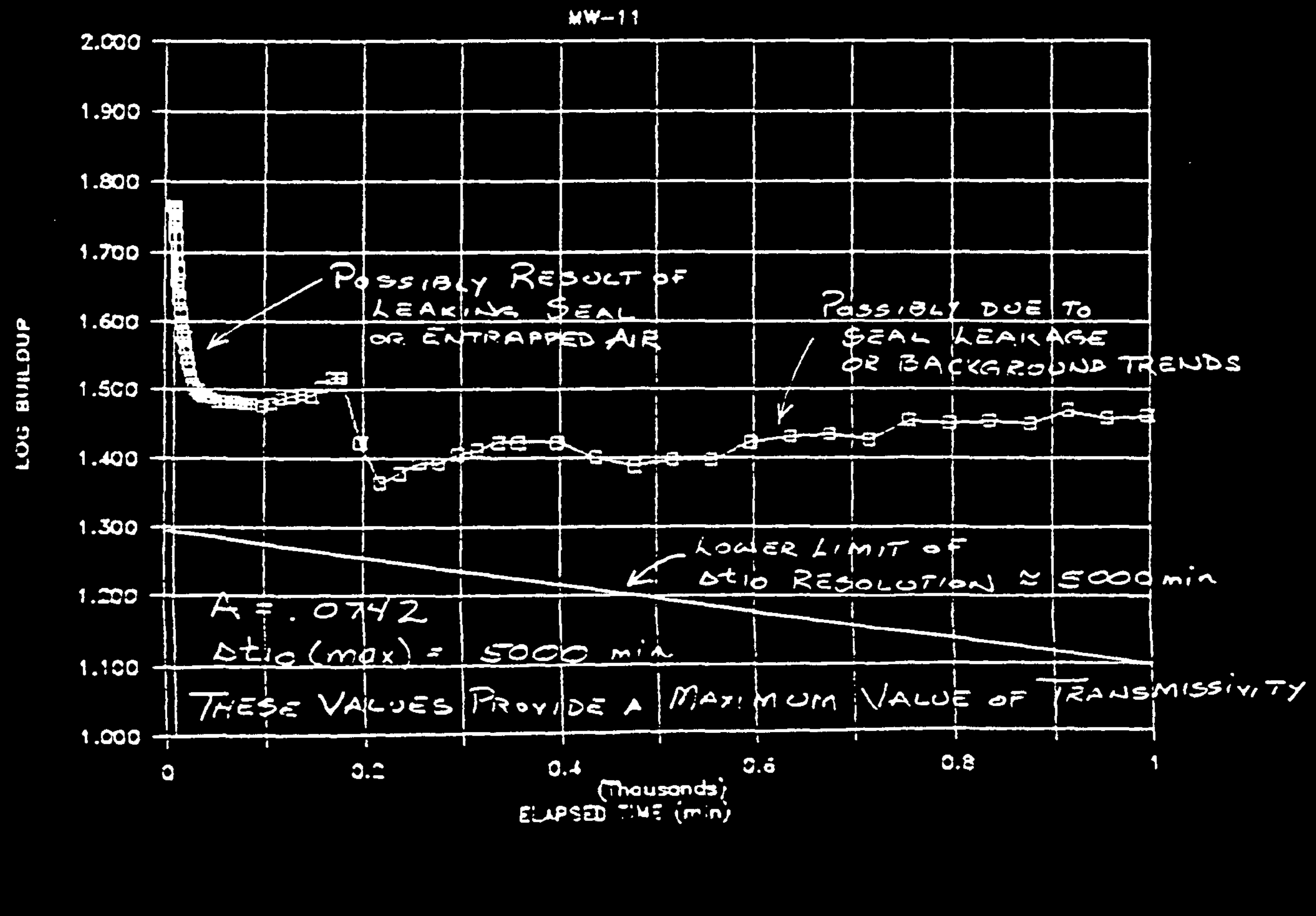
MODIFIED HVORSLEV PLOT: TRANSDUCER DATA

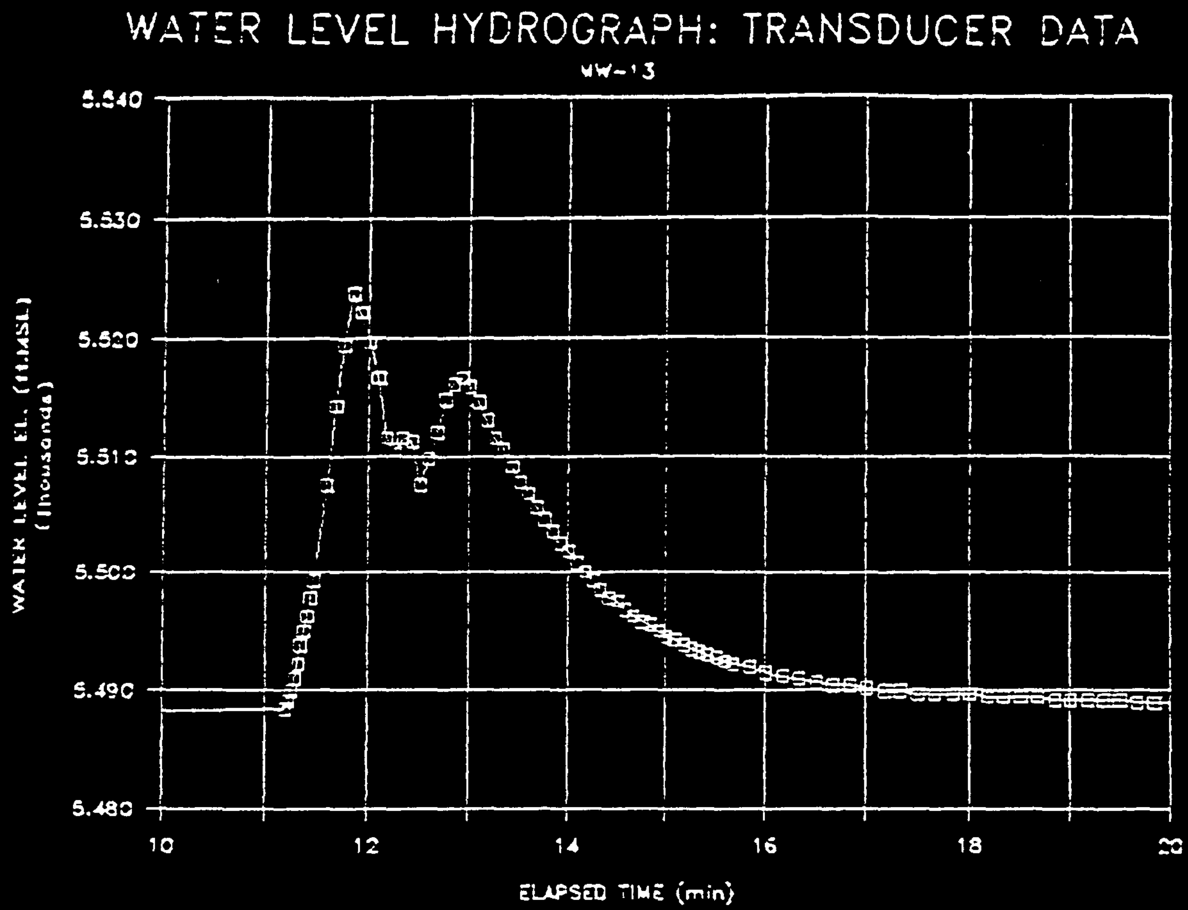


WATER LEVEL HYDROGRAPH: TRANSDUCER DATA

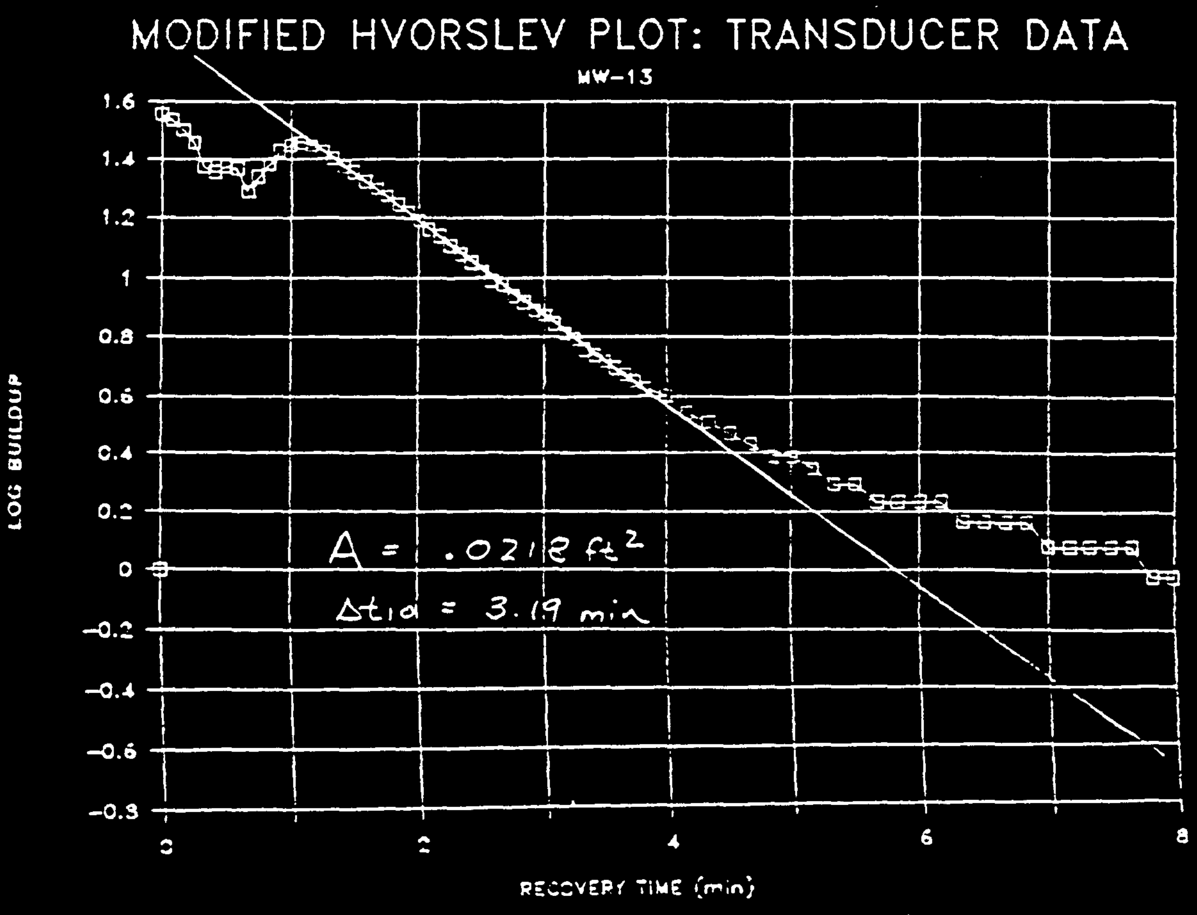


MODIFIED HVORSLEV PLOT: TRANSDUCER DATA

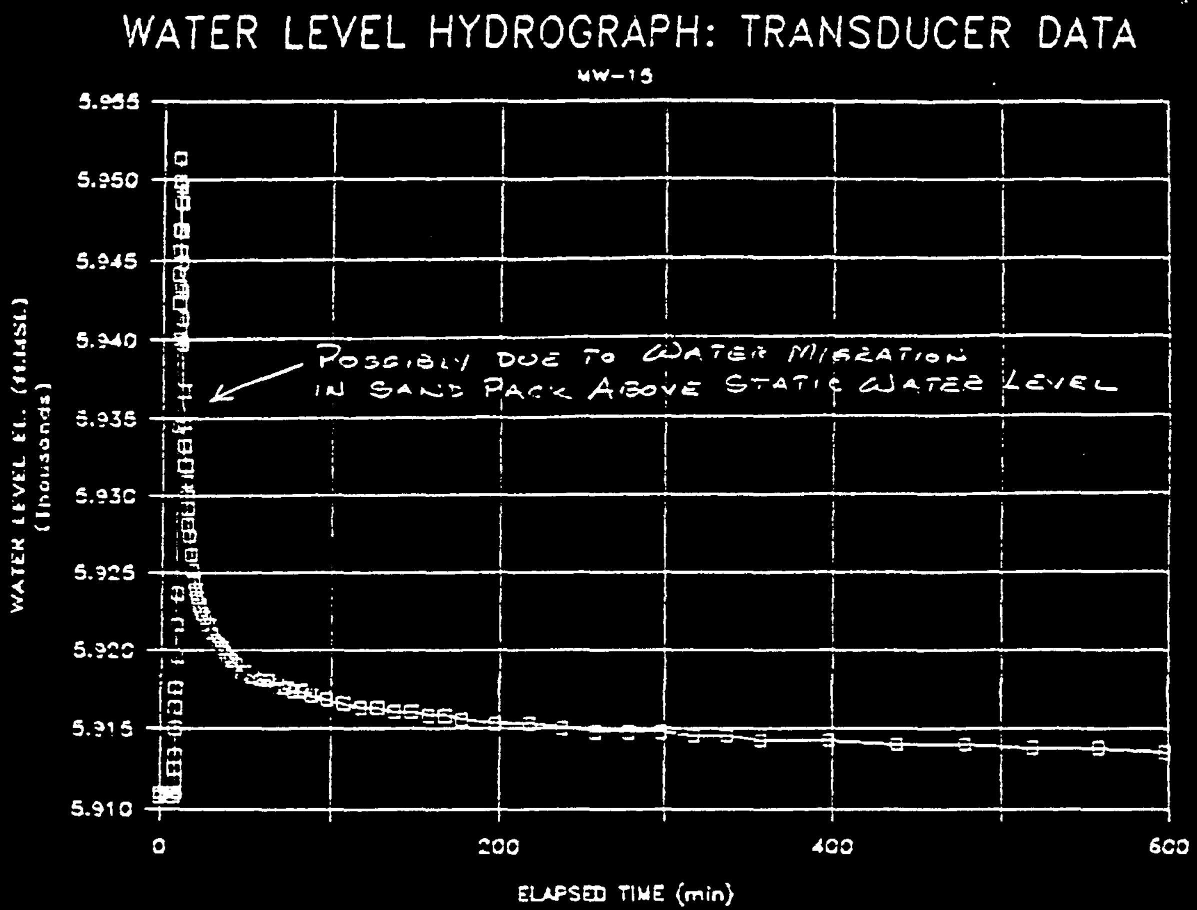




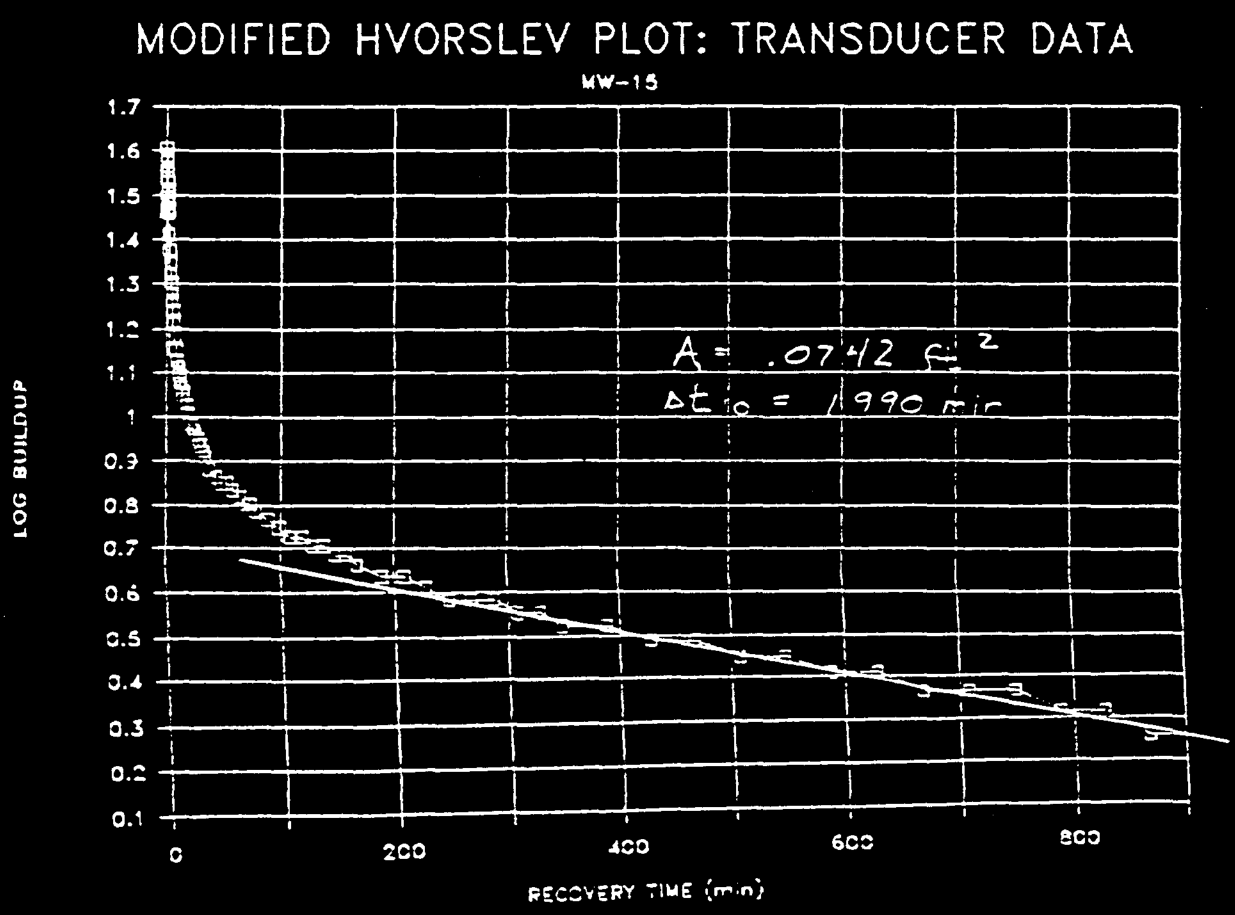
WATER LEVEL HYDROGRAPH: TRANSDUCER DATA
MW-13
WATER LEVEL EL. (ft.MSL)
(Thousands)
5.540
5.530
5.520
5.510
5.500
5.490
5.480
10
12
14
16
18
20
ELAPSED TIME (min)



MODIFIED HVORSLEV PLOT: TRANSDUCER DATA
MW-13
LOG BUILDUP
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
RECOVERY TIME (min)
A = .0218 ft²
Δt10 = 3.19 min



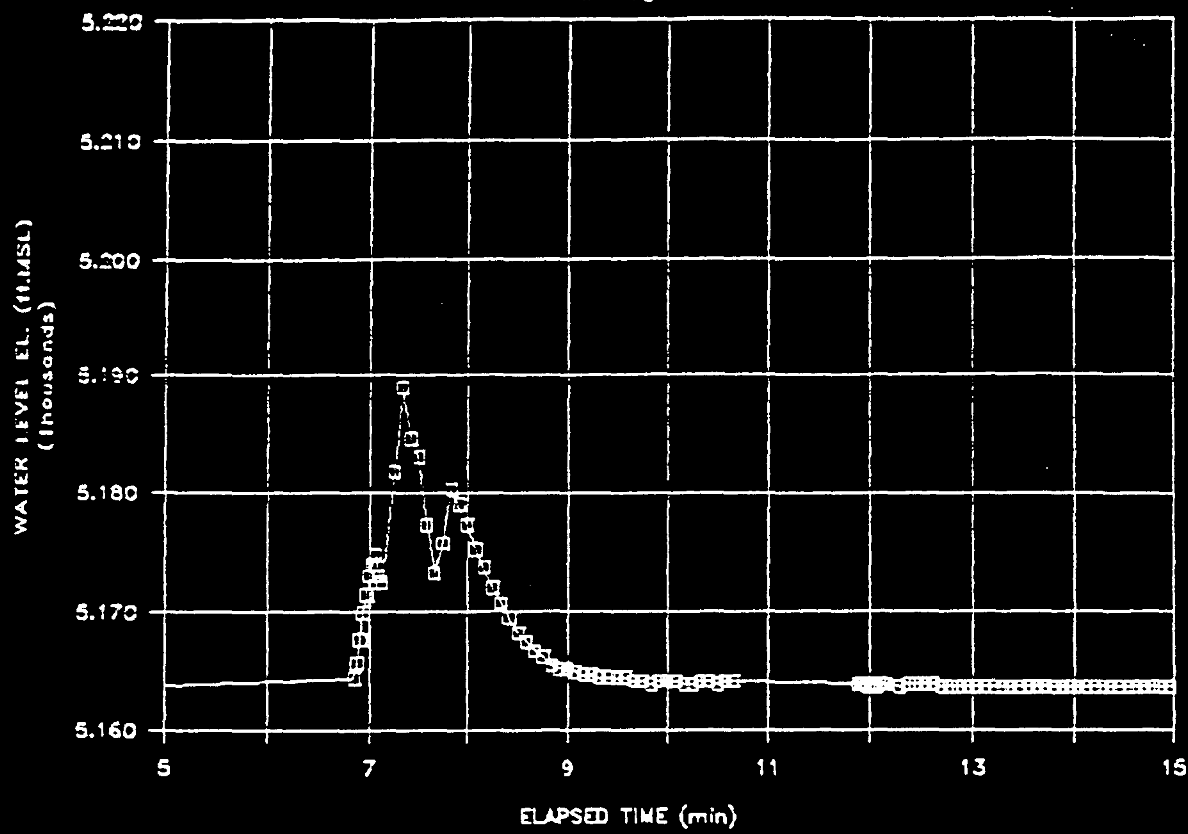
WATER LEVEL HYDROGRAPH: TRANSDUCER DATA
MW-15
WATER LEVEL EL. (ft.MSL)
(Thousands)
5.955
5.950
5.945
5.940
5.935
5.930
5.925
5.920
5.915
5.910
0
200
400
600
ELAPSED TIME (min)
POSSIBLY DUE TO WATER MIGRATION
IN SAND PACK ABOVE STATIC WATER LEVEL



MODIFIED HVORSLEV PLOT: TRANSDUCER DATA
MW-15
LOG BUILDUP
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
200
400
600
800
RECOVERY TIME (min)
A = .0742 ft²
Δt₀ = 1990 min

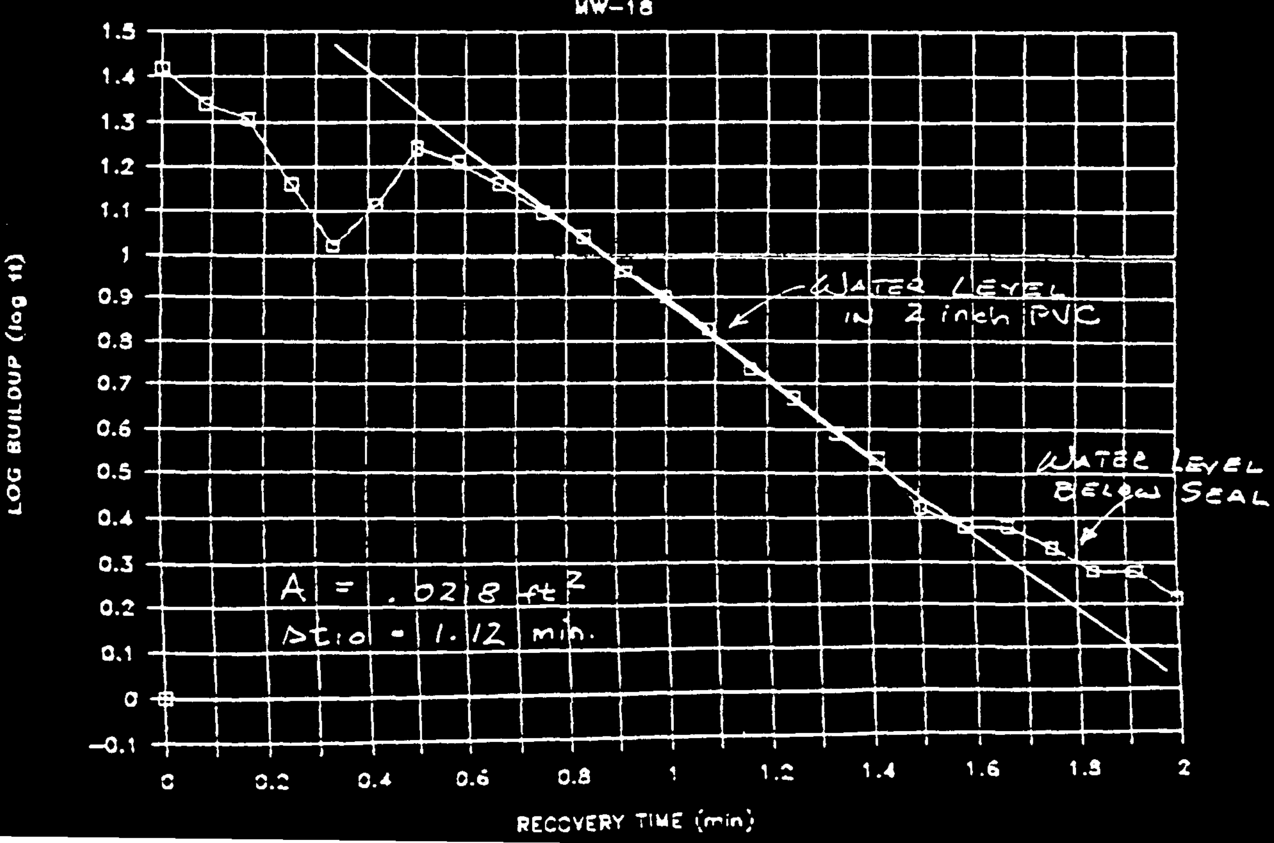
WATER LEVEL HYDROGRAPH: TRANSDUCER DATA

MW-18



MODIFIED HVORSLEV PLOT: TRANSDUCER DATA

MW-18



APPENDIX 8.C

OBSERVED DISCHARGES DURING EXPLORATION DRILLING

6 - Rhyolite

- 6 0 undifferentiated
- 6 1 qtz eye rhyolite porphyry massive
- 6 2 qtz eye rhyolite porphyry flow banded
- 6 3 auto bx
- 6 4 contact bx
- 6 5 hydrothermal bx

7 - Vitrophyre

- 7 0 undifferentiated
- 7 1 biotite vitrophyre
- 7 2 biotite-plag vitrophyre
- 7 3 auto breccia

Alteration

Main alteration type

- 0 unaltered
- 1 opalization
- 2 chal/qtz replacement/flooding
- 3 cristobalite ± alunite ± clay
- 4 qtz + sericite
- 5 clay
- 6 propylitic (chlorite ± epidote ± tale ± clay ± pyrite)
- 7 bleached

Intensity of alteration

- 0 none
- 1 weak
- 2 moderate
- 3 strong

ALL DRILLING DISCHARGE OBSERVATIONS

BOREHOLE NUMBER	TOP	BOTTOM	ROCK	MODIFIER	ALTERATION	INTENSITY	DISCHARGE
QM- 34	215.0	220.0	5	3	2	2	2
QM- 34	225.0	230.0	5	3	2	2	2
QM- 35	215.0	220.0	4	4	2	3	2
QM- 36	215.0	220.0	2	1	2	2	2
QM- 37	240.0	245.0	2	1	7	1	2
QM- 38	200.0	205.0	2	2	5	1	2
QM- 39	210.0	215.0	6	2	2	1	2
QM- 40	115.0	120.0	6	1	2	2	1
QM- 40	200.0	205.0	7	1	5	2	2
QM- 41	115.0	120.0	2	0	2	2	1
QM- 41	235.0	240.0	7	1	7	1	2
QM- 54	85.0	90.0	2	0			2
QM- 57	170.0	175.0	5	4	7		1
QM- 57	260.0	265.0	2	1			2
QM- 58	95.0	100.0	2	2	7	2	3
QM- 59	195.0	200.0	6	3	2	3	1
QM- 59	230.0	235.0	6	1	2	2	2
QM- 60	85.0	90.0	5	3	2	2	1
QM- 60	195.0	200.0	6	1	2	2	2
QM- 61	175.0	180.0	2	0	5	2	2
QM- 62	180.0	185.0	2	1	0	0	2
QM- 63	200.0	205.0	2	2	3	2	2
QM- 64	180.0	185.0	3	3	2	3	2
QM- 65	235.0	240.0	2	1	7	2	1
QM- 65	315.0	320.0	2	0	7	1	2
QM- 66	195.0	200.0	3	3	2	2	2
QM- 67	195.0	200.0	4	1	2	2	2
QM- 68	200.0	205.0	2	1	2	3	2
QM- 69	185.0	190.0	2	1	7	2	2
QM- 70	200.0	205.0	2	0	3	1	2
QM- 71	255.0	260.0	2	0	7	2	2
QM- 73	205.0	210.0	7	0	2	2	2
QM- 74	215.0	220.0	2	1	6	1	2
QM- 75	260.0	265.0	2	0	0	0	2
QM- 77	260.0	265.0	5	2	2	2	2
QM- 78	255.0	260.0	4	2	2	1	2
QM- 79	195.0	200.0	5	3	2	3	1
QM- 79	395.0	400.0	2	1	2	1	2
QM- 80	200.0	205.0	5	4	2	3	2
QM- 81	280.0	285.0	5	4	2	2	2
QM- 82	160.0	165.0	3	3	2	3	2
QM- 83	160.0	165.0	5	1	0	0	2
QM- 84	155.0	160.0	5	3	5	1	2
QM- 85	160.0	165.0	4	4	5	2	1
QM- 85	215.0	220.0	4	3	5	1	2
QM- 87	260.0	265.0	5	3	2	3	2
QM- 88	255.0	260.0	4	3	2	1	2
QM- 89	220.0	225.0	2	1	2	2	2
QM- 90	295.0	300.0	6	1	2	3	2
QM- 92	180.0	185.0	3	4	2	2	2
QM- 93	145.0	150.0	2	0	2	1	1
QM- 93	195.0	200.0	4	4	2	1	2
QM- 94	200.0	205.0	2	1	5	3	2

DRILLING DISCHARGE OBSERVATIONS IN BASALT (Rock = 2)

BOREHOLE NUMBER	TOP	BOTTOM	ROCK	MODIFIER	ALTERATION	INTENSITY	DISCHARGE
QM- 36	215.0	220.0	2	1	2	2	2
QM- 37	240.0	245.0	2	1	7	1	2
QM- 38	200.0	205.0	2	2	5	1	2
QM- 41	115.0	120.0	2	0	2	2	1
QM- 54	85.0	90.0	2	0			2
QM- 57	260.0	265.0	2	1			2
QM- 58	95.0	100.0	2	2	7	2	3
QM- 61	175.0	180.0	2	0	5	2	2
QM- 62	180.0	185.0	2	1	0	0	2
QM- 63	200.0	205.0	2	2	3	2	2
QM- 65	235.0	240.0	2	1	7	2	1
QM- 65	315.0	320.0	2	0	7	1	2
QM- 68	200.0	205.0	2	1	2	3	2
QM- 69	185.0	190.0	2	1	7	2	2
QM- 70	200.0	205.0	2	0	3	1	2
QM- 71	255.0	260.0	2	0	7	2	2
QM- 74	215.0	220.0	2	1	6	1	2
QM- 75	260.0	265.0	2	0	0	0	2
QM- 79	395.0	400.0	2	1	2	1	2
QM- 89	220.0	225.0	2	1	2	2	2
QM- 93	145.0	150.0	2	0	2	1	1
QM- 94	200.0	205.0	2	1	5	3	2
QM- 95	240.0	245.0	2	0	6	2	2
QM- 96	195.0	200.0	2	0	6	1	2
QM- 97	195.0	200.0	2	1	2	2	2
QM- 98	300.0	305.0	2	1	2	1	2
QM- 99	300.0	305.0	2	0	2	1	2
QM- 100	235.0	240.0	2	1	7	2	2
QM- 101	210.0	215.0	2	1	0	0	1
QM- 101	245.0	250.0	2	0	0	0	2
QM- 116	220.0	225.0	2	1	0	0	2
QM- 117	395.0	400.0	2	1	0	0	2
QM- 121	135.0	140.0	2	1	7	1	2
QM- 122	85.0	90.0	2	1	5	1	2
QM- 123	85.0	90.0	2	1	7	2	1
QM- 128	260.0	265.0	2	4	2	2	2
QM- 130	210.0	215.0	2	4	2	2	1
QM- 130	250.0	255.0	2	4	2	2	2
QM- 132	245.0	250.0	2	0	2	1	2
QM- 133	225.0	230.0	2	0	2	2	1
QM- 133	295.0	300.0	2	0	6	1	2
QM- 134	115.0	120.0	2	1	2	1	3
QM- 135	135.0	140.0	2	3	2	3	1
QM- 136	175.0	180.0	2	0	6	1	2
QM- 193	295.0	300.0	2	1	6	2	2
QM- 195	255.0	260.0	2	0	6	2	2
QM- 198	235.0	240.0	2	1	6	2	2
QM- 199	245.0	250.0	2	1	7	2	2
QM- 199	315.0	320.0	2	0	6	1	3
QM- 200	275.0	280.0	2	1	6	1	2
QM- 200	345.0	350.0	2	1	6	1	3

APPENDIX 8.D

HYDROCHEMICAL DATA

QUARTZ MOUNTAIN:
WATER QUALITY DATABASE

SAMPLING PERIOD:
FEB 1988

IDENTIFIER		GENERAL						MAJOR CATIONS				MAJOR ANIONS						
TEST POINT	DATE	TEMP (C)	FIELD COND (umho/cm)	FIELD pH (su)	LAB COND (umho/cm)	LAB pH (su)	TDS (mg/l)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	CO3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	Cl (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	F (mg/l)
MW-1	2/24/88	10.5	290.00	6.25	364.00	5.0	358.00	28.90	17.70	47.20	16.50	N/A	3.10	327.00	2.20	0.10	-0.02	0.19
MW-2	2/24/88	10.7	190.00	7.00	214.00	6.9	225.00	14.70	3.90	12.00	9.20	N/A	51.00	69.30	1.60	-0.10	-0.02	0.24
MW-3	2/23/88	10.0	142.00	6.95	174.00	7.7	173.00	15.10	5.10	32.60	15.80	N/A	112.00	8.90	1.20	0.12	-0.02	0.07
MW-5	2/27/88	10.0	245.00	6.90	302.00	6.8	249.00	20.00	2.30	61.80	26.80	N/A	200.00	1.30	0.80	-0.10	-0.02	0.09
MW-6	2/23/88	9.7	[illegible]	6.77	80.80	7.8	107.00	6.50	5.10	9.50	11.40	N/A	52.00	0.40	1.40	0.11	-0.02	0.07
MW-7	2/25/88	11.5	160.00	7.30	327.00	8.5	230.00	29.70	5.40	46.90	15.30	14.60	183.00	-0.10	4.80	0.15	-0.02	0.19
MW-9	2/25/88	8.0	60.00	7.75	60.20	7.3	4167.00	15.90	16.40	1.70	1.80	N/A	93.60	-0.10	11.30	0.38	0.10	-0.05
MW-10	2/24/88	11.0	180.00	7.05	222.00	6.9	227.00	14.40	4.40	43.70	9.40	N/A	51.50	78.80	1.40	-0.10	-0.02	0.25
MW-11	2/24/88	10.5	75.00	7.10	92.20	6.8	136.00	12.10	6.80	17.50	1.40	N/A	55.60	-0.10	1.40	0.22	-0.02	-0.05
MW-12	2/24/88	13.0	110.00	7.80	120.00	7.8	134.00	11.30	7.60	16.80	10.50	N/A	74.90	2.60	1.50	0.26	-0.02	0.07
MW-13	2/88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MW-14	2/26/88	11.0	150.00	7.50	191.00	7.5	165.00	11.50	6.40	37.60	16.70	N/A	108.00	15.80	1.80	-0.10	-0.02	0.05
MW-15	2/26/88	5.2	60.00	7.55	78.90	6.9	319.00	11.80	7.20	1.20	0.60	N/A	11.00	20.40	2.20	0.11	-0.02	0.07
MW-16	2/26/88	12.0	150.00	6.60	169.00	7.8	149.00	11.00	3.00	45.20	17.60	N/A	106.00	1.00	1.80	0.40	-0.02	-0.05
MW-17	2/27/88	9.5	70.00	7.50	90.50	7.1	128.00	13.40	1.10	10.90	2.10	N/A	54.60	0.50	2.00	0.16	-0.02	0.08
MW-18	2/24/88	10.0	220.00	7.55	273.00	7.4	198.00	13.70	5.40	80.20	30.90	N/A	177.00	1.60	1.40	0.20	-0.02	-0.05
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	2/29/88	N/A	N/A	N/A	1.90	5.7	3.00	0.50	-0.10	0.20	0.03	N/A	2.60	0.20	1.50	-0.10	-0.02	-0.05
TRIP BLANK	2/29/88	N/A	N/A	N/A	0.90	5.8	2.00	0.40	-0.10	0.60	-0.01	N/A	2.60	0.40	1.40	-0.10	-0.02	-0.05
LAB BLANK	2/29/88	N/A	N/A	N/A	1.10	5.6	5.00	0.20	-0.10	-0.10	-0.01	N/A	2.60	0.10	1.50	-0.10	-0.02	-0.05

NOTES

N/A Not applicable or measurement/analysis not performed.
\- Detection limit.

QUARTZ MOUNTAIN:
WATER QUALITY DATABASE

SAMPLING PERIOD:
FEB 1988

IDENTIFIER		TRACERS AND METALS																
TEST POINT	DATE	TOC (mg/l)	Phenols (mg/l)	B (mg/l)	As (mg/l)	Ba (mg/l)	Cd (mg/l)	Cu (mg/l)	Cr (mg/l)	Fe (mg/l)	Pb (mg/l)	Mn (mg/l)	Hg (mg/l)	Se (mg/l)	Ag (mg/l)	Sb (mg/l)	Zn (mg/l)	Total CN (mg/l)
MW-1	2/24/88	-1.00	0.005	-0.10	0.007	-0.05	-0.005	-0.10	-0.005	5.10	-0.005	1.33	-0.001	-0.005	-0.005	-0.005	0.21	-0.005
MW-2	2/24/88	-1.00	0.011	-0.10	0.140	-0.05	-0.005	-0.10	-0.005	2.80	-0.005	1.05	0.005	-0.005	-0.005	-0.005	-0.10	-0.005
MW-3	2/23/88	-1.00	-0.005	-0.10	0.006	-0.05	-0.005	-0.10	-0.005	0.90	-0.005	-0.01	0.072	-0.005	-0.005	-0.005	-0.10	-0.005
MW-5	2/23/88	-1.00	0.009	-0.10	0.020	-0.05	-0.005	-0.10	-0.005	1.20	-0.005	6.63	-0.003	-0.005	-0.005	-0.005	-0.10	-0.005
MW-6	2/23/88	-1.00	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.10	-0.005	0.03	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-7	2/25/88	-1.00	-0.005	-0.10	0.100	-0.05	-0.005	-0.10	-0.005	0.40	-0.005	0.05	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-9	2/25/88	-1.00	-0.005	-0.10	-0.005	1.65	-0.005	0.13	-0.005	36.10	-0.005	0.06	0.001	-0.005	-0.005	-0.005	0.42	-0.005
MW-10	2/24/88	-1.00	0.006	-0.10	0.130	-0.05	-0.005	-0.10	-0.005	2.80	-0.005	1.07	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-11	2/24/88	-1.00	0.005	-0.10	0.010	-0.05	-0.005	-0.10	-0.005	0.70	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-12	2/24/88	-1.00	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.40	-0.005	0.03	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-13	2/88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MW-14	2/25/88	-1.00	-0.005	-0.10	0.220	0.06	-0.005	-0.10	-0.005	1.40	-0.005	0.52	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-15	2/26/88	-1.00	0.012	-0.10	0.200	-0.05	-0.005	-0.10	-0.005	0.50	-0.005	0.07	0.058	-0.005	-0.005	0.010	-0.10	-0.005
MW-16	2/26/88	-1.00	0.007	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.80	-0.005	0.02	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-17	2/27/88	-1.00	-0.005	-0.10	0.006	-0.05	-0.005	-0.10	-0.005	0.50	-0.005	0.01	-0.001	-0.005	-0.005	-0.005	0.14	-0.005
MW-18	2/24/88	-1.00	0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.40	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	2/29/88	-1.00	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	0.02	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
TRIP BLANK	2/29/88	-1.00	0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
LAB BLANK	2/29/88	-1.00	0.008	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005

QUARTZ MOUNTAIN:

WATER QUALITY DATABASE

SAMPLING PERIOD:
FEB 1988

IDENTIFIER		RADIOLOGICAL			
TEST POINT	DATE	Gross alpha (pCi/l)	Gross beta (pCi/l)	Error alpha (pCi/l)	Error beta (pCi/l)
MW-1	2/24/88	3.8300	15.30	N/A	N/A
MW-2	2/24/88	0.0581	2.87	N/A	N/A
MW-3	2/23/88	3.2400	6.28	N/A	N/A
MW-5	2/23/88	0.7500	1.75	N/A	N/A
MW-6	2/23/88	0.0774	1.83	N/A	N/A
MW-7	2/25/88	7.4600	6.04	N/A	N/A
MW-9	2/25/88	249.0000	230.00	N/A	N/A
MW-10	2/24/88	0.4830	2.61	N/A	N/A
MW-11	2/24/88	0.8580	4.69	N/A	N/A
MW-12	2/24/88	1.3500	5.40	N/A	N/A
MW-13	2/88	N/A	N/A	N/A	N/A
MW-14	2/26/88	0.1060	3.70	N/A	N/A
MW-15	2/26/88	4.6900	10.70	N/A	N/A
MW-16	2/26/88	0.0927	1.45	N/A	N/A
MW-17	2/27/88	0.0370	0.307	N/A	N/A
MW-18	2/24/88	0.4690	4.06	N/A	N/A
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	2/29/88	0.1990	0.311	N/A	N/A
TRIP BLANK	2/29/88	0.0129	0.841	N/A	N/A
LAB BLANK	2/29/88	0.1330	0.284	N/A	N/A

QUARTZ MOUNTAIN
WATER QUALITY DATABASE

SAMPLE PERIOD:
APR - MAY 1988

IDENTIFIER		GENERAL						MAJOR CATIONS				MAJOR ANIONS						
TEST POINT	DATE	TEMP (C)	FIELD COND (umho/cm)	FIELD pH (su)	LAB COND (umho/cm)	LAB pH (su)	TDS (mg/l)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	CO3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	Cl (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	F (mg/l)
MW-1	4/30/88	10.6	250.00	6.60	304.00	4.4	282.00	19.70	22.30	21.90	19.60	N/A	0.00	234.00	1.93	0.20	-0.02	0.21
MW-2	5/1/88	9.0	110.00	7.96	146.00	7.6	615.00	40.00	9.50	3.20	2.60	N/A	82.00	9.50	1.91	0.49	-0.02	0.10
MW-3	4/28/88	10.8	90.00	8.90	183.00	7.6	148.00	14.50	7.80	24.50	21.00	N/A	116.00	-0.10	1.42	0.18	-0.02	-0.05
MW-5	4/29/88	9.2	245.00	7.40	317.00	7.0	234.00	17.60	5.60	70.30	28.00	N/A	203.00	1.00	0.76	-0.10	-0.02	0.07
MW-6	5/1/88	10.2	90.00	6.20	92.40	7.9	115.00	13.20	10.90	6.10	12.00	N/A	55.70	0.60	1.41	-0.10	-0.02	0.07
MW-7	4/29/88	9.8	130.00	7.60	333.00	8.4	234.00	36.00	8.90	32.10	19.60	11.60	165.00	5.60	4.91	0.16	-0.02	0.17
MW-9	4/28/88	11.0	70.00	7.55	118.00	7.2	1954.00	15.70	9.70	3.80	4.40	N/A	68.60	3.90	2.39	0.67	-0.02	0.08
MW-10	4/30/88	10.0	210.00	7.60	219.00	6.9	222.00	15.40	7.70	26.90	13.80	N/A	51.50	62.10	1.14	0.10	-0.02	0.21
MW-11	4/29/88	9.0	80.00	7.89	89.70	6.9	137.00	13.20	11.40	11.00	3.60	N/A	54.50	-0.10	1.24	0.25	-0.02	-0.05
MW-12	4/29/88	12.0	110.00	8.70	121.00	8.1	137.00	11.60	10.60	9.00	15.50	N/A	74.10	2.40	1.56	0.15	-0.02	0.05
MW-13	4/30/88	10.9	200.00	7.40	201.00	7.6	196.00	12.90	10.40	18.20	22.50	N/A	108.00	14.40	1.20	-0.10	-0.02	0.05
MW-14	4/30/88	11.0	190.00	7.50	195.00	7.5	195.00	13.80	11.90	21.70	21.00	N/A	108.00	15.10	1.26	-0.10	-0.02	0.06
MW-15	4/30/88	8.5	75.00	7.30	71.70	6.8	209.00	13.40	13.90	0.70	2.30	N/A	10.50	11.20	1.58	0.18	-0.02	0.07
MW-16	4/27/88	13.0	260.00	6.00	174.00	7.6	138.00	12.80	9.40	29.70	19.20	N/A	106.00	0.80	1.29	0.40	-0.02	-0.05
MW-17	4/27/88	10.0	45.00	7.10	89.00	7.3	123.00	13.80	6.70	5.10	4.10	N/A	55.70	0.30	1.39	0.14	-0.02	0.05
MW-18	4/28/88	10.1	130.00	7.15	285.00	7.4	191.00	15.20	9.20	65.90	31.00	N/A	184.00	2.30	0.93	0.19	-0.02	-0.05
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	5/1/88	5.8	0.92	9.19	1.50	5.8	16.00	-0.10	1.10	1.70	0.16	N/A	2.10	-0.10	1.02	-0.10	-0.02	-0.05
TRIP BLANK	5/1/88	N/A	N/A	N/A	1.20	5.6	8.00	-0.10	-0.10	-0.10	-0.01	N/A	2.60	-0.10	0.96	-0.10	-0.02	-0.05
LAB BLANK	5/1/88	N/A	N/A	N/A	1.30	5.6	6.00	-0.10	-0.10	0.20	-0.01	N/A	2.10	-0.10	0.98	-0.10	-0.02	-0.05

NOTES

N/A Not applicable or measurement/analysis not performed.
- Detection limit.

SAMPLE PERIOD:
APR - MAY 1988

IDENTIFIER		TRACERS AND METALS																
TEST POINT	DATE	TOC (mg/l)	Phenols (mg/l)	B (mg/l)	As (mg/l)	Ba (mg/l)	Cd (mg/l)	Cu (mg/l)	Cr (mg/l)	Fe (mg/l)	Pb (mg/l)	Mn (mg/l)	Hg (mg/l)	Se (mg/l)	Ag (mg/l)	Sb (mg/l)	Zn (mg/l)	Total CN (mg/l)
MW-1	4/30/88	-1.00	0.0052	-0.10	0.026	-0.05	-0.005	-0.10	-0.005	11.80	-0.005	0.32	-0.001	-0.005	-0.005	-0.005	0.20	-0.005
MW-2	5/1/88	1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	10.10	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-3	4/28/88	-1.00	-0.0050	-0.10	0.006	0.05	-0.005	-0.10	-0.005	0.24	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-5	4/28/88	1.20	-0.0050	-0.10	0.024	-0.05	-0.005	-0.10	-0.005	0.86	-0.005	2.83	0.002	-0.005	-0.005	-0.005	0.20	-0.005
MW-6	5/1/88	-1.00	-0.0050	-0.10	0.009	-0.05	-0.005	-0.10	-0.005	0.10	-0.005	-0.01	0.045	-0.005	-0.005	-0.005	-0.10	-0.005
MW-7	4/29/88	-1.00	-0.0050	-0.10	0.063	-0.05	-0.005	-0.10	0.006	0.23	-0.005	-0.01	0.003	-0.005	-0.005	-0.005	-0.10	-0.005
MW-9	4/28/88	6.60	0.0090	-0.10	-0.005	0.06	-0.005	-0.10	0.005	0.40	-0.005	0.02	-0.001	-0.005	-0.005	-0.005	0.20	-0.005
MW-10	4/30/88	-1.00	-0.0050	-0.10	0.180	-0.05	-0.005	-0.10	-0.005	0.64	-0.005	0.78	-0.001	-0.005	-0.005	-0.005	0.10	-0.005
MW-11	4/29/88	-1.00	0.0064	-0.10	0.011	0.05	-0.005	-0.10	-0.005	0.14	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-12	4/29/88	3.50	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.18	-0.005	-0.01	0.001	-0.005	-0.005	-0.005	0.10	-0.005
MW-13	4/30/88	-1.00	0.0052	-0.10	0.245	0.07	-0.005	-0.10	-0.005	1.37	-0.005	0.86	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-14	4/30/88	-1.00	-0.0050	-0.10	0.570	0.06	-0.005	-0.10	-0.005	1.34	-0.005	0.30	-0.001	-0.005	-0.005	-0.005	0.20	-0.005
MW-15	4/30/88	-1.00	0.0074	-0.10	0.425	-0.05	-0.005	-0.10	-0.005	0.44	-0.005	-0.01	-0.001	-0.005	-0.005	0.005	-0.10	-0.005
MW-16	4/27/88	-1.00	-0.0050	-0.10	0.005	-0.05	-0.005	-0.10	-0.005	0.17	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-17	4/27/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.23	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-18	4/28/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.32	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	5/1/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.27	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
TRIP BLANK	5/1/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.10	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
LAB BLANK	5/1/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005

QUARTZ MOUNTAIN: WATER QUALITY DATABASE

SAMPLE PERIOD:
APR - MAY 1988

IDENTIFIER		RADIOLOGICAL			
TEST POINT	DATE	Gross alpha (pCi/l)	Gross beta (pCi/l)	Error alpha (pCi/l)	Error beta (pCi/l)
MW-1	4/30/88	0.00	14.39	0.80	11.99
MW-2	5/1/88	7.20	10.62	3.74	12.64
MW-3	4/28/88	2.95	27.95	3.06	17.75
MW-5	4/28/88	0.61	0.00	2.09	20.06
MW-6	5/1/88	0.00	0.00	1.07	10.78
MW-7	4/29/88	3.73	0.00	3.44	17.12
MW-9	4/28/88	21.20	34.80	7.33	18.62
MW-10	4/30/88	0.00	20.05	1.12	12.12
MW-11	4/29/88	1.14	0.00	1.67	11.12
MW-12	4/29/88	0.00	0.00	1.07	15.60
MW-13	4/30/88	0.00	0.00	0.80	11.23
MW-14	4/30/88	0.00	0.00	1.13	11.33
MW-15	4/30/88	1.82	12.96	1.89	11.36
MW-16	4/27/88	0.00	0.00	1.14	16.34
MW-17	4/27/88	0.00	0.79	1.08	16.48
MW-18	4/28/88	0.00	0.00	1.22	17.20
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	5/1/88	0.00	11.10	0.90	10.39
TRIP BLANK	5/1/88	0.00	2.08	0.88	9.92
LAB BLANK	5/1/88	0.00	9.19	0.89	10.21

QUARTZ MOUNTAIN:
WATER QUALITY DATABASE

SAMPLING PERIOD:
SEP 1988

IDENTIFIER		GENERAL						MAJOR CATIONS				MAJOR ANIONS						
TEST POINT	DATE	TEMP (C)	FIELD COND (umho/cm)	FIELD pH (su)	LAB COND (umho/cm)	LAB pH (su)	TDS (mg/l)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	CO3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	Cl (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	F (mg/l)
MW-1	9/20/88	N/A	N/A	N/A	352.00	4.4	346.00	10.70	16.40	30.30	9.50	N/A	0.00	330.00	1.50	0.15	-0.02	0.22
MW-2	9/20/88	N/A	N/A	N/A	110.00	7.8	119.00	10.40	6.30	7.60	5.80	N/A	65.20	2.20	1.32	0.17	-0.02	0.08
MW-3	9/22/88	N/A	N/A	N/A	169.00	7.7	176.00	8.40	5.00	19.00	10.60	N/A	111.00	-0.10	1.10	0.17	-0.02	-0.05
MW-5	9/22/88	N/A	N/A	N/A	278.00	6.9	249.00	15.40	2.00	38.20	15.70	N/A	198.00	1.00	0.62	-0.10	-0.02	0.08
MW-6	9/22/88	N/A	N/A	N/A	77.80	8.0	116.00	4.00	5.20	6.80	4.50	N/A	50.70	0.10	1.19	0.11	-0.02	0.06
MW-7	9/20/88	N/A	N/A	N/A	326.00	8.4	244.00	20.70	5.00	44.90	9.60	15.50	180.00	11.10	4.76	0.10	-0.02	0.18
MW-9	9/22/88	N/A	N/A	N/A	55.30	7.2	27629.00	5.70	6.30	3.40	1.60	N/A	75.60	-0.10	1.35	0.17	-0.02	0.06
MW-10	9/21/88	N/A	N/A	N/A	282.00	6.8	280.00	14.70	4.10	34.30	6.70	N/A	44.50	177.00	1.06	-0.10	-0.02	0.35
MW-11	9/23/88	N/A	N/A	N/A	80.30	7.1	103.00	7.70	6.70	9.80	1.70	N/A	52.80	0.70	1.09	0.12	-0.02	0.08
MW-12	9/21/88	N/A	N/A	N/A	110.00	7.8	134.00	7.70	7.10	9.50	5.70	N/A	68.30	2.90	1.27	0.17	-0.02	0.07
MW-13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MW-14	9/23/88	N/A	N/A	N/A	180.00	7.5	196.00	7.40	6.70	21.30	9.20	N/A	106.00	13.90	1.04	-0.10	-0.02	-0.05
MW-15	9/23/88	N/A	N/A	N/A	59.90	6.8	136.00	8.40	6.30	2.90	0.80	N/A	9.30	22.50	1.23	-0.10	-0.02	0.07
MW-16	9/21/88	N/A	N/A	N/A	172.00	7.6	151.00	8.00	3.30	21.60	8.20	N/A	106.00	0.70	1.15	0.44	0.06	-0.05
MW-17	9/21/88	N/A	N/A	N/A	93.70	7.2	145.00	8.70	1.00	7.70	3.40	N/A	54.90	1.30	1.81	0.21	-0.02	0.06
MW-18	9/21/88	N/A	N/A	N/A	270.00	7.6	220.00	13.70	5.80	30.90	18.50	N/A	184.00	2.00	0.74	-0.10	-0.02	-0.05
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	9/22/88	N/A	N/A	N/A	2.30	6.1	9.00	-0.10	-0.10	0.80	0.10	N/A	2.60	-0.10	0.66	-0.10	-0.02	-0.05
TRIP BLANK	9/22/88	N/A	N/A	N/A	1.30	5.9	9.00	-0.10	-0.10	0.10	-0.10	N/A	2.60	-0.10	0.68	-0.10	-0.02	-0.05
LAB BLANK	9/24/88	N/A	N/A	N/A	2.50	6.3	7.00	-0.10	-0.10	-0.10	-0.10	N/A	2.60	-0.10	0.69	-0.10	-0.02	-0.05

NOTES

N/A Not applicable or measurement/analysis not performed.
- Detection limit.
RNA Results not available; samples currently being analyzed.

QUARTZ MOUNTAIN
WATER QUALITY DATABASE

SHEET: 2 OF 3

SAMPLING PERIOD:
SEP 1988

IDENTIFIER		TRACERS AND METALS																
TEST POINT	DATE	TOC (mg/l)	Phenols (mg/l)	B (mg/l)	As (mg/l)	Ba (mg/l)	Cd (mg/l)	Cu (mg/l)	Cr (mg/l)	Fe (mg/l)	Pb (mg/l)	Mn (mg/l)	Hg (mg/l)	Se (mg/l)	Ag (mg/l)	Sb (mg/l)	Zn (mg/l)	Total CN (mg/l)
MW-1	9/20/88	-1.00	-0.0050	-0.10	0.016	-0.05	-0.005	-0.10	0.024	12.70	-0.005	1.11	-0.001	-0.005	-0.005	-0.005	0.24	-0.005
MW-2	9/20/88	-1.00	-0.0050	0.11	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-3	9/22/88	-1.00	-0.0050	-0.10	0.013	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-5	9/22/88	1.20	-0.0050	-0.10	0.020	-0.05	-0.005	-0.10	-0.005	0.54	-0.005	6.14	0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-6	9/22/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-7	9/20/88	-1.00	-0.0050	-0.10	0.043	-0.05	-0.005	-0.10	-0.005	0.10	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-9	9/22/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.12	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-10	9/21/88	-1.00	-0.0050	-0.10	0.027	-0.05	-0.005	-0.10	-0.005	3.06	-0.005	1.22	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-11	9/23/88	-1.00	-0.0050	-0.10	0.016	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-12	9/21/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MW-14	9/23/88	-1.00	-0.0050	-0.10	0.045	0.08	-0.005	-0.10	-0.005	0.56	-0.005	0.42	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-15	9/23/88	-1.00	-0.0050	-0.10	0.058	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	0.02	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-16	9/21/88	-1.00	-0.0050	-0.10	0.007	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	0.025	-0.005	-0.005	-0.005	-0.10	0.006
MW-17	9/21/88	2.40	-0.0050	-0.10	0.006	-0.05	0.021	-0.10	-0.005	0.06	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	0.62	-0.005
MW-18	9/21/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	9/22/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	0.03	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
TRIP BLANK	9/22/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
LAB BLANK	9/24/88	-1.00	-0.0050	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005

QUARTZ MOUNTAIN: SHEET: 3 OF 3
WATER QUALITY DATABASE

SAMPLING PERIOD:
SEP 1988

IDENTIFIER		RADIOLOGICAL			
TEST POINT	DATE	Gross alpha (pCi/l)	Gross beta (pCi/l)	Error alpha (pCi/l)	Error beta (pCi/l)
MW-1	9/20/88	RNA	RNA	RNA	RNA
MW-2	9/20/88	RNA	RNA	RNA	RNA
MW-3	9/22/88	RNA	RNA	RNA	RNA
MW-5	9/22/88	RNA	RNA	RNA	RNA
MW-6	9/22/88	RNA	RNA	RNA	RNA
MW-7	9/20/88	RNA	RNA	RNA	RNA
MW-9	9/22/88	RNA	RNA	RNA	RNA
MW-10	9/21/88	RNA	RNA	RNA	RNA
MW-11	9/23/88	RNA	RNA	RNA	RNA
MW-12	9/21/88	RNA	RNA	RNA	RNA
MW-13	N/A	N/A	N/A	N/A	N/A
MW-14	9/23/88	RNA	RNA	RNA	RNA
MW-15	9/23/88	RNA	RNA	RNA	RNA
MW-16	9/21/88	RNA	RNA	RNA	RNA
MW-17	9/21/88	RNA	RNA	RNA	RNA
MW-18	9/21/88	RNA	RNA	RNA	RNA
QTZ MT SPR	N/A	N/A	N/A	N/A	N/A
FIELD BLANK	9/22/88	RNA	RNA	RNA	RNA
TRIP BLANK	9/22/88	RNA	RNA	RNA	RNA
LAB BLANK	9/24/88	RNA	RNA	RNA	RNA

QUARTZ MOUNTAIN
WATER QUALITY DATABASE

SAMPLING PERIOD:
DEC 1987 - JAN 1988

IDENTIFIER		GENERAL							MAJOR CATIONS				MAJOR ANIONS						
TEST POINT	DATE	TEMP (C)	FIELD COND (umho/cm)	FIELD pH (su)	LAB COND (umho/cm)	LAB pH (su)	TDS (mg/l)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	CO3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	Cl (mg/l)	NO3-N (mg/l)	NO2-N (mg/l)	F (mg/l)
MW-1	12/29/87	11.0	150.00	7.30	145.00	7.5	147.00	9.00	2.30	42.90	9.10	N/A	104.00	0.42	1.07	0.40	-0.02	-0.05
MW-2	12/31/87	10.2	311.00	N/A	289.00	7.4	219.00	10.00	3.50	26.20	22.30	N/A	175.00	1.43	0.75	0.21	-0.02	-0.05
MW-3	12/29/87	10.6	150.00	N/A	197.00	7.6	178.00	10.00	3.60	35.60	16.40	N/A	114.00	0.17	1.20	0.20	-0.02	-0.05
MW-5	12/29/87	8.0	235.00	N/A	331.00	6.8	240.00	14.50	0.90	64.10	18.60	N/A	199.00	1.70	0.67	0.14	-0.02	0.07
MW-6	12/30/88	9.5	30.00	N/A	114.00	7.7	125.00	5.80	4.60	13.20	7.80	N/A	64.60	0.88	1.34	-0.10	-0.02	0.05
MW-7	1/2/88	11.7	356.00	N/A	344.00	8.7	247.00	22.00	4.10	36.70	11.00	42.00	170.00	7.65	5.31	-0.10	0.02	0.14
MW-9	1/3/88	5.3	61.00	N/A	59.20	7.4	31900.00	4.80	2.50	1.50	1.00	N/A	90.00	-0.10	3.38	0.33	0.02	-0.05
MW-10	12/29/87	9.5	240.00	N/A	232.00	6.9	218.00	11.00	3.20	37.60	10.20	N/A	48.60	74.70	1.19	-0.10	-0.02	0.20
MW-11	1/1/88	10.0	93.00	N/A	102.00	7.1	131.00	6.80	4.80	12.30	1.40	N/A	56.90	-0.10	1.11	0.19	-0.02	-0.05
MW-12	12/30/88	N/A	N/A	N/A	136.00	8.1	140.00	10.00	6.10	12.00	7.30	N/A	72.40	1.63	1.57	-0.10	-0.02	0.07
MW-13	12/87	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MW-14	12/30/87	10.5	213.00	N/A	213.00	7.5	185.00	6.20	5.50	33.80	11.60	N/A	106.00	12.30	1.27	-0.10	-0.02	0.06
MW-15	1/2/88	11.0	69.00	7.30	84.80	6.4	166.00	9.50	5.40	1.30	0.70	N/A	8.80	25.20	1.54	-0.10	-0.02	0.05
MW-16	12/28/87	11.0	140.00	7.10	143.00	7.5	145.00	8.50	2.20	45.50	11.80	N/A	106.00	0.49	1.04	0.39	-0.02	-0.05
MW-17	12/30/87	N/A	N/A	N/A	95.20	7.2	124.00	9.50	0.70	7.90	7.00	N/A	56.40	0.41	1.28	0.11	-0.02	0.05
MW-18	12/31/87	9.9	311.00	N/A	284.00	7.4	217.00	9.50	3.80	60.40	26.90	N/A	174.00	1.74	0.83	0.20	-0.02	-0.05
QTZ MTN SPR	12/29/87	8.5	69.00	N/A	73.40	6.8	104.00	5.80	5.50	1.50	1.00	N/A	39.00	0.82	1.86	-0.10	-0.02	-0.05
FIELD BLANK	12/31/87	13.2	0.00	N/A	1.90	8.1	8.00	-0.10	-0.10	0.20	0.03	N/A	3.60	0.51	0.57	-0.10	-0.02	-0.05
TRIP BLANK	12/31/88	N/A	N/A	N/A	1.20	7.6	10.00	-0.10	-0.10	-0.10	-0.01	N/A	4.10	0.34	0.59	-0.10	-0.02	-0.05
LAB BLANK	1/4/88	N/A	N/A	N/A	1.10	6.6	19.00	-0.10	-0.10	-0.10	-0.01	N/A	1.60	0.34	0.57	-0.10	-0.02	-0.05

NOTES

N/A Not applicable or measurement/analysis not performed.
\- Detection limit.

QUARTZ MOUNTAIN:
WATER QUALITY DATABASE

SAMPLING PERIOD:
DEC 1987 - JAN 1988

IDENTIFIER TRACERS AND METALS

TEST POINT	DATE	TOC (mg/l)	Phenols (mg/l)	B (mg/l)	As (mg/l)	Ba (mg/l)	Cd (mg/l)	Cu (mg/l)	Cr (mg/l)	Fe (mg/l)	Pb (mg/l)	Mn (mg/l)	Hg (mg/l)	Se (mg/l)	Ag (mg/l)	Sb (mg/l)	Zn (mg/l)	Total CN (mg/l)
MW-1	12/29/87	1.00	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.05	-0.005	-0.01	0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-2	12/31/87	-0.60	-0.005	-0.10	0.010	-0.05	-0.005	-0.10	-0.005	0.21	0.010	0.03	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-3	12/29/87	-0.60	-0.005	-0.10	0.005	-0.05	-0.005	-0.10	-0.005	0.22	-0.005	0.02	-0.001	-0.005	0.006	-0.005	-0.10	-0.005
MW-5	12/29/87	1.80	-0.005	-0.10	0.040	-0.05	-0.005	-0.10	-0.005	0.55	-0.005	5.10	0.002	-0.005	-0.005	-0.005	-0.10	-0.005
MW-6	12/30/88	1.20	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.16	-0.005	-0.01	-0.001	-0.005	0.062	-0.005	-0.10	-0.005
MW-7	1/2/88	0.90	-0.005	-0.10	0.160	-0.05	-0.005	-0.10	-0.005	0.45	-0.005	0.02	0.002	-0.005	-0.005	-0.005	-0.10	-0.005
MW-9	1/3/88	0.80	-0.005	0.14	-0.005	-0.05	-0.005	-0.10	-0.005	0.20	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-10	12/29/87	-0.60	-0.005	-0.10	0.170	-0.05	-0.005	-0.10	-0.005	0.86	-0.005	0.73	3.800	-0.005	-0.005	-0.005	-0.10	-0.005
MW-11	1/1/88	1.20	-0.005	-0.10	0.020	-0.05	-0.005	-0.10	-0.005	0.07	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	0.005
MW-12	12/30/88	0.80	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.25	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-13	12/87	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MW-14	12/30/87	0.80	-0.005	-0.10	0.400	-0.05	-0.005	-0.10	-0.005	0.61	-0.005	0.25	-0.001	-0.005	0.030	-0.005	-0.10	-0.005
MW-15	1/2/88	-0.60	-0.005	0.11	0.510	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	0.02	-0.001	-0.005	-0.005	0.020	-0.10	-0.005
MW-16	12/28/87	-0.60	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.65	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-17	12/30/87	1.00	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.12	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
MW-18	12/31/87	-0.60	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	0.005	0.38	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
QTZ MTN SPR	12/29/87	1.50	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	0.11	-0.005	-0.01	-0.001	-0.005	0.008	-0.005	-0.10	-0.005
FIELD BLANK	12/31/87	-0.60	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
TRIP BLANK	12/31/88	-0.60	-0.005	0.12	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005
LAB BLANK	1/4/88	-0.60	-0.005	-0.10	-0.005	-0.05	-0.005	-0.10	-0.005	-0.05	-0.005	-0.01	-0.001	-0.005	-0.005	-0.005	-0.10	-0.005

WATER QUALITY DATABASE

SAMPLING PERIOD:
DEC 1987 - JAN 1988

IDENTIFIER		RADIOLOGICAL			
TEST POINT	DATE	Gross alpha (pCi/l)	Gross beta (pCi/l)	Error alpha (pCi/l)	Error beta (pCi/l)
MW-1	12/28/87	-0.50	-2.00	N/A	N/A
MW-2	12/31/87	-1.00	3.36	N/A	N/A
MW-3	12/29/87	2.20	5.62	N/A	N/A
MW-5	12/29/87	-1.00	8.35	N/A	N/A
MW-6	12/30/88	-0.50	3.08	N/A	N/A
MW-7	1/2/88	17.10	12.70	N/A	N/A
MW-9	1/3/88	271.00	252.00	N/A	N/A
MW-10	12/29/87	-1.00	-2.50	N/A	N/A
MW-11	1/1/88	1.28	7.22	N/A	N/A
MW-12	12/30/88	-0.50	5.57	N/A	N/A
MW-13	12/87	N/A	N/A	N/A	N/A
MW-14	12/30/87	-0.50	4.70	N/A	N/A
MW-15	1/2/88	1.30	7.01	N/A	N/A
MW-16	12/28/87	-0.50	2.54	N/A	N/A
MW-17	12/30/87	-0.50	-2.00	N/A	N/A
MW-18	12/31/87	-0.50	3.47	N/A	N/A
QTZ MTN SPR	12/29/87	-0.50	6.60	N/A	N/A
FIELD BLANK	12/31/87	-0.50	-2.00	N/A	N/A
TRIP BLANK	12/31/88	-0.50	-0.50	N/A	N/A
LAB BLANK	1/4/89	-0.50	-1.00	N/A	N/A

QUARTZ MOUNTAIN GOLD CORP.

935 Marine Building, 355 Burrard Street, Vancouver, B.C. V6C 2G8 • (604) 662-7557 • Telecopy: (604) 662-8956 Telex 04-507887

FOR IMMEDIATE RELEASE March 1, 1988

Quartz Mountain Gold Releases Computer Calculated Reserves

Quartz Mountain Gold Corp. today released new reserve figures for the Crone Hill and Quartz Butte ore bodies, located in the western portion of their Quartz Mountain property in south central Oregon. These calculations incorporate the results of 1987 drilling and show a substantial increase in overall grade of the deposits. The contained gold in mineral inventory now is in excess of three million ounces.

Drill proven and probable reserves at various minimum cut-off grades are as follows:

Cut-off Grade	Tons	Grade oz gold/ton	Contained Ounces of Gold
.015	66.4 million	.030	2,007,000
.020	44.9 million	.037	1,661,000
.030	23.4 million	.049	1,146,000

These represent approximately a 20 percent increase in grade over previous estimates. Reserve estimates are based on assays from 577 drill holes at 100 foot centres on Crone Hill and Quartz Butte. Assays exceeding 0.30 were reduced to 0.30 ounces per ton to avoid over estimation of grade.

"These increases clearly show the effect of the five high grade zones discovered by the infill drilling of 1987", said Dr. William H. Bird, Chairman and C.E.O. of Quartz Mountain Gold Corp. "The higher average grade improves the economics of the deposits and will lower the per ounce cost of producing gold."

The reserve estimate does not include the Angels Camp bonanza structure nor the Angel Peak and Drews Creek prospects. Reserves for these areas will be reported later when drilling on the prospects is further advanced. Galactic Resources Ltd., Quartz Mountain Gold Corp.'s joint venture partner on the project, is currently directing a Minproc (U.S.A.) Inc. feasibility study for the first phase heap leach mine to be located on Crone Hill.

Quartz Mountain Gold Corp. commenced trading on The Toronto Stock Exchange today under the symbol QZM.T, is listed on the U.S. NASDAQ National Market System under the symbol QZMGF and also trades on the Vancouver Stock Exchange under the symbol QZM.V.

William H. Bird

Dr. William H. Bird
Chairman & C.E.O.

QUARTZ MOUNTAIN GOLD CORP.

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FOR IMMEDIATE RELEASE October 27, 1987

Summer Program Completes over 150,000 feet of Drilling

Vancouver, B.C. -- Dr. William H. Bird, Chairman and CEO of Quartz Mountain Gold Corp., and Robert M. Friedland, Chairman and CEO of Galactic Resources Ltd., announced today that the summer, 1987 development program has drilled 373 holes totalling 137,847 feet. At the end of October the completed program will have finished over 400 holes containing more than 150,000 feet of drilling. These holes, along with the 204 holes of the 1986 drilling, will provide the ore reserve data base with over 225,000 feet of drilling and 45,000 assays. The ore bodies will have been drilled on 100-foot centers providing sufficient coverage to prove reserves.

Of the 383 holes drilled during the past summer, 316 holes are within the Crone Hill and Quartz Butte ore bodies. These new ore holes have expanded the reserves at depth and on the south and north of the ore bodies.

Grades drilled during 1987 were generally higher than those reported in 1986. Nineteen new holes contained high grade intercepts of from 25' to 200' grading above 0.1 ounces of gold per ton. Fifty-seven new holes contained intercepts grading from .05 to 0.1 ounces of gold per ton over thickness of 25' to 150'. Seventy-five holes contained unusually thick intercepts of from 100 to 400 feet of .03 to .05 ounces of gold per ton. The remaining holes contained expected grades and thicknesses. These new drill holes will add significantly to the overall grade of the ore bodies.

Development drilling at Crone Hill and Quartz Butte will be complete by the end of October. Exploration drilling at the Angels Camp, Quartz Butte, Crone Hill and additional eastern targets will continue into the winter.

Quartz Mountain Gold Corp. has been upgraded within the NASDAQ System from our introductory listing to the National Market System. The NASDAQ symbol is QZMGF. Up-to-the-minute trades and quotes are now available through brokers and quotes will be printed daily in the financial papers. Quartz Mountain Gold also trades on the Vancouver Stock Exchange under the symbol QZM.V.

William H. Bird

Dr. William H. Bird
Chairman & C.E.O.

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GALACTIC RESOURCES LTD.

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FOR IMMEDIATE RELEASE June 22, 1987

Quartz Mountain Gold Discovers High-Grade Bonanza Structure at Angels Camp

Robert M. Friedland, Chairman and CEO of Galactic Resources Ltd., confirms today the discovery of a high-grade gold bonanza structure at Angels Camp in the eastern half of Quartz Mountain Gold's 10,000-acre southern Oregon property. Galactic Resources Ltd. and Quartz Mountain Gold are developing the property through a joint venture agreement. January 1987 drilling intersected a 50-foot section of this structure assaying a quarter of an ounce of gold per ton. Subsequent geological mapping delineated a 3-mile long fracture zone that passes through Angels Camp and part of the Angel Peak and Drews Creek prospects.

This fracture zone is exposed at the surface in only one area near the discovery drill hole at Angels Camp. A continuous channel sample cut across the outcrop in late May produced the following assays:

	Length in feet	Oz/ton Gold	Oz/ton Silver
1st Section	5	0.312	0.26
2nd Section	8	0.390	1.99
3rd Section	13	4.886	7.94
4th Section	13	0.652	0.91

The channel was cut at an angle to the true thickness of the structure. A weighted average over the true thickness of 20 feet runs 1.966 ounces of gold per ton and 3.39 ounces of silver per ton.

The epithermal gold exploration model developed by the Quartz Mountain Gold geologists predicted the existence of high-grade bonanza structures. The Angels Camp fracture zone and other similar structures on the property are now important targets for gold exploration. Initial plans call for extensive trenching to expose the structures at the surface and a major drilling program to delineate ore bodies at depth.

At Crone Hill and Quartz Butte in the western half of the Quartz Mountain Gold property, work is progressing rapidly to develop a heap leach mine and to prove

- more -

Jerry G.

QUARTZ MOUNTAIN GOLD CORP.

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FOR IMMEDIATE RELEASE

May 11, 1987

Quartz Mountain Gold Announces Mineral Inventory

Vancouver, B.C. - Dr. William H. Bird, Chairman and C.E.O. of Quartz Mountain Gold Corp., announced today the first results of the Wright Engineers Ltd. evaluation of the gold resources at Crone Hill and Quartz Butte. The data base for this evaluation is derived from over 200 holes drilled during the past year on the Company's 10,000-acre southern Oregon property. Reserves at Crone Hill and Quartz Butte have not yet been completely drilled out. A U.S. $2.5 million budget has been dedicated to finish this task over the coming six months. The presented numbers do not include any results from the Angels Camp, Angel Peak or Drews Creek areas in the eastern half of the property. These targets will also be drilled out this summer and the appropriate reserves added to the overall engineering plan for the property.

Wright Engineers calculated that, to date, Quartz Mountain Gold's drilling program has delineated 128.6 million tons containing a mineral inventory of over 2.5 million ounces of gold at a cut off grade of .01 ounces of gold per ton and an average grade of .02 ounces of gold per ton. At a higher cut off grade of .02 ounces of gold per ton, a mineral inventory of nearly 1.5 million ounces of gold are contained in 47.6 million tons grading .03 ounces of gold per ton.

These contained ounces and tonnage numbers are much larger than the numbers used to develop Quartz Mountain Gold's original heap leach engineering plans. New studies and tests are now underway to determine how best to recover the maximum amount of gold. The studies will require from four to six months to complete and to be integrated into a meaningful prefeasibility study on the entire Crone Hill and Quartz Butte reserves.

The past year's drilling has outlined a large low stripping ratio deposit of easily leached oxide ore on Crone Hill. The Company is examining the possibility of building a first phase low cost heap leach operation using this ore in order to offset any delays in its fast-track production plans. This operation will allow Quartz Mountain Gold to attain production as it completes the engineering necessary to exploit the full potential of the property. The first phase Crone Hill heap leach pit design under consideration contains 12.1 million tons of ore grading .028 ounces of gold per ton with a cut off grade of .015 ounces of gold per ton and a 0.8 to 1 stripping ratio.

- more -

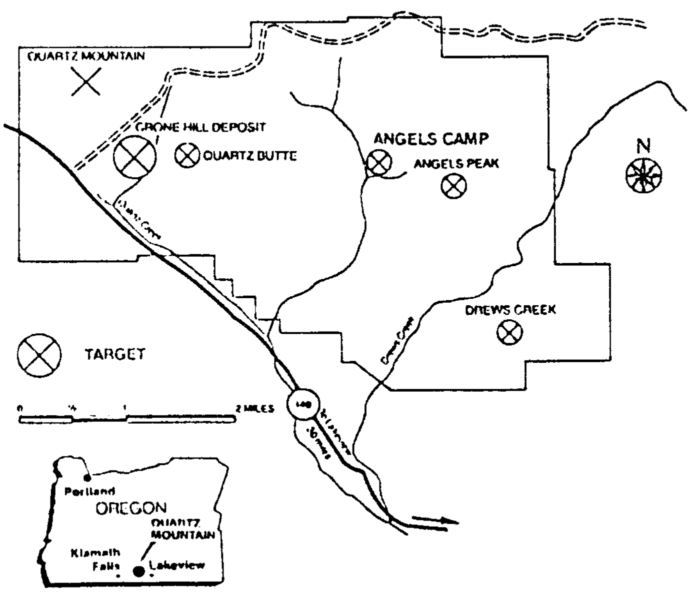
Quartz Mountain Gold Corp. is in the process of concluding a project management/engineering agreement for their Oregon project with Minproc (U.S.A.) Inc., a subsidiary of Minproc Holdings Limited of Perth, Australia. Minproc has brought 23 gold projects into production world wide during the last 7 years and is a joint venture partner with Fluor Corp. to develop the Ridgeway, South Carolina mine for Galactic Resources Ltd. and Amselco Minerals Inc., an wholly owned subsidiary of B.P. North America Inc. Minproc will bring its full range of expertise in mine planning, metallurgical engineering and project management to bear on the project to determine the optimum method for beneficiating the entire mineable reserve on the property.

Quartz Mountain Gold Corp. trades on the Vancouver Stock Exchange under the symbol QZM.V.

- 30 -

William H. Bird, Chairman and C.E.O.

OREGON PROJECT AREA



QUARTZ MOUNTAIN GOLD CORP.

935 Marine Building, 355 Burrard Street, Vancouver, B.C. V6C 2G8 • (604) 662-7557 • Telecopy: (604) 682-4033 Telex: 04-507887

FOR IMMEDIATE RELEASE

December 16, 1986

Quartz Mountain Gold Corp. Announces Gold Discovery
At Angels Camp
Drilling to Begin in January

Vancouver, B.C. - Dr. William H. Bird, Chairman and CEO of Quartz Mountain Gold Corp., announced today that detailed geological mapping and sampling at Angels Camp, Oregon has resulted in an important new surface discovery of ore-grade gold. Angels Camp lies three miles east of the Company's Crone Hill and Quartz Butte gold deposits and it is one of the untested exploration targets in the eastern portion of the 10,000-acre southern Oregon Property. The discovery marks the first time that gold has been found in this area and it represents an important success in the application of the Quartz Mountain Gold exploration model to other targets controlled by the Company.

Quartz Mountain Gold plans an immediate drill program at Angels Camp to test the full extent of the gold discovery. Drilling roads and permits are currently being completed and a reverse circulation drilling rig is being mobilized to begin work during the first week in January. The Angels Camp drilling program will be part of an expanded Winter schedule on the property that will include additional fill-in drilling at Crone Hill and Quartz Butte.

Wright Engineers Ltd. of Vancouver has been engaged by Quartz Mountain Gold Corp. to prepare a Prefeasibility Study on the Crone Hill and Quartz Butte deposits. Prospects for the new discovery at Angels Camp will be included in this study in a section on the potential of the eastern part of the property.

Quartz Mountain Gold Corp. trades on the Vancouver Stock Exchange under the symbol QZM.V.

\- 30 -

Dr. William H. Bird, Chairman & C.E.O.

ABSTRACT

Geology and Mineralization in the Quartz Mountain Gold District

Peter A. Dilles

William R. Rohtert

November 11, 1986

Disseminated gold mineralization has been outlined within two endogenous rhyolite dome complexes and within the adjacent basaltic flows and volcaniclastic beds in the Quartz Mountain district. Both domes occur along a northwest-trending intrusive belt approximately 20 kilometers long by 5 kilometers wide. Fifteen individual domes, ranging from 300 meters to more than 3000 meters in diameter, have been emplaced along the trace of the McLaughlin Lineament of Lawrence (1976). This lineament is a 200 kilometer long dextral--oblique strike-slip fault with over 15 kilometers of offset. Recent mapping indicates two types of domes are present in the intrusive belt: 1. exogenous glassy domes of felsic to intermediate composition, and 2. endogenous, quartz-eye rhyolite porphyry domes which appear to be spatially and genetically related to the gold mineralization. This assemblage is similar to the intrusive rocks in a parallel belt ten kilometers to the north near the White King and Lucky Lass uranium mines which has been described by Weissenburger (1984).

At Quartz Mountain, the endogenous rhyolite domes cut, are interbedded with, and are locally overlain by, an areally extensive series of basalt flows of unknown age. The older basalts, which host most of the gold mineralization, exceed 1000 feet in thickness. They are unconformably overlain by a series of younger basalt flows which exceed 2000 feet in thickness. Variations in phenocryst mineralogy, texture, and field occurrence further divide the younger series into three sub-units: 1. a lower, trachytic plagioclase--magnetite basalt member; 2. a middle olivine basalt member; and an upper aphanitic and scoreaceous member. The older, mineralized basalts intertongue with proximal hydrovolcanic and volcaniclastic tuff breccias that ring endogenous rhyolite domes at five locations in the district. Basaltic material is present in the fragment population of hydrothermal and vent breccias which feed and cross-cut the rhyolites and associated tuff-rings. Detrital rhyolitic material is locally interbedded with heterolithic mafic tuffs in the older basalts.

Four endogenous rhyolite domes in the district have been mined for mercury. Cinnabar occurs with opal, alunite, clay and native sulfur in zones of intense acid-leaching at the apices of the mineralized endogenous domes. The gold mineralization at Crone Hill and Quartz Butte occurs beneath the zone of mercury mineralization. Native gold accompanies pervasive silica flooding and veining and is associated with pyrite, marcasite, and stibnite. Silicification is frequently intermixed with variable propylitic, argillic, and sericitic alteration. Gold ore occurs in hot-spring sinter breccias; quartz veins, stockworks and hydrothremal brecias along intrusive contacts; and in a stratabound zone of replacement mineralization occupying a tuff breccia horizon. Reserves in excess of one million contained ounces of gold have been outlined in drilling since 1983.

NEWS RELEASE

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Telephone: (604) 687-7169

FOR IMMEDIATE RELEASE ***JANUARY 17, 1989***

David S. Jennings, President of Quartz Mountain Gold Corp. and Robert M. Friedland, Chairman of Galactic Resources Ltd., announced today that Quartz Mountain Gold Corp. suspended trading in its securities on January 13, 1989 in order to clarify remarks, attributed to William R. Rohtert, Vice-President, Exploration, of Quartz Mountain Gold Corp., which appeared in two news articles that were published without the knowledge and authority of the Companies or their Boards of Directors. The inaccurate and misleading news articles appeared in two Oregon newspapers and implied that Quartz Mountain Gold Corp. and joint-venture partner Galactic Resources Ltd. have made a positive production decision on the Quartz Mountain gold project in Lake County, Oregon based on advance feasibility information from independent consultants Davy McKee Corporation of San Ramon, California.

While the Companies have received preliminary results from the Phase I oxide, open-pit/heap leach study by Davy McKee on the Crone Hill and Quartz Butte deposits, no production decision has yet been made. Further refinement of the preliminary study will be necessary before any final production decisions can be made on the project. The preliminary information received to date indicates that a reduction in the preliminary capital cost estimates will be necessary to achieve acceptable oxide open-pit economics at a gold price of $350-400 U.S. per ounce. The Companies are working closely with Davy McKee to obtain lower capital costs and enhance project economics by earth-works re-engineering, incorporation of used mining equipment wherever possible, evaluation of conveyor/radial stacker alternatives, and, most importantly, assessing the impact of incorporating West Crone high-grade vein material and/or Angels Camp breccia reserves to the mine plan. Davy McKee estimates that the re-evaluation of this material will take approximately 12 to 15 weeks.

In addition, Davy McKee has initiated Phase II of the overall project feasibility analysis which is the evaluation of the gold-bearing sulphide reserve beneath the oxide reserve. Both heap leach and milling alternatives of the oxide and sulphide reserves will be addressed in the study which will be available no sooner than the end of April, 1989.

Quartz Mountain Gold Corp. is listed on the US NASDAQ National Market System under the symbol QZMGF and also trades on the Toronto Stock Exchange under the symbol QZM.T. and Vancouver Stock Exchange under the symbol QZM.V.. Galactic trades on the Montreal, Toronto, and Vancouver stock exchanges (GLC.M, GLC.T, and GLC.V), and is listed on the US NASDAQ System (GALCF). NASDAQ quotes in US $ are listed daily in the *Wall Street Journal* under *NASDAQ National Market Issues*.

David S. Jennings
President
Quartz Mountain Gold Corp.

Robert M. Friedland
Chairman
Galactic Resources Ltd.

Mining firm raked over coals i

From the Lake County Examiner

The Vancouver Stock Exchange and two of its listed companies, Galactic Resources and Quartz Mountain, were the subjects of a May 29 Forbes magazine article, "Scam Capital of the World."

"Half the companies on the VSE are out-and-out scams," author Joe Queenan quotes Vancouver writer and former VSE floor trader Adrian du Plessis as saying about the exchange. "And the rest are rig jobs of some sort."

"No one churns out a body of fiction of as consistently high a quality as the companies listed on the VSE," Queenan continues. He adds 'journalists love rewriting these guys' press releases."

"The exchange's own press releases tout the VSE as a home for junior mining companies, noting that 'of the more than 2300 companies listed on the VSE as of the end of 1988, 72 percent were natural-resource related.' Actually, 1,500 into 2,300 is 65 percent, not 72 percent, which gives you an idea of how trustworthy numbers are out here.

"Moreover, according to writer du Plessis, out of 1,205 companies on the VSE, only about 50 actually produce minerals, and only 10 to 15 are profitable. Other journalists say that not more than a tenth of the 2,300 companies listed on the VSE are real companies, in the sense that they have earnings, profits, employees, products or futures.

"But brokers unaffiliated with the exchange look baffled when asked how many legitimate companies there are on an exchange where Technigen once vaulted to $16 a share with promises of a computerized golf course and driving range.

" 'I don't know of any,' says one. 'You go into a stock because you know the promoter can run

The gold mines 'produce far more press releases than precious metals'

it up to 12 bucks, and then you try to get out before the bottom falls out.'

"When John Woods, editor of Vancouver Stockwatch, was asked how many VSE companies actually evolved into 'real' companies that stayed around for a few years, he looked amused. 'One percent?' he theorized. 'Well, that's the pessimistic view. The optimistic view? Two percent.' "

The article also highlights two VSE players, Larry Brilliant and Robert Friedland, who are connected with Galactic and Quartz Mountain.

"What sort of person is attracted to the VSE? Let's take Larry Brilliant, a New Age hype machine cut from a different, more capacious cloth than the generic Howe Street con artists. Brilliant is a chest-thumping epidemiologist who supposedly helped the World Health Organization wipe out smallpox in India and Southeast Asia before wiping out investors in western Canada."

Brilliant is on the board for SEVA, described as "a foundering organization seeking to wipe out blindness in Nepal."

Two other SEVA board members included Ram Dass and Wavy Gravy. Dass was called "the reconstructed Harvard acidhead who, with his pal Timothy Leary, helped introduce hallucinogenic drugs to North America." Wavy Gravy was said to be "the anarchistic ex-acidhead who was master of ce... Woodstock, who helped run a pig... in 1968 and who now raises mon... cataract operations.

"SEVA's absurd board also inc... Friedland, one of the most suc... pushers in Vancouver history, wh... Resources lost $44 million last y... introduced Brilliant to the VSE."

The article includes a detailed ... on Brilliant with other references ... and Galactic, plus one mentio... Mountain.

According to the sidebar, "Frie... gold mines, including Galactic R... Cornucopia, produce far more p... than precious metals, is one of th... SEVA and knows how to milk the... of Nepal for all the press cove... worth."

Brilliant and Friedland are ... friends who knew how to make ... the VSE.

"To this day Brilliant insists t... really knew anything about the fi... tecture of the VSE. The facts s... wise.

"Brilliant participated in a hos... Friedland's promotions, making ... $100,000 investment in Galactic, a... ing money in Quartz Mountai... Friedland productions. He spli... finder's fee with two other men wh... needed to line up investors to ... floundering gold mine.

"And the guy who claims to be ... admitted to FORBES that he b... $100,000 when he 'did an arbitrage... different classes of Galactic stock.

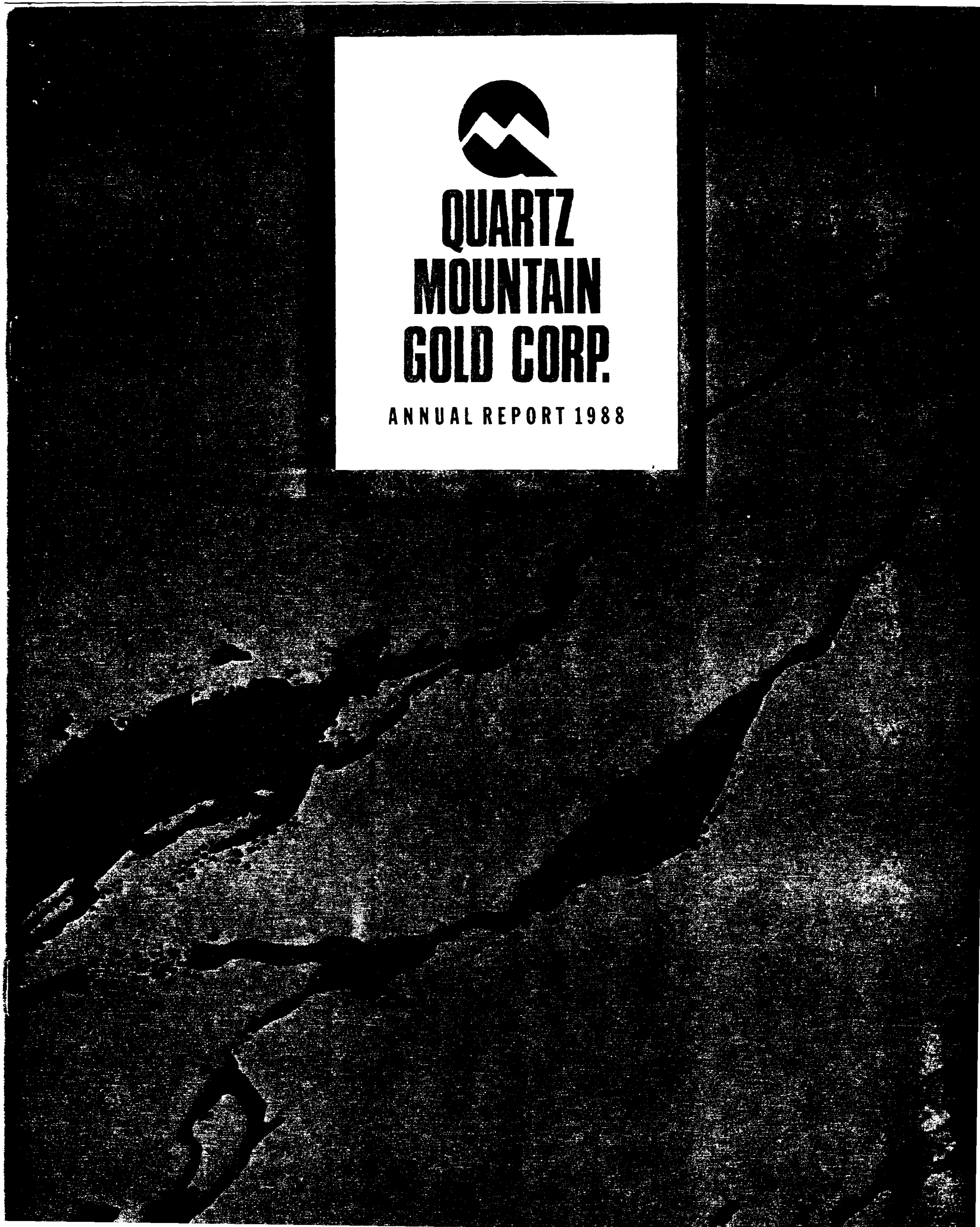
Queenan, however, concentrate... in general.

"The VSE, founded in 1907, is

Jerry, This was given to me. It appeared in the Klamath Falls Herald & News. Bob

QUARTZ MOUNTAIN GOLD CORP.

ANNUAL REPORT 1988



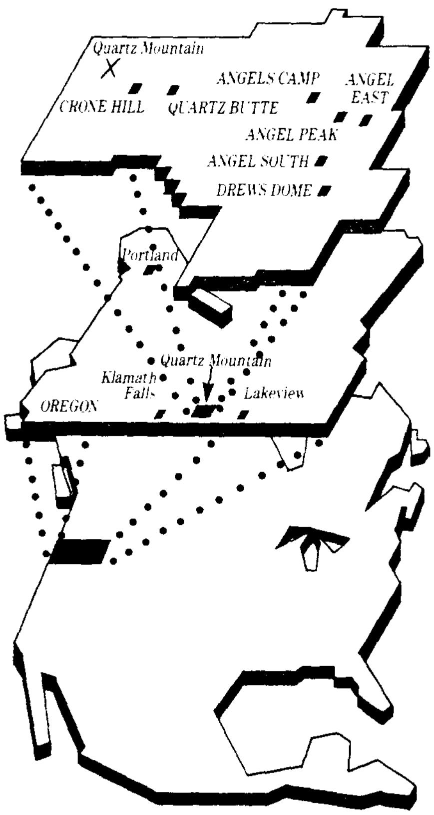
OPERATIONS REPORT

The Quartz Mountain property in south central Oregon contains several volcanic-hosted, hot spring-type gold deposits. Feasibility work is underway to evaluate two deposits on the western side of the property, Crone Hill and Quartz Butte, which were delineated by over 40 miles of drilling in 577 rotary and diamond drill holes. Drilled out on a grid with 100 foot centres, the deposits have an in situ proven and probable resource as follows:

CUT-OFF GRADE	TONS	GOLD GRADE (oz/ton)	CONTAINED OUNCES
.015	66.4 million	.030	2,007,000
.020	44.9 million	.037	1,661,000
.030	23.4 million	.049	1,146,000

With these two areas drilled out, the exploration focus has shifted to the next potential gold deposits. On the eastern half of the property, drilling at Angels Camp has indicated a small, high-grade gold resource. Drilling has now started at Angel East and Drews Dome, where geology, geochemical anomalies and alteration signatures show the potential for considerable structurally controlled mineralization. Other promising targets are Angel South and Angel Peak. At Quartz Butte, drilling is underway on several high-grade zones that could significantly enhance the overall economics of the project.

Exploration continues to improve the economics of the Quartz Mountain property, with drilling underway on high grade zones below the Quartz Butte deposits and on several other targets on the eastern half of the property.



MINE PLANNING

All aspects of gold production from Crone Hill and Quartz Butte are being examined in a full-scale feasibility study conducted by Davy McKee Corporation of San Ramon, California. This engineering firm has carried out studies and engineering work on many gold mines currently in operation, such as Echo Bay's Cove, FMC's Paradise Peak and Homestake's McLaughlin Mine.

Metallurgical testing has been subcontracted to McClelland Laboratories of Sparks, Nevada and will address the beneficiation of both oxide and sulfide ores. A drilling program to obtain the required metallurgical samples is complete and test work is well underway. Ore deposit modelling and mine design are being conducted by Pincock, Allen & Holt of Lakewood, Colorado.

The 10,000 acre Quartz Mountain property has moderate relief and climate and a good infrastructure. Water and power are readily available; State Highway 140 and ancillary logging roads provide easy access. Heap leaching, milling or a combination of both processes are being considered for the Crone Hill and Quartz Butte deposits.

When the feasibility work is completed in several months, the Company will have a definitive analysis of project economics on which to base a production decision.

GEOLOGY

The Quartz Mountain property contains a series of volcanic-hosted, hot spring gold deposits, with Crone Hill and Quartz Butte the best defined.

At Quartz Mountain, a 2000 foot thick sequence of volcanic rocks is typical of the Basin and Range geology that extends across Nevada and parts of Utah, California and Colorado, as well as south central Oregon. The two types of volcanics present are basalts (as flows, breccias and tuffs), and rhyolites (as domes, flows and breccias).

Gold mineralization at Quartz Mountain is related to rhyolite domes that have intruded the basalt volcanic rocks along northwest trending, regional structural weaknesses. The intrusion of these domes fractured and prepared the ground for the deposition of gold.

The gold bearing waters of the epithermal (hot spring) system travelled along faults and fractures and spread out horizontally, through rocks that were more permeable due to brecciation or an originally porous nature. Quartz and other minerals, including gold, were deposited. The gold is finely disseminated throughout permeable host rock and more highly concentrated in veins and along feeder structures. Northwest and northeast striking, steep faults provide strong ore control at Crone Hill and Quartz Butte.

Gold mineralization occurs in rhyolites, volcaniclastic rocks (tuffs and breccias) and basalts, and is accompanied by silica (quartz and chalcedony) and associated with pyrite, marcasite and minor stibnite, or their oxidized equivalents. The upper portions of the gold deposits have been oxidized, making the ore more amenable to heap leaching.

The Crone Hill gold deposit is a kidney shaped ellipse centred on the rhyolite dome and extending into the adjacent basalts and tuffs. It measures about 3500 feet in the longest dimension, varies in width from 800 to 2000 feet and has a vertical extent of 250 feet. The deposit lies at or close to the surface, making it ideal for open pit mining.

The Quartz Butte gold deposit lies somewhat deeper under a mercury bearing acid leach zone. It is about 1200 feet across and vertical thickness is variable, averaging 150 feet. The gold mineralization is centred on, and mainly contained within, the rhyolite dome.

At Angels Camp, on the eastern portion of the property, a different type of deposit is seen. Gold deposition is controlled by north-northwest trending structures and within a strongly veined and brecciated portion of the tuffs and breccias. Much higher gold grades, up to several ounces per ton and averaging approximately .2 ounces of gold per ton, are found in a body 200 to 250 feet long, 25 to 50 feet wide and up to 300 feet in vertical extent. There is no low grade, disseminated mineralization around this highly altered pipe-like zone. Gold occurs with silver in electrum and acanthite, associated with chalcedony, clay and iron oxides and with minor pyrite at depth. The potential for similar structures in the area is strong. Each high-grade zone found could act as a "sweetener" for the main deposits, adding 10,000 to 20,000 ounces of gold to the project.

EXPLORATION

While mine planning for the Crone Hill and Quartz Butte deposits is underway, Quartz Mountain Gold Corp. continues to search for both new discoveries and additions to known deposits.

At Quartz Butte, six high-grade zones have been identified both within and below the disseminated gold deposit. Drilling is underway to determine the continuity and significance of these zones. The high-grade areas may represent vein systems that acted as feeder zones to the disseminated gold reserves. Some could significantly enhance the overall economics of the open pit deposit; others have the potential to develop into stand-alone underground deposits.

On the eastern half of the property, an aggressive exploration program has advanced to the drilling stage. Geophysical and geochemical surveys have shown promising results, and geologic mapping and sampling, particularly along the ten miles of new drill road constructed, have further defined interesting drill targets at Drews Dome, Angel East, Angel South, Angels Camp and Angel Peak.

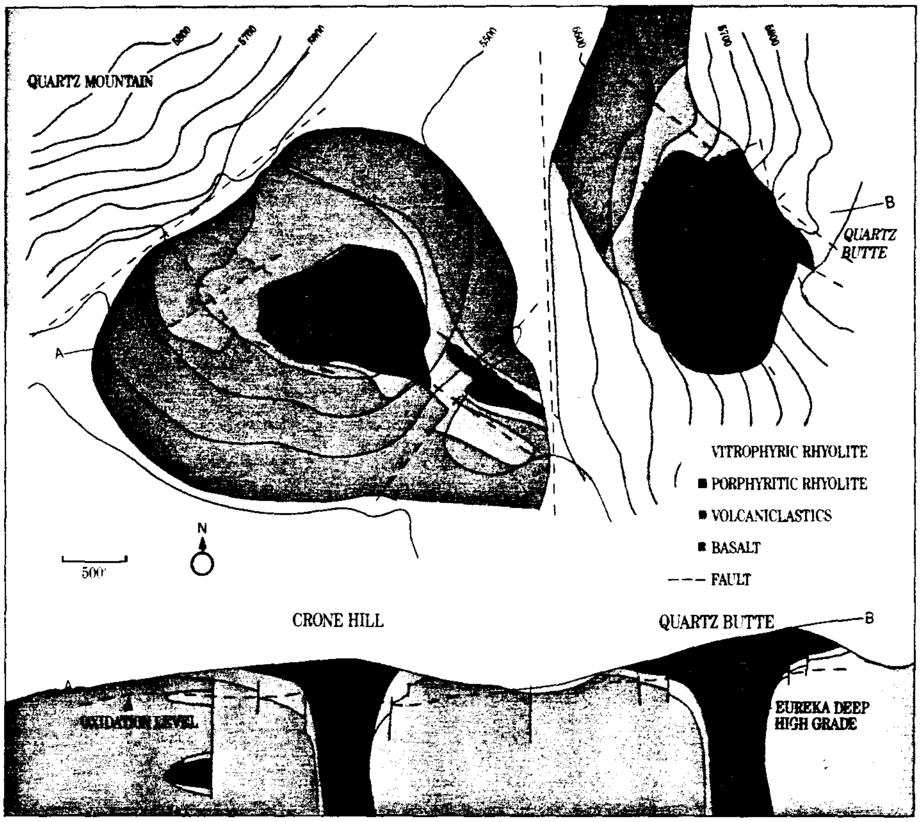
ENVIRONMENT

Development of the mineral resources of an area must go hand-in-hand with careful consideration of the environment. The impact of the production of wealth from the earth can be minimized both during and after a mining operation.

At Quartz Mountain, environmental studies have been ongoing since the property was acquired. Steffen Robertson and Kirsten, of Lakewood, Colorado, has provided environmental and permitting support. Baseline environmental studies have been completed and air and water quality monitoring continues at all times. The local wildlife, botany and archeology have been studied. The sociological and economic impact of a mining operation is also being examined.

Quartz Mountain Gold Corp. and SRK have worked closely with the local community, the Forest Service and all levels of regulatory agencies, including the Department of Environmental Quality (DEQ), the Department of Geology and Mineral Industries (DOGAMI) and Lake County officials.

Quartz Mountain Gold Corp. looks forward to being a productive and harmonious member of the community.



Crone Hill and Quartz Butte geology.

GLOSSARY

ACANTHITE: A silver mineral that may contain gold.

ACID LEACH ZONE: A zone that has been strongly altered by acidic waters percolating through the rock.

ALTERATION: Changes in the chemical or mineralogical composition of a rock caused by weathering or hydrothermal solutions.

ANOMALY: A deviation from normal. In exploration, a deviation that suggests the presence of the substance being sought.

BASALT: A volcanic rock.

BASELINE ENVIRONMENTAL STUDIES: Studies of the normal state of the environment that are used as a reference.

BENEFICIATION: Recovery of the highest possible amount of the desired metal from an ore.

BRECCIA: A rock made up of angular fragments formed by crushing or explosive force.

CHALCEDONY: Extremely fine-grained quartz.

CONTAINED OUNCES: The number of ounces of gold in the in situ resource. More work is needed to determine *mineable* ounces (contained in the ore that will be removed in a mining operation) and *recoverable* ounces (produced as the final product of the processing facilities).

DIAMOND DRILL: A drill that produces solid samples of the rock, in the form of cylinders (core).

DISSEMINATED: Ore minerals that are fine-grained and evenly distributed throughout waste rock, usually in relatively low concentrations.

ELECTRUM: A natural alloy of gold and silver.

EPITHERMAL: Pertaining to a hot spring.

FEEDER ZONE: A spatially constricted zone that has allowed mineralizing fluids to pass through.

FLOW: Rock produced by a lava flow.

GEOCHEMICAL ANOMALY OR SIGNATURE: A concentration of an element in soil, water or rock that is markedly different from the normal concentration of the surroundings.

HEAP LEACHING: Dissolving minerals or metals from ore with chemical solutions that are sprinkled on heaps of ore. The metal-bearing fluid is then run through a process that removes the metal.

HOT SPRING-TYPE GOLD DEPOSIT: A gold deposit formed by hot, gold-bearing fluids passing through near surface rocks and depositing gold.

HYDROTHERMAL: Hot water solutions, or changes caused by these solutions.

INFRASTRUCTURE: The framework of services and facilities required by a mining operation.

IN SITU: In its natural position or place. When referring to a mineral resource, in the ground.

LEACH: To remove minerals or metals by percolating fluids.

MARCASITE: An iron sulfide mineral.

MILLING: Removing metals from ore by a process that begins with very fine grinding of the rock.

OXIDE: Mineralized material in which some of the original minerals have been oxidized (rusted). This process makes the material more permeable and releases gold that may have been originally bound in minerals. Oxidized ore is more amenable to the heap leach process.

Extensive metallurgical testing is part of a definitive, bankable feasibility study being conducted on two deposits at the Quartz Mountain property in Oregon.

PERMEABLE: Having a texture that permits fluids to move through the material.

PROVEN AND PROBABLE RESOURCE:
Proven: Well-established by closely spaced measurements.
Probable: Similar to proven. Measurements are more widely spaced but the degree of assurance is high enough to assume continuity.

PYRITE: An iron sulfide mineral.

REVERSE CIRCULATION DRILL: A type of rotary drill.

RHYOLITE: A volcanic rock.

ROTARY DRILL: A drill that breaks up rock and carries it to surface as chips.

STIBNITE: An antimony sulfide mineral.

SULFIDE: A metalic mineral with sulfur as one of its components.

TUFF: A rock formed from small volcanic fragments.

VOLCANICLASTIC: A rock composed of volcanic fragments.

VOLCANICS: Rocks produced by a volcano.

MARKET FOR THE COMPANY'S COMMON SHARES AND RELATED SHAREHOLDER MATTERS

The Company's common shares are listed and trade in Canada on the Vancouver Stock Exchange and on The Toronto Stock Exchange (since March 1988), under the symbol QZM, and are quoted in the United States on The National Market System of the National Association of Securities Dealers Automated Quotation System (NASDAQ), under the symbol QZMGF (since September 1987).

The following table sets forth the high and low sales prices, in Canadian dollars, for the Company's common shares, as reported on the Vancouver Stock Exchange for each fiscal quarter for the past two fiscal years:

		PRICES	
1987	ENDED	HIGH	LOW
First Quarter	October 31, 1986	4.20	2.0[illegible]
Second Quarter	January 31, 1987	3.10	1.5[illegible]
Third Quarter	April 30, 1987	5.00	1.0[illegible]
Fourth Quarter	July 31, 1987	4.95	3.0[illegible]
1988			
First Quarter	October 31, 1987	6.50	2.20
Second Quarter	January 31, 1988	4.20	2.60
Third Quarter	April 30, 1988	3.10	1.55
Fourth Quarter	July 31, 1988	2.05	1.20

The following table sets forth the high and low sales prices, in U.S. dollars, for the Company's common shares as quoted on NASDAQ for the periods indicated:

		PRICES	
1988	ENDED	HIGH	LOW
First Quarter	October 31, 1987	4.812	1.812
Second Quarter	January 31, 1988	3.062	1.937
Third Quarter	April 30, 1988	2.440	1.440
Fourth Quarter	July 31, 1988	1.750	1.000

As of September 30, 1988 there were 2,073 registered shareholders of the Company's common shares.

The Company has not had earnings from operations to date and, consequently, the Company does not have any history of paying cash dividends.

There are currently no restrictions on the export or import of capital out of or into Canada, nor are there foreign exchange controls or other governmental laws restricting remittance of dividends or other payments to non-resident holders of the Company's common stock.

Dividends paid by the Company on shares of common stock owned by residents of the United States are subject to Canadian withholding tax at a rate equal to a maximum of 15% of the dividend paid. The existing tax treaty between the United States and Canada essentially calls for taxation of shareholders by the shareholder's country of residence. In those instances in which a tax may be assessed by the other country, a corresponding credit against the tax owed in the country of residence is normally available.

CORPORATE INFORMATION

DIRECTORS

Manuel Beer
Independent Consultant
Zurich, Switzerland

Robert L. Cook
Vice President, Finance,
Secretary-Treasurer & Director
Galactic Resources Ltd.

*Eric V. Friedland
Geologist/Geophysicist
Touchstone Resources Company

*Lal J. Gondi
Vice President & Director
Continental Securities

David S. Jennings
President & Chief Executive Officer
Quartz Mountain Gold Corp.

*Members of the audit committee

MANAGEMENT

David S. Jennings
President & Chief Executive Officer

Robert L. Cook
Secretary

Kathryn D. Holopainen
Manager, Corporate Affairs

Allan J. Marter
Vice President, Finance,
Assistant Secretary &
Chief Financial Officer

William R. Rohtert
Vice President, Exploration

Laurel B. Sheppard
Controller

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SHARES LISTED

NASDAQ National Market System (QZMGF)
Toronto Stock Exchange (QZM.T)
Vancouver Stock Exchange (QZM.V)

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Canada M5C 1B3

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Deloitte Haskins & Sells
Vancouver, Canada

LEGAL COUNSEL

Russell & Du Moulin
Vancouver, Canada

Stoel Rives Boley Jones & Grey
Seattle, Washington and Portland, Oregon U.S.A.

ANNUAL GENERAL MEETING

The Annual General Meeting of Shareholders of the Company will be held on Thursday, December 15, 1988 at 10:00 a.m. in the Gazebo 1 Room of the Pan Pacific Hotel, 999 Canada Place, Vancouver, Canada.

FORM 10-K

A copy of the annual report on Form 10-K, as filed with the U.S. Securities and Exchange Commission, is available to shareholders without charge on written request to:

Allan J. Marter
Vice President, Finance
Quartz Mountain Gold Corp.
670 Marine Building
355 Burrard Street
Vancouver, B.C.
Canada V6C 2G8

QUARTZ MOUNTAIN GOLD CORP.

Quartz Mountain Property:

This 10,000 acre property is located in south-central Oregon, 30 miles west of Lakeview and 30 miles north of the California border.

Over two million ounces of gold are contained in the proven and probable reserves of the Crone Hill and Quartz Butte deposits, located on the western half of the property. The Davy McKee Corporation of San Ramon, California is conducting a definitive feasibility study, investigating both heap leaching and conventional milling of these deposits.

On the eastern half of the claim block an extensive and thorough exploration program is underway. Drilling has begun on Drews Dome, one of five high-priority targets. The eastern portion of the district shows strong potential for a new discovery, comparable to Crone Hill and Quartz Butte, indicated by similar geology, epithermal alteration and geochemical anomalies.

An exciting high-grade area on Quartz Butte, the Eureka Deep Zone, is also being drilled. This zone may be a feeder vein system and has the potential to be developed as a stand-alone, underground deposit.

The company is undertaking a program to broaden its assets base through the acquisition of other high quality properties.

Financing

Quartz Mountain Gold Corp. is debt-free with working capital in excess of U.S. $3,500,000.

Management

The company is guided by mining industry professionals with successful exploration, development and production experience, and enjoys an exceptional relationship with world capital markets.

President & C.E.O., Director	David S. Jennings
Vice-President, Finance	Allan J. Marter
Vice-President, Exploration	William R. Rohtert
Secretary and Director	Robert L. Cook
Director	Manuel Beer
Director	William H. Bird
Director	Eric V. Friedland
Director	Lal Gondi

WAVECREST RESOURCES LTD.

AND

DIAMOND HEAD MINES

ANNOUNCE:

A Field Tour of the

Quartz Mountain Gold Deposit

Lake County, Oregon

Schedule

June 20, 1986	7 p.m.	Conference Lake County Community Center 11 North "G" Street Lakeview, Oregon
June 21, 1986	8 a.m.	Field Tour Meet in Parking Lot of the Skyline Motel Best Western Lakeview, Oregon 503/947-2194

Open by Invitation to Members of the:

USGS

DOGAMI

AIME

Northwest Academic Community

ABSTRACT

QUARTZ MOUNTAIN GOLD DEPOSIT, Lake County, Oregon: The effect of paleo-groundwater levels on volcanic activity and shallow epithermal gold mineralization.

W. R. Rohtert
April 9, 1986

Quartz Mountain is a disseminated, volcanic-hosted, hot-spring gold deposit. It occurs in a Mid-Miocene composite volcanic field which is intruded by a west-northwest trending belt of highly altered endogenous rhyolite porphyry domes and unaltered latite vitrophyre plugs that have been dated at 7.3 ± 0.9 m.y. The intrusive belt measures 12 miles in length by 3 miles in width and includes eight rhyolites and six latites which range in size from less than 1000 to over 10,000 feet in diameter. The volcanic stratigraphy dips gently to the north and includes over 1000 feet of dacite pyroclastic breccias, andesite flows, silicic ash flow tuffs, and volcaniclastic rocks equated with the Cedarville Formation of Russell (1928). Both the Cedarville Formation and the silicic intrusive rocks are unconformably overlain by thin flows of high-alumina olivine tholeiite which have been assigned to the Pliocene Warner Basalt. Three fault sets are evident in the volcanic field: 1) north-south normal faults with displacements of 100 to 200 feet that are part of the regional Basin and Range structural pattern; 2) N60W normal faults with displacements of 200-500 feet that have apparently guided the emplacement of the intrusive bodies; and 3) major, N45W right-lateral strike-slip faults which terminate the other two sets. The northwest alignment of intrusives and structures is a key element of the McLaughlin lineament of Lawrence (1976) which is a recurrently-active, 120 mile long zone of dextral offset in the Tertiary rocks of southern Oregon.

Four of the rhyolites in the Quartz Mountain intrusive belt have produced mercury from near-surface, cinnabar-alunite-sulfur bearing opal deposits. These rhyolites are mantled with a carapace of sub-areal talus breccia and display solfataric alteration due to intense acid leaching. In contrast, the rhyolite on Crone Hill contains ore-grade gold mineralization in a zone of silicification and clay-sericite alteration. The Crone Hill rhyolite is ringed in part by a tuff cone up to thirty feet thick which includes a basal heterolithic eruption breccia, a cross-bedded base-surge deposit, and an upper, massive airfall tuff. Overlying the rhyolite within the tuff cone is a thirty foot thick deposit of hot-spring sinter which includes vent breccia, pool accumulate and apron conglomerate. Gold ore on Crone Hill is present in three geologic environments: 1) re-silicified portions of the hot-spring sinter deposit. 2) quartz stockworks and hydrothermal breccia pipes along the intrusive contact of the rhyolite porphyry, and 3) a tabular zone of of stratabound replacement mineralization in a 100 foot thick amygdaloidal dacite tuff breccia horizon that contains "flat" quartz veins dilating upper and lower stratigraphic contacts. Gold occurs in the native form and in association with pyrite or limonite. Accessory minerals include marcasite and stibnite in a gangue of chalcedony, kaolinite, sericite and adularia. Strong anomalies in gold, arsenic, antimony and mercury delineate the surface expression of a paleo-geothermal cell roughly 3000 feet in diameter on Crone Hill. The potential resource of the entire property is in excess of one million ounces of gold.

The contrasting alteration assemblages and volcanic landforms at Crone Hill versus the other rhyolites in the intrusive belt reflect the level of the paleo-groundwater table at the time of volcanism and hydrothermal activity. Rhyolites emplaced above the water table vented as viscous flows or gas-charged ash-flow tuffs and are surrounded by landslide deposits. They were altered by the acidic, vapor-dominated portions of geothermal systems which formed fumarolic fields and deposited mercury at the surface by condensation. In contrast, the rhyolite on Crone Hill was emplaced at or below the water table and vented in a hydrovolcanic eruption to produce a tuff cone. It was altered by a water-dominated geothermal system of near-neutral pH which formed hot springs and deposited gold by cooling at the surface, by boiling in vein and breccia conduits, and by fluid mixing in porous volcanic horizons which acted as paleo-aquifers. The recognition of paleo-groundwater control on the loci of gold mineralization provides the definitive criteria to evaluate the potential of untested volcanic terrain for buried ore bodies in favorable stratigraphic horizons. The model also predicts that zones of boiling and gold-sulfide deposition occur at depths of 200-1000 feet below the four mercury deposits in the Quartz Mountain district.

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INVITATION LIST

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Northwest Academic Community

Quartz Mountain Field Tour

6/20/86 - 6/21/86

Quartz Mountain, Oregon

QUARTZ MOUNTAIN GOLD DEPOSIT, Lake County, Oregon: The effect of paleo-groundwater levels on volcanic activity and shallow epithermal gold mineralization.

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NEWS RELEASE

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FOR IMMEDIATE RELEASE

March 31, 1989

QUARTZ MOUNTAIN FEASIBILITY STUDY SHOWS STEADY PROGRESS

VANCOUVER, B.C. -- Continuing reports from the feasibility study on the Quartz Mountain Gold Project in Lake County, Oregon, show steady progress. The reports indicate heap leach and flotation gold recoveries of 70% and improved project economics through selective mining. The announcement detailing the feasibility study progress report was made by David S. Jennings, President and Chief Executive Officer of Quartz Mountain Gold Corp., and Robert L. Cook, Senior Vice-President, Finance, of Galactic Resources Ltd. Quartz Mountain and Galactic are joint venture partners in the project.

Gold Recoveries 70%

Davy McKee Corporation of San Francisco, California, independent engineering contractor to the venture, has reviewed final column leach tests on the Crone Hill and Quartz Butte oxide mineralization. The tests were run under standard conditions by McClelland Laboratories of Reno, Nevada using 15 lbs. cement and 15 lbs. lime per ton to agglomerate. Leach cycle times average 60-80 days with cyanide consumption averaging less than 1.5 lbs/ton with a weighted average recovery of 70%.

Gold recoveries in Crone Hill sulphide concentrates have been shown in preliminary flotation tests to exceed 70%. Work is now underway to assess further concentrate treatment and to optimize flotation techniques.

Selective Mining Improves Project Economics

Through subcontractor Pincock, Allen and Holt of Denver, Colorado, Davy McKee has provided the latest in a series of floating cone models of the Crone Hill and Quartz Butte deposits. These models define open pit mineralization of two types:

a) disseminated oxide heap leach;
b) higher-grade oxide and sulphide quartz vein-related mineralization.

Recent block modelling studies emphasize the significance of the vein-related mineralization. A combination of selective open pit mining and milling of this higher grade material with a parallel heap leaching operation may significantly improve overall project economics. Various scales of milling plus leaching alternatives are under evaluation by Davy McKee.

Current Crone Hill and Quartz Butte Deposit Estimates

Mineralization Type	Tons	Grade (opt)	Contained Ounces
Vein (oxide & sulphide)	2,572,000	0.097	250,025
Heap Leach (oxide only)	7,958,000	0.029	231,250
Total	10,530,000		481,275

These figures are generated by computerized methods for specific economic parameters and are subject to change.

Davy McKee expects to complete three tasks during the second quarter of 1989. The first will be the completion of the disseminated oxide portion of the feasibility study. The second will be to assess the effect of vein-related mineralization on this study and thirdly, a preliminary assessment of bulk mining and milling of the total oxide and sulphide resource.

Quartz Mountain Gold Corp. trades on the Toronto and Vancouver Stock Exchanges (QZM.T, QZM.V) and is listed on the U.S. NASDAQ National Market System (QZMGF). Galactic Resources Ltd. trades on the Toronto, Montreal, and Vancouver Stock Exchanges (GLC.T, GLC.M, GLC.V), in Canada, and on the American Stock Exchange (GLC.A) in the United States. American Stock Exchange quotes in US$ are listed daily in the Wall Street Journal under American Stock Exchange Composite Transactions.

David S. Jennings
President & C.E.O.
Quartz Mountain Gold Corp.

Robert L. Cook
Senior Vice-President, Finance
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FOR IMMEDIATE RELEASE **JANUARY 17, 1989**

David S. Jennings, President of Quartz Mountain Gold Corp. and Robert M. Friedland, Chairman of Galactic Resources Ltd., announced today that Quartz Mountain Gold Corp. suspended trading in its securities on January 13, 1989 in order to clarify remarks, attributed to William R. Rohtert, Vice-President, Exploration, of Quartz Mountain Gold Corp., which appeared in two news articles that were published without the knowledge and authority of the Companies or their Boards of Directors. The inaccurate and misleading news articles appeared in two Oregon newspapers and implied that Quartz Mountain Gold Corp. and joint-venture partner Galactic Resources Ltd. have made a positive production decision on the Quartz Mountain gold project in Lake County, Oregon based on advance feasibility information from independent consultants Davy McKee Corporation of San Ramon, California.

While the Companies have received preliminary results from the Phase I oxide, open-pit/heap leach study by Davy McKee on the Crone Hill and Quartz Butte deposits, no production decision has yet been made. Further refinement of the preliminary study will be necessary before any final production decisions can be made on the project. The preliminary information received to date indicates that a reduction in the preliminary capital cost estimates will be necessary to achieve acceptable oxide open-pit economics at a gold price of $350-400 U.S. per ounce. The Companies are working closely with Davy McKee to obtain lower capital costs and enhance project economics by earth-works re-engineering, incorporation of used mining equipment wherever possible, evaluation of conveyor/radial stacker alternatives, and, most importantly, assessing the impact of incorporating West Crone high-grade vein material and/or Angels Camp breccia reserves to the mine plan. Davy McKee estimates that the re-evaluation of this material will take approximately 12 to 15 weeks.

In addition, Davy McKee has initiated Phase II of the overall project feasibility analysis which is the evaluation of the gold-bearing sulphide reserve beneath the oxide reserve. Both heap leach and milling alternatives of the oxide and sulphide reserves will be addressed in the study which will be available no sooner than the end of April, 1989.

Quartz Mountain Gold Corp. is listed on the US NASDAQ National Market System under the symbol QZMGF and also trades on the Toronto Stock Exchange under the symbol QZM.T. and Vancouver Stock Exchange under the symbol QZM.V.. Galactic trades on the Montreal, Toronto, and Vancouver stock exchanges (GLC.M, GLC.T, and GLC.V), and is listed on the US NASDAQ System (GALCF). NASDAQ quotes in US $ are listed daily in the *Wall Street Journal* under *NASDAQ National Market Issues*.

David S. Jennings
President
Quartz Mountain Gold Corp.

Robert M. Friedland
Chairman
Galactic Resources Ltd.

New! *New!* *Same!*

and Growing!

THE NEW HEADQUARTERS FOR

GALACTIC SERVICES, INC. and **WAVECREST RESOURCES, INC.**

A Subsidiary of Galactic Resources, Ltd. — *A Subsidiary of Quartz Mountain Gold Corp.*

is at the corner of South Virginia and McCarran Boulevard in CORPORATE POINTE,

Fax: GALACTIC **702/829-AuAg**

5250 South Virginia Street
Suite 300
Reno, Nevada 89502
702/829-1100

Fax: WAVECREST **702/829-2828**

Effective 2/15/88

Jerry
FYI

John B -
Good follow thru. It's only your good saving [illegible] [illegible] good.
[illegible]

John B,

It appears that the field offices are slipping on filing reports on mine visits, e.g., Len's trip to Qtz. Mtn

Needs attention

interim review

Len — please file mine reports in your files when you visit mine areas — please forward to Don a copy of your Qtz Mtn mine report

John B

Don & John
If this is inadequate let me know. Any more would take research time & phone calls.

J

MEMO REPORT

AIME Field Trip to Quartz Mtn. Gold Deposit near Lakeview June 21, 1986

OWNERSHIP & HISTORY:

The property was reported as the Crone Prospect by Brooks (1963, p. 176).

Am uncertain who present claim owners are; but believe I heard Rhotert mention Don Tracy. The current exploration activity was initiated by Anaconda Mining Co. in 1984 and is presently a joint venture by Wave-crest Resources Ltd., and Diamond Head Mines. Project geologist is Wm. R. Rohtert formerly with Anaconda.

LOCATION:

Largely in NE$\frac{1}{4}$ Sec. 34, T. 37 S., R. 16 E., but probably extending into Secs. 26, 27, and 35, of the same township. Elevation range is from about 5,450 up to 5,640 ft on a small butte called Crone Hill.

EXPLORATION & DEVELOPMENT:

Exploration reportedly began with an extensive soil and surface rock sampling program. This was followed by or coupled with geologic mapping. Diamond drilling surface excavation and road construction has also been done at the prospect.

GEOLOGY:

See copy of abstract and references supplied by Will Rohtert.

The three veins shown for Quartz Butte appear to define a graben below near surface disseminated ore. The graben mimics the outline of the throat of the dome complex. Lateral and vertical alteration zoning supports the vein interpretations and is consistent with late penecontemporaneous intrusion of rhyolite and mineralization. Vertical stress accompanying late stage magma movement may have generated the mineralized fractures.

High grade intercepts commonly have visible gold in what alternatively may be (1) a stringer zone of chalcedony or quartz veinlets, (2) clay-sericite seams without prominent veining, (3) irregular siliceous and sulphidic replacements of rhyolite, (4) breccias with silicified and pyritized fragments, (5) or thin, fresh, gold-bearing aplite dikes cutting fresh or propyllitized volcanics. The absence of well defined, prominent quartz veins is striking and seemingly at odds with the relatively large volume of disseminated gold mineralization in the deposits if these high grade quartz vein structures are ore fluid conduits.

These observations are consistent with the findings of White et al (1964) at Steamboat Spring, Nevada and distinct from districts such as Bodie, California and Republic, Washington. Existence of gold-bearing, fresh appearing aplite dikes may be genetically significant, but these have not yet been adequately studied.

Wall rock alteration adjacent to the high grade intercepts at Quartz Butte is not megascopically distinct from alteration distant from the veins (Fig. 6). The veins seem to cut "fresh" high silica rhyolite with only minimal alteration selvages on vein walls. This lack of significant alteration may imply limited exposure time for the hydrothermal fluids carrying gold in the mineralized structures. The phenomena could also be ascribed to upwelling near neutral alkaline and highly CO charged ore fluids in equilibrium with the rhyolite. The absence of well developed vein structures supports either contention. The pervasive broad development of argillic alteration with the disseminated, near-surface gold deposit contrasts with the incipient alteration of vein walls of the imputed feeder zones at depth.

High Grade Veins on Crone Hill

Exploration drilling on Crone Hill found high grade intercepts that probably are feeder veins. A number of possible combinations of linkages can be proposed, but the authors favor the presence on Crone Hill of four veins and their splays. Using this array for the intercepts, the authors propose that the drilling indicates a mineral inventory within the disseminated deposit of 1,262,000 tons of high grade ore that averages 0.28 ounces of gold per ton. Figure 4 shows a typical vertical section of the Alice vein, the largest proposed vein structure on Crone Hill. Importantly, none of the four proposed veins underlies the disseminated orebody, and none penetrate brecciated rhyolite. Rather, they seem to be independent of brecciation. The absence of identified feeder veins on Crone Hill below near-surface gold disseminations is in contrast to vein locations at Quartz Butte (Fig. 6).

All Crone Hill veins gently dip north 10 degrees to 25 degrees, and intersect pervasively argillized rhyolite as well as volcanic and volcaniclastic units. Presence of vein structures cutting a variety of rock types suggests that vein development is independent of lithologic controls.

The intercepts of high grade ore include (1) chalcedonic replacements, (2) sulfide-bearing quartz-adularia and chalcedony veinlets or their oxidation product, and (3) clay-sulfide seams (or their oxidized equivalents). Alunite or adularia are present in some richer intercepts with earthy alunite more common near surface. Adularia occurs more often within the illite-bearing argillic zone. No persistent uniformly mineralized and well-developed quartz vein structure has been recognized. Rather, the gently dipping zones of high grade ore are assumed to be faults that channeled hydrothermal fluids. Exploration drilling has not completely exhausted the potential for discovering additional high grade veins under Crone Hill, but the paucity of veins at depth, below the illite-bearing argillic alteration zone and its disseminated gold orebody, is particularly puzzling. Sericitic alteration found at depth at Quartz Butte has not been identified on Crone Hill. Normal fault structures similar to those at depth at Quartz Butte also appear to be missing. Still, argillization is centered about the Crone Hill endogenous rhyolite dome and its breccia, and the disseminated ore extends as a breccia root down the throat of the Crone Hill dome complex. Circular vein-fault structures commonly developed ringing many large mineralized breccias in other areas do not seem to have formed at Crone Hill, or if formed, have not been recognized to date.

Discussion

Although dissimilarities between geologic settings and probable fluid flow are apparent, alteration mineralogy in the Quartz Mountain district has many parallels in the Steamboat Springs area, Nevada (White et al, 1964). In both districts hot spring sinter deposits are almost entirely siliceous. Opal and chalcedonic sinter contain notable quantities of cinnabar. Both districts have chalcedony-quartz rich veins at depths greater than 200 feet that change upwards to chalcedony and then to opal near the surface.

Surface alteration in both districts consists of acid sulfate leach products that give way to montmorillonite-illite and illite mixtures. Sericite forms below the argillic zone. Near surface alteration zones are mostly flat-lying irregular masses that are underlain by fresh or only weakly altered rock (Fig. 4 and 6).

K-Ar dates on the Quartz Mountain endogenous rhyolite dome complexes cluster close to 7.0 Ma, but a single K-Ar date on vein adularia returned an age of about 5.5 Ma. The life of the hot spring system is inferred by the dating of rhyolite domes as well as the adularia to be in excess of 1,000,000 years, a contention supported by analagous evidence at Steamboat Springs (Silberman et al, 1979).

Epithermal hot spring activity associated with the Quartz Mountain rhyolite domes has produced very large areas of argillic alteration that contain a minimum estimated 100,000,000 tons averaging 0.0255 ounces gold per ton. Planar vein-like, high grade zones totalling about 2,000,000 tons averaging 0.29 ounces gold per ton have also been drill-indicated below and within the disseminated ore. However, veins identified to date are few in number, small, irregular and seem insufficient to account for the large volume and tonnage of disseminated mineralization.

Higher grade gold zones identifiable at depth and in the near surface disseminated deposits are believed to represent feeder systems. These planar zones are poorly defined structurally and lack large, distinct assemblages of silicate alteration minerals. The absence of numerous well developed veins within and below the disseminated zones is consistent with individual feeders having a short life in a long lived geothermal event. Feeder veins found below Quartz Butte support the contention that they formed as a result of late stage magma evolution and movement in the Quartz Butte dome complex. The apparent absence of such veins below the Crone Hill disseminated deposit cannot be easily explained.

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284

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Galley Proof

Relationship Between Low-Grade Gold Disseminations and High-Grade Veins in the Quartz Mountain District, Oregon

V.F. Hollister[1] and D.S. Jennings

I have checked this proof.
I have marked all changes or corrections I wish to be made.

Signed D.S. Jennings

Telephone (604) 662-7557

PLEASE FORWARD ILLUSTRATION PHOTOPRINTS TO THE EDITOR WITH YOUR PROOFS.

[1]8069 Philbert St., Mission, British Columbia V2V 3W9, Canada, and 9 Quartz Mountain Gold Corp, 950-789 W. Pender St, Vancouver, British Columbia V6C 1H2

Gold and mercury mineralization related to epithermal hot springs occurs spatially associated with rhyolite dome complexes in the Quartz Mountain district, Lake County, Oregon. Drilling of over 800 holes from 1983 to 1991, mostly by Quartz Mountain Gold Corp., has resulted in a mineral inventory of at least 100,000,000 tons, averaging 0.0255 ounce gold per ton in two near-surface, disseminated gold ore bodies, Quartz Butte and Crone Hill. Extensive gold disseminations are underlain by and include rare, higher-grade veins that could be feeders for the near-surface, quasi-horizontal, pervasively mineralized gold dissemination. The veins contain about 2,000,000 tons of ore, averaging 0.29 ounce gold per ton. Approximately 750,000 tons of this underlie Quartz Butte, and the remainder is included in the Crone Hill low-grade dissemination. With a mineral inventory of about 3,000,000 ounces, Quartz Mountain is currently the largest known gold deposit in Oregon.

As now known, the veins seem too few in number and too sporadically positioned to account for the volume of near-surface gold disseminations. We offer hypotheses to explain the apparent anomaly between the volume of disseminated gold ore and the paucity of feeders. Quartz Mountain has numerous alteration and mineralization similarities with the well-studied Steamboat Springs district (White and others, 1964). Coincidences between the two districts are noted.

Key words:
Gold and mercury mineralization
Epithermal veins
Mineral exploration

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Introduction

Quartz Mountain in Lake County, Oregon, is currently the largest known gold deposit in Oregon. In this article we summarize exploration to date and expand on previous descriptions of the district. Data for this article were generated mostly by the Quartz Mountain Gold Corp. staff between 1985 and 1989, within the property boundary shown on figure 1. Anaconda and others had previously carried out preliminary geological and geochemical studies, but Quartz Mountain's field personnel undertook most of the district's definitive exploration and associated geological investigations concomitant with numerous drilling campaigns.

acanda
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Geological Setting

Quartz Mountain is located in the northern part of the Basin and Range Province of south-central Oregon (fig. 1). It occurs in a 15-mile-long belt of rhyolite domes and dome complexes that are part of a Tertiary bimodal volcanic terrane. The district includes the Crone Hill and Quartz Butte disseminated gold deposits and their genetically related superjacent mercury occurrences. Both deposits are associated with high-silica, endogenous rhyolite domes. The district has numerous, exogenous, less siliceous rhyolitic domes as well, most of which are not mineralized (Sawlin and others, 1991). Figure 1 shows five endogenous and numerous exogenous domes outcropping within the N 70 degree W trending district. The district lies within and is a small part of the N 50 degree W trending McLoughlin fracture zone (McLeod and others, 1975). McKee and others (1983) and McLeod and others (1975) have provided potassium-argon ages from the domes that cluster around 7.0 Ma. The dome intrusive-extrusive complexes occur within, penetrate, and overlie at least a 300-meter thickness of 13 Ma and younger volcanic rocks, including dacite flows, flow breccias and tuffs, basalt and andesite flows, and flow breccias. Volcaniclastic rocks occur haphazardly in this sequence. The domes are locally overlapped by thin, high-alumina, olivine tholeiite flows that may be penecontemporaneous with some domes. Similar basalts occur in the area ranging in age from Miocene to Quaternary. The regional

N70°W
N50°W
Volcaniclastic

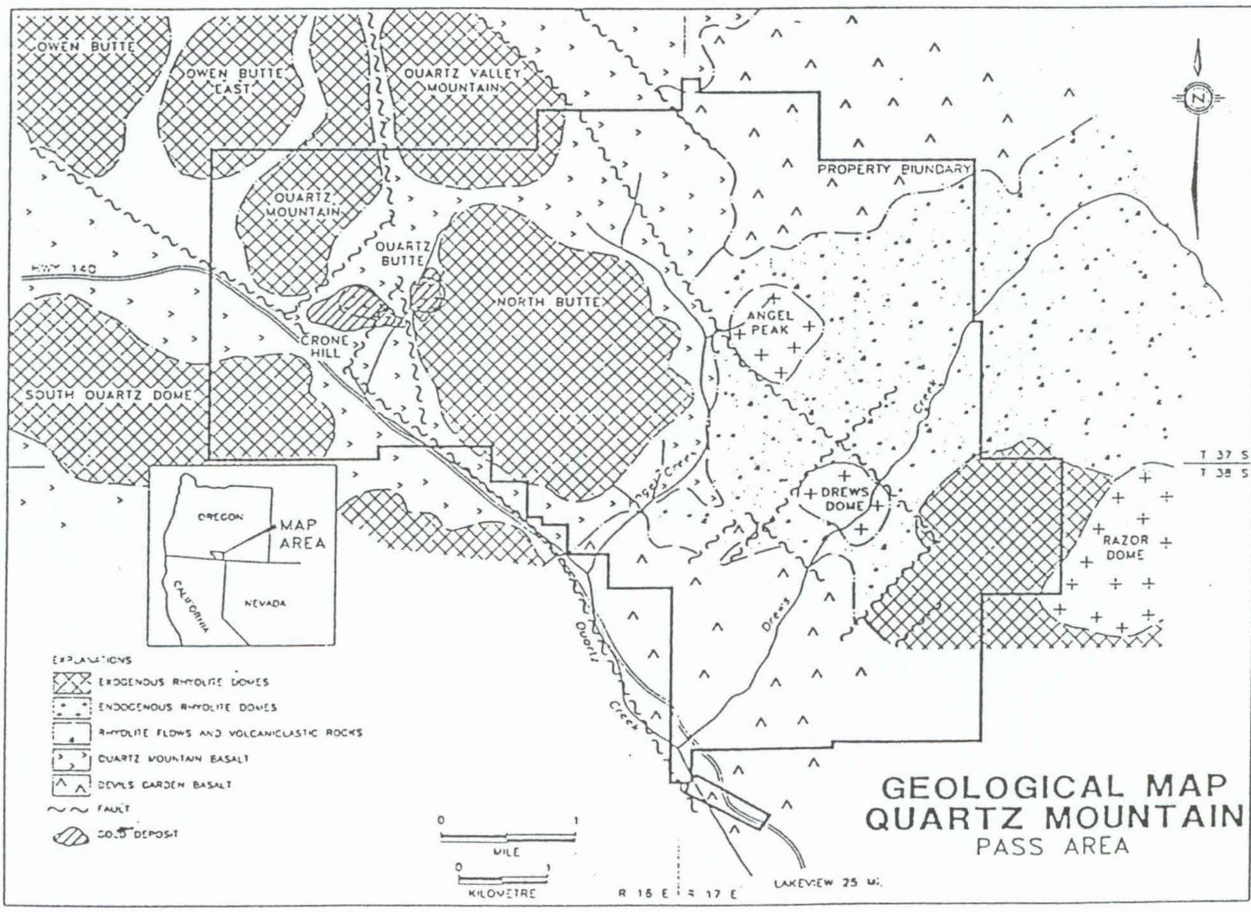

Figure 1. Generalized geological map of Quartz Mountain Pass area, Quartz Mountain district, Lake County, south-central Oregon. Outlined area represents claim block of Quartz Mountain Gold Corp.

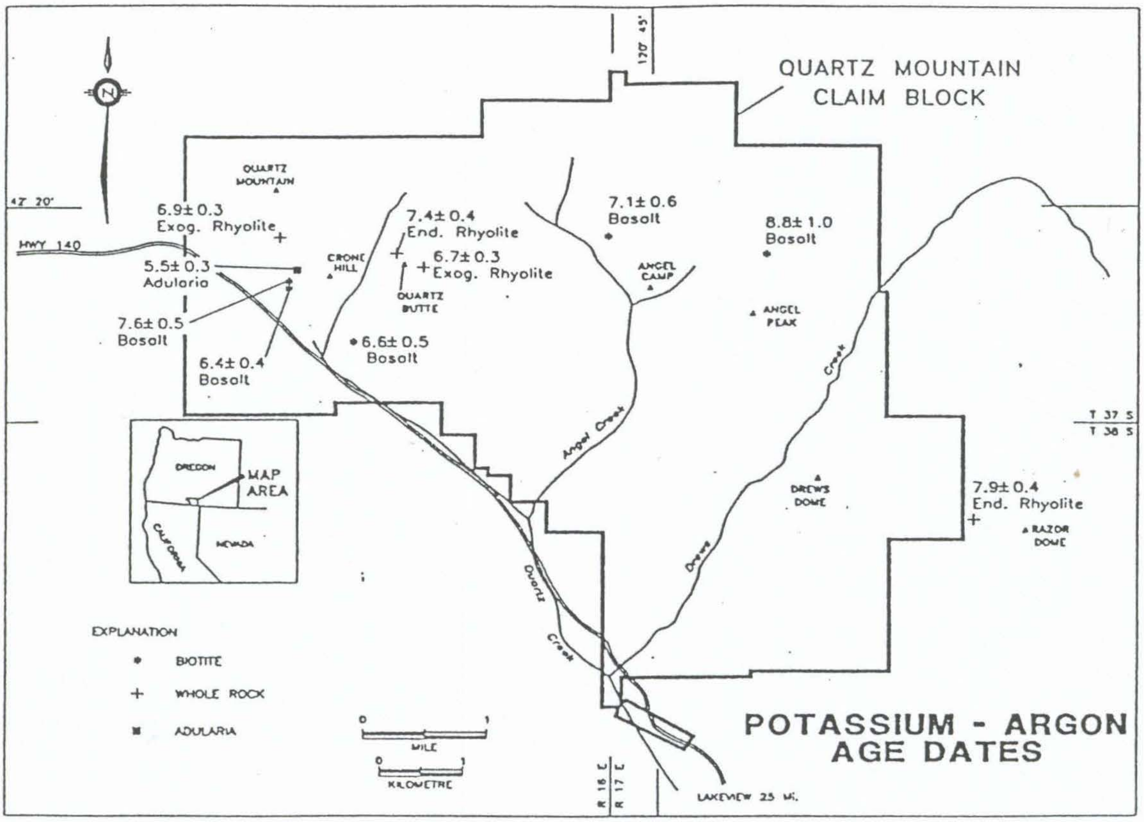

Figure 2. Map showing location of rock types and their potassium-argon age dates within the Quartz Mountain claim block.

geological relations are reviewed by Hart and others (1984) and Sawlin and others (1991).

Disseminated Gold and Mercury Mineralization

The two disseminated gold deposits, Crone Hill and Quartz Butte (fig. 1), and their associated, relatively small, endogenous rhyolite domes were erupted penecontemporaneously with high-alumina basalt. Both deposits have very large, exposed, gold-bearing, kaolinitic and argillic alteration zones that surround the domes. A third, exposed, similar alteration zone occurring around the Angel Peak dome has gold disseminations on its north and west sides (fig. 1). The Angel Peak occurrences are insufficiently quantified to be included in a mineral inventory at this time; additional exploration is warranted.

Silberman and others (1979) cite potassium-argon dating studies on igneous rocks at Steamboat Springs, Nevada, and elsewhere to substantiate long-lived hydrothermal systems. Their data indicate that hydrothermal activity in hot spring systems has persisted for two or more million years in some districts. A parallel is suggested for Quartz Mountain. Hydrothermal adularia from Crone Hill has yielded a 5.5 Ma potassium-argon age (Quartz Mountain Gold Corp. Private Report, 1988) (Figs. 2, 3). When combined with potassium-argon ages for nearby domes, igneous and hydrothermal activity could span at least two million years. The repeated deposition of basalt flows with rhyolite domes over a large area for this time period is compatible with a large source magma chamber for these igneous rock and their gold ores. The spatial relationship between endogenous domes and disseminated gold ore is consistent with a genetic linking of the two.

Mercury ores have been mined from the Crone Hill, Quartz Butte, Angel Peak, and Drews rhyolite domes, but gold deposits are significant only in and near Crone Hill, Quartz Butte, and Angel Peak (fig. 1).

Mercury Deposits

Most mercury production has come from Crone Hill, Angel Peak, and Quartz Butte. All mercury occurrences are characterized by acid-leached alteration suites comprised of opal, chalcedony, quartz, kaolin, and alunite. Sulfur is locally and erratically present. The protolith for all mercury deposits is rhyolite and hot spring siliceous sinter.

Although oxidation persists to maximum depths of 360 feet at Quartz Butte and 165 feet at Crone Hill, cinnabar is the most important mercury mineral. Geo-

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Project Geologist

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702-852-3126

WAVECREST RESOURCES LTD.

AND

DIAMOND HEAD MINES

ANNOUNCE:

A Field Tour of the

Quartz Mountain Gold Deposit

Lake County, Oregon

Schedule

June 20, 1986	7 p.m.	Conference Lake County Community Center 11 North "G" Street Lakeview, Oregon
June 21, 1986	8 a.m.	Field Tour Meet in Parking Lot of the Skyline Motel Best Western Lakeview, Oregon 503/947-2194

Open by Invitation to Members of the:

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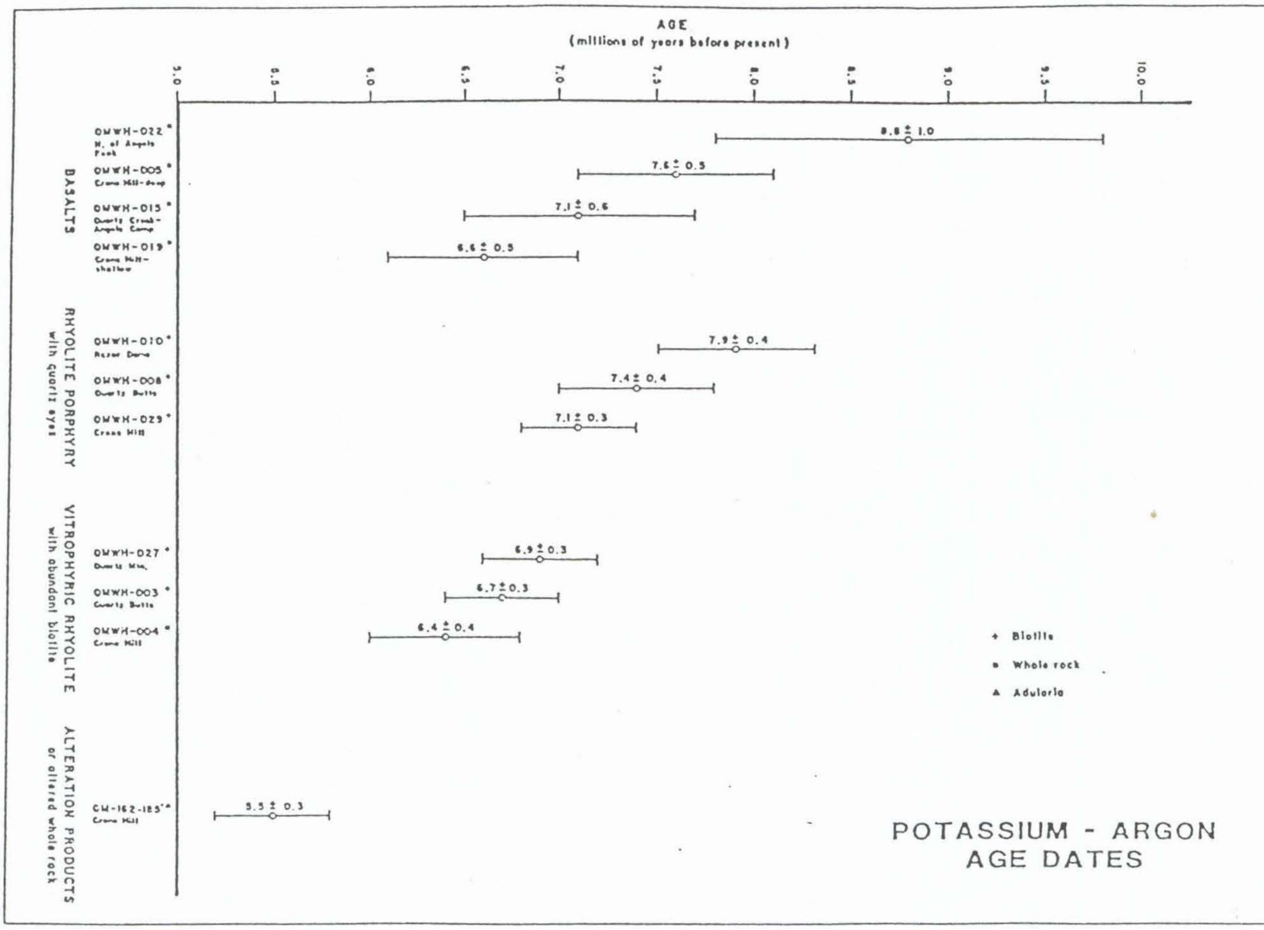

Figure 3. Precision of age dates for different rock types within the Quartz Mountain claim block.

chemical studies show that only minor traces of arsenic and antimony accompany mercury.

Thick talus, in excess of 15 feet, composed mostly of opaline and chalcedonic silica is found in trenches around Crone Hill. Little such talus occurs below the other mercury deposits. Restoring the talus opalite back to its presumed, original mercury mine site on Crone Hill could have raised the hill's elevation as much as 100 feet at the time of mineralization. Significant mercury mineralization at Crone Hill could therefore have had a pre-erosion vertical extent of 120 feet, whereas significant mercury mineralization at Quartz Butte may have had a pre-erosion vertical extent of only 60 feet.

Disseminated Gold Deposits

Disseminated gold occurs at both Crone Hill (fig. 4) and Quartz Butte (figs. 5, 6), with most ores at Crone Hill appearing near the present topographic surface. The Crone Hill dome is largely brecciated, but brecciation is only weakly developed in the other mineralized domes. Most disseminated gold ores at Quartz Butte do not outcrop. At Crone Hill, the top of gold disseminations grading above 0.008 ounce per ton is within 30 feet of the base of past mercury mining. Perhaps 100 feet separate the base of the mercury mine excavations at Quartz Butte and the top of the 0.008-ounce gold disseminations. In 800 holes drilled before 1991, a minimum of 100,000,000 tons of ore averaging 0.0255 ounce of gold per ton were found in the Crone Hill and Quartz Butte disseminated deposits.

In both ore bodies, native gold occurs with adularia, quartz, marcasite, pyrite, pyrrhotite, stibnite, arsenopyrite, arsenian pyrite, and rare traces of tetrahedrite, galena, chalcopyrite, and barite in veins, veinlets, veinlet swarms, and breccias. The ratio of gold to silver is 1.5: 1. Because oxidation at Crone Hill extends to depths of only 165 feet, most of this ore body is sulfidic. Although oxidation extends to 360 feet at Quartz Butte, much of this ore body is also sulfidic. Both ore bodies have irregular lower surfaces and tops (figs. 4, 6), but tend to be elongated subhorizontally.

Most disseminated gold ores are found in volcanic wall rocks at Crone Hill (tuff, 42 percent, basalt; 32 percent) with only 26 percent occurring in the brecciated,

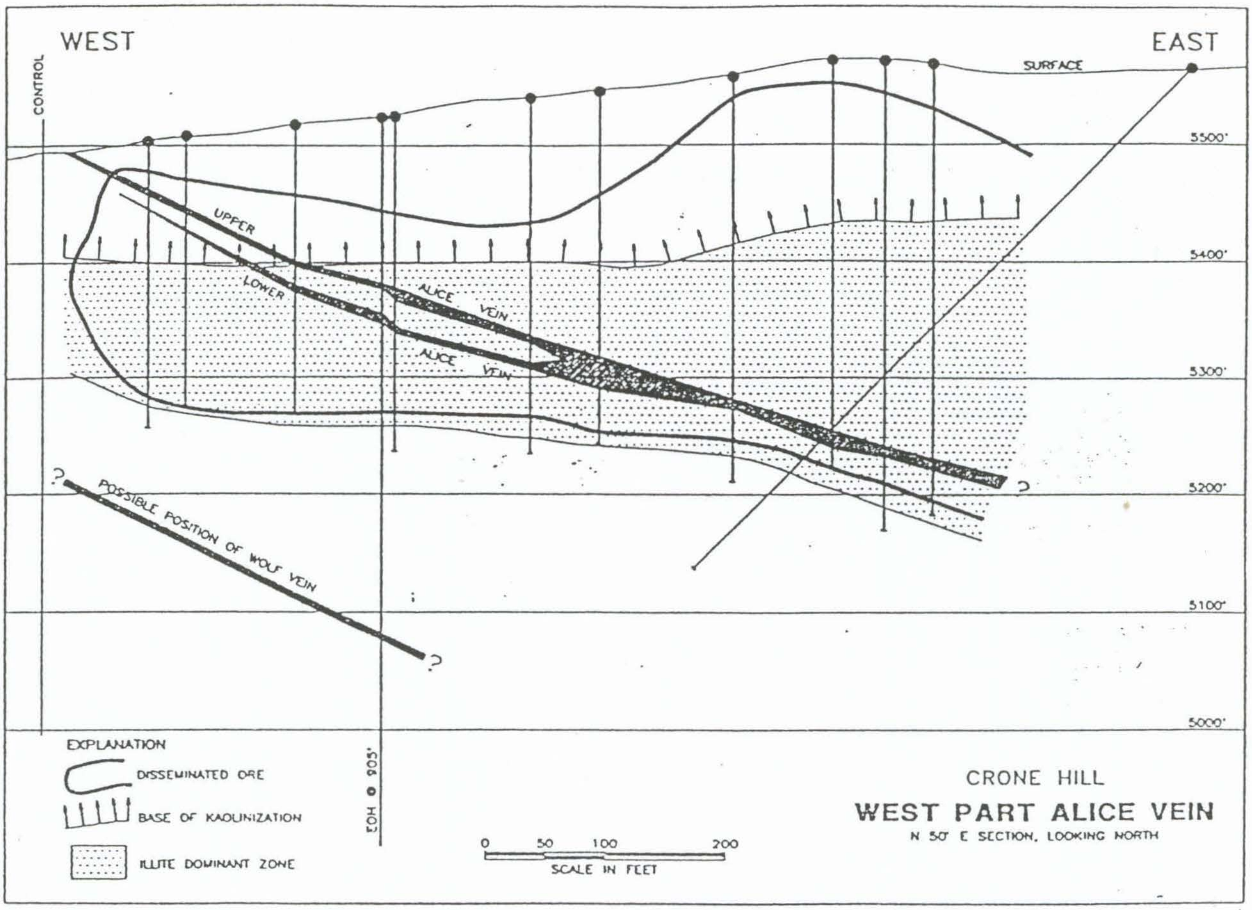

Figure 4. Cross section of the west part of Alice vein in Crone Hill located in the western part of the Quartz Mountain claim block.

endogenous rhyolite dome. At Quartz Butte, 68 percent of the gold ore occurs in the rhyolite dome, 28 percent in tuff, and 4 percent in basalt. Total sulfide at Crone Hill may average 8 percent but at Quartz Butte it averages about 3 percent. The high iron content of the basalt and its involvement as an ore host at Crone Hill may have influenced the high sulfide content of that ore.

Alteration in all rocks in the disseminated gold ores is predominantly argillic with silicification of the protolith well developed only in and near breccias and in the walls of veinlet swarms. Kaolinite is most common above the current water table, along with limonite, earthy alunite, jarosite, hematite, chalcedony, and quartz. Part of this oxidized zone may have developed above the water table at the time of hydrothermal activity, with the water table dropping since mineralization. However, no water table present at the time of mineralization has been established. The common alteration assemblages below the water table include illite and illite-montmorillonite mixtures and chlorite, adularia, pyrite, and zeolites. Sericitic alteration occurs locally with some structures at Quartz Butte below the argillic zone at depths greater than 200 feet (fig. 6). Pervasive argillization irregularly weakens at about that level, mostly giving way to downward shrinking amoeboid "root zones" and narrowing tabular sheets of argillic alteration in propyllitically altered or fresh volcanic rocks. Most disseminated gold occurs in the illite-bearing, argillic alteration suite.

High-Grade Veins on Quartz Butte

Deep drilling has revealed a number of high-grade gold intercepts in rhyolite below the Quartz Butte disseminated gold deposit. Most intercepts appear at depths greater than 200 feet.

Figures 5 and 6 show one of many interpretative vein configurations that may be derived from these intercepts. Other vein configurations are clearly possible. We favor this interpretation for the nonoutcropping veins inferred from the drill intercepts, projected to the surface. The three veins shown are the largest. Other smaller, less certainly defined veins were also indicated, but these were omitted from the figures because their positions and projections are most subjective. The link of intercepts shown

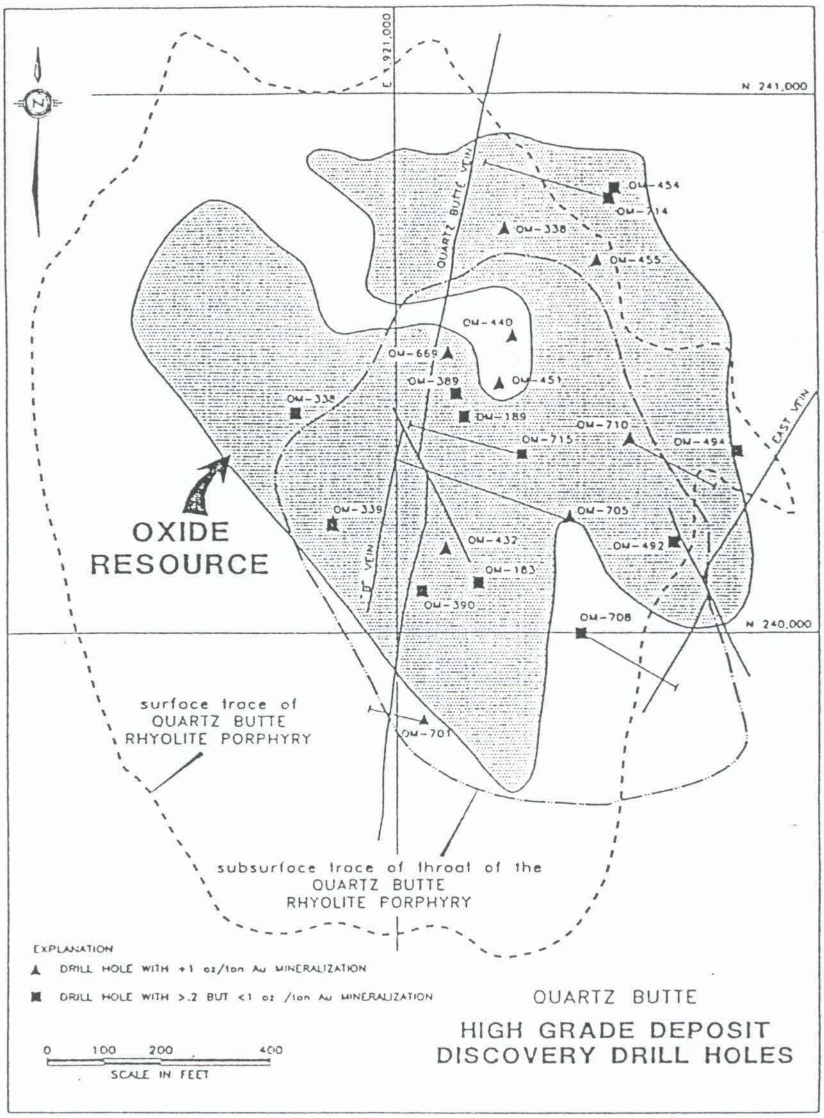

Figure 5. Map showing the distribution of high-grade gold samples from Quartz Butte in the western part of the Quartz Mountain claim block.

in figures 5 and 6 provide for a vein potential of 750,000 tons averaging 0.3 ounce gold per ton.

The three veins shown for Quartz Butte appear to define a graben below near-surface disseminated ore. The graben mimics the outline of the throat of the dome complex. Lateral and vertical alteration zoning supports the vein interpretations and is consistent with late penecontemporaneous intrusion of rhyolite and mineralization. Vertical stress accompanying late-stage magma movement may have generated the mineralized fractures.

High-grade intercepts commonly have visible gold in what alternatively may be (1) a stringer zone of chalcedony or quartz veinlets, (2) clay-sericite seams without prominent veining, (3) irregular siliceous and sulfidic replacements of rhyolite, (4) breccias with silicified and pyritized fragments, or (5) thin, fresh, gold-bearing aplite dikes cutting fresh or propyllitized volcanics. The absence of well-defined, prominent quartz veins is striking and seemingly at odds with the relatively large volume of disseminated gold mineralization in the deposits if these high-grade quartz vein structures are ore fluid conduits.

These observations are consistent with the findings of White and others (1964) at Steamboat Springs, Nevada, and distinct from districts like Bodie, California, and Republic, Washington. Existence of gold-bearing, fresh-appearing aplite dikes may be genetically significant, but these have not yet been adequately studied.

Wall rock alteration adjacent to the high-grade intercepts at Quartz Butte is not megascopically distinct from alteration distant from the veins (fig. 6). The veins seem to cut "fresh" high-silica rhyolite with only minimal alteration selvages on vein walls. This lack of significant alteration may imply limited exposure time for the hydrothermal fluids carrying gold in the mineralized structures. The phenomena could also be ascribed to upwelling near neutral alkaline and highly CO_2-charged ore fluids

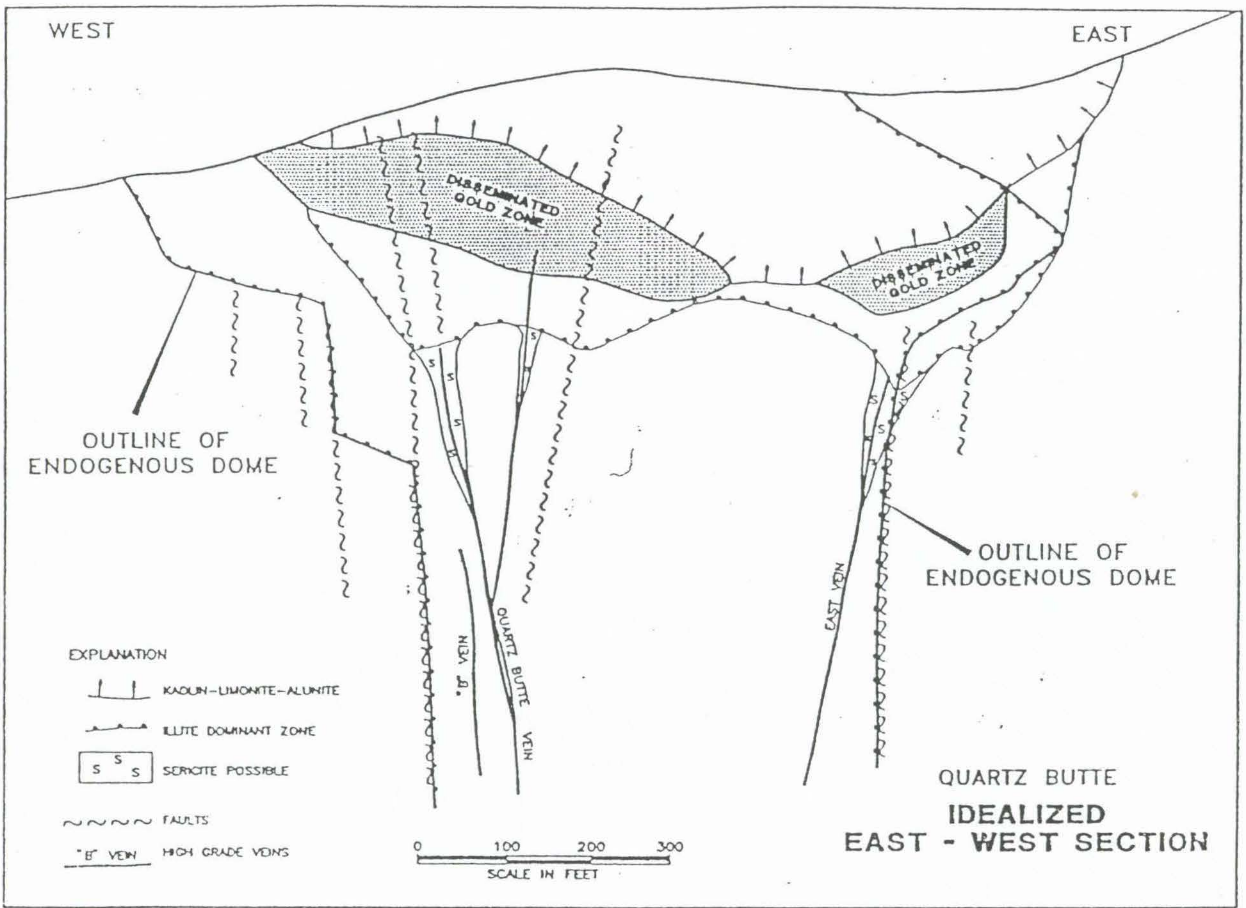

Figure 6. East–west cross section of Quartz Butte showing major alteration zones and high-grade gold-bearing veins.

in equilibrium with the rhyolite. The absence of well-developed vein structures supports either contention. The pervasive broad development of argillic alteration with the disseminated, near-surface gold deposit contrasts with the incipient alteration of vein walls of the imputed feeder zones at depth.

High-Grade Veins on Crone Hill

Exploration drilling on Crone Hill found high-grade intercepts that probably are feeder veins. A number of possible combinations of linkages can be proposed, but we favor the presence on Crone Hill of four veins and their splays. Using this array for the intercepts, we propose that the drilling indicates a mineral inventory within the disseminated deposit of 1,262,000 tons of high-grade ore that averages 0.28 ounce of gold per ton. Figure 4 shows a typical vertical section of the Alice vein, the largest proposed vein structure on Crone Hill. Importantly, none of the four proposed veins underlie the disseminated ore body, and none penetrate brecciated rhyolite. Rather, they seem to be independent of brecciation. The absence of identified feeder veins on Crone Hill below near-surface gold disseminations is in contrast to vein locations at Quartz Butte (fig. 6).

All Crone Hill veins gently dip 10°–25°N, and intersect pervasively argillized rhyolite as well as volcanic and volcaniclastic units. Presence of vein structures cutting a variety of rock types suggests that vein development is independent of lithologic controls.

The intercepts of high-grade ore include (1) chalcedonic replacements, (2) sulfide-bearing quartz-adularia and chalcedony veinlets or their oxidation product, and (3) clay-sulfide seams (or their oxidized equivalents). Alunite or adularia are present in some richer intercepts with earthy alunite more common near the surface. Adularia occurs more often within the illite-bearing argillic zone. No persistent uniformly mineralized and well-developed quartz vein structure has been recognized. Rather, the gently dipping zones of high-grade ore are assumed to be faults that channeled hydrothermal fluids. Exploration drilling has not completely exhausted the potential for discovering additional high-grade veins under Crone Hill, but the paucity of veins at depth, below the illite-bearing argillic alteration zone and its disseminated gold ore body, is particularly puzzling. Sericitic alteration found at depth at Quartz Butte has not been identified on Crone Hill. Normal fault structures similar to those at depth at Quartz Butte also appear to be missing. Still, argillization is centered about the Crone Hill endogenous rhyolite dome and its breccia, and the disseminated ore extends as a breccia root down the throat of the Crone Hill dome complex. Circular vein-fault structures commonly developed ringing although the large mineralized breccias found in other areas do not seem to have formed at Crone Hill, or if formed, have not been recognized to date.

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→ Circular vein-fault structures ringing large mineralized breccias found in other areas.......

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Received October 30, 1992; revised January 14, 1993; accepted June 21, 1993.

We thank the Quartz Mountain Gold Corp. staff collectively for their very high level of professionalism in these many work programs. Dr. D.E. White offered numerous suggestions that improved the manuscript. In particular, his comments on mineralization in the Steamboat Springs district were helpful.

PROJECT NAME: OWL HOLLOW

ALSO KNOWN AS: VETERAN copy in file

OWNER(S): SUMMIT MINERAL VENTURES INC (OPERATOR)

METAL(S): GOLD

EXPL. STATUS: EXPLORATION
ACTIVITY STATUS: ACTIVE

MINESEARCH #: 057331

MOST RECENT SOURCE: 1984

LOCATION

STATE: OREGON
COUNTY: JACKSON
LOCALE: ROGUE RIVER
LONGITUDE: 123.11.55
LATITUDE: 42.23.31

GENERAL COMMENTS

SUMMIT DID SOME WORK ON THIS PROPERTY IN 1984. (NGS 1984 ANNUAL REVIEW)

COMPANY INFORMATION

WE HAVE BEEN UNABLE TO LOCATE THE COMPANY.

BIBLIOGRAPHY

MILS SEQUENCE # 0410290144
NARROW-GAGE SCOUT 1984 ANNUAL REVIEW

WORK HISTORY

1984: BEFORE THE PROPERTY WAS OFFERED FOR SALE, IT UNDERWENT ROCK CHIP, SOIL AND PLANT SAMPLING. GEOPHYSICAL WORK ON THE PROPERTY INCLUDED EIGHT MILES OF IP SURVEYS AND A DETAILED AIR-MAGNETOMETER SURVEY. A TOTAL OF 11,525 FT WERE DRILLED IN 32 HOLES NEAR ONE OF THE FOUR RHYOLITES. (NGS 6/85)

1985: ANACONDA SOLD THE PROPERTY TO DIAMOND HEAD FOR WHAT ANACONDA CONSIDERS TO BE A GOOD PRICE. (PC 10/85)

COMPANY INFORMATION

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935-355 BURRARD ST
VANCOUVER, BC V6C 2G8
(604) 687-7169

BIBLIOGRAPHY

NARROW-GAGE SCOUT 6/85 P.11
PERSONAL CONVERSATION 10/85

QUARTZ MOUNTAIN GOLD DEPOSIT

LAKE COUNTY, OREGON

FIELD TOUR AND SYMPOSIA

June 20-21, 1986

Bill Bird
Eric Freedland
Galactic Resources
~~Loswell Dodaste~~
Will Rohtert

ash-flow tuff

AGENDA

anaconda
wavecrest Res inc

7:00 p.m.	WELCOME and INTRODUCTION W.H. Bird President: Diamond Head Mines	50 mil . 040 5 mil 0.10 *
7:10 p.m.	GEOLOGY OF THE QUARTZ MOUNTAIN DEPOSIT Will W.R. Rohtert Project Geologist: Diamond Head Mines	
7:30 p.m.	PETROGRAPHY OF THE QUARTZ MOUNTAIN DEPOSIT Lazlo Dudas Consultant McLoughlin { major crustal margins; Ed " volcanic center	
7:45 p.m.	HOT SPRING GOLD DEPOSITS Harold F. Bonham Hal Nevada Bureau of Mines	
8:00 p.m.	DISCUSSION	High sulfur acid sulfate systems exploration Targets

not spectacular, very subtle
repetative events better
Alkaline chloride system.
super-imposed systems
alunite-argillic alteration

American Institute of Mining, Metallurgical and Petroleum Engineers

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Portland, OR 97201
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301 N. G.

SUMMER FIELD TRIP
JUNE 20, 21, AND 22, 1986

We will meet Friday evening at 7:00 p.m. at the Lake County Community Center, 11 N. "G" St., Lakeview, Oregon. Mr. William R. Rohtert, project geologist for Wavecrest Resources, Ltd., will talk about the Quartz Mountain gold deposit that we will visit on Saturday.

On Saturday we will meet at 8:00 a.m. in the parking lot of the Skyline Motel Best Western, Lakeview, Oregon, 503/947-2194, for the Quartz Mountain field tour. If anyone is interested, we can stop on the return trip to look for sunstones. If you wish a copy of an abstract on the Quartz Mountain gold deposit, please call Peter E. Baer, 661-7995.

On Sunday, we will visit the Tucker Hill perlite deposit. There was an article on perlite on page 40 of the January issue of Mining Engineering.

CAR POOL

Is there any interest in setting up a car pool from Portland or Albany for Friday, June 20th? Please call by Friday, June 13, 1986: Peter E. Baer in the Portland area, 661-7995; Darrell Larson in Albany, 967-5844.

RESERVATIONS

Please make your own reservations directly with the motel: Skyline Motel Best Western, Lakeview, Oregon, 947-2194. Rates: Single, $28 + tax; Double (2 beds), $36 + tax.

ABSTRACT

QUARTZ MOUNTAIN GOLD DEPOSIT, Lake County, Oregon: The effect of paleo-groundwater levels on volcanic activity and shallow epithermal gold mineralization.

W. R. Rohtert
April 9, 1986

Quartz Mountain is a disseminated, volcanic-hosted, hot-spring gold deposit. It occurs in a Mid-Miocene composite volcanic field which is intruded by a west-northwest trending belt of highly altered endogenous rhyolite porphyry domes and unaltered latite vitrophyre plugs that have been dated at 7.3 $\pm$ 0.9 m.y. The intrusive belt measures 12 miles in length by 3 miles in width and includes eight rhyolites and six latites which range in size from less than 1000 to over 10,000 feet in diameter. The volcanic stratigraphy dips gently to the north and includes over 1000 feet of dacite pyroclastic breccias, andesite flows, silicic ash flow tuffs, and volcaniclastic rocks equated with the Cedarville Formation of Russell (1928). Both the Cedarville Formation and the silicic intrusive rocks are unconformably overlain by thin flows of high-alumina olivine tholeiite which have been assigned to the Pliocene Warner Basalt. Three fault sets are evident in the volcanic field: 1) north-south normal faults with displacements of 100 to 200 feet that are part of the regional Basin and Range structural pattern; 2) N60W normal faults with displacements of 200-500 feet that have apparently guided the emplacement of the intrusive bodies; and 3) major, N45W right-lateral strike-slip faults which terminate the other two sets. The northwest alignment of intrusives and structures is a key element of the McLaughlin lineament of Lawrence (1976) which is a recurrently-active, 120 mile long zone of dextral offset in the Tertiary rocks of southern Oregon.

Four of the rhyolites in the Quartz Mountain intrusive belt have produced mercury from near-surface, cinnabar-alunite-sulfur bearing opal deposits. These rhyolites are mantled with a carapace of sub-areal talus breccia and display solfataric alteration due to intense acid leaching. In contrast, the rhyolite on Crone Hill contains ore-grade gold mineralization in a zone of silicification and clay-sericite alteration. The Crone Hill rhyolite is ringed in part by a tuff cone up to thirty feet thick which includes a basal heterolithic eruption breccia, a cross-bedded base-surge deposit, and an upper, massive airfall tuff. Overlying the rhyolite within the tuff cone is a thirty foot thick deposit of hot-spring sinter which includes vent breccia, pool accumulate and apron conglomerate. Gold ore on Crone Hill is present in three geologic environments: 1) re-silicified portions of the hot-spring sinter deposit. 2) quartz stockworks and hydrothermal breccia pipes along the intrusive contact of the rhyolite porphyry, and 3) a tabular zone of of stratabound replacement mineralization in a 100 foot thick amygdaloidal dacite tuff breccia horizon that contains "flat" quartz veins dilating upper and lower stratigraphic contacts. Gold occurs in the native form and in association with pyrite or limonite. Accessory minerals include marcasite and stibnite in a gangue of chalcedony, kaolinite, sericite and adularia. Strong anomalies in gold, arsenic, antimony and mercury delineate the surface expression of a paleo-geothermal cell roughly 3000 feet in diameter on Crone Hill. The potential resource of the entire property is in excess of one million ounces of gold.

The contrasting alteration assemblages and volcanic landforms at Crone Hill versus the other rhyolites in the intrusive belt reflect the level of the paleo-groundwater table at the time of volcanism and hydrothermal activity. Rhyolites emplaced above the water table vented as viscous flows or gas-charged ash-flow tuffs and are surrounded by landslide deposits. They were altered by the acidic, vapor-dominated portions of geothermal systems which formed fumarolic fields and deposited mercury at the surface by condensation. In contrast, the rhyolite on Crone Hill was emplaced at or below the water table and vented in a hydrovolcanic eruption to produce a tuff cone. It was altered by a water-dominated geothermal system of near-neutral pH which formed hot springs and deposited gold by cooling at the surface, by boiling in vein and breccia conduits, and by fluid mixing in porous volcanic horizons which acted as paleo-aquifers. The recognition of paleo-groundwater control on the loci of gold mineralization provides the definitive criteria to evaluate the potential of untested volcanic terrain for buried ore bodies in favorable stratigraphic horizons. The model also predicts that zones of boiling and gold-sulfide deposition occur at depths of 200-1000 feet below the four mercury deposits in the Quartz Mountain district.

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Planning & Building Office (503) 947-4494
LAKE COUNTY COURTHOUSE LAKEVIEW, OREGON 97630

LAKE COUNTY PLANNING COMMISSION

AGENDA

TUESDAY, NOVEMBER 19, 1985 - 7:30 P.M.

LAKE COUNTY SENIOR/COMMUNITY CENTER
11 NORTH "G" STREET, LAKEVIEW

ITEM #1 Public Hearing on Conditional Use Application, File No. 291 by Victor A. Anker to establish a dwelling on a 40-acre parcel described as: NW¼NE¼, Section 16, Township 39 South, Range 18 East, W.M., in Lake County, Oregon which is located approximately 12½ miles west of Lakeview on State Highway 140, then southwest on County Road 1-22 approximately 600 feet, then south on a private road approximately ¼ mile, in an A-2, Agriculture Use, Zone.

ITEM #2 Public Hearing on Conditional Use Application, File No. 292 by Duane P. Siebert to place a mobile home as a single-family dwelling on property described as: Lots 3 and 4, Block 341 of the Oregon Valley Land Co.'s Second Addition to the Town of Lakeview, Lake County, Oregon which is located between 996 and 982 South "G" Street, Lakeview, in a C-1, Commercial, Zone.

ITEM #3 Public Hearing on Conditional Use Application, File No. 293 by Wavecrest Resources Ltd. to conduct operations for the exploration of mineral potential by drilling seven (7) drill holes on property described as: Lying within the S½NE¼, N½SE¼ and a portion lying within the E½NW¼, Section 34, Township 37 South, Range 16 East, W.M., in Lake County, Oregon which is located approximately 26 miles west of Lakeview on State Highway 140 across State Highway 140 from Quartz Mountain Rural Center in an F-1, Forest Use, Zone.

ITEM #4 Request by Leroy Stewart for boundary modification of Partition Permit #1019.

Wavecrest Resources Ltd.

William R. Rohtert
Project Geologist

District Office:
1820 Whites Creek Lane
Reno, Nevada, USA
89511
~~702-852-3126~~
702 358-4006

Main Office:
935-355 Burrard St.
Vancouver, B.C., Canada
V6C-2G8
604-662-7557

Quartz Mountain Project
Baseline Environmental Studies
Lake County, Oregon

Submitted to:

Fremont National Forest
Oregon Department of Geology
and Mineral Industries
Oregon Department of Environmental Quality

Submitted by:

Pegasus Gold Corporation
North 9 Post Street
Suite 400
Spokane, Washington 99201

November, 1989

PREFACE

On July, 1989, Pegasus Gold Corporation entered into an Option Agreement with Galactic Services Inc. to acquire Galactic 50 percent interest in the Quartz Mountain Project. During the next 12 months, Pegasus intends to conduct additional exploration drilling on the property, undertake extensive metallurgical testing, and initiate the permit process for a mine.

The Baseline Environmental Studies contained within this document were prepared by SRK Consultants under the direction of Galactic Services. The baseline studies describe existing environmental conditions at the Quartz Mountain Project site and constitute the base against which the environmental effects of mine can be assessed.

For further information contact:

John S. Fitzpatrick
Director
Community and Regulatory Affairs
Pegasus Gold Corporation
5944 Highway 12 West
Helena, Montana 59601

(406) 442-3977

1.0 INTRODUCTION

TECHNICAL REPORT NO. 1

INTRODUCTION

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

STEFFEN ROBERTSON AND KIRSTEN (COLORADO) INC.
1755 East Plumb Lane Suite 230
Reno, Nevada 89502

Revised November 1988

FOREWORD

This report was prepared by Steffen Robertson and Kirsten (Colorado) Inc. for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
J.D. Thatcher	EIS Project Principal	SRK
D.W. Struhsacker	EIS Project Manager	SRK
D. Holloran	Soils Task Leader	SRK
M.L. Wilson	Vegetation/Range Task Leader	SRK
M.L. Sharp	Wildlife Task Leader	SRK
P.A. Fishman	Aquatic Biology Task Leader	SRK
R.H. Wheeler	Surface Water, Forestry Task Leader	SRK
F. Marinelli	Groundwater Task Leader	SRK
R.G. Steen	Air Quality /Climatology Task Leader	SRK
R.H. Winthrop	Archaeology/Cultural Resources Task Leader	SRK
G. Blankenship	Socioeconomics, Land Use, Recreation, Transportation Task Leader	SRK
C. Adams	Visual Resources Task Leader	SRK
W.E. Marlatt	Noise Task Leader	SRK
A. Smith	Geochemistry Task Leader	SRK

LIST OF FIGURES

1.0 INTRODUCTION

1.1 PURPOSE AND REGIONAL OVERVIEW

Steffen Robertson and Kirsten (Colorado) Inc. (SRK) was retained by Galactic Services, Inc. (GALACTIC) to conduct environmental baseline studies for the proposed Quartz Mountain Gold Mine in Lake County, Oregon. These studies are described in this Baseline Report which is intended to serve as a technical support document for the Environmental Impact Statement (EIS) currently being prepared by SRK under the direction of the USDA Forest Service, Fremont National Forest (USFS). This EIS is being prepared in accordance with USFS guidelines for implementing the Council of Environmental Quality Regulations (40 CFR 1500-1508) related to the National Environmental Policy Act of 1969 (NEPA).

The Quartz Mountain Gold Project study area (Figure 1.1-1 and Plate 1-1) is located in Lake County, Oregon near the summit of Quartz Mountain Pass, approximately 30 miles west-northwest of Lakeview, Oregon. This area is transitional to the Basin and Range Province to the south, the Cascade Province to the west, and the Columbia River Plateau to the north. Elevations within the project area range from 5,400 ft to 6,600 ft, and the topography is dominated by round to oval-shaped buttes of moderate relief.

The Quartz Mountain Gold Project area is drained by northeast-trending drainages which flow in between the buttes. Climate in the project area is moderate with warm summer days and cool nights, and cool winter days and cold nights. The annual average precipitation in the project area ranges from approximately 20 to 25 inches. Most of this precipitation is in the form of winter snows and locally intense summer thunderstorms. The vegetation of the project area reflects this climate and consists primarily of species characteristic of the Ponderosa Pine Zone or dry forest environment.

The project area is serviced by Oregon State Highway 140. The nearest communities, Lakeview, Bly, and Klamath Falls, Oregon, also lie along this route. Like much of the rest of the Northwest, the economy of this part of Oregon has been somewhat depressed in recent years. The local economy is based primarily upon agriculture, ranching, and forest products.

1.2 PROJECT DESCRIPTION

GALACTIC proposes to develop the Quartz Mountain Gold Project as a joint venture with Capricorn Resources, Inc. (CRI) and Wavecrest Resources, Inc. (WRI). GALACTIC will be the operator of the Quartz Mountain Gold Project. The proposed project will consist of one or more open-pit mines, a processing facility, and ancillary and support facilities. The mine and processing facility will operate up to seven days per week for a period of up to 10 years. Between 5 to 10 million tons of ore and 10 to 20 million tons of waste rock will be mined from the area.

Environmental baseline studies have been conducted in the study area indicated in Figure 1.1-1. The data collected in the Quartz Mountain project area include baseline information for the following: geology, soils, vegetation, wildlife, aquatic biology, surface water, groundwater, air quality and climatology, archaeology and cultural resources, socio-economics, recreation, visual resources, and noise. The surface water, groundwater, air quality, climatology, visual resources, and noise environmental baseline studies have established specific data monitoring stations shown in Figure 1.2-1.

The following report discusses in detail the existing environment within this study area. Some of the environmental baseline studies within the project area are ongoing, and more information will be collected on either a regular or seasonal basis. This additional information will be supplemented as an addendum to this volume as soon as it becomes available.

2.0 GEOLOGY

TECHNICAL REPORT NO. 2

GEOLOGY

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

GALACTIC SERVICES, INC.
5250 South Virginia Street, Suite 300
Reno, Nevada 89502

Revised December 1988

FOREWORD

This report was prepared by Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mines, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
R.S. Mattson	President, Galactic Services,Inc.	GALACTIC
W.B. Williams	General Manager, Quartz Mountain Gold Mine	GALACTIC
W.J. Clark	Director, Environmental Programs	GALACTIC
M.S. Enders	Director, Geology & Task Leader	GALACTIC
T.J. Thomas	Field Geologist	WRI
K.D. Russell	Project Manager	WRI
B.A. Hart	Geo-Statistician	WRI
R.N. Warren	Editor	WRI

LIST OF FIGURES

SUMMARY

The Quartz Mountain Gold Project is located in the Basin and Range Province which in this region is characterized by northwest-trending right-lateral fault zones and north-trending normal faults. These structures form a series of long, open valleys bounded by steep-sided mountain ranges.

The geology of the Quartz Mountain area consists of mid-Miocene regional basalt flows, tuffs and rhyolitic volcanic dome complexes. Younger, Plio-Pleistocene lake bed and alluvial sediments are interspersed among the volcanic domes and basalt plateaus. The rhyolite domes in the vicinity of Quartz Mountain occupy the McLoughlin Lineament (6.4 to 8.1 m.y.). Subparallel normal faults and a conjugate set of north to northeast-trending faults are also present. Hydrothermal alteration and gold mineralization are spatially and genetically related to the implacement of endogenous quartz rhyolite porphyry domes. The faults controlled the movement of mineralizing fluids which deposited the gold and related trace elements.

Two specific areas within the Quartz Mountain Project, Crone Hill and Quartz Butte, have been studied in detail. Based on the initial reconnaissance program which identified the gold mineralization, an extensive exploratory core and reverse circulation drilling program was conducted to provide an accurate geologic and reserve evaluation of these gold deposits.

The Crone Hill deposit is approximately 3,000 feet wide and 300 feet thick. The gold is dispersed in rhyolite, tuff and basalt rock types. The Quartz Butte deposit measures 1,000 feet wide by 100 feet thick. The ore zones are coalescing, stacked masses of higher-grade material within disseminated, lower-grade rock. Ore zones are also associated with siliceous rock alteration in and near faults.

2.0 GEOLOGY

2.1 INTRODUCTION

The geology of the Quartz Mountain Project is based upon a compilation of several years of geologic investigations, including field mapping and eight series of drilling on the Crone Hill and Quartz Butte areas. The purpose of this section is to provide a concise overview of the geology of the property to more accurately evaluate the recoverable resource potential of the Crone Hill and Quartz Butte ore bodies.

2.1.1 Objective

The objective of the exploration program in south-central Oregon and at the Quartz Mountain property was to discover a bulk-mineable disseminated gold deposit. To accomplish this objective, Wavecrest Resources, Inc. (WRI) conducted an exploration program from 1985 through 1988 that included geologic mapping, sampling, diamond core and reverse circulation drilling, metallurgical testing, and other related exploratory work. At present, a complete geologic and reserve calculation is being conducted to evaluate the Crone Hill and Quartz Butte deposits.

2.1.2 Study Area

The Quartz Mountain property encompasses over 9,875 acres of contiguous, unpatented mining claims and fee land, and is located entirely within the Fremont National Forest (see Figure 1.1-1). Within this boundary, two specific project areas, Crone Hill and Quartz Butte, have been studied in detail to determine the viability of gold production. To this end, WRI, Quartz Mountain Gold Corp. and Galactic Services, Inc. have undertaken an aggressive exploration and development program to meet these goals.

claims are still maintained in the Lakeview area. Bonanza lodes in the epithermal veins of the High Grade district produced about 14,000 ounces of gold between 1880 and 1959 (Peterson and McIntyre 1970).

2. A syn-rhyolite plagioclase porphyry basalt; and

3. The post-rhyolite diktytaxitic basalts of the Devils Garden lava field (McKee et al. 1983).

The trachytic and plagioclase porphyry basalts are strongly argillized and host gold-bearing quartz veins at the Crone Hill deposit (Plate 2.1, Unit Tb). The diktytaxitic basalt is unaltered where observed and appears to cap the rhyolite sequence in the east half of the district. Basalt vents in the Quartz Mountain Pass vicinity are characterized by scoriaceous basalt and basalt bombs.

Although much of the textural and mineralogic detail is obscured by hydrothermal alteration, three textural varieties of basalt are noted. These include:

1. Fine-grained basalt with prominent vesicles which are typically filled with clay, sulfides, or silica;

2. Dense, fine-grained basalt; and

3. Dense basalt with prominent plagioclase phenocrysts.

2.3.2.2.2 <u>Tuff</u>

Pyroclastic rocks on Crone Hill and Quartz Butte are assigned to the heterolithic tuff unit (Plate 2-1, Unit Tht). These rocks were derived mostly from phreatic eruptions associated with emplacement of the rhyolite bodies but may be in part phreato-magmatic. The heterolithic tuff unit includes:

1. Lapilli tuff;

2. Tuff breccia;

3. Fine-grained tuff; and

4. Coarse basaltic volcanic breccia.

The heterolithic tuff beds contain widely varying percentages of basalt and rhyolite clasts, but the basal portions of the unit tends to be more basaltic. Most coarse-grained beds are massive, but the finer grained and better sorted portions display conspicuous bedding, both graded and cross-bedded. A crystal-rich variant of the heterolithic tuff which contains locally abundant ($\leq$ 10%) biotite phenocrysts is poorly sorted and matrix supported. Some Tht outcrops contain textures suggestive of gas streaming, and portions are further brecciated and overprinted with pyritic chalcedony. Heterolithic assemblages of variably altered fragments in the thickness with underlying rock types. Weathering appears to be uniform throughout the Crone Hill and Quartz Butte areas.

2.3.3 Structure

The tectonic setting of the Quartz Mountain district is dominated by three fault zones: the northwest-trending McLoughlin fault zone; a conjugate set of northwest- and northeast-trending normal faults and joints; and of north-trending faults. Since actual fault traces are rarely observed in the field, most faults are inferred from drill data, field relations and analysis of topographic and air photo features (Figure 2.3-1). The McLoughlin fault in the vicinity of Crone Hill and Quartz Butte is expressed as the topographic trough of Quartz Valley. The dominant northwest and northeast drainage patterns reflect the conjugate joint/fault set.

Structure controls mineralization on Crone Hill and Quartz Butte. Faults trending N50-80°W appear to have localized emplacement of the endogenous domes and served as conduits for mineralizing hydrothermal fluids.

Bedding attitudes in the basalt and pyroclastic units do not have consistent patterns. Most beds are gently dipping, but variable strike directions suggest disruption by the above-mentioned faults.

2.3.4 Alteration and Mineralization

2.3.4.1 Alteration

The alteration patterns of the Crone Hill and Quartz Butte deposits are similar and are divided into three epithermal alteration suites:

1. A central silicified rhyolite core;

2. A variably silicified and argillized tuff and basalt margin; and

3. A propylitic fringe.

The central core of both deposits consists of moderately to densely silicified porphyritic rhyolite with quartz phenocrysts in a glassy to aphanitic matrix. Biotite is locally preserved. The central core grades upward into less silicified rock which is capped by a leached or advanced argillic assemblage.

Permeable rocks adjacent to the Crone Hill and Quartz Butte rhyolites are variably argillized and silicified. These alteration zones are more complex and laterally extensive than those on Quartz Butte. The highest gold concentrations on Quartz Butte are associated with faults that cut the silicified rhyolite core, but the highest grade zones on Crone Hill are on the margins of the rhyolite dome.

Gold to silver ratios in the ore bodies average about 1:1, but the ratio can be as high as 1:4 in deeper parts of the deposits. Gold grains are typically less than 20 microns in size and are either disseminated in the host rock or are concentrated in veins or veinlets. Native gold occurs within unoxidized material, within sulfides, or finely dispersed in silica. Mineralized oxidized rocks typically contain gold in quartz veins, but gold may also occur as free grains within oxide pits in the host rock or on fractures with geothite and hematite. Liberation from primary sulfides during oxidation is suggested by the oxide ore mineralogy.

Free gold has not been identified at the surface but has been found in a few drill samples. The gold grains were .5 mm to .7 mm wide and .5 mm to 2 mm thick. The coarser gold is from quartz-veined, silicified rhyolite, tuff, and basalt, and is also associated with silica flooding.

Marcasite, covellite, chalcopyrite, anatase, and bravoite also were noted as accessory constituents.

land flow. In the Quartz Mountain Gold Project study area the stability in terms of mass movement of the landtype and soil mapping units in the natural state was rated very stable, with no evidence of deep-seated failure observed, or stable, with occasional rotational slumps found. The slightly less stable soils typically occur on the steeper slopes of landforms underlain by basaltic lavas. The expected mass movement as a result of man's activities will be unchanged for all mapping units relative to their stability in the natural state.

Potential surface soil erosion by sheet erosion and rill and gully erosion after removal of vegetative cover varies from low to high for the various mapping units in the Quartz Mountain Gold Project area. This erosion potential is a function of soil characteristics (especially depth, slope gradient and length), hydrologic characteristics of the soil and bedrock, and climate. In general, moderately deep to deep soils in upland basins and alluvial valleys or on gently rolling basalt lava and tuff tablelands have moderate to high erosion potential. Soils on slopes with a gradient of less than 15 percent will have some loss of surface soils materials, and slopes greater than 40 percent will experience considerable soil loss.

PORPHYRY/PORPHYRITIC - An igneous rock of any composition that contains conspicuous large crystals in a fine-grained groundmass; a textural term for a rock that resembles a porphyry.

PROPYLITIC - A type of hydrothermal alteration characterized by the formation of calcite, chlorite, epidote, serpentine, quartz, pyrite, and iron oxides.

PSEUDOMORPHS - A mineral whose outward crystal form is that of another mineral species, typically as a result of hydrothermal alteration.

PYROCLASTIC - Pertaining to a clastic rock material formed by volcanic explosion or aerial explosion from a volcanic vent.

RHYOLITE - A group of extrusive igneous rocks, typically porphyritic and commonly exhibiting flow texture, with phenocrysts of quartz and alkali feldspar in a glassy or very fine-grained groundmass.

RIGHT-LATERAL FAULT - A fault along which the displacement is such that in plan view the side opposite the observer appears displaced to the right.

SCORIACEOUS - Textural term for a coarsely vesicular rock, usually a basalt or andesite.

SILIFICATION - The introduction of and replacement by silica, generally resulting in the formation of fine-grained quartz, chalcedony, or opal, which may fill pores and replace existing minerals.

TEPHRA - Clastic volcanic ejecta usually found around the vent of a crater.

THOLEIITES - Type of basalt containing orthopyroxene in a glassy matrix.

TRACHYTIC - Textural term for volcanic rocks having feldspar crystals arranged in a parallel or subparallel fashion.

VESICULAR - The texture of an igneous rock characterized by abundant vesicles formed as a result of the expansion of gases during cooling of the rock.

VITROPHYRE - Any porphyritic igneous rock having a glassy groundmass.

2.7 LIST OF PRINCIPAL PREPARES

2.7.1 William R. Rohtert

Mr. Rohtert is an exploration geologist with expertise in precious and base metals exploration in western United States and Alaska. Prior to becoming Vice President of Exploration of Wavecrest Resource, Inc. in 1985, he served as project geologist for the Quartz Mountain program from 1982 to 1985. Since becoming Vice President of Wavecrest, Mr. Rohtert has supervised the exploration of the Quartz Mountain Project as team leader and coordinator for the development of the geologic interpretation of the area.

Mr. Rohtert received his B.S. in Geology from the University of California (L.A.) in 1975 where he developed expertise in mafic and ultramafic rocks of Southwest Oregon. He received his M.S. degree in Geology from the University of Colorado in 1980 after completing his thesis on a uranium deposit in California. In addition to his position with Wavecrest Resource, Inc. Mr. Rohtert has held positions in exploration with Anaconda Minerals Co., Nevada Exploration, Portland General Electric, American Copper and Nickel, and Getty Minerals Co.

2.7.2 Kevin Russell

Mr. Russell is an exploration geologist and the project geologist for the Quartz Mountain Gold Project from January 1987 to February 1988. Mr. Russell's expertise includes volcanic rocks and associated epithermal gold deposits, and the regional geology and stratigraphy of the Basin and Range.

Mr. Russell graduated from California State University at Fresno, where he received his B.A. and M.A. in geology. His major field of study was the volcanic stratigraphy of epithermal gold and silver deposits.

In addition to his present position as project geologist with Wavecrest Resource, Inc. Mr. Russell has held geologist positions with Nevco Minerals Co., Anaconda Mineral Co., Conoco Minerals Co., and American Copper and Nickel Co.

2.7.3 Trevor J. Thomas

Mr. Thomas is a regional reconnaissance geologist with expertise in mapping, sampling and regional research in molybdenum, gold, silver districts of Nevada, California, Washington, and Oregon. Mr. Thomas was a major contributor to the Quartz Mountain project from 1986 through 1988 during

3.0 SOILS

TECHNICAL REPORT NO. 3

SOILS

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

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and

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Revised December 1988

FOREWORD

This report was prepared by Northwest Soil Consulting and Steffen Robertson and Kirsten (COLORADO) Inc. (SRK) for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
D.W. Holloran	Soils Task Leader	SRK
J.E. Kiel	Reclamation Task Leader	SRK
K.S. Menard	Graphics	SRK

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3.0 SOILS

3.1 INTRODUCTION

3.1.1 Objectives

Steffen Robertson and Kirsten (Colorado) Inc. (SRK) was retained by Galactic Services, Inc. (GALACTIC) to conduct environmental baseline studies for the proposed Quartz Mountain Gold Mine in Lake County, Oregon. Soil studies are described in this Soils Baseline Report which is intended to serve as a technical support document for the Environmental Impact Statement (EIS) currently being prepared by SRK under the direction of the USDA Forest Service, Fremont National Forest (USFS). This EIS is being prepared in accordance with USFS guidelines for implementing the Council of Environmental Quality Regulations (40 CFR 1500-1508) related to the National Environmental Policy Act of 1969 (NEPA).

The soil baseline study was designed to accomplish the following objectives:

1. Describe soils occurring within the study area and prepare a soils map showing the study area occurrence of these soils: and

2. Describe study area soil characteristics which will affect reclamation planning for disturbed areas associated with the proposed Quartz Mountain Gold Mine.

3.1.2 Study Area

The Quartz Mountain Gold Project study area (Figure 1.1-1) is transitional between great basin and mountain geography and includes a diversity of geology (Plate 2.1) and soils. The study area is approximately 30 miles west-northwest of Lakeview, Oregon, with elevations ranging from 5,400 to 6,600 feet. The topography is dominated by round to oval-shaped buttes of moderate relief. These buttes have a general northwestern alignment and are dominantly composed of intrusive rhyolitic rocks.

Climate in the project area is moderate with warm summer days and cool nights, and cool winter days and cold nights. The project area receives approximately 20 to 25 inches of precipitation on an average annual basis. Most of this precipitation is in the form of winter snows and locally intense summer thunderstorms.

3.2 LITERATURE REVIEW

The USFS publication Fremont National Forest Soil Resource Inventory (SRI) (USFS, 1979), provides the technical framework for this study. The Soil Taxonomy Handbook (USDA 1975), The National Soils Handbook (USDA 1974), and The Soil Survey Manual (Revised) (USDA 1979) provide technical guidance in conducting soil survey investigations. The SRI report was reviewed in detail and much of the information included in this report was obtained or modified from this document.

3.4 RESULTS AND DISCUSSIONS

3.4.1 Mapping Unit Delineations (modified from SRI report)

Soil mapping units are delineated by identifying soils with similar characteristics. Mapping unit identification is shown on the soils map as numbers and letters (Figure 3.3-1). The most dominant soil type accounts for at least 70 percent of the mapping unit delineation.

The dominant soil of the mapping unit is described in the mapping unit description. Within the mapping unit other soils occur. Those most commonly associated with the dominant soil are listed in the descriptions as inclusions. These inclusions normally account for no more than 30 percent of the unit.

Soil map unit and other map units are defined as land types that have a definable range of characteristics based on similar soil, geology, landform, slope, and vegetation types. Three types of mapping units were defined in the study area:

1. Standard Mapping Units: These map units contain at least 70 percent of one land type that have similar characteristics, such as dominant soil type; common land type inclusions; bedrock; landform and slope; elevation; vegetation type; drainage type; permeability rates; and profile characteristics, including coarse fragment content. These units are labeled with a two digit number, commonly followed by the suffix A, B, or C. These letters denote the slope categories of the soil types and are defined as: A (0-15 percent slopes), B (16-40 percent slopes), and C (greater than 40 percent slope).

2. Mapping Unit Complexes: These map units, shown on the map with three digits, are used in areas where two or more mapping units are present but cannot be distinguished from each other in the scale used in the soils map.

3. Miscellaneous Map Units: Map units or land types that are too variable to be described by a definable range of characteristics are labeled with a single digit number on the soils map.

There are 32 mapping units recognized in this survey. Four (4) are miscellaneous mapping units, two (2) are mapping unit complexes, and twenty-six (26) are standard mapping units (Appendix 3.D).

TABLE 3.4-1

ACREAGES OF EACH MAPPING UNIT
IN THE QUARTZ MOUNTAIN GOLD PROJECT STUDY AREA

MAP UNIT[1]	ACREAGE[2]	MAP UNIT	ACREAGE
3	27.27	37B/R.O.	73.56
4	10.29	37C	22.88
4A	14.15	40A	222.00
6	35.54	40B	1041.02
16*	261.22	41A	540.65
18*	9.25	41B	806.22
30A	31.18	41C	141.86
31A	153.32	63A	218.43
34A	318.54	63B	20.25
34B	72.00	64	631.36
34B/R.O	11.89	64A*	369.82
34A*	243.01	64B*	125.32
34B*	168.32	65	98.09
34C/R.O.*	5.12	348	186.76
37A	1008.53	417	24.91
37B	555.32		

[1]Map units identified in the study area are described in accompanying text and their distribution shown on Figure 3.3-1.

[2]Acreage calculations by Wilsey & Ham, Portland, Oregon.

The soil is moderately well to poorly drained. Permeability is moderate in the surface soils and slow or very slow in the subsoils.

Range of Profile Characteristics of Soil 16*

Litter: Leaves and stems; 0 to 0.25 inches thick.

Surface layers: Very dark gray to dark grayish brown silt loam or clay loam; weak to moderate, medium, granular structure; soft to hard; slightly plastic; pH ranges from 5.6 to 6.6; 5 to 10 inches thick.

Subsoil layers: Very dark gray to black clay loam or silty clay loam; strong, fine to medium subangular blocky structure; lower subsoil is strongly mottled, gleyed, and has massive structure; very hard; plastic to very plastic; pH ranges from 6.0 to 7.0; over 40 inches thick; intermittent hardpan is hard and strongly cemented.

3.4.2.6 Mapping Unit 18*

Mapping unit 18* consists dominantly of Landtype 18* and minor amounts of Landtypes 17 and 19. Landtype 18* is similar to Landtype 17 with the exception of internal drainage soil color and vegetation. It is similar to Unit 16 with the exception of elevation and position in the landscape.

Landtype 18* has deep to very deep alluvial over residual soils which have developed in tuff, breccia, and lava sediments. Surface layers are thin and medium to moderately fine textured. Subsoil layers are thick to very thick and fine textured. Sand and gravel lenses occur locally.

Bedrock is soft to moderately hard, massive rhyolite-dacite ash-flow tuff, tuffaceous sedimentary rock, and breccia. Depth to bedrock ranges from 40 to 144 inches.

Typically, Landtype 18* occurs on wide alluvial valleys adjacent to major streams and rivers. Slopes are less than 5 percent.

This landtype ranges in elevation above 5,000 feet and of sedges, rushes, meadow foxtail, and bluegrass, and scattered patches of stands of mixed conifers.

The soil is moderately well to somewhat poorly drained. Permeability is moderate in the surface soils and slow or very slow in the subsoils.

sage, bitterbrush, phlox, bottlebrush squirreltail, Idaho fescue, and mountain mahogany.

The soil is well drained. Permeability is moderate to slow in the surface soils and slow or very slow in the subsoils. Coarse fragment content average less than 35 percent in the textural control section.

Range of profile Characteristics of Soil 30A

Litter: None

Surface layers: Dark brown or dark grayish brown loam or clay loam; weak, fine granular structure; 10 to 30 percent coarse fragments by volume; soft; slightly by plastic to plastic; pH ranges from 5.0 to 7.0; 6 to 16 inches thick.

Subsoil layers: Dark reddish brown to dark brown stony clay loam, silty clay loam or silty clay; moderate, fine to medium subangular blocky structure with occasional moderate, coarse prismatic structure; 5 to 50 percent coarse fragments by volume; very hard; very plastic; hard, and massive; pH ranges from 5.0 to 7.0; 9 to 29 inches thick.

3.4.2.8 Mapping Unit 31A

Mapping Unit 31A consists dominantly of Landtype 31A and minor amounts of Landtypes 28, 30B, 56A, and 34A. Landtype 31A is similar to Landtype 28 with the exception of soil depth and vegetative type. It is similar to Landtype 30B with the exception of slope range coarse fragment content, and position in the landscape.

Landtype 31A has shallow to moderately deep, stony residual soils located primarily on lower elevations. Surface soils are thin and medium to moderately fine textured. Subsoils are thin and moderately fine or fine textured. Surface vesicular basalt boulders commonly cover up to 50 percent of the surface. Rock outcrops and boulder parches are common within some areas.

Bedrock is interbedded soft, reddish brown tuff or hard, gray basalt or andesite. Depth to bedrock ranges from 15 to 25 inches.

Typically, Landtype 31A occurs on gently rolling basalt lava and tuff tablelands on slopes from 0 to 15 percent slopes. It occurs on a wide range of elevations but primarily on lower elevations or forest fringe areas.

unit occurs primarily on lower elevations but includes some units at higher elevations.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, big sage, wax currant, mules ear, bottlebrush squirreltail, squawcarpet, Ross sedge, serviceberry, Idaho fescue, lupine, bluegrass, phlox, and Oregon grape. Some units also contain manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 34A

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown or dark brown loam; weak, fine granular structure; 10 to 50 percent gravel, cobbles, and stones by volume; soft; slightly plastic; pH ranges from 5.5 to 6.8; 5 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark brown stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 35 to 70 percent gravel, cobbles, and stone by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 36 inches thick.

3.4.2.10 Mapping Unit 34B

Mapping Unit 34B consists dominantly of Landtype 34B and minor amounts of Landtypes 34A, 34C, and 37B. Landtype 34B is similar to Landtype 34A with the exception of landforms, slope range, and position in the landscape. It is similar to Unit 34C with the exception of slope range. Unit 37B differs by vegetative type.

Landtype 34B has moderately deep, stony residual and colluvial reddish brown soils with ponderosa pine timber types. Surface soils are very thin or thin and medium or moderately fine textured. Subsoil layers are moderately thick and moderately fine textured. Large vesicular basalt boulders up to 3 feet long are common.

Bedrock is interbedded soft, reddish brown tuff or hard gray basalt. They are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches. Some areas are deeper than 48 inches to bedrock.

Bedrock is interbedded soft, reddish brown tuff or hard gray basalt. They are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches. Some areas are deeper than 48 inches to bedrock.

Typically, Landtype 34B occurs on basaltic eruptive centers, shield volcanoes, and block fault scarps on slopes from 16 to 40 percent. It occurs on a wide range of elevations but is most typically found on lower elevations.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, Oregon grape, mules ear, Ross sedge, Idaho fescue, mountain mahogany, big sage, wax currant, squawcarpet, serviceberry, lupine, and occasionally manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Coarse fragment content average greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 34B

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown on dark brown loam or clay loam; weak to moderate, fine granular structure; 10 to 50 percent gravel, cobbles, and stone by volume; soft; slightly plastic; pH ranges from 5.5 to 6.8; 5 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark brown stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 35 to 70 percent gravel, cobbles, and stones by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 36 inches thick.

3.4.2.12 Mapping Unit 34A*

Mapping Unit 34A* consists dominantly of Landtype 34A* and minor amounts of Landtypes 34B*, and 35. Landtype 34A* is similar to Landtype 34B* with the exception of slope range. It is different from Unit 35 in vegetative type. Landtype 34A* is found on south slopes and has a mesic temperature regime. 34A is found at higher elevation and on north slopes. They are frigid.

Landtype 34A* has moderately deep to deep, stony and residual reddish brown soils with ponderosa pine timber types.

mesic temperature regime. Landtypes 34A, 34B, and are found at higher elevations and on north slopes. They are frigid.

Landtype 34B has moderately deep to deep, stony residual and colluvial reddish brown soils with ponderosa pine timber types. Surface soils are very thin or thin and medium or moderately fine textured. Subsoil layers are moderately thick and moderately fine textured. Large vesicular basalt boulders up to 3 feet long are common.

Bedrock is interbedded soft, reddish brown tuff or hard gray basalt. They are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches.

Typically, Landtype 34B occurs on basaltic eruptive centers, shield volcanoes, and block fault scarps on slopes from 16 to 40 percent. It occurs on a wide range of elevations but is most typically found on lower elevations.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, Oregon grape, mules ear, Ross sedge, Idaho fescue, mountain mahogany, big sage, wax currant, squawcarpet, serviceberry, lupine, and occasionally manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Coarse fragment content average greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 34B*

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown or dark brown loam or clay loam; weak to moderate, fine granular structure; 10 to 50 percent gravel, cobbles, and stone by volume; soft; slightly plastic; pH ranges from 5.5 to 6.8; 5 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark brown stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 35 to 70 percent gravel, cobbles, and stones by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 36 inches thick.

3.4.2.14 Mapping Unit 34C*/R.O.

Mapping Unit 34C*/R.O. consists dominantly of Landtype 34C* and minor amounts of Landtypes 34B and 37C. Landtype

3.4.2.15 Mapping Unit 37A

Mapping Unit 37A consists dominantly of Landtype 37A and minor amounts of Landtypes 28, 30A, 34A, and 37B. Landtype 37A is similar to Landtype 34A with the exception of timber type, and it is similar to Unit 37B with the exception of slope range and landforms.

Landtype 37A has moderately deep to deep, stony and residual reddish brown soils with mixed timber types. Surface soils layers are very thin or thin and medium or moderately coarse textured. Subsoils are moderately thick to thick and moderately fine or medium textured. Large basalt boulders commonly occupy a large part of the soil surface.

Bedrock is interbedded hard, red to gray basalt or soft, reddish brown tuff. The tuff rock is soft and massive. The basalt layers are hard and highly fractured. Depth to bedrock ranges from 25 to 48 inches. Some areas are greater than 48 inches to bedrock.

Typically, Landtype 37A occurs on gently rolling plateaus and tablelands on medium or high elevations. Slopes range from 0 to 15 percent.

This landtype ranges in elevation above 5,500 feet and supports mixed conifers, snowbrush, manzanita, squawcarpet, serviceberry, mules ear, Ross sedge, wax currant, phlox, bottlebrush squirreltail, Oregon grape, lupine, and big sage.

The soil is well drained. Permeability is moderate to rapid in the surface soils and moderate to slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 37A

Litter: Needles, leaves, twigs, and decomposing organic matter; 0.5 to 3 inches thick.

Surface layers: Dark brown to black loam or sandy loam; weak, medium granular and weak, fine subangular blocky structure; 5 to 35 percent coarse fragments by volume; soft; friable; pH ranges from 5.5 to 7.0; 5 to 16 inches thick.

Subsoil layers: Dark reddish brown or dark brown gravelly, cobbly, or stony clay loam, silty clay loam, or occasionally loam; moderate, fine or medium subangular blocky structure; 35 to 80 percent coarse fragments by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 32 inches thick.

coarse fragments by volume; hard; plastic; pH ranges from 5.5 to 7.5; 20 to 33 inches thick.

3.4.1.17 Mapping Unit 37B/R.O.

Mapping Unit 37B consists dominantly of Landtype 37B and minor amounts of Landtypes 37A, 37C, 34B and 26. Landtype 37B is similar to Landtype 37A and 37C with the exception of landforms and slope range. Unit 34B differs by timber type, and Landtype 26 contains deep, colluvial soils.

Landtype 37B has moderately deep to deep, reddish brown, stony residual and colluvial soils with mixed conifer timber types. Surface soil layers are very thin or thin and medium or moderately coarse textured. Subsoil layers are moderately thick to thick and moderately fine or medium textured. Large, vesicular basalt boulders make up a large part of the soil surface and profile, and rock outcrops make up 10 to 20 percent of the unit.

Bedrock is interbedded, soft, reddish brown tuff and hard, gray basalt or andesite. These rocks are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches. Some areas are deeper than 48 inches to bedrock.

Typically, Landtype 37B occurs on moderately steep lands consisting of basaltic eruptive centers, block faults, and shield volcanoes. Slopes range from 16 to 40 percent.

This landtype ranges in elevation above 5,500 feet and supports mixed conifers, snowbrush, manzanita, squawcarpet, mules ear, serviceberry, wax currant, Ross sedge, Oregon grape, bottlebrush squirreltail, phlox, lupine, and sagebrush.

The soil is well drained. Permeability is moderate to rapid in the surface soils and moderate to slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 37B

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 3 inches thick.

Surface layers: Dark brown loam or sandy loam; weak, medium granular and weak, fine subangular blocky structure; 5 to 15 inches thick.

Subsoil layers: Dark brown to dark reddish brown gravelly, cobbly, or stony clay loam, silty clay loam, or occasionally loam; moderate or weak, fine, loam; moderate or weak, fine, subangular blocky structure; 35 to 80 percent coarse fragments by volume; hard; plastic; pH ranges from 6.0 to 7.5; 20 to 40 inches thick.

(40-49) Residual and Colluvial Soils From Rhyolite

3.4.2.19 Mapping Unit 40A

Mapping Unit 40A consists dominantly of Landtype 40A and minor amounts of Landtypes 34A and 40B. Landtype 40A is similar to Landtype 34A with the exception of soil type and landform and it is similar to Unit 40B with the exception of slope range.

Landtype 40A had moderately deep to deep, brown and gravelly residual soils associated with rhyolitic eruptive centers. Surface soils are thin and moderately coarse or medium textured. Subsoil layers are moderately thick, gravelly, and moderately coarse or coarse textured. This landtype is often characterized by exposed mineral soil and no organic litter or ground cover vegetation.

Bedrock consists mostly of moderately hard, competent, highly fractured, light gray rhyolite. Soft tuff, welded tuff, obsidian, rhyolitic breccia, and andesites occur locally -- primarily along the perimeter of the landform. Depth to bedrock ranges from 30 to 50 inches.

Typically, Landtype 40A occurs on gentle slopes associated with dome-shaped uplifts which consist of rhyolitic lava. Slopes are less than 15 percent.

This landtype ranges in elevation above 4,500 feet and supports ponderosa pine, manzanita, Ross sedge, bottlebrush squirreltail, squawcarpet, phlox, snowbrush, mules ear, mountain mahogany, and Oregon grape.

The soil is excessively well drained. Permeability is rapid in the surface soils and rapid to very rapid in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 40A

Litter: Needles, leaves, twigs, and decomposing organic matter; 0 to 2 inches thick.

Surface layers: Very dark gray to dark brown, sandy loam or loam; weak, fine granular structure; 5 to 50 percent angular and subround gravels and cobbles by volume; soft; nonplastic to

Surface layers: Very dark gray to dark brown sandy loam; weak medium granular and weak, fine subangular blocky structure; 10 to 50 percent angular and subround gravels and cobbles by volume; soft; nonplastic to slightly plastic; pH ranges from 6.0 to 7.0; 6 to 12 inches thick.

Subsoil layers: Yellowish brown to dark brown, gravelly and cobbly sandy loam or loamy sand; weak, fine subangular blocky structure; 20 to 70 percent angular and subround gravels and cobbles by volume; soft; nonplastic; pH ranges from 6.2 to 7.2; 20 to 50 inches thick.

3.4.2.21 Mapping Unit 40C

Mapping Unit 40C consists dominantly of Landtype 40C and minor amounts of Landtypes 40B, 41C, and 42. Landtype 40C is similar to Landtype 40B with the exception of slope range, and it is similar to unit 41C with the exception of timber type.

Landtype 40C has moderately deep to deep, gravelly, residual and colluvial soils which occur on steep slopes on rhyolitic domes. Surface soils are thin and moderately coarse textured. Subsoils are moderately thick to thick, gravelly or cobbly, and coarse to moderately coarse textured. Some areas are characterized by a high portion of exposed mineral soil.

Bedrock consists mostly of highly fractured, competent, and moderately hard rhyolite which may be foliated. Rhyolitic breccia, andesite, welded tuff, tuff, and obsidian occur locally along the perimeter of the landform. The bedrock layers are primarily vertically jointed. Depth to bedrock ranges from 30 to 60 inches.

Typically, Landtype 40C occurs on steep slopes usually on south aspects and associated with rhyolitic dome uplifts. Slopes are greater than 40 percent.

This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, snowbrush, manzanita, mules ear, squawcarpet, Ross sedge, Oregon grape, mountain mahogany, and bottlebrush squirreltail.

The soil is excessively well drained. Permeability is rapid in the surface soils and rapid or very rapid in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 41A

Litter: Needles, leaves, twigs, and decomposing organic matter; 0.5 to 3 inches thick.

Surface layers: Very dark gray to dark yellowish brown loam or sandy loam; very weak, medium granular structure; 10 to 40 percent angular and subround gravels and cobbles by volume; loose, nonplastic; pH ranges from 6.0 to 7.0; 6 to 12 inches thick.

Subsoil layers: Dark yellowish brown or dark grayish brown gravelly and cobbly sandy loam or loamy sand; single grain or very weak, fine subangular blocky structure; 20 to 70 percent angular and subround gravels and cobbles by volume; loose; nonplastic, pH ranges from 6.2 to 7.4; 24 to 50 inches thick.

3.4.2.23 Mapping Unit 41B

Mapping Unit 41B consists dominantly of Landtype 41B and minor amounts of Landtypes 41A, 41C, 40B, and 42. Landtype 41B is similar to Landtype 40B with the exception of timber type, and it is similar to units 41A and 41C with the exception of slope ranges.

Landtype 41B has moderately deep to deep, gravelly and cobbly residual and colluvial soils on rhyolitic domes with mixed timber types. Surface soils are thin and moderately coarse or medium textured. Subsoils are moderately thick to thick, moderately coarse or coarse textured, and gravelly or cobbly.

Bedrock is mainly vertically jointed, moderately hard, and highly fractured rhyolite which is often foliated. Welded tuff, tuff, andesite, obsidian, and breccia may occur locally but primarily along the perimeter of the landform. Depth to bedrock ranges from 30 to 60 inches.

Typically, Landtype 41B occurs on dome-shaped lava uplifts on north aspects on slopes from 16 to 40 percent.

This landtype ranges in elevation above 5,200 feet and supports mixed conifers, snowbrush, manzanita, Ross sedge, bottlebrush squirreltail, lupine, snowberry, Oregon grape, squawcarpet, and needlegrass.

The soil is excessively drained. Permeability is rapid in the surface soils and rapid or very rapid in the subsoils.

The soil is excessively drained. Permeability is rapid in the surface soils and rapid or very rapid in the subsoils. Coarse fragment content average greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 41C

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 3 inches thick.

Surface layers: Very dark grayish brown to dark yellowish brown loam or sandy loam; single grain or very weak, medium granular structure; 10 to 60 percent angular and subround gravels and cobbles by volume; loose; nonplastic; pH ranges from 6.0 to 7.0; 8 to 14 inches thick.

Subsoil layers: Dark grayish brown, dark brown, or dark yellowish brown gravelly and cobbly sandy loam or loamy sand; single grain or very weak, fine subangular blocky structure; 30 to 80 percent angular and subround gravels and cobbles by volume; loose; nonplastic; pH ranges from 6.0 to 7.5; 20 to 50 inches thick.

(50-76) Residual and Colluvial Soils from Pyroclastic Rocks and Vesicular Basalt

3.4.2.25 Mapping Unit 63A

Mapping Unit 63A consists dominantly of Landtype 63A and minor amounts of Landtypes 62A and 63B. Landtype 63A is similar to Landtype 62A with the exception of soil texture. It is similar to Unit 63B with the exception of slope range and position in the landscape.

Landtype 63A has moderately deep and deep brown to yellowish brown loamy residual soils with ponderosa pine vegetation. Surface soils are thin and moderately coarse or medium textured. Subsoils are thin to moderately thick and medium to moderately coarse textured.

Bedrock is massive and soft to moderately hard brown or yellowish brown tuff or breccia. Depth to bedrock ranges from 22 to 40 inches. Bedrock weathers rapidly when exposed and becomes highly fractured.

Typically, Landtype 63A occurs on gently sloping ridges and sideslopes at lower elevations and above juniper associated vegetation. Slopes range from 0 to 15 percent.

lupine, Ross sedge, bottlebrush squirreltail, and some juniper, mountain mahogany, and bitterbrush.

The soil is well drained. Permeability is rapid in the surface soils and rapid in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 63B

Litter: Needles, leaves, twigs, and decomposing organic matter; 0.25 to 2 inches thick.

Surface layers: Dark brown or very dark grayish brown loam or sandy loam; weak, medium granular structure; 0 to 5 percent gravel by volume; soft; slightly plastic; pH ranges from 6.5 to 7.2; 5 to 12 inches thick.

Subsoil layers: Dark brown or brown sandy loam; weak, fine subangular blocky structure; 0 to 50 percent gravels and cobbles by volume; soft to slightly hard; slightly plastic; pH ranges from 6.5 to 7.5; 15 to 30 inches thick.

3.4.2.27 Mapping Unit 64

Mapping Unit 64 consists dominantly of Landtype 64 and minor amounts of Landtypes 30A, 35, 56A, and 63A. Landtype 64 is similar to Landtype 63A with the exception of soil parent material and plant community type.

Landtype 64 has moderately deep to deep, brown and yellowish brown gravelly residual soils with ponderosa pine-bitterbrush vegetation. Surface soils are very thin to thin and moderately coarse or medium textured. Subsoil layers are moderately thick to thick and moderately fine to moderately coarse textured.

Bedrock is soft and massive rhyolitic ash-flow tuff, ashy diatomite, and lacustrine tuffaceous siltstone and sandstone. Depth to bedrock ranges from 25 to 45 inches.

Typically, Landtype 64 occurs on gently rolling tablelands at lower elevations along the forest fringe. Slopes are less than 15 percent.

This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, bitterbrush, Idaho fescue, Ross sedge, bottlebrush squirreltail, squawcarpet, and some manzanita and mountain mahogany.

sedge, bottlebrush squirreltail, squawcarpet, and some manzanita and mountain mahogany.

The soil is well drained. Permeability is rapid or moderate in the surface soils and slow or moderate in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 64A*

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 2 inches thick.

Surface layers: Very dark grayish brown or dark brown sandy loam or loam; weak, fine granular structure; 2 to 25 percent subround and angular gravel by volume; soft, slightly plastic; pH ranges from 6.0 to 7.0; 4 to 7 inches thick.

Subsoil layers: Dark yellowish brown, dark brown, or dark reddish brown gravelly clay loam, loam, or sandy loam; weak to moderate, medium granular and weak to moderate, fine subangular blocky structure; 3 to 60 percent gravels and cobbles by volume; slightly hard; slightly plastic; pH ranges from 6.4 to 7.2, 25 to 40 inches thick.

3.4.2.29 Mapping Unit 64B*

Mapping Unit 64B* consists dominantly of Landtype 64B* and minor amounts of Landtypes 30A, 35, 56A, and 63A. Landtype 64B* is similar to Landtype 63A with the exception of soil parent material and plant community type. Landtype 64B* is similar to these other Landtypes except that 64B* is mesic, not frigid, and is found at lower elevations and on south slopes.

Landtype 64B* moderately deep to deep, brown and yellowish brown gravelly residual soils with ponderosa pine-bitterbrush vegetation. Surface soils are very thin to thin and moderately coarse or medium textured. Subsoil layers are moderately thick to thick and moderately fine to moderately coarse textured.

Bedrock is soft and massive rhyolitic ash-flow tuff, ashy diatomite, and lacustrine tuffaceous siltstone and sandstone. Depth to bedrock ranges from 25 to 45 inches.

Typically, Landtype 64B* occurs on gently rolling tablelands at lower elevations along the forest fringe. Slopes are less than 16 to 40 percent.

This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, aspen, bitterbrush, Idaho Fescue, Ross sedge, bottlebrush squirreltail, squawcarpet, and some manzanita and mountain mahogany.

The soil is somewhat poorly to moderately well drained. Permeability is rapid or moderate in the surface soils and slow or moderate in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 65

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 2 inches thick.

Surface layers: Very dark grayish brown or dark brown sandy loam or loam; weak, fine granular structure; 2 to 25 percent subround and angular gravel by volume; soft, slightly plastic; pH ranges from 6.0 to 7.0; 4 to 7 inches thick.

Subsoil layers: Dark yellowish brown, dark brown, or dark reddish brown gravelly clay loam, loam, or sandy loam; weak to moderate, medium granular and weak to moderate, fine subangular blocky structure; 3 to 60 percent gravels and cobbles by volume; slightly hard; slightly plastic; pH ranges from 6.4 to 7.2, 25 to 40 inches thick.

TABLE 3.5-1

INTERPRETATIONS FOR EROSION AND COMPACTION

Land-type No.	Natural Stability and Type of Mass Movement	Expected Mass Movement as a Result of Man's Activities	Surface Soil Erosion Potential (Sheet)	Soil Erosion Potential (Rill & Gully)	Compac-tion Hazard	Displace-ment Hazard
Miscellaneous landtypes 1-8 and 11-12 are not rated due to highly variable characteristics.						
16*	N.A.	N.A.	Moderate	High	High	High
18*	N.A.	N.A.	Moderate	High	High	High
30A	Very Stable	Unchanged	High	Moderate-High	Low-Summer High-Winter	Low
31A	Very Stable	Unchanged	High	Moderate-High	Low-Summer High-Winter	
34A	Very Stable	Unchanged	Low	Low	High	Low
34B	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
34B/ R.O.	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
34A*	Very Stable	Unchanged	Low	Low	High	Low
34B*	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
34C*	Stable-Rotational Slumps	Unchanged	Moderate	Moderate	High	Moderate
37A	Very Stable	Unchanged	Low	Low	High	Low
37B	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
37B/ R.O.	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
37C	Stable-Rotational Slumps	Unchanged	Moderate	Moderate	High	Moderate
40A	Very Stable	Unchanged	Low	Low	Low	Moderate
40B	Very Stable	Unchanged	Moderate	Moderate-High	Low	High
40C	Very Stable	Unchanged	High	Severe	Low	High
41A	Very Stable	Unchanged	Low	Low	Low	Low-Moderate
41B	Very Stable	Unchanged	Moderate	Moderate-High	Low	Moderate-High
41C	Very Stable	Unchanged	High	Severe	Low	High
63A	Very Stable	Unchanged	Low	Low	Moderate	Low
63B	Stable-Rotational Slumps	Unchanged	Moderate	Moderate	Moderate	Moderate
64	Very Stable	Unchanged	Low	Low	Moderate	Low
64A*	Very Stable	Unchanged	Low	Low	Moderate	Low
64B*	Very Stable	Unchanged	High	High	Moderate	Moderate
65	Very Stable-	Unchanged	Low	Low	Moderate	Low

NOTE: Land types are described in accompanying text.

3.7 GLOSSARY

A-HORIZON - Zone of eluviation. The uppermost zone in the soil profile, from which soluble salts and colloids are leached, and in which organic matter has accumulated. Generally the most fertile soil layer.

ALLUVIAL - Pertaining to material that is transported and deposited by running water.

ALLUVIUM - A general term for all detrital and unconsolidated material deposited or in transit in streams, including gravel, sand, silt, clay, and all variations and mixtures of these.

ANDESITE - A dark gray to black, dense, fine-grained extrusive igneous rock. Very similar to basalt.

ASH - Uncemented volcanic ejecta less than 4.0 mm in diameter.

AVAILABLE WATER - The portion of water in a soil that can be absorbed by plant roots, usually considered to be that water held in the soil against a tension of up to approximately 15 bars.

AVAILABLE WATER HOLDING CAPACITY - The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil. Commonly defined as the difference between the percentage of soil water at field capacity and the percentage at wilting point. This difference multiplied by the bulk density and divided by 100 gives a value in surface inches of water per inch depth of soil.

BASALT - A very dark to black, dense, fine-grained extrusive igneous rock. Very similar to andesite.

BEARING CAPACITY - The maximum load that a soil can support before failing.

BEDROCK - The more or less solid rock in place either on or beneath the surface of the earth. It may be soft or hard and have a smooth or irregular surface.

B-HORIZON - Illuvial horizon. The lower soil zone which is enriched by the deposition or precipitation of material from the overlying zone or A-horizon.

BRECCIA - A rock composed of coarse angular fragments cemented together.

COMPOSITE CONE - A volcanic cone built of alternating layers of rhyolitic and andesitic lava and pyroclastic material, with moderately steep or steep slopes.

CREEP - Slow mass movement of soil and soil material down relatively steep slopes primarily under the influence of gravity but facilitated by saturation with water and by alternate freezing and thawing.

CRITICAL SOIL - The term "critical soil" is frequently used by laymen, but it is a meaningless term unless it is related to a specific function. Many soils may be critical for one reason or another, but different soils may not be critical for the same reasons. For example, a deep, wet, plastic and unstable soil will be critical in relation to road location and stability. This soil is not critical in relations to regeneration and droughtiness problems. Another soil may be very shallow over hard bedrock. This soil is not critical from the standpoint of road stability, but may be critical as to regeneration problems resulting from droughtiness and low fertility. It may also be critical in relation to surface erosion. The term "critical soil" must be defined by the user in relation to its intended purpose.

DEBRIS SLIDE - A rapidly moving slide composed of soil, bedrock, or both.

DISPLACEMENT - Soil displacement refers to the repositioning or removal of the surface soil layers by mechanical action.

DUFF - The more or less firm organic layer on top of mineral soil, consisting of fallen vegetative matter in the process of decomposition, including everything from litter on the surface to pure humus. Duff is a general, nonspecific term.

DURIPAN - A subsurface horizon that is cemented by silica.

EOLIAN SOIL MATERIAL - Soil material accumulated through wind action.

EROSION - (1) The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep; (2) detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:

Acceleration Erosion - Erosion much more rapid than normal, natural, or geologic erosion primarily as a

GEOMORPHOLOGY - The study of landforms as they relate to geologic composition and history.

GLACIATED VALLEY - U-shaped valley formerly occupied by a glacier.

GRAVEL - A rock fragment between 2.0 millimeters and 3 inches in diameter.

GROUND COVER - Litter, slash, grasses, forbs, or low-growing reproduction which absorbs rainfall energy, reduces overland flow, and keeps soil from being washed or blown away.

HUMMOCKY - Hilly, uneven landscape resulting from deep-seated soil movement, usually of a rotational nature.

HYDROPHOBIC - lacking a strong affinity for water, water repellent.

INCLUSION - Landtype found within a mapping unit that is not extensive enough to be mapped separately or as part of a complex.

INFILTRATION - The gradual downward flow of water from the surface through the soil to ground water and water table reservoirs.

INTRUSIVE BEDROCK - This applies to those igneous rocks derived from magmas that have been injected into older rocks at depth without reaching the surface. These magmas are slow-cooling and form coarse-textured rocks, such as granite.

LACUSTRINE DEPOSIT - Material deposited in lake water and later exposed either by lowering the water level or by the elevation of the land.

LANDFORM - Structural configuration of the topography as a result of past and present geological activity.

LANDSLIDE - A mass of material that has slipped downhill under the influence of gravity, frequently occurring when the material is saturated with water.

LANDTYPE - A land system with a designated soil, vegetation, geology, topography, climate, and drainage situation. The basic taxonomic unit in the Soil Resource Inventory.

LAPILLI - Volcanic ejecta between 4 mm and 32 mm in diameter.

LAVA DOME - Lava domes are masses of lava which have issued from central vents to build a dome-shaped pile of lava.

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ANNUAL GENERAL MEETING

The Annual General Meeting of Shareholders of the Company will be held on Thursday, December 15, 1988 at 10:00 a.m. in the Gazebo 1 Room of the Pan Pacific Hotel, 999 Canada Place, Vancouver, Canada.

FORM 10-K

A copy of the annual report on Form 10-K, as filed with the U.S. Securities and Exchange Commission, is available to shareholders without charge on written request to:

Allan J. Marter
Vice President, Finance
Quartz Mountain Gold Corp.
670 Marine Building
355 Burrard Street
Vancouver, B.C.
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9.0 AIR QUALITY AND CLIMATOLOGY

TECHNICAL REPORT NO. 9

AIR QUALITY AND CLIMATOLOGY

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

AIR SCIENCES INC.
12687 West Cedar Drive
Lakewood, Colorado 80228

and

STEFFEN ROBERTSON AND KIRSTEN (COLORADO) INC.
1755 East Plumb Lane Suite 230
Reno, Nevada 89502

Revised December 1988

Table 11.4-37
Lakeview School District #7, Oregon
Revenue and Expenditure Analysis

(Nominal Dollars)

	Actual 1983-84	% Tot Exp	Actual 84-85	% Tot Exp	Actual 85-86	% Tot Exp	Actual 86-87	% Tot Exp	Budget 87-88	% Tot Exp	Average 83/84-87/88	% Tot Exp
Instruction	1,779.0	58.4%	1,858.5	54.7%	1,953.7	58.6%	1,965.8	58.4%	2,188.6	57.6%	1,949.1	57.5%
Supporting Svcs	1,221.8	40.1%	1,472.9	43.4%	1,346.7	40.4%	1,355.5	40.2%	1,549.1	40.8%	1,389.2	41.0%
Interagency	45.9	1.5%	64.7	1.9%	29.3	0.9%	47.3	1.4%	59.0	1.6%	49.2	1.5%
Debt Service	0.0	0.0%	0.0	0.0%	4.0	0.1%	0.0	0.0%	2.0	0.1%	1.2	0.0%
Total Expenditures	3,046.7	100.0%	3,396.1	100.0%	3,333.6	100.0%	3,368.7	100.0%	3,798.7	100.0%	3,388.8	100.0%

Source: Lakeview School District #7 Budget;
Planning Information Corporation, January 1987

FOREWORD

This report was prepared by Air Sciences Inc. and Steffen Robertson and Kirsten (COLORADO) Inc. (SRK) for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
R. G. Steen	Project Manager	SRK
C. J. Riley	Project Engineer	SRK
J. W. Johnson	Data Program Specialist	SRK

Table 11.4-39
Lakeview School District #7, Oregon
Revenue and Expenditure Analysis

General Fund per Student Expenditures (1987 Dollars)

	Actual 1983-84	% Tot Exp	Actual 84-85	% Tot Exp	Actual 85-86	% Tot Exp	Actual 86-87	% Tot Exp	Budget 87-88	% Tot Exp	Average 83/84-87/88	% Tot Exp
Enrollment(ADM)	954.8		920.8		901.9		910.4		966			
Instruction	2,121.6	58.4%	2,206.8	54.7%	2,287.0	58.6%	2,243.6	58.4%	2,265.6	57.6%	2,224.9	65.7%
Supporting Svcs	1,457.1	40.1%	1,748.9	43.4%	1,576.4	40.4%	1,547.0	40.2%	1,603.7	40.8%	1,586.6	46.8%
Interagency	54.7	1.5%	76.8	1.9%	34.3	0.9%	54.0	1.4%	61.1	1.6%	56.2	1.7%
Debt Service	0.0	0.0%	0.0	0.0%	4.7	0.1%	0.0	0.0%	2.1	0.1%	1.4	0.0%
Total Expenditures	3,633.4	100.0%	4,032.6	100.0%	3,902.4	100.0%	3,844.6	100.0%	3,932.4	100.0%	3,869.1	114.2%

Source: Lakeview School District #7 Budget;
Planning Information Corporation, January 1987

LIST OF TABLES

show that Union District #5 averaged $3,900 per student, Paisley District #11 spent $6,400 and Plush District #18 spent $8,300 (Plush #18 had only 11 students in the district). (Oregon Department of Education, 1987.)

11.4.4.4 Union School District

The Union School District is located in the Westside rural center, west of Lakeview. The district has one older building with a new addition.

This building serves first through eighth grades and has a capacity of 87 students and a Fall 1987 enrollment of 65 students.

High school students who live in the Union District are bussed to Lakeview High School. Union School District pays approximately $4,860 in tuition for each high school student enrolled in the Lakeview District.

There were 22 Union High School students enrolled in the Lakeview district in Fall of 1987. The district is concerned that an increase of 11 high school students moving to the district would generate unbudgeted tuition expenses, and require the district to go to the voters for an increase in the district's tax base (Knowles, pers. comm., 19 January 1987).

In school year 1986-87, Union District 5 budgeted $267,035 in general fund revenues and received $297,016 in actual revenues. The district budgeted $419,761 in expenditures and had $306,803 in actual expenditures. Budgeted tuition expenses were $120,000 and actual tuition expenses were $84,610. The district began the year with a fund balance of $303,913. The budgeted 1987 fund balance was $45,000 and the actual fund balance was $294,126. (Union School District #5 1987 Year End Financial Report.)

11.4.4.5 Lake District Hospital

The Lake District Hospital and Skilled Nursing Facility is located in Lakeview and is operated by the Lake Health District, a special health district which is chartered by the State of Oregon. The district is governed by a 5-member Board of Directors. District boundaries include all of Lake County and portions of Harvey and Deschutes Counties.

Facilities

The facility includes a 24 bed acute care hospital and a 47 bed nursing home. Currently, the hospital beds are divided into the following wards, although the number of beds in each total suspended particulate was 20 ug/m^3 with a maximum of 85 ug/m^3. The arithmetic mean concentration of particulate less than 10 micrometers in diameter was 12 ug/m^3 with a maximum of 86 ug/m^3. These concentrations are well below the state and federal ambient air quality standards for particulate matter. On the average the concentrations of total suspended particulate are about twice as high as the concentrations of particulate less than 10 micrometers in diameter.

Nurses (RNs,LPNs,Aides)	22 positions, 15 FTE employees
Clerical	12
Administrative	13.5
Laboratory	3
Radiology	2
Respiration/Physical Therapy	3.5
Maintenance/Dietary	22
Nursing Home Staff	17

The administrative category includes: Administration, Central Supply, Purchasing, Accounting, and Collections.

The current staff is adequate to meet service demands at the hospital. It was noted that like many hospitals in the nation, there is a great deal of difficulty in recruiting nurses to fill vacancies that arise.

District Budget

The district's 1987-88 general fund budget totals $3.26 million. Salaries and Benefits ($1.98 million) and Materials and Supplies ($908,000) account for 89 percent of all expenditures. Capital expenditures are budgeted at $156,000.

The district derives 84 percent of total general fund revenues from patient fees, 12 percent from property taxes levied by Lake County and distributed to the district, and the remainder from miscellaneous sources. The districts property taxation boundaries include all of Lake County and portions of Harvey and Deschutes counties. In the current budget year, the districts Assumed Value totals $190.7 million and the property tax rate is set at 1.86 millions.

Future Plans

The hospital plans to construct a medical clinic adjacent to the hospital to house five doctors in private practice. Funding for the project will be obtained via a loan against the interest derived from a trust fund set up for the hospital. The hospital will lease space to the physicians at a rate that will pay off the loan. Current plans are to build the clinic in two phases, with the first phase beginning in the summer of 1988 and completed by the summer of 1989. The second phase will be built when needed. The cost of each phase of construction is approximately $225,000. There are no

9.0 AIR QUALITY AND CLIMATOLOGY

9.1 INTRODUCTION

9.1.1 Objectives

The objectives of the air quality/climatology section of this report are to characterize the existing air quality of the project area and to provide a general description of the climatic characteristics of the project area. The site-specific meteorology and air quality data will be used for the air quality impact assessment.

9.1.2 Study Area

The air quality/climatology study area is the same as for the other disciplines (Figure 1.1-1). Total suspended particulate (TSP), particulate less then 10 um (PM10), wind speed, wind direction, wind direction variation, temperature, precipitation and evaporation data were collected at the air quality monitoring station located on the Quartz Mountain Gold Project site for the period 1 November 1987 through 31 October 1988. The station is located in the broad Quartz Creek Valley, approximately 500 feet from the nearest forested areas on either side of the valley and 1,000 feet from the forested area up-valley. The station is at an elevation of approximately 5,390 feet above mean sea level at Universal Transverse Mercator coordinates 4687625 m. N, 680175 m. E. This location is about 1,000 feet from the west boundary of the project and approximately 400 feet northeast of state highway 140. Meteorological data collected from this site should be generally representative of the winds over most of the site, and specifically of the winds that could carry pollutants to populated locations along the highway and valley. Particulate measurements will be representative of the levels throughout the site, except very near local activity, including Highway 140. The location is shown in Figure 1.2-2. The remaining climatological data presented in this section were gathered from locations surrounding the project area.

The Lake County public assistance caseload has averaged about 325 cases for the first 10 months of 1987. This is a slight increase over 1985 and 1986 public assistance caseloads.

The divisions administrative budget for the 1987-89 biennium is $201,270 (Todd, pers. comm., 5 January 1988). Funding for the various public assistance programs is derived from federal sources (approximately 50 percent of total), the state general fund, and other sources including child support payments (Roberts 1987).

11.4.4.6.2 Children's Services

Children's Services are provided by the Children's Services Division (CSD) of the Oregon Department of Human Resources. The mission of CSD is to develop and provide essential social services for children and their families to assure the physical, mental, emotional, and social well being of children. Services provided by the division include the following:

Adoptive Service

Family Services

Child Protective Services

Substitute Care

Foster Home Certificate

Foster Care

Residential Care

The Lakeview branch of CSD is co-located with Adult and Family Services. Office space dedicated to CSD totals 773 square feet. There are two CSD staff members in the Lakeview office. The budget for the 1987-89 biennium is $200,395 (Bender, pers. comm., 11 November 1987).

11.4.4.6.3 Mental Health

Mental Health Services are provided by Lake County under the supervision of the Mental Health Division of the Oregon Department of Human Resources. The Mental Health Division is responsible for the administration of the state mental health programs and laws. This includes, among other responsibilities, the coordinating and promoting of community southwest of the project site and Summer Lake is about 43 miles north of the project site. These data are representative of the climate experienced in the region.

9.2.2 Results and Discussion

9.2.2.1 Temperature

Site-specific temperature data is presented in Table 9.2-1. The daily average temperature for the period November 1987 through October 1988 was 42.4 deg F. The coldest month was January with a recorded daily average of 23.7 deg F. The warmest month was July with a daily average of 64.2 deg F.

Table 9.2-2 summarizes the average monthly temperatures for Round Grove weather station for the period from 1951 to 1980. The annual average is 44.1 degrees F.

January is the coldest month with an average temperature of 28.7 degrees F and July is the warmest month with and average of 62.3 degrees F.

9.2.2.2 Precipitation and Evaporation

Table 9.2-3 shows site-specific monthly precipitation data. Data was collected from January through October 1988. The total precipitation for this period was 12.4 inches. Maximum monthly precipitation occurred in April. Minimum monthly precipitation occurred during October.

Table 9.2-4 shows average monthly precipitation at Round Grove for the period from 1951 to 1980. The average annual precipitation is 18.04 inches.

Site-specific evaporation data were collected May - October 1988 and are presented in Table 9.2-5. The total evaporation during this period was 35.19 inches. Highest average monthly evaporation occurred during July and August.

Nearby evaporation data is not as prevalent as precipitation data. The closest available information was gathered at Tulelake, California and Summer Lake, Oregon, each of which are about 44 miles from the project site. Table 9.2-6 shows average monthly pan evaporation at Tulelake for the period of 1962 to 1979 and at Summer Lake for the period of 1961 to 1979. Evaporation is expected to be greater at these stations because they are lower in elevation than Quartz Mountain.

11.4.4.6.4 Lake County Public Health Office

The Lake County Public Health Office provides the following services:

Immunization

Treatment for Sexually Transmitted Diseases

Blood Pressure Checks

Women's, Infants, and Children's (WIC) Nutrition Program

Prenatal Program

The Public Health Office has offices in Lakeview that include a waiting room, main office, WIC Clinic, and Immunization Room.

The department has one full time Registered Nurse position shared by two people and one part time Administrative Assistant. (One part time Registered Nurse is located in Christmas Valley.)

Funding for the Public Health Department is obtained from the grants, users fees, and the Lake County General Fund. Fiscal year 1987-88 general fund expenditures for public health are budgeted at $117,711.

11.4.4.6.5 Lake County Senior Services

Services to Senior Citizens in Lakeview are provided by the Lake County Senior Citizens Association under contract to the Klamath Basin Senior Citizens Council. The goal of the Association is to assist older persons to live as independently as possible and to discourage unnecessary or premature institutionalization. Senior Services in the Lakeview area include the following:

Advocacy

Information and Referral

Outreach

Escort

Transportation

Legal Assistance

Congregate Meals

TABLE 9.2-2

AVERAGE MONTHLY TEMPERATURES
ROUND GROVE WEATHER STATION, OREGON (1951-1980)
(deg F)

Month	Average
JAN	28.7
FEB	32.8
MAR	34.5
APR	38.3
MAY	47.6
JUN	54.7
JUL	62.3
AUG	60.8
SEP	54.9
OCT	46.2
NOV	36.2
DEC	30.3
ANN	44.1

TABLE 9.2-3

AVERAGE MONTHLY PRECIPITATION
QUARTZ MOUNTAIN GOLD PROJECT
JANUARY - OCTOBER 1988

Month	Inches
JAN	3.34
FEB	0.35
MAR	1.35
APR	3.88
MAY	1.81
JUN	0.79
JUL	0.18
AUG	0.36
SEP	0.35
OCT	0.00
ANN	12.4

TABLE 11.4-40

LAKE COUNTY, OREGON SENIOR CITIZENS ASSOCIATION
SERVICE OBJECTIVE FISCAL YEAR 1988-89

Service	Service Objective FY 1988 & FY 1989	
Personal and Home	23 persons	3,500 hours
Home Delivered Meals	70 persons	3,000 meals
Case Management	25 persons	100 hours
Outreach	100 persons	100 contracts
Health*	25 persons	200 tests/meetings
Congregate Meals	800 persons	15,000 meals

Service objectives are contingent upon availability of funds.

*Includes: Diabetic Screening Clinic
Blood Pressure Clinic
Support Group Meetings

SOURCE: Lake County District #11: Area Agency on Aging two year plan fiscal year 1988-1989.

TABLE 9.2-6

AVERAGE MONTHLY PAN EVAPORATION
TULELAKE, CALIFORNIA AND SUMMER LAKE, OREGON
(inches)

Month	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL
Tulelake	8.02	8.34	9.45	8.54	6.65	3.62	44.62
Summer Lake	7.49	8.87	11.21	9.71	6.58	3.48	47.34

Population

Although the major employer in town ceased operations, the population of Bly is believed to be about the same as during the years that the mills were operating. The 1980 Census estimate for Bly was 246. Current Bly population is estimated at 238. (Portland State University 1987.) According to the Bly Postmaster, there are approximately the same number of postal boxes being used in Bly as when the mills were in operation (Terzich, pers. comm., 12 January 1988). Many people are believed to commute to Klamath Falls and Lakeview for jobs.

Housing

Housing vacancy information for Bly in not readily available. There are three residential units listed for sale in and near Bly, and few other vacant houses are thought to exist in the area (Himes, pers. comm., 12 January 1988). There are currently eight parcels of land for sale in Bly ranging in size from one lot to 20 acres. (Nicholson, pers. comm., 2 February 1988.)

The Bley-was subdivision, located in Bly has 100 lots, about 20 of which are currently occupied by mobile homes and site built houses. The subdivision was developed by Weyerhauser and has paved streets and water and sewer mains in place. The subdivision has its own water system and connects to the Bly Water and Sanitation District sewer system.

Three miles north-east of town the Pinecrest subdivision has 115 platted lots, 20 of which are currently occupied. This subdivision has paved streets, well water, and septic systems. Both mobile and site built homes are allowed in Pinecrest.

In addition there are some subdivided rural lots in the general Bly area that could be occupied but require the development of wells and septic systems.

TABLE 9.2-7

FREQUENCY OF WINDS BY SPEED AND DIRECTION
QUARTZ MOUNTAIN PROJECT - QUARTZ MOUNTAIN, OREGON
NOVEMBER 1987 - OCTOBER 1988

DIRECTION	SPEED CLASS INTERVALS(KNOTS) 1,<3	3,<6	6,<10	10,<16	16,<21	>21	ALL	MEAN SPEED
N	.3	.8	.1	.0	.0	.0	1.2	4.1
NNE	.2	.4	.2	.0	.0	.0	.8	4.3
NE	.2	.4	.3	.0	.0	.0	.9	4.7
ENE	.3	.5	.3	.0	.0	.0	1.1	4.8
E	.5	.4	.2	.0	.0	.0	1.2	3.8
ESE	1.9	2.2	1.0	.0	.0	.0	5.1	4.0
SE	2.3	4.7	4.3	.4	.0	.0	11.7	5.4
SSE	.8	1.8	2.0	.2	.0	.0	4.7	5.6
S	.5	1.9	1.5	.0	.0	.0	3.9	5.3
SSW	.3	1.3	1.1	.0	.0	.0	2.8	5.4
SW	.5	1.1	.5	.0	.0	.0	2.1	4.7
WSW	.7	1.2	.5	.0	.0	.0	2.4	4.3
W	2.8	1.9	.9	.0	.0	.0	5.6	3.4
WNW	12.4	6.5	2.9	.1	.0	.0	21.9	3.4
NW	3.8	6.9	2.1	.1	.0	.0	12.9	4.2
NNW	.7	1.3	.1	.0	.0	.0	2.1	3.5
ALL	28.3	33.3	18.0	.8	.0	.0	80.4	4.3

Calm (less than one knot) = 19.6%
Period mean wind speed = 3.6 knots

Lagoon capacity is rated at 75,000 gallons per day and was designed to serve a population similar to the design maximum of the water system, 1,400 people. Like the water system, the lagoons are currently operating at just over 40 percent of design capacity. No improvements or additions to the system would be required to meet maximum design population demands (Himes, pers. comm., 14 December 1987).

District Funding

The district is operated on an enterprise basis, with user charges and district property tax revenues covering all operating and maintenance expenditures. The addition of new users to both systems would not adversely impact the district's fiscal condition (Himes, pers. comm., 14 December 1987).

11.4.4.7.2 Bly Fire Protection District

The Bly Fire Protection District serves a 17 square mile area around Bly.

The district has an all volunteer staff of 13 fire fighters, which is an adequate number, according to the Chief. The district has the following equipment:

2 class A engines

1 quick attack truck

1 3000 gallon tanker

According to the Chief, all equipment is in excellent condition and adequate for the district's needs. The engines and attack truck are stored in an approximately 1,600 square foot garage and the tanker is stored in a 2,400 square foot tanker barn that also has training and equipment space.

The district averages 12 to 15 calls per year, primarily structure fires. Bly has an ISO fire insurance rating of 7. Funding for the district is provided by a mill levy (Lawrence, pers. comm., 12 January 87).

11.4.4.7.3 Sprague Valley Medical Clinic

The Southern Oregon Rural Health Clinic operates the Sprague Valley Medical Clinic in Bly.

The clinic provides general medical, emergency and X-ray service. The clinic building contains an office, examination room, emergency and X-ray rooms and a reception office.

9.3 AIR QUALITY

Baseline particulate concentrations collected at the site are presented in Table 9.3-1 and Table 9.3-2 as TSP and PM10 concentrations, respectively. Particulates exist at moderate levels because they are generated naturally as a function of climate, vegetation and soil type.

The site is in a very rural area and distant from sources of nitrogen oxides, carbon monoxide, and toxic compounds. These pollutants are not naturally produced in significant quantities, unlike particulates, and are therefore assumed to be present at negligible ambient levels.

9.3.1 Methods

The data were gathered at the location shown in Figure 1.2-1 by two PM10 samplers and one TSP sampler. The PM10 samplers used are General Metal Works Model GMWS 2310 samplers equipped with General Metal Works Model 321-B Size Selective Inlet. The TSP sampler is a General Metal Works Model 2000 sampler. The samplers are maintained and operated by Air Sciences Inc. Filters are weighed before and after exposure. Particulate concentrations are determined by calculating the net change in filter weight in relation to the volume of air drawn through the filter. The total volume of air is calculated by multiplying the known volumetric flow rate (corrected to standard conditions) by the duration of the sampling period (24 hours). The minimum detection limit of the sampling technique is 2 ug/m3.

9.3.2 Results and Discussion

The air quality of the Quartz Mountain area is generally good. The TSP and PM10 concentrations are well below the ambient standards set by the State of Oregon and the Federal Government.

According to Oregon regulations (OAR 340-31-015) the concentrations of TSP shall not exceed : 60 ug/m^3 as an annual geometric mean, 100 ug/m^3 for a 24-hour concentration for more than 15 percent of the samples collected in any calendar month, and 150 ug/m^3 for a 24-hour concentration more than once per year.

Federal particulate standards (40 CFR, Part 50.6) limit airborne concentrations of PM10. The standards are 150 ug/m^3 as the 24-hour worst case and 50 ug/m^3 as the annual arithmetic mean.

school levels. Administrative and support staff serve all grades in the school. Current staffing consists of:

2 Administrators

2 Secretaries

21.5 FTE Teachers (serve grades 7-12)

1 Part-time Librarian

2 Part-time Special Education Teachers

9 Part-time Aides

1 Head Cook

1 Assistant Cook

4 Kitchen Helpers

2 Custodians

Part-time Sweepers and Bus Drivers

Both schools are operated by Klamath County School District headquartered in Klamath Falls. Operating budgets are not prepared for individual schools, however, based on district wide per-student operating costs, it was estimated that the current budgets are approximately $390,000 for Gearhart School and $900,000 for Bonanza School. Average per student costs are estimated at $3,700 district wide. Teachers salaries average $27,000 per year (Simmons, pers. comm., 16 December 1987).

11.4.5 Land Use

Lake County surface area totals 8,300 square miles or 5,299,789 acres. Table 11.4-41 displays Lake County land ownership.

Approximately 77 percent of Lake County is in public ownership. Almost 70 percent is controlled by the federal government (46 percent BLM, 19.3 percent Forest Service, 4.5 percent U.S. Fish and Wildlife Service). State government owns 4.4 percent of Lake County land and local government owns 2.8 percent.

Just over 23 percent of the total Lake County land area is in private ownership. Parcels over 40 acres in size comprise the largest category of private land ownership (16.3 percent of total). The timber industry owns 4.9 percent of

TABLE 9.3-2
PARTICULATE LESS THAN 10 MICROMETERS
QUARTZ MOUNTAIN GOLD PROJECT - QUARTZ MOUNTAIN, OREGON
(μg/m3)

	1987		1988									
Day	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	-	-	2	-	2	-	-	-	-	12	-	-
2	-	-	-	-	-	-	-	3	11	-	-	-
3	-	-	-	7	-	8	6	-	-	-	-	-
4	-	-	2	-	3	-	-	-	-	-	86	28
5	**	**	-	-	-	-	2	-	-	20	-	-
6	-	-	-	**	-	10	-	7	5	-	24	25
7	-	-	2	-	4	-	2	-	-	12	-	-
8	-	**	-	-	-	-	-	2	17	-	-	-
9	-	-	-	-	-	3	2	-	-	-	-	-
10	-	-	2	5	7	-	-	-	-	-	17	-34
11	3	4	-	-	-	-	-	-	-	**	-	-
12	-	-	-	5	-	22	-	4	**	-	19	23
13	-	-	2	-	4	-	2	-	-	9	-	-
14	-	2	-	-	-	-	-	7	16	-	-	-
15	-	-	-	4	-	3	**	-	-	-	-	-
16	-	-	2	-	6	-	-	-	-	-	38	6
17	7	3	-	-	-	-	-	-	-	13	-	-
18	-	-	-	2	-	3	-	6	29	-	14	27
19	-	-	6	-	3	-	28	-	-	27	-	-
20	-	2	-	-	-	-	-	13	42	-	-	-
21	-	-	-	4	-	2	18	-	-	-	-	-
22	-	-	3	-	10	-	-	-	-	-	9	9
23	3	4	-	-	-	-	-	-	-	31	-	-
24	-	-	-	7	-	3	-	22	15	-	15	23
25	-	-	4	-	4	-	13	-	-	35	-	-
26	-	7	-	-	-	-	-	13	**	-	-	-
27	-	-	-	7	-	8	4	-	-	-	-	-
28	-	-	7	-	4	-	-	-	-	-	8	27
29	**	2	-	-	-	-	-	-	-	36	-	-
30	-	-	-	-	-	2	-	14	16	-	27	12
31	-	-	2	-	2	-	18	-	-	20	-	-
Arithmetic mean	4	3	3	5	4	6	9	9	19	21	26	21
Geometric mean	4	3	3	5	4	5	6	7	16	19	20	19
Maximum	7	7	7	7	10	22	28	22	42	36	86	34
Number of obs.	3	7	11	8	11	10	10	10	8	10	10	10

Period of record arithmetic average = 11.5
Period of record geometric average = 7.3
Number of valid observation = 108
** Indicates invalid or missing data

the total while parcels of less than 40 acres in size are just under two percent of the total Lake County land area.

Table 11.4-42 displays existing Lake County land use categories in acres and as a percent of total. Grazing and timber uses total 92 percent of total Lake County acreage while urban and rural residential uses total less than one percent.

Table 11.4-43 displays the amount of Lake County land area that is designated in each of Lake County's eight zoning categories. Over 96 percent of total Lake County land is designated in either General Rural or Forest Recreation Zones.

Table 11.4-44 displays the amount of land designated to each zone within the Lakeview urban growth area boundaries.

Table 11.4-45 displays the acreage in each of the zone categories in the Town of Lakeview.

Project Site

The site of the proposed Quartz Mountain Gold Project is entirely within the Forest Zone, according to the Lake County Land Use Plan (Steiger 1979b). Mining is allowed as a conditional use in the Forest Zone and should be recognized as a suitable use where it is found to be of greater economic and social benefit than the preservation of forested lands according to the Lake County Comprehensive Plan.

The Quartz Mountain settlement is comprised of 35 acres southwest and across Highway 141, from the project site, and is classified as a Rural Center. This includes seven parcels under separate ownerships, ranging in size from 15.8 acres to 145 acres. Approximately 28 acres are developed and seven are underdeveloped.

Approximately 26 of the developed acres are in residential use and one acre is in commercial use, although the general store at Quartz Mountain is not in operation at the time of this study (Steiger 1979b).

11.4.6 Transportation

This section discusses the existing Transportation system in southern Lake County. The elements of the Lake County transportation system include:

1) Highways, Roads, and Streets

2) Air

9.4 GLOSSARY

ATMOSPHERIC STABILITY - tendency of the atmosphere to mix vertically and horizontally. A stable atmosphere has very limited mixing so pollutants emitted into the atmosphere tend to remain concentrated over time. An unstable atmosphere has considerable mixing and pollutants tend to spread and dilute rapidly over time.

CLIMATOLOGY - the science that deals with climates, which are the average course or condition of the weather at a place over a period of years as exhibited by temperature, winds, and precipitation.

DAS - see data acquisition system

DATA ACQUISITION SYSTEM - a system which collects raw data, converts it to a digital form, performs calculations on it, and stores the results for later access.

DIGITAL - relating to a method of computing where quantities are represented electronically as digits, usually in the binary system, rather than as an analog or continuous signal.

DISPERSION - the scattering and distribution of components from a fixed or constant source in the surrounding medium.

METEOROLOGY - the atmospheric phenomena and weather of a region.

MICROGRAM - one millionth of a gram, 10^-6 grams, abbreviated ug.

MICROMETER - one millionth of a meter, 10^-6 meters, abbreviated um.

PAN EVAPORATION - evaporation observed at a standard Class A pan installation by observers following standard techniques. Class A pans are generally of metal, unpainted, 47.5 inches in diameter, 10 inches deep and mounted on a platform several inches above the surrounding soil.

PARTICULATE LESS THAN 10 um - particulate matter suspended in the atmosphere where the particle aerodynamic diameters (particles that act identically to spherical particles with specific gravity of one and diameters of 10 um in a stream of air) are nominally less than 10 micrometers in diameter. Usually given in the units of micrograms per standard cubic meter (ug/m^3).

TABLE 11.4-44

LAKEVIEW, OREGON URBAN GROWTH AREA
ACREAGE BY ZONE CATEGORY

Zone	Acres
Residential	631
Commercial	453
Industrial	828
TOTAL	1,912

SOURCE: Steiger 1979b.

TABLE 11.4-45

TOWN OF LAKEVIEW, OREGON
ACREAGE BY ZONE CATEGORY

Zone	Acres
Residential	452
Commercial	69
Industrial	194
TOTAL	897

SOURCE: Steiger 1979b.

9.5 PUBLIC AND AGENCY CONTACTS

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TABLE 11.4-46

U.S. HIGHWAY 395
SELECTED 1986 ADT

Mile Post	Location Description	1986 ADT
120.83	Valley Falls Automatic Recorder Sta. 19-004, 0.26 mile south of Lakeview-Burns Highway (US395).	740
138.36	0.01 mile north of Warner Highway (ORE140)	910
138.38	0.01 mile south of Warner Highway (ORE140)	1,350
140.73	0.01 mile north of road to Hot Springs	1,600
141.74	0.01 mile north of road to Uranium Reduction Mill	2,750
142.09	0.10 mile north of road to Anderson Lumber Company	2,700
142.63	North town limits of Lakeview	2,550
142.89	0.01 mile north of 6th Street North	3,450
143.02	0.01 mile north of Klamath Falls-Lakeview Highway (ORE140)	3,950
143.06	0.03 mile southeast of Klamath Falls-Lakeview Highway (ORE140)	7,600
143.12	0.01 mile south of 3rd Street North	8,000
143.29	0.01 mile north of Center Street	8,800
143.31	0.01 mile south of Center Street	7,700
143.64	0.01 mile north of 4th Street South	6,000
143.66	0.01 mile south of 4th Street South	6,200
143.87	0.01 mile north of 7th Street South	5,400
144.05	South town limits of Lakeview, 0.01 mile south of 9th Street South	2,950
144.21	0.01 mile south of 10th Street South	2,950
144.46	0.01 mile south of 12th Street South	1,600
148.64	0.01 mile north of Crane Creek Road	1,100
156.50	0.10 mile south of Kelley Creek Road	
157.43	New Pine Creek Automatic Recorder, Sta. 19-008, 0.30 mile north of Oregon-California State Line	

9.7 LIST OF PRINCIPLE PREPARERS

9.7.1 Rodger G. Steen

Mr. Steen is a technical expert in air pollution regulations and in the analysis of ambient air impacts from industrial emission sources. His expertise includes the development of emission inventories, design of control strategies, and atmospheric dispersion modeling. Mr. Steen has analyzed regulatory requirements and estimated air impacts from mines and metal refining processes throughout the United States.

Mr.Steen received a B.S. from Brown University in engineering and a M.S. in Atmospheric Sciences from the University of Chicago. He is a registered Professional Engineer in Colorado and a Certified Consulting Meteorologist (American Meteorological Society). For the past 15 years he has been involved in analysis and technical management of air pollution projects. He has provided technical guidance for a variety of projects ranging from nuclear and coal fired power generation units to chemical production sources, sources of pesticides, and other toxics to mines.

Particular projects, with some similarities to the Quartz Mountain Project, include other work in Oregon and projects throughout the West. Mr. Steen analyzed impacts from woodstove emissions on Oregon cities for presentation to the Oregon Department of Environmental Quality (DEQ). Thus, he is familiar with some of the concerns of Oregon and the DEQ. He has provided guidance for the analysis of impacts from cyanide heap-leach and metal refining projects in Nevada, California, Colorado, and Utah. From these, he is familiar with the various sources of pollution from a mining operation, the mitigation methods, and the issues of greatest concern to the public. He has also managed baseline monitoring programs for particulates and other pollutants, so he has an appreciation for the meaning of baseline data and the need to protect the public health and welfare.

9.7.2 Cynthia J. Riley

Ms. Riley is a chemical engineer with expertise in process design, evaluation of environmental impacts, and environmental permitting.

In 1977, Ms. Riley received a B. S. in chemical engineering from the University of New Hampshire. She is a registered Professional Engineer in the State of Colorado.

TABLE 11.4-47

OREGON HIGHWAY 140
SELECTED 1986 ADT

Mile Post	Location Description	1986 ADT
30.93	Bly Mountain Summit	1,300
.82	0.05 mile west of Sprague River Road	1,300
36.92	0.05 mile east of Sprague River Road	1,200
40.63	0.15 mile west of Godowa Springs Road at Beatty	1,150
40.88	0.10 mile east of Godowa Springs Road at Beatty	1,150
44.98	Beatty Automatic Recorder, Sta. 18-017, 4.20 miles east of Beatty	980
50.37	0.01 mile west of Camp 6 Road	1,200
50.39	0.01 mile east of Camp 6 Road	1,100
53.86	0.01 mile west of Edler Road at Bly	1,500
53.88	0.01 mile east of Edler Road at Bly	1,200
63.39	Klamath-Lake County Line	810
70.75	4.00 miles southeast of Quartz Mountain Pass Summit	630
81.91	Drews Gap Summit, 0.12 mile east of Dog Lake Road	660
88.99	0.10 mile west of Tunnell Hill Road	910
89.10	0.01 mile east of Tunnell Hill Road	1,100
90.50	1.23 miles west of Westside Road at Maddock Corners	1,050
92.43	0.70 miles east of Westside Road at Maddock Corners	1,500
93.90	0.01 mile west of road to Airport	2,000
95.36	0.01 mile west of Roberta Avenue	2,200
95.38	0.01 mile east of Roberta Avenue	2,300
95.71	0.01 mile east of "R" Street	4,200
95.91	West town limits of Lakeview	4,100
96.05	0.01 mile west of "L" Street	4,900
96.36	0.01 mile west of Fremont Highway (US395)	5,700

10.0 ARCHAEOLOGY AND CULTURAL RESOURCES

percent of the town's streets have recently been improved, 25 percent were paved in 1965 and the remainder were paved before 1965 or in small projects since that date. Most streets are in adequate condition. There is an ongoing need for patching, sealing, and overlaying which is being addressed by the Lakeview Public Facilities Plan (Anderson 1987).

County roads in the Lakeview urban growth area are paved and well maintained (Anderson 1987).

Air

The Lake County Public Airport, near Lakeview, is the only airport in the study area. The airport is a general aviation facility, although a commuter airline did provide service at one time (Silvermoon 1982).

The airport has a 6,200 foot paved, lighted runway with instrument approach equipment, and another 5,000 foot runway. Fuel, rental cars, and Taxis are available at the airport (Lake County Chamber of Commerce 1987).

Rail

The Goose Lake 55 Railroad is owned by the Lake County Rail Commission and operated by Great Western Railway. The railroad is so named because it is 55 miles long and travels around the western side of Goose Lake. The railroad operates bi-weekly service between Lakeview and Alturas.

The railroad was purchased by the county in 1986, after Southern Pacific closed the spur to their mainline from Alturas. The closure would have required the lumber mills and wood products manufactures in the area to ship by truck, at considerable expense.

The Lake County Rail Commission was established by the county to oversee railroad operations. The commission includes representations from the county, Lakeview and the lumber mills.

Bus

Bus service to Lakeview is provided by the Red Ball Stage Lines. Two buses operate daily between Lakeview and Klamath Falls (Red Ball, pers. comm., 2 February 1988).

TECHNICAL REPORT NO. 10

ARCHAEOLOGY AND CULTURAL RESOURCES

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

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Lakeview Park Board
Lakeview OR

FOREWORD

This report has been prepared by Winthrop Associates and Steffen Robertson and Kirsten (Colorado) Inc. for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibility of the following personnel:

Project Staff	Project Responsibility	Organization
R. H. Winthrop	Cultural Resources Task Leader	SRK
K. R. Winthrop	Archaeologist	SRK
D. J. Gray	Field Director	SRK
W. Tonsfeldt	Historian (railroad logging)	SRK

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SUMMARY

This report summarizes archaeological studies conducted at Quartz Mountain, Lake County, Oregon, in support of the Quartz Mountain Gold Project. The study area contains both prehistoric (Native American) and historic sites and isolates. Ethnologically the general region of the project lies between the Plateau and Great Basin culture areas, and was used as a resource area by Klamath, Modoc, and Northern Paiute Indians. Historic uses by Euro-American settlers include mining, logging, and ranching, all of which have left material remains in the project area.

Preliminary archaeological studies for the project were conducted in summer 1986 and spring 1987. These studies were for locating exploration activities and for earlier planned test work. An intensive survey of 11.5 sections was undertaken in August and September 1987, in support of the proposed full-scale mining activities at Quartz Mountain. This report summarizes methods and findings of this comprehensive survey, and incorporates data collected in earlier work at the site.

A total of 44 sites have been recorded: 10 historic and 34 prehistoric. A total of 50 isolates were recorded: 16 historic and 34 prehistoric. Survey personnel reidentified an additional 13 previously recorded sites, 2 historic and 11 prehistoric. Thus a total of 107 sites and isolated finds have been identified in the study area.

All prehistoric sites consist of lithic scatters, i.e., stone tools and debris without evidence of structures or permanent habitation. No evidence was noted of burials or cremations, nor have Native America groups identified any sites of particular symbolic or religious significance (i.e., non-archaeological) in the study area. The prehistoric sites are deemed significant through a previously existing Programmatic Memorandum of Agreement between the U.S. Forest Service and the Oregon State Historic Preservation Office, governing lithic scatter sites in eastern Oregon.

Historic sites of particular importance include the Ewauna Box Camp, a mercury retort, and the railroad system remaining from the period of railroad logging on the Forest. Other historic sites include can dumps, a cabin, and a mine site.

11.8 LIST OF PRINCIPAL PREPARERS

11.8.1 George F. Blankenship

Mr. Blankenship is a founder of Planning Information Corporation and is responsible for project administration, local government liaison, and community development activities for impact assessments.

Mr. Blankenship received his Master of Urban and Regional Planning from the University of Colorado in 1980, after completing undergraduate degrees in both social work (Colorado State University, 1978) and anthropology (University of Nebraska, 1970).

In 1979 he joined Briscoe, Maphis, Murray and Lamont, Inc., a growth management consulting firm in Boulder, Colorado, where he performed socioeconomic analysis and growth management and planning services for energy, mining, and defense projects in Colorado, Nevada, Montana, and Wyoming. In 1982 he joined Denver Research Group, where he assumed the position of Coordinator for the Overthrust Industrial Association (OIA), a voluntary organization formed to help local governments accommodate industry-related growth in a five-county region of Wyoming, Utah, and Idaho. As Director of Community Development at Denver Research Group, he coordinated five Wyoming Industrial Siting Administration (WISA) applications and served as principal witness at the WISA hearings. Since the founding of Planning Information Corporation, he has served as project administrator, coordinated the socioeconomic analysis, and been responsible for preparing mitigation plans and strategies for mining, energy, and nuclear waste projects in several western states.

11.8.2 Jed M. Goldstein

Mr. Goldstein is a planner specializing in fiscal impact analysis, municipal facilities and services studies, social impact monitoring, real estate market analysis, and computer applications, and a co-founder of Planning Information Corporation.

Mr. Goldstein holds a Master of Planning and Community Development from the University of Colorado at Denver (1982) and a B.A. in sociology from the University of Massachusetts (1970).

His experience has included working as a planner for the City of Englewood, Colorado (1980-81), where he was responsible for studies of local housing conditions and helped explore financial alternatives for a large-scale downtown

10.0 ARCHAEOLOGY AND CULTURAL RESOURCES

10.1 INTRODUCTION

This section of the baseline report identifies prehistoric and historic archaeological sites within the Quartz Mountain Gold Project study area, as shown in Figure 1.1-1.

10.1.1 Objectives

The main objective of this research was to identify archaeological sites within the study area, to provide baseline information to guide facilities siting for the proposed project, and to facilitate the planning of mitigation measures needed to comply with federal and state archaeological protection statutes. A second objective was to solicit Native American comments regarding the project, particularly to determine if the study area contained other (non-archaeological) cultural resources requiring protection or mitigation (e.g., sacred sites).

At the request of the Fremont National Forest archaeologist, Mr. John Kaiser, and in accord with general archaeological practices, locational data for the sites described below have been excluded from this report (Kaiser, pers. comm., 6 January 1988). For the same reason, maps providing site locations have been omitted. A full report on the archaeological survey will be filed with the U.S. Forest Service (Fremont National Forest), and with the Oregon State Historic Preservation Office.

10.1.2 Study Area

The Quartz Mountain project area is located in south-central Oregon (Figure 1.1-1) on the extreme western edge of the Basin and Range geologic province, an area characterized by northwest trending mountains separated by interior-drained valleys. Ethnologically, the general vicinity of the project area served as a resource area for Klamath, Modoc, and Northern Paiute tribes.

The intensive archaeological survey described below covered approximately 7000 acres and encompass the following locations:

1. Sections 25, 26, 27, 35, 36, and the northeast half of 34, Township 37 South, Range 16 East, Mount Diablo Base and Meridian;

preparing the recreation resource analysis for a gold mine in South Dakota. Her experience at other firms has included participation in several major environmental planning projects (URS Company, (1979-85), including a study of the ability of municipalities to finance wastewater construction projects.

Ms. Taylor holds a Master of Planning and Community Development from the University of Colorado at Denver (1987), as well as a Master of English from the University of Denver (1973). Her planning thesis was "Denver's Parks Planning Process," which analyzed past and present parks planning in Denver and proposed a model requiring that opportunities for public input to future parks planning decisions be keyed to certain threshholds of project cost, size, environmental impact, and potential for controversy.

10.2 REGULATORY REQUIREMENTS

10.2.1 Federal Requirements

Federal statutes and regulations impose requirements regarding the inventory and protection of archaeological sites for the Quartz Mountain Gold Project in at least three ways. (1) Under the requirements of the National Environmental Policy Act (NEPA), a broad range of data must be collected and analyzed to assess the environmental consequences of any proposed project, enhancing the ability of public agencies to "protect, restore, and enhance the environment" (40 CFR 1500.1). This assessment must include consideration of all cultural resources to be affected by the project, evaluating their potential historic, scientific, and social significance (Scovill et al. 1977). (2) Under the requirements of the National Historic Preservation Act (NHPA), all cultural resources within the project area must be evaluated in terms of their potential eligibility for the National Register of Historic Places. Potentially eligible sites must be analyzed and recorded. These data, together with assessments of potential impacts to such sites and proposals for mitigation of these impacts must be reviewed by the State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation (ACHP) -- a review known informally as the Section 106 process (36 CFR 800.1; ACHP 1986). Note that the criteria for archaeological significance used in Section 106 review (36 CFR 60.4) are also applicable for evaluation under NEPA. (3) Sites of significance to Native American peoples receive certain distinct procedural protections (Sec. 10.2.3).

10.2.2 State Requirements

The protection of archaeological sites on private lands within the project area is governed by Oregon statutes and land use policies, and by the Lake County Comprehensive Plan. Under the Oregon Land Use Act (1973), state land use planning is decentralized. Statewide land use goals and guidelines adopted by Oregon's Land Conservation and Development Commission (LCDC) are implemented by each county and municipality through the development of a comprehensive plan.

The preservation of archaeological sites falls within the concern of LCDC Goal 5, governing the conservation and protection of open space, scenic and historic areas, and natural resources. Goal 5 discusses twelve categories of sites, of which two are relevant: historic areas, "land with sites, structures and objects that have local, statewide or national historical significance," and cultural areas, "characterized by evidence of an ethnic, religious or social

12.0 RECREATION

10.3 LITERATURE REVIEW

10.3.1 Ethnographic Background

The Quartz Mountain vicinity appears to have served as a resource area for three Native American peoples: the Klamath, Modoc, and Northern Paiute. Klamath territory lay to the west of the project; Modoc territory to the southwest; and Northern Paiute territory to the east. In addition, historic use of the project area, beginning in the mid-nineteenth century, has also been significant.

10.3.1.1 The Klamath/Modoc

The Klamath subsistence pattern was characterized by a strong reliance on aquatic resources for foods and raw materials, found along the marshes, rivers, and lakes within their territory. In addition to fishing, deer, elk, and other animals were hunted, and a wide range of seeds, roots, and berries were gathered (Spier 1930). While ethnologically grouped as a Plateau culture, the Klamaths were strongly influenced both by the California culture area to the south, and by the Great Basin to the east (Spier 1930). The Modoc, a people closely related to the Klamath both linguistically and culturally, differed in their subsistence orientation in matters of emphasis. Occupying a dryer, more open country to the south of the Klamath people, the Modoc placed greater reliance on hunting and seed gathering than on aquatic life (Stern 1966).

The Klamath possessed a complex material culture, a ranked society, strong religious beliefs centered around shamanism, and extensive relations with neighboring tribes involving trade, intermarriage, and warfare. On the basis of linguistic and archaeological evidence, the Klamaths appear to have a long history in this area; cultural patterns documented at the time of Euro-American contact may date from at least the last 5,000 years (Aikens and Minor 1978, Cressman 1956). These cultural patterns are documented in the ethnographic literature by a number of anthropologists (Gatschet 1890, Spier 1930, Stern 1966), and are summarized in a number of recent works (Minor et al. 1979, Silvermoon and Kaiser 1985).

The yearly cycle alternated between winter villages near ice-free streams or springs, and movement through the spring and summer through a series of hunting and fishing sites. In the spring, groups dispersed to fishing stations, moving in the summer to prairies to gather roots and berries, and to the mountains and desert to hunt. With the ripening of pond lily seeds in the marshes in August and September, the Klamath congregated once more in villages. While summer camps were

TECHNICAL REPORT NO. 12

RECREATION

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

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Revised December 1988

banks, lake edges, and moist areas for the sparsely scattered plants which formed the bulk of their diet. This semi-nomadic existence required a minimum of material possessions. Tools were often manufactured at the place of usage, with favorite or bulky tools stored at the winter habitation site. Shelters were ephemeral, consisting of brush windbreaks in the summer, and a structure of willows covered with matting of tule or grass in the winter (Kelly 1932, Wheat 1967).

As is characteristic of hunting-gathering groups existing within sparse environments, the social organization of the aboriginal Northern Paiute was relatively informal. Political leadership in any formal sense appears to have been a product of the post-contact period (Whiting 1950, Steward and Wheeler-Voegelin 1954). Families were integrated within a series of localized bands, of which Omer Stewart (1939) identified twenty-one, the largest significant unit of social organization for the northern Paiute. Bands were named for distinctive flora or fauna of a given territory, rather than for staple food items. The Quartz Mountain project area falls within the aboriginal territory of the Yahuskin ("Crawfish-eaters") band, a group centered around Silver Lake (Stewart 1939). The Yahuskins were involved at the Klamath Treaty Council of 1864, and became members of the Klamath Reservation, along with the Modocs and Klamaths (Steward and Wheeler-Voegelin 1954).

10.3.2 Previous Archaeological Research

Archaeological studies have been conducted both east of Quartz Mountain, on the western edge of the northern Great Basin, and (to a lesser extent) west, in the Klamath Basin. This research will be reviewed briefly.

10.3.2.1 Northern Great Basin

There have been a number of excavations, surveys and overviews (e.g., Minor et al. 1979) for the northern Great Basin which serve to delineate the major outlines of the prehistory and history of the region. Prehistoric hunters and gatherers entered the region towards the end of the Pleistocene. These early cultures conform to the North American Paleo-Indian tradition, which is characterized by large, fluted projectile points and an emphasis on hunting Pleistocene megafauna (Fagan 1983, Minor et al. 1979). After about 10,000 B.P. [B.P. = before the present, calculated by convention from A.D. 1950.], the extinction of Pleistocene megafauna and the development of Holocene environments gave rise to the Archaic adaptation pattern in North America, marked by hunting and gathering economies utilizing a broad range of foods, including a greater reliance on vegetable resources (Snow 1976). Medium-sized points, used on atlatl

FOREWORD

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Project Staff	Project Responsibility	Organization
G. Blankenship	Project Manager	SRK
E.A. Taylor	Recreation Task Leader	SRK

Research in Surprise Valley (O'Connell 1975), some sixty miles southeast of Quartz Mountain, suggests similar patterns. There major settlements, including subterranean earth lodges, occurring between 6500 and 4500 B.P., are replaced by more ephemeral wickiups and windscreens in the succeeding period. Again, a more sedentary settlement pattern appears to be replaced by a less sedentary one, correlating with significant shifts in climate and food sources (Aikens 1982).

In the last several decades, archaeological research on the northern Great Basin has shifted from a concern with establishing reliable chronologies to a more complex investigation of the interrelation of culture, climate, and biota. At one time Steward's (1938) ethnographic model of a highly nomadic Desert Culture, involving "a broad-based plant foraging, supplemented by hunting, and occasionally fishing" (Fowler 1982), seemed the appropriate guide for archaeological reconstructions in the Great Basin. Better data on post-Pleistocene paleoclimates, more detailed studies of the flora and fauna of particular microenvironments, further ethnographic research on subsistence strategies among Basin peoples (e.g., Paiute ethnobotany), and archaeological investigations of the type mentioned above, have combined to create a more complex picture of the prehistory of the northern Great Basin.

10.3.2.2 Klamath Basin

Much of our information regarding the prehistory of the Klamath Basin comes from the cultural resource surveys conducted on public lands (e.g., Gray 1984). A study of site distribution within the Winema National Forest (west of the project area) documents the strong association of aboriginal sites with lacustrine and riverine environments (Philipek 1983). Archaeological research in the area has been summarized by Minor et al. (1979), and by Silvermoon and Kaiser (1985). The Nightfire Island site near Lower Klamath Lake in northeastern California, some 60 miles (97 km) southwest of Quartz Mountain, has provided considerable data for the prehistory of the marsh- and lake-oriented cultures of this region. The earliest strata date to approximately 7000 B.P. (Sampson 1985).

The only major archaeological site publication for the northern Klamath Basin is an excavation at the Kawumkan Springs midden in the 1950s (Cressman 1956). The Kawumkan Springs site is located along the Sprague River, about eight miles east of the town of Chilcquin, or some 60 miles (97 km) northwest of Quartz Mountain. This site consisted of a large midden, some 160 by 250 feet in area, with associated housepits and features. Cressman's excavation revealed a long

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10.3.3 Historic Background

The Quartz Mountain project area lies within that portion of the American west which was settled in the late nineteenth century. Like other areas in southern Oregon, those activities of economic and social significance which have guided the historic use of this area include ranching, logging, mining, and recreation. Located as it is in a natural pass through the mountains between the Klamath Basin and the Goose Lake Basin, the Quartz Mountain area has served as a travel route since the 1870s. There are several types of historic sites which occur in the vicinity, and within the project area.

10.3.3.1 Central Military Wagon Road

The Central Oregon Military Road, a route of importance to the state's history (Minor et al. 1979), ran through Quartz Valley approximately following the route of Highway 140. The road was completed in 1872. A portion of it remains south of the project area along Drews Creek. Rock alignments, where rocks were cleared from the path of the road, and blazed trees mark the route. Trees were blazed with three parallel, horizontal lines, about four inches apart but are, by now, healed over (Prouty 1985a).

10.3.3.2 Railroad Logging: the Ewauna System

The development of railroad logging after the turn of the century, and particularly between the two World Wars, provided an important stimulus to the regional economy. Recent studies of railroad logging in the Klamath Basin and adjacent areas have begun to outline the economic and social processes involved in this form of industrial exploitation of the rural American West (Tonsfeldt 1987a, 1987b, 1987c). These studies combine research into traditional historical sources with interviews and archaeological data. This work provides a background for defining research issues applicable to railroad logging remains within the project area, as well as providing a model for proceeding with this research.

The Quartz Mountain area was integrated into the Klamath Basin railroad logging complex through the activities of the Ewauna Box Company. The Ewauna Box Company was a large box-making enterprise in Klamath Falls. Drawn by the rich timber resources of the Quartz Mountain area, the company built a railroad line out to the area in 1929, extending the line already completed between Klamath Falls and Bly. The mainline was built to technical specifications which exceeded those in standard practice for railroad logging lines, presumably in the hopes of selling the mainline to O.C. and E. (a railroad

LIST OF TABLES

10.4 RESEARCH METHODS

10.4.1 Introduction

In broad terms, there are four stages involved in the archaeological treatment of sites: (1) establishing what is already known regarding the archaeological and historical record of the area in question (pre-field research); (2) performing a field survey to identify previously unrecorded sites in the project area; (3) evaluating all identified sites in terms of National Register criteria of significance [36 CFR 60], which would normally include subsurface testing of sites considered potentially significant; and (4) assessing impacts and carrying out mitigation measures, including -- where no better alternative is possible -- mitigation through data recovery excavation. To date, pre-field research has been undertaken, and the comprehensive field survey has been performed. Results of the survey are detailed in Sections 10.5 and 10.6.

10.4.2 Previous Studies in Project Area

Based on what is known of the regional archaeological record (Section 10.3), previous archaeological studies on the Fremont Forest (Silvermoon and Kaiser 1985), and previous studies at Quartz Mountain (Winthrop Associates 1986, 1987a, 1987b, 1987c, Connolly 1987, and Prouty 1985b), one can form an estimate of the types of prehistoric and historic sites likely to be encountered in the project area can be formed. All prehistoric sites discovered at Quartz Mountain to date have been lithic scatters, although a number of other types of sites are known on the Fremont Forest, including quarries, pictographs, rock rings, cairns, and walls. The project area also contains numerous remains relating to the history of the area. The Ewauna Box Camp and associated railroad logging features occur within the area, as do the remains of a mercury retort. Recorded historic sites at Quartz Mountain include can and bottle dumps, and debris from a settlement. Elsewhere on the Forest homesteads, campgrounds, and remnants of mining, logging, and grazing activities have been identified.

Most surveys previously undertaken in the project area have been conducted in support of Forest Service logging operations, which involve a lesser intensity of impact than would occur with mining operations. Forest Service personnel have performed some surveys in support of mineral exploration in the project area (in 1984, 1985) and have also monitored test drilling operations at some sites. In addition, the Department of Transportation has conducted surveys of the right of way along Highway 140 in support of a road widening project (Connolly 1985; Pettigrew 1986). However, this

12.0 RECREATION

12.1 INTRODUCTION

This section of the baseline report describes the existing recreation opportunities on the Quartz Mountain Gold Project study area as shown in Figure 1.1-1, and the area of potential indirect recreation impact as shown in Figure 12.1-1.

12.1.1 Objectives

The objectives of the recreation studies were to gather sufficient data to identify existing recreation resources in the project study area and, at a general level, in the area of potential indirect recreation impact. The studies were designed to provide information on developed recreation sites, such as campgrounds and picnic areas; major recreation trails; scenic roads and highways; outstanding natural and manmade features with recreation potential; designated and proposed National Natural Landmarks; designated and proposed Wild and Scenic Rivers; designated and proposed Wilderness Areas; high quality fishing waters; existing and planned recreation use, including hunting and fishing; and areas with potential for various types of dispersed recreation activities, according to the Recreation Opportunity Spectrum (ROS) classification system.

12.1.2 Study Area

12.1.2.1 Project Study Area

The Quartz Mountain Gold Project Study area (Figure 1.1-1) is located in Lake County, Oregon near the summit of Quartz Mountain Pass approximately 30 miles west-northwest of Lakeview, Oregon, in the Fremont National Forest. Almost all of the study area is in the Bly Ranger District. Elevations within the project area range from 5,400 ft to 6,600 ft. The topography is dominated by round to oval-shaped buttes of moderate relief.

The project area is serviced by Oregon State Highway 140. The nearest communities are Lakeview, Bly, and Klamath Falls, Oregon, all of which also lie along this route. U.S. Forest Service (USFS) road 3660 passes through the project study area between Quartz Butte and Quartz Mountain, joining Highway 140 at Quartz Mountain Pass.

transect spacing was intensified in both "high" and "medium" categories, to increase the sample included in the survey.

Accordingly, the Quartz Mountain project area was surveyed in two intensities, defined as follows. (1) High Intensity. Transects 10 - 20 meters apart, principally for areas of moderate slope and lower elevation, particularly near stream courses, with initial transect spacing at 15 meters. (2) Medium Intensity. Transects 20 - 50 meters apart, for other areas, i.e., steeper terrain and higher elevations. Transect spacing followed the above guidelines where conditions permitted. These procedures were approved by the Fremont Forest Archaeologist and the Oregon State Archaeologist (Appendix 10.A).

10.4.4 Field Procedures and Conditions

The project area included approximately 7,000 acres. Survey personnel were in the field between 24 August 1987 and 29 September 1987. Crew size ranged from two to six people; for much of the time two, three-person crews worked separately.

To facilitate the survey, the total acreage was divided into eleven management units. Summaries of the survey in each unit were prepared to provide information on terrain, vegetation, water, survey conditions (visibility, disturbances to the ground), and cultural material not formally recorded as a site or isolate (e.g., mining trenches). In addition to unit summaries, the survey personnel kept records of individual transects. Individual transects were numbered within each management unit; each crew member completed a brief transect form at the end of every transect. These forms included a space for terrain, survey conditions, vegetation, water, sites/isolates recorded, and materials noted but not recorded. Both the transect forms and the unit summaries document the procedures followed and provide detailed information on the survey.

Transect spacing followed the guidelines described above. In order to insure systematic coverage the last transect of every group was flagged, providing an accurate return point. Also, one person on each crew acted as lead, following a direct compass bearing; the rest of the crew were more free to meander on their transects, maximizing ground visibility.

Field conditions necessitated some modification of the proposed coverage. The meadow areas in Quartz Valley and Angel Creek drainage were covered by thick grasses, and are seasonally marshy; they do not represent high sensitivity areas, although the slopes just above the meadows do. Many of the flat spots, such as the top of Quartz Mountain, which were

10.5 SURVEY FINDINGS: PREHISTORIC

10.5.1 Introduction

All of the prehistoric sites are lithic scatters, and are considered significant under the previously existing Programmatic Memorandum of Agreement (PMOA) on lithic scatters between SHPO and the USFS. Further work at any of these sites, therefore, is not needed to evaluate significance, but to ascertain the specific potential of any site by refining the characterization of that site. Management of the sites should take into account the projected impact, those sites immediately endangered receiving the first attention. Evaluation of the sites should take into account the recent excavation by the Department of Transportation (DOT) of three lithic scatters in the project area, and the fact that a number of the sites are quite small and probably only of a surface nature. We suggest that any future testing and mitigation of the lithic scatters consider the information potential of the entire range of sites, considered as an ensemble, rather than evaluating each site in isolation from the others.

Unless otherwise noted, tools and debitage were of obsidian. "Primary" refers to debitage with cortex on one side; "secondary" refers to interior flakes larger than 0.5-1 cm diameter; "tertiary" refers to small pressure flakes. Few tertiary flakes were noted at any site, probably because they are not readily visible on the ground surface.

10.5.2 Prehistoric Sites Recorded

Thirty-four prehistoric sites were recorded; all are lithic scatters. The sites ranged in size from small, localized deposits of less than 25 flakes, to large, diffuse scatters with areas of artifact concentrations and tools, covering many acres (Table 10-5-1). Thirteen previously recorded prehistoric sites are in the project area; eleven of these were relocated, and when necessary the site forms were updated (Table 10.5-2).

10.5.3 Isolates

Thirty-four isolated finds were recorded; these consisted of isolated tools or small concentrations of lithic debris totalling ten or fewer artifacts (PMOA Criteria). These isolates are listed in Table 10.5-3. Tools were collected from these isolates. While analysis of the isolates will be included in subsequent reports, further field work is not necessary.

12.1.2.2 Area of Concern for Potential Indirect Recreation Impact

The area of concern for potential indirect recreation impacts extends north from the project study area to Silver Lake, east to the Hart Mountain National Antelope Refuge, south to Alturas, California, and west to Klamath Falls. This would include Summer Lake, Goose Lake, and Clear Lake. However, most of the work force is expected to recreate on the Fremont National Forest itself (Woodward, pers. comm., 10 February 1988).

TABLE 10.5-1

PREHISTORIC SITES (NEWLY RECORDED) CONTINUED.

SRKS-P-14: Lithic scatter about 80 x 30 m; maximum density of 12 flakes/sq m; mainly secondary flakes, one projectile point tip collected.

SRKS-P-15: Lithic scatter with 60 m diameter; mainly secondary flakes with maximum density of 4-5 flakes/m sq.

SRKS-P-16: Lithic scatter, about 60 m diameter, mainly secondary flakes, two bifaces collected.

SRKS-P-17: Lithic scatter, about 60 x 30 m; mainly secondary flakes, maximum density 5 flakes/sq m.

SRKS-P-18: Large, heavily disturbed site at south end of Quartz Valley; two bifaces collected.

SRKS-P-19: Lithic scatter, about 25 x 35 m; mainly secondary flakes; two utilized flakes noted.

SRKS-P-20: Large, diffuse lithic scatter covering terrace above Drews Creek, about 600 x 75 m. No tools collected; two areas of flake concentration noted. Historic component to site, consisting of railroad grade, logging cable, cans and debris.

SRKS-P-21: Very small lithic scatter, about 25 flakes, one uniface.

SRKS-P-22: Very small lithic scatter, about 25 flakes, one projectile point and one CCS uniface collected.

SRKS-P-23: Very small lithic scatter, about 20 flakes.

SRKS-P-24: Very small lithic scatter, about 30 flakes.

SRKS-P-25: Very small lithic scatter, about 20 flakes.

SRKS-P-26: Very small lithic scatter, about 20 flakes.

SRKS-P-27: Very small lithic scatter, about 25 flakes.

SRKS-P-28: Very small lithic scatter; about 40 flakes, one projectile point; heavily disturbed by roads through site.

TABLE 10.5-2

PREHISTORIC SITES (PREVIOUSLY RECORDED)

35-LK-2151: Lithic scatter. Excavation by DOT in progress during survey.

35-LK-2152: Lithic scatter. Excavation by DOT in progress during survey.

35-LK-2153: Large lithic scatter. Excavation by DOT in progress during survey. Lithics noted during survey extending N and W of excavation. The site appears to be part of a complex which extends across the highway to the area now destroyed by a quarry, road, and railroad grades; this area is recorded here as SRKS-P-18.

35-LK-1969: Small lithic scatter, not relocated during the survey; possibly falls within our site SRKS-P-7.

35-LK-1971: Lithic scatter relocated during survey; site form amended and map redrawn. Light lithic scatter, 100 x 50 meters, maximum density 4-5 flakes/sq m.

35-LK-1972: Site not relocated during the survey.

35-LK-1970: Site investigated last year; no new data added to the site form. However, it was noted during the survey that using the criteria employed during this survey, site boundaries would have extended beyond those originally designated.

35-LK-1973: Relocated during survey; site form amended and site remapped. Lithic scatter with mainly secondary flakes and maximum flake density of 12 flakes/sq m.

35-LK-1974: Relocated and reflagged; no changes to site form. Small lithic scatter, with average density of 1 flake/2 sq m.

35-LK-1975: Large, dispersed lithic scatter with historic component. Further survey in this area extended the boundaries beyond those of the original survey. Site report amended, site remapped.

02-01-QU-PH-1: Site relocated; largely destroyed by current mining activities.

SRK-HL-1: Extensive, light lithic scatter tested spring 1987.

SRK-HL-4: Small lithic scatter tested spring 1987.

SRK-HL-5: Small lithic scatter, now in SRKS-P-7.

and Quartz Butte. The loop south of the highway starts at the edge of the study area, but is almost entirely out of the area. The Quartz Mountain loop is mostly in the study area, and the Quartz Butte loop is completely in the study area. Together, the Quartz Mountain and Quartz Butte loops provide 15 miles of cross-country ski trail. All of these trails have been developed within the last two years (Woodward, pers. comm., 2 February 1988).

Except for the trail around Quartz Butte, all snowmobile and cross-country ski trails in the vicinity are marked. The Oregon Department of Highways is planning to construct a "snow park" and winter sports interpretive site at Quartz Pass on road 3715, where it intersects Highway 140 (Woodward, pers. comm., 10 February 1988). Construction is planned for summer 1988, in conjunction with road widening (Woodward, pers. comm., 2 March 1988). The State of Oregon requires a winter sports parking permit for use of snow parks, which funds plowing and maintaining these areas (Oregon, 1983).

Since the Quartz Butte cross-country trail is not marked and not advertised, it probably receives little use (Woodward, pers. comm., 2 March 1988).

No designated scenic waterways occur in the study area.

12.2.1.3 Scenic Roads and Highways

No specially designated scenic roads or highways pass through the area. Highway 140 and road 3660 both pass through the study area, however. Highway 140 connects Klamath Falls with recreation resources to the east, and road 3660 provides some of the access to the Gearhart Mountain Wilderness Area. In the Draft Environmental Impact Statement for the Fremont National Forest Proposed Land and Resource Management Plan, the Highway 140 viewshed is described as natural appearing, while the road 3660 viewshed is described as slightly altered or altered (USFS 1987a).

12.2.1.4 Outstanding Natural and Manmade Features

The study area has no outstanding natural features, and no manmade features that would enhance its recreation potential.

12.2.1.5 National Natural Landmarks

There are no designated or proposed National Natural Landmarks in the project study area (Atkins, pers. comm., 7 March 1988).

TABLE 10.5-3 Continued

#44: Projectile point

#45: Several flakes

#47: Projectile point

#48: Projectile point

#49: Several flakes and biface fragment

#50: Several flakes

#53: Projectile point

#54: Point tip

#55: Point midsection

#62: Point tip

#64: Projectile point

#65: Several flakes, biface fragment

12.2.2.2 Snowmobiling

Some snowmobiling occurs on road 3660, and the area south of Highway 140 is used heavily. Snowmobiles are not restricted to roads and trails. As stated above, total winter recreation use in the area is approximately 500 RVDs per year (Woodward, pers. comm., 2 March 1988).

12.2.2.3 Camping

Flat areas for tent sites, meadows with scattered ponderosa pine, accessibility via jeep roads, and screening from highway traffic combine to make the Quartz Butte area popular for car-side camping, especially during hunting season. The area hosts an estimated 40 to 50 camps during the two weeks of deer season, in October (Woodward, pers. comm., 10 March 1988).

12.2.2.4 Hunting

Hunting is the principal recreational use in the Quartz Mountain area, and most hunting is for big game. Deer and elk are hunted in the rifle and archery season (Conn, pers. comm., 10 March 1988). The area provides good winter range for mule deer, and while some of the deer present in summer and fall migrate to California, others remain (Anderson, pers. comm., 9 March 1988). The Lake County Atlas, a supplement to the Lake County Comprehensive Plan, was amended in 1982 to include a Wildlife Habitat map. That map does not show any wildlife habitat in the Quartz Mountain area (Cannon 1983).

Although the study area is used by many deer hunters for car camping, hunters tend to use the area as a base, fanning out into nearby areas, and deer hunting itself is no more popular in the study area than elsewhere in the 821 square mile Interstate Hunt Unit (Conn, pers. comm., 10 March 1988). An estimated 40 to 50 camps use the area in the course of the two weeks of deer hunting in October (Woodward, pers. comm., 10 March 1988).

The area also supports some incidental blue grouse hunting, and occasional recreational fur trapping of bobcat and coyote (Conn, pers. comm., 10 March 1988). Blue grouse are hunted on the headwaters of Drews Creek, just above the study area (Anderson, pers. comm., 9 March 1988). Lake County has had a closed season on beaver trapping for several years (Conn, pers. comm., 10 March 1988).

12.2.2.5 Fishing

Upper Drews Creek crosses the southeast corner of the study area, and Quartz Creek parallels Highway 140 along the

10.6 SURVEY FINDINGS: HISTORIC

10.6.1 Introduction

Ten historic sites were recorded in the project area (Table 10.6-1). Nine historic sites were newly recorded, and the site form of one previously recorded site was amended. These sites include Ewauna Camp and the mercury retort, which need additional consideration regarding their significance. Railroad grades occur throughout the project area, and these grades will also need further consideration. Sixteen isolates were recorded, including several small or recent dumps (Table 10.6-2). Two previously recorded can dumps are also in the project area. Finally, various cultural remains from the historic and modern period were noted but not formally recorded. These finds are discussed in detail below.

10.6.2 Ewauna Camp

Ewauna Box Company was a large box making enterprise located in Klamath Falls. In 1929, the Ewauna Company ran a railroad line out to Quartz Mountain to harvest the timber. The company established a seasonal (except for possibly one year when the operations continued through the winter) family camp at Ewauna Camp. The camp remained in operation until 1936. Houses were small temporary structures brought in by rail, and there was a school. At the end of the 1936 season, Ewauna abandoned its operations at Quartz Valley and moved its camp. The Forest Service used the area for fire camps in the 1970s, and today many campers use the area for recreational purposes.

The archaeological management of Ewauna Camp involves three considerations: (1) What is there? What is the extent and integrity of the archaeological remains? (2) What are they worth? (3) What should be done with them? The first consideration is satisfied by the completed pedestrian survey, the results of which are described below.

10.6.2.1 Description

Numerous features were located during the survey within a 60 acre area which is designated here as the site. (1) The southwest part of the site contains a complex of features and railroad grades which includes a "roundhouse" engine repair area (F-12) and another feature with direct access to the main grade (F-6). (2) The features in the north part of the site consist almost entirely of can dumps in and along the main grade; Dick Bennett suggests that portions of the grade were abandoned during the time the camp was used, hence the dumps in the grades (Bennett, pers. comm., 14 August 1987). (3) The

12.2.2.7 Off-Road Vehicle (ORV) Use

ORV use is permitted in the study area. The Fremont National Forest Off-Road Vehicle Use and Policy established in 1976 permits ORV use on more than 95 percent of the forest. In Fremont National Forest generally, high road density (3.68 road miles per square mile of land area) and gentle topography create very favorable conditions for ORV use. Current use in the forest as a whole amounts to less than one percent of total recreation use. The only areas of the forest where ORV use is prohibited are the Gearhart Mountain Wilderness and the Goodlow Mountain Research Natural Area. In the Fort Rock-Cabin Lake area, vehicles are not permitted from November to March, in order to reduce harassment of deer in their key winter range areas (USFS 1987a).

12.2.2.8 Hiking and Backpacking

Backpacking opportunity in the study area is limited due to the presence of a highway, a paved road, and several jeep trails, since the potential for encountering vehicles tends to make foot travel less attractive.

Quartz Mountain, at 6,047 feet, is less than 650 ft in elevation and less than a mile from the intersection of Highway 140 and road 3660, giving it some potential for an easy family hike, although there is nothing to recommend it over other nearby areas.

12.2.2.9 Horseback Riding

There is virtually no horseback riding in the study area (Woodward, pers. comm., 10 March 1988). In this area, horses generally are not used in hunting (Conn, pers. comm., 10 March 1988).

12.2.2.10 Woodcutting

The Fremont National Forest Recreation Specialist doubts that the study area is used for woodcutting, since the trees are mostly ponderosa pine and white fir, which are not preferred for firewood (Woodward, pers. comm., 10 March 1988).

TABLE 10.6-2

HISTORIC ISOLATES

#4:	Scattered cans and aspen dendroglyphs
#6:	Metal frame
#7:	Handmade wooden toboggan
#11:	Can scatter/ lithic scatter; 6 cans, glass fragments, prospect trench nearby.
#15:	Can dump, single loci; 40-50 cans in prospect trench, some glass fragments, wooden box top.
#16:	Small dump, approximately 20-30 cans, glass jar fragments, alarm clock base, electrical wiring, "Zenith 2" carburetor, coffee-table tray frame (post 1950s?).
#18:	Can dump, about 50 cans, glass fragments.
#21:	Can dump, about 20 cans, some glass fragments, one auto turn signal housing.
#26:	Stove parts
#29:	Farm machinery parts
#32:	Can dump, about 30-40 cans
#33:	Can dump, about 30 cans
#34:	Quartz Mountain Lookout--little of the lookout remains; there are scattered pieces of wood, metal scraps, stove parts, pipe, and trash on top of Quartz Butte.
#52:	Hunter's camp, probably post 1950; about 50-100 cans, bottle fragments, two 55-gallon barrels cut for stoves, hanging rack in trees, bedsprings, deer antlers in tree.
#59:	Industrial dump, post 1950; auto/truck seat springs, seven metal tire rings, Goodyear tires, 55-gallon barrel stove and stove pipe, culvert pipe, car parts, paint cans, pocket tobacco tins, glass and metal fragments, gallon oil cans, bucket.
#61:	Dump; about 100 cans, glass and plate fragments, wooden box with open top covered in wire mesh; near railroad grade.

available regarding what percent of total use they represent (USFS 1987a). About 50 percent of deer hunters visiting the Forest come from outside the Forest influence zone (i.e., Lake County and eastern Klamath County) (USFS 1987a).

12.3.1.1.1 Fremont National Forest: Developed Sites

About 24 percent of total recreation use in the Forest occurs on developed sites (campgrounds, picnic areas, ski areas). The Forest has 22 developed recreation sites on a total of about 250 acres. Nearly all of the sites are family campgrounds. The sites have a combined reasonable capacity of 2,285 persons at one time (PAOT). All sites are in the Roaded-Natural ROS setting. Cottonwood Camp is a group campsite with a 75 PAOT capacity. Warner Canyon is a privately owned ski area on 94.3 acres, with a capacity of 1,020 skiers per day. Long-range plans call for adding 2 lifts to increase capacity to 1,785 skiers per day.

Demand for developed recreation at Fremont National Forest is expected to increase an average of 2 percent annually over the next 50 years. Calculated on a daily basis, the current RVD capacity for all developed sites is 1,165 RVDs per day. The Forest has the potential to increase this figure to 2,898 RVDs per day, or 326,133 RVDs per 162-day average season of use (USFS 1987a). These calculations assumed a reasonable capacity of 3.4 RVDs per acre, and included recreation development projects in the Bly Ranger District at Quartz Mountain, as a first priority for development, and Ewauna, as a third priority (USFS 1987a).

12.3.1.1.2 Fremont National Forest: Dispersed Recreation

Present dispersed recreation use of the Forest averages 154,400 RVDs annually.

At present, modified recreation settings (including scenic travel corridors) receive about 70 percent of the recreational use on the Forest. The following table, based on an average of 200,000 RVDs annually, compares current capacity with current demand for each ROS class:

ROS Class	Capacity (RVDs)	Demand (RVDs)
Wilderness	3,400	3,200
Roaded Natural	698,061	143,200
Roaded Modified	1,150,061	44,400
Semiprimitive Motorized	3,306	2,000
Semiprimitive Nonmotorized	10,817	7,200

While present capacity exceeds demand in all categories, the Fremont National Forest Management Plan DEIS projects

10.6.4 Other Historic Sites

These sites are unlikely to need further work immediately, either because it is possible to evaluate them on the basis of information collected during the survey and literature search, or because they are unlikely to be affected by the mining project in the near future.

10.6.5 Previously Recorded Dumps

Two can dumps were previously recorded, identified as SRK-HL-2 and SRK-HL-3.

10.6.6 Isolated Finds

This category of finds constitutes a class of items which are of marginal value archaeologically, due to their isolated nature. For some of these items, recording in the field constitutes adequate mitigation. For others, analysis in the field or collection is necessary to preserve their limited information potential. For the following isolates, we suggest that recording is sufficient mitigation for all the isolates except the dumps. The dumps are all small (less than 100 cans) and/or fairly recent (and hence not historic). However, there are eleven such isolates, and together they represent a group which may have potential to yield information regarding historic use of the project area. We suggest that at least a sample of the dumps be investigated further, by detailed recording of the contents and collection of a representative sample of the artifacts. Evaluation of these resources, based on background research, will lead to specific recommendations regarding the treatment of the dumps (i. e. which ones to sample, which recording system to use).

10.6.7 Railroad Grades

Railroad grades from the era of railroad logging, and presumably related to the Ewauna system, occur throughout the project area. These grades were noted when crossed during the survey. Two wooden culverts were noted along the grade by Drews Creek. The Ewauna system was reportedly exceptional since the railroad grades were built to a higher engineering standard than usual for logging grades. Further evaluation and mitigation of the grades could involve research into the Ewauna logging system as well as additional fieldwork to further document the grades, associated features, and the engineering specifications employed.

10.6.8 Noted/Not Recorded Remains

Skid trails, numerous mining trenches, mining claim markers, several corrals, an old road to Quartz Butte, and trout streams, and 4,000 acres of lakes and reservoirs (Lake County Chamber of Commerce, [n.d.]c).

12.3.1.4 Hart Mountain National Antelope Refuge

Located northeast of Lakeview, Hart Mountain National Antelope Refuge is a 240,000 acre wildlife preserve administered by the U.S. Fish & Wildlife Service. Hart Mountain is a rugged volcanic ridge, with elevations ranging from 4,500 ft to 8,065 ft. The Refuge provides varied habitats, and over 330 species of wildlife have been recorded in the area (Lake County Chamber of Commerce, [n.d.]b; U.S. Fish & Wildlife, 1986).

Remoteness and rough access roads limit visitation. The area is open to hiking, backpacking, fishing, rockhounding, and restricted hunting (antelope season and special bow and blackpowder seasons only) (Collison 1987a).

12.3.2 Sites and Facilities

Sites and facilities discussed in this section include both specific naturally occurring features which lend themselves to recreational use and constructed features which facilitate recreational use.

12.3.2.1 Developed Recreation Sites

The supply of developed recreation facilities in Klamath and Lake counties was tabulated in the State of Oregon's 1983 Outdoor Recreation Plan (Oregon 1983). Present need was estimated, and future need projected for 1990. As shown in Table 12.3-1, existing need exceeds supply in Klamath County for ball fields, tennis courts, all purpose courts, and all types of parks, while in Lake County, existing need exceeds supply for campsites, trails, ball fields, tennis courts, all purpose courts, and all types of parks (Oregon 1983). The Quartz Mountain Socioeconomic Baseline Report contains an inventory of community-based recreation facilities in Lake County.

12.3.2.1.1 Campgrounds and Picnic Areas

Table 12.3-2 lists campgrounds and picnic areas other than Fremont National Forest facilities identified in the area of influence. Where available, visitor estimates are provided.

occasional debris (metal parts, logging cable, glass and can fragments) were noted throughout the project area, and have been documented in the management unit summaries.

TABLE 12.3-2

PICNIC AND CAMPING AREAS (OTHER THAN FREMONT NATIONAL FOREST) IN AREA OF CONCERN FOR POTENTIAL INDIRECT RECREATION IMPACT

PICNIC AREAS

Goose Lake State Recreation Area
Lake County. Oregon Parks and Recreation Division. 64.10 acres. 24 picnic units. Day use attendance 53,330 in FY 1984-85.

Booth Wayside Area
Lake County. Oregon Parks and Recreation Division. 311.26 acres. 6 picnic units. Day use attendance 23,678 in FY 1984-85.

Chandler Wayside Area
Lake County. Oregon Parks and Recreation Division. 85.09 acres. 6 picnic units. Day use attendance 18,160 in FY 1984-85.

Robert Sawyer: Fort Rock Area
Lake County. Oregon Parks and Recreation Division. 190 acres. 6 picnic units. Day use attendance 12,204 in FY 1984-85.

Collier Memorial
Klamath County. Oregon Parks and Recreation Division. 655.62 acres. 68 picnic units. Day use attendance 405,892 in FY 1984-85.

Klamath Falls-Lakeview Forest Wayside
Klamath County. Oregon Parks and Recreation Division. 80 acres. 69 picnic units. No day use attendance in FY 1984-85.

Highway Well Wayside
Lake County, U.S. 395. BLM. 1 picnic unit. Water.

S'Ocholis
Klamath County. USFS. Picnic units. Water, fishing.

Fairgrounds Park
Klamath County. Picnic units.

Stevenson
Klamath County. Picnic units. Fishing.

east part of the site consists of two badly disturbed features. The first (F-13) is a scatter of artifacts related to industrial purposes; the second (F-14) is a complex of artifacts and features (here termed loci) which suggest that this may have been a residential part of the camp. (4) The southeast part of the camp has two wells, and a number of dumps and possible plumbing features. (5) The center of the site is a much-used meadow surrounding the junction of various roads. Although there is an almost continuous scatter of historic artifacts throughout this area, it is heavily disturbed and no features were discernible.

10.6.2.2 Integrity

Visitors and workers in the area since the 1930s have undoubtedly scavenged useful and interesting items from the whole site, and later projects in the site area have affected many of the features. The meadow area has been reseeded; Forest Service fire camps have cleaned up the area; road construction, campers and hunters have all affected the original integrity of the site. Nonetheless, the integrity of the various areas and features varies. The features and railroad grades in the southwest part of the site maintain integrity of association, and the features maintain sufficient attributes to reconstruct at least general functions. The can dumps along the railroad grades appear fairly intact (F-5, F-15 through 22); although undoubtedly relic hunters have removed various items, the cans remain. The dumps in the east and south have been largely cleaned up; little remains at many of these dumps except for concentrations of broken glass, ceramic material, and metal fragments. Features are difficult to distinguish and function is difficult to ascertain.

Surface indications suggest that there is little in the way of a significant subsurface component to the site. Artifacts have been worked into the ground since the camp was abandoned, and duff and ground cover vegetation have obscured the outlines of some of the features. Although some subsurface work may be needed during the testing or data recovery phase, it is unlikely to be either very extensive or very deep.

10.6.3 Mercury Retort

The mercury retort (SRKS-H-2) was built during the cinnabar mining episode in Lake County history in the 1950s. Although it does not meet the federal requirements for age (at least fifty years old) to be a significant resource, it may be a relatively unique feature relating to an important episode in Lake County history. Evaluation of this site is likely to include a brief summary of cinnabar mining in the area, interviews with the builder of the retort, and a description of how it worked.

TABLE 12.3-2 CONTINUED

Jackson Creek Campground
Klamath County. USFS. Tent and trailer sites. Water, fishing, hunting, hiking.

Sprague River Campground
Klamath County. USFS. Trailer, tent and picnic sites. Water, fishing, hunting, hiking.

Cave Lake Campground
Modoc County.

Lilly Lake Campground
Modoc County.

Plum Valley Campground
Modoc County.

Stone Reservoir Campground
Modoc County.

Cedar Pass Campground
Modoc County.

Big Sage Reservoir Campground
Modoc County.

OTHER RECREATION AREAS

Nimrod River West
Klamath County. Fishing.

Nimrod River East
Klamath County. Fishing.

J.F. Kimball
Klamath County. Oregon Parks and Recreation Division. 19.44 acres. No picnic units. Day use attendance 19,026 in FY 1984-85.

Cedar Pass Ski Tow
Modoc County, 16 miles northeast of Alturas. Skiing.

Warner Valley Ski Area
Lake County, 10 miles north of Lakeview. Downhill and cross-country skiing.

TABLE 10.6-1

HISTORIC SITES

SRKS-H-7: Ewauna Box Camp.

SRKS-H-2: Mercury retort.

02-01-341: Mining trench; this site was previously recorded by the Forest Service. The site form was amended during this survey.

SRKS-H-1: Can dump, with remains relating to family occupation, 1930s or 1940s.

SRKS-H-3: Can dump with several loci, 1930s or 1940s.

SRKS-H-4: Schoolhouse site, next to Highway 140. This collapsing one-room school was reportedly the Ewauna Camp school, and was moved to its present location.

SRKS-H-5: Can dump on eastern edge of Quartz Valley.

SRKS-H-6: Dendroglyph site; approximately eighteen aspen trees inscribed with markings from the early decades of the century.

SRKS-H-8: Angel Peak mining site; this site consists of several structures and an associated mine. It was in use in the 1950s, and was related to the mercury boom during that time.

SRKS-H-9: Cabin; this site consists of the collapsed remains of a notched log cabin along Drews Creek.

10.5.4 Noted/Not Recorded Remains

Single flakes and areas of widely dispersed flakes were noted throughout the project area. These finds were especially prevalent around the sites, and along the edges of Quartz Valley. This information is recorded in individual unit summaries.

12.3.2.5 National Natural Landmarks

There are no designated National Natural Landmarks in Klamath County. Nine potential sites have been identified:

Goodlow Mountain Research Natural Area

Sphagnum Bog

Bluejay Research Natural Area

Wickiup Springs

Cannon Well

Cherry Creek Basin

Crater Lake National Park

Black Rock

Klamath Lake Graben

Lake County has one designated site, the Fort Rock State Monument, which is north of the area of concern. Potential sites include Hole-in-the-Ground, Lost Forest Research Natural Area, and Warner Valley (Warner Lakes-Crump Lake).

12.3.2.6 Wild, Scenic and Recreation Rivers

The North Fork of the Sprague River from the head of the river spring to Forest Road 335 is eligible for Scenic River classification, while the lower portion from Forest Road 335 to the forest boundary is eligible for Recreation River classification. Primary use is for fishing. Rainbow, redband, and bull trout are native, while brown and brook trout are introduced species. The river provides approximately 4,000 RVDs per year. The river is not used for rafting or canoeing (USFS 1987a).

The Sycan River is also eligible for Scenic River classification except for the segment through Sycan Marsh, which is only eligible for Recreation River classification. Primary recreation use is fishing, although some isolated segments support incidental river floating during spring peak flows. Redband, rainbow, and bull trout are native, while brook and brown trout are introduced species. The river corridor provided over 6,400 RVDs in 1981 (USFS 1987a).

In addition to the Sprague River and Sycan River, the Lower Williamson River from the western boundary of Winema National Forest to Collier State Park meets the criteria for a

TABLE 10.5-3

PREHISTORIC ISOLATES

#1: Obsidian biface fragment

#2: Projectile point fragment, several flakes

#3: Projectile point tip

#5: Several flakes, one utilized

#12: Obsidian projectile point fragment

#13: Small concentration of secondary flakes

#14: Obsidian biface

#17: One biface, one uniface, 2 obsidian cores, several flakes and chunks of obsidian

#19: A few flakes and one uniface

#20: A few flakes

#22: Projectile point fragment

#24: Projectile point fragment

#25: A few flakes, obsidian and basalt

#30: Biface fragment

#35: Projectile point, few flakes

#37: Dispersed obsidian flakes noted in an erosional context

#38: Biface fragment

#39: Projectile point

#40: Biface and a few flakes

#41: One projectile point, two bifaces

#42: Projectile point, a few flakes

#43: Projectile point

from north to south and 15 miles wide, with one narrow spur four miles long and two miles wide on the east side of the area, and contains 113,120 acres of public land. The area provides opportunities for solitude, primitive recreation, and scenic vistas of the Summer Lake basin, Winter Ridge, and the high desert country east of the wilderness (BLM 1987). Wild horses are found on the eastern edge of the area (BLM 1985).

Abert Rim Wilderness Study Area (OR-1-101) is long and narrow, located along Abert Rim at the eastern shore of Lake Abert for 21 miles, ranging from 1 1/2 to 2 miles in width. Features include rugged, steep slopes of the largest continuous fault scarp in North America. Highway 395 was named an Oregon State scenic route because of the scenery in this area (BLM 1987). Opportunities for primitive and unconfined recreation include hiking, backpacking, camping, sightseeing, photography, wildlife observation, horseback riding, and hunting. Wildlife is abundant, and plants are varied (BLM 1985).

Fish Creek Rim Wilderness Study Area (OR-1-117) is located approximately 20 miles east of Lakeview. The area is used for hunting and sightseeing, and receives moderate to heavy hunting pressure. Primitive recreation use is very low (BLM 1985).

12.3.3 Dispersed Recreation Opportunities

Dispersed recreation refers to recreation use that occurs outside of developed recreation sites. Dispersed recreation may include activities such as scenic driving, hunting, backpacking, and recreation in primitive environments.

In planning for management of public lands, the BLM and the U.S. Forest Service both make use of the Recreation Opportunity Spectrum (ROS) (see section 12.2.2 for an explanation of the ROS).

12.3.3.1 Cross-Country Skiing

While cross-country skiers frequently utilize developed ski trails, cross-country skiing may be considered a dispersed activity, since skiers are restricted in their choice of locations only by the terrain and snow conditions, ability and endurance, landowner restrictions, and the quality of the outdoor environment.

Most of the roads in the Fremont National Forest are not plowed in winter (Woodward, pers. comm., 10 March 1988), making the network of hiking trails, jeep trails and logging roads available for cross-country skiing.

TABLE 10.5-1 Continued.

SRKS-P-29: Very small lithic scatter; about 25 flakes, one core collected.

SRKS-P-31: Very small lithic scatter, about 25 flakes.

SRKS-P-33: Very small lithic scatter, about 30-50 flakes.

SRKS-P-34: Very small lithic scatter, about 30-50 flakes, one point, one tip, one uniface collected.

SRKS-P-35: Very small lithic scatter about 30-50 flakes.

SRKS-P-36: Very small lithic scatter, about 40 flakes.

land immediately east of Hart Lake and following the western refuge boundary south to the southern refuge boundary permits upland and migratory game bird hunting (U.S. Fish & Wildlife, [n.d.]).

Lake County reports an annual mule deer harvest of over 10,000, the largest mule deer harvest in the state. More than 35,000 water fowl are harvested annually. Game fowl includes dove, quail, sage hens, pheasants, ducks and geese (Lake County Chamber of Commerce, [n.d.]b).

Klamath County reports excellent waterfowl hunting, especially ducks and geese, at Klamath Marsh. Antelope, deer and other game is also found (Klamath County Visitors & Convention Bureau, [n.d.]).

Modoc County is a popular deer hunting area, and usually has one of California's highest annual deer kills. The largest antelope herd in the state is in this area. The national wildlife refuge near Alturas provides excellent duck and goose hunting on a no-fee, first come, first served basis, on 1,440 of the refuge's total 6,000 acres (Lake County Chamber of Commerce, [n.d.]c).

Table 12.3-4 presents hunting license statistics for Klamath and Lake counties, using data at the county level from a 1981 survey to estimate license sales by county in other years. In 1981, Klamath County had 271.48 hunting license sales per 1000 population while Lake county had 382.90, which compares with 136.79 in the state as a whole.

Deer rifle hunting appears to be good in the area immediately surrounding Quartz Mountain. The project study area is located in the center of the Interstate hunt unit (75). In that unit in 1986, 3,118 rifle hunters harvested 1,123 deer averaging 14 days per animal, which compares with a state average of 21 days per animal, as shown in Table 12.3-5.

Other hunt areas in the area of concern for potential indirect impacts ranged from 8 to 21 days per animal. Bow hunters were more variable, ranging from no animals in 76 days of hunting in the Juniper unit to 10 days per animal in the Sprague unit, which compares with a state average of 41 days per animal. In the area of concern, only the Klamath Falls unit had elk rifle season hunters, with no animals taken. The elk bow season brought a few hunters to the Interstate, Klamath Falls, and Silver Lake units, but only in the Silver Lake unit was there a harvest. Antelopes were hunted in the Interstate, Silver Lake, Wagontire, Juniper, Beatys Butte, and Warner units, with 329 hunters averaging 4 days per animal in the Beatys Butte unit.

TABLE 10.5-1

PREHISTORIC SITES (NEWLY RECORDED)

SRKS-P-1: Small lithic scatter of about 50 flakes, mainly secondary flakes, one projectile point.

SRKS-P-2: Projectile point/preform cache of four points, five preforms, and a few secondary and primary flakes.

SRKS-P-3: Small lithic scatter of about 100 flakes, with some basalt debitage, mainly secondary flakes.

SRKS-P-4: Small lithic scatter of about 50 secondary flakes.

SRKS-P-5: Small lithic scatter of about 50 secondary and a few primary flakes; two tools (one biface, one uniface) collected.

SRKS-P-6: Lithic scatter, about 40 m diameter, with a maximum density of 5 flakes/sq m; mostly secondary flakes; three tools collected (Elko point, two point fragments).

SRKS-P-7: Large, dispersed lithic scatter covering 50-60 acres. Several areas of artifact concentration were noted throughout site; some cryptocrystalline debitage noted; seventeen tools, including projectile points, collected.

SRKS-P-8: Small lithic scatter of about 100 flakes, mostly secondary, some primary.

SRKS-P-9: Lithic scatter, about 40 x 80 m, maximum density 12 flakes/sq m; mainly secondary flakes, three tools collected.

SRKS-P-10: Lithic scatter, about 40 x 40 m, average density 2-3 flakes/sq m; mainly secondary flakes; six tools collected.

SRKS-P-11: Lithic scatter, about 100 m across, maximum density 5-7 flakes/sq m; mainly interior flakes, two bifaces collected.

SRKS-P-12: Small lithic scatter of about 100 flakes, mainly secondary, a few primary; two biface fragments collected.

SRKS-P-13: Small lithic scatter of about 50-100 secondary flakes, two bifaces, one projectile point.

Table 12.3-5. Hunter success and recreation days, 1986.

Hunting Season/Animal	Interstate 75	Klamath Falls 32	Sprague 33	Silver Lake 76	Wagontire 73	Juniper 71	Beatys Butte 70	Warner 74	State Total
	Wildlife Management Units								
Deer Rifle Season									
Hunters	3,118	4,666	1,086	4,494	957	319	483	2,236	238,616
Total Harvest	1,123	1,563	262	1,657	403	148	416	1,007	81,286
Total Hunter Days	16,160	20,783	5,495	26,851	4,140	2,056	3,290	9,847	1,724,517
Days/Animal	14	13	21	16	10	14	8	10	21
Deer Bow Season									
Hunters	52	143	13	162	0	19	32	156	15,369
Total Harvest	14	72	7	18	0	0	6	79	3,431
Total Hunter Days	748	1,183	72	1,069	0	76	211	1,560	140,280
Days/Animal	53	16	10	59	NA	NA	35	20	41
Elk Rifle Season									
Hunters	NA	12	*	NA	NA	NA	NA	NA	124,557
Total Harvest	NA	0	*	NA	NA	NA	NA	NA	15,662
Total Hunter Days	NA	24	*	NA	NA	NA	NA	NA	702,101
Days/Animal	NA	NA	*	NA	NA	NA	NA	NA	45
Elk Bow Season									
Hunters	10	20	0	10	NA	NA	NA	0	14,106
Total Harvest	0	0	0	10	NA	NA	NA	0	1,415
Total Hunter Days	70	140	0	100	NA	NA	NA	0	133,605
Days/Animal	NA	NA	NA	10	NA	NA	NA	NA	94
Antelope Harvest									
Hunters	50	NA	NA	30	58	48	329	78	1,830
Total Harvest	32	NA	NA	14	22	25	191	42	905
Total Hunter Days	144	NA	NA	114	225	162	859	318	6,385
Days/Animal	5	NA	NA	8	10	6	4	8	7

Source: Oregon Department of Fish & Wildlife, Wildlife Division. 1987 Big Game Statistics.

Notes: * = Included in Klamath Falls figures; combined area.
Antelope areas may differ from deer and elk areas: Interstate = East Interstate (475A); Silver Lake = East Fort Rock-Silver Lake (476A); Wagontire = South Wagontire (473A); Beatys Butte = East Beatys Butte (470A)+West Beatys Butte (470B) + Hart Mtn Refuge (470C).

originally designated as high sensitivity, were in fact too dry to be considered high probability areas. In general, transect spacing was determined on the basis of the overall sensitivity of the management unit or sub-unit. If small areas of high sensitivity occurred within a large parcel designated as medium sensitivity, that area was given closer scrutiny in the course of individual transects. All of Units 3 and 6, and most of Units 2 and 7, were located in areas with a large portion of high sensitivity areas; these units were surveyed almost entirely in transects spaced 10-20 meters apart.

Refuge; native cutthroat and redband trout, rainbow trout), Honey Creek, Twentymile Creek, Deep Creek and Camas Creek (heavily used; native trout), and Blue Creek and Drake Creek (rainbow trout) (Collison 1987b).

South of Bly, Gerber Reservoir offers developed facilities as well as fishing. East of Dog Lake, Willow Valley Reservoir yields bass and catfish. Goose Lake, south and west of Lakeview, supports a type of redband trout in spite of its salt content. Fishing is restricted to summer in several streams west of Lakeview to protect redband trout populations. These include Thomas, Cox, Bauers, Augur, Drews and Cottonwood Creeks (Collison 1987b).

Klamath County offers more than 100 lakes and streams. Upper Klamath Lake provides some of the largest trout in the state. Unlike most lakes in the area of concern, the northern portion of Upper Klamath Lake is not open year-round. The Williamson River and Wood River flow into Upper Klamath Lake. The Williamson is noted for sizable rainbow and brook trout, and warmwater fish in the lower portion, which mostly flows through private land. Most access to the Williamson is in the Winema National Forest. The Wood River is one of the state's most highly regarded fly-fishing streams ([Oregon Economic Development Department, Tourism Division], n.d., Oregon Regional Fishing Areas). The Sprague River offers large brown trout (Collison 1987b).

Modoc County offers 255 miles of trout streams and 4,000 acres of lakes and reservoirs ([Lake County Chamber of Commerce], [n.d.]c). Lily Lake and Cave Lake offer developed facilities (Collison 1987b).

Resident angler licenses sales per 1000 population area similar for Klamath and Lake counties and the state as a whole (Table 12.3-6). Nonresident and 10-day angler licenses in Klamath County make up 4.6 percent and 6.4 percent, respectively, of the state's sales in these categories, and in both counties, nonresident and 10-day sales per 1000population area much higher than in the state as a whole.

The only game fish reported in the 1977 angler survey were trout and warmwater fish. These figures are shown in Table 12.3-7. No survey has been undertaken since that time. Area 34 roughly corresponds to Klamath County, and Area 52 to Lake County. Area 52 appears to be a major warmwater fishery in terms of angler days, with 12.6 percent of the state's angler days for warmwater fish, but not in terms of catch.

previous survey work has been site specific, e.g., covering proposed routes or drill pads, rather than constituting an area-wide, intensive survey. These previous surveys cover only a small percentage of the total area requiring evaluation, and occur in a scattered fashion throughout the project area. Given the scope of the proposed project, it was felt to be more prudent and cost effective to include the entire project area in an intensive pedestrian survey, excepting only those areas previously surveyed by Winthrop Associates in earlier project-related work.

10.4.3 Survey Intensity

All archaeological survey involves sampling: first, because subsurface sites are imperfectly represented by surface materials; and second, because for any large study (such as the present project) it is financially impractical to provide visual coverage through pedestrian survey of every square foot of ground. Accordingly, it is essential to prepare a sampling strategy for the survey, to direct more intense fieldwork to areas of higher probability, a type of predictive modeling (ACHP 1986).

The data available before performing this survey suggested that prehistoric sites would most likely be located in lower elevation areas, near water courses, and on lands that are flat or of moderate slope. Historic sites, are also likely to occur in these areas, but -- particularly in the case of mining or logging activities -- may also occur in areas of higher elevation and steep terrain. Thus, it is reasonable to assume that these will be a higher possibility of finding sites in areas of lower elevation and moderate slope. These areas therefore received greater attention in the field survey.

The Fremont Forest's standards for cultural resource surveys involve three probability classes. High probability (e.g., areas near water, ridges, saddles, meadows) are to be surveyed in transects of no more than 20 meters. Medium probability areas (e.g., rock outcrops, moderately steep slopes) are surveyed in transects of 20 - 100 meters. In low probability areas (e.g., high elevations, steep dissected ridges and sideslopes) 20 percent of the area is to be surveyed (Kaiser 1984). Given the nature of the proposed ground-disturbing activities, these survey standards were judged not to be sufficiently intensive. Of particular concern was the fact that historic remains could occur anywhere within the project area, and the inclusion of a "low" probability category did not allow sufficient sampling of those areas. Consequently, the Forest's "low" probability areas were included within the "medium" classification. In addition,

Table 12.3-7. Angler days and catch, 1977: Areas 34 and 52.

	Angler Days				Catch			
	Area 34 Totals 1977	Area 52 Totals 1977	State Totals 1977	+ or - Confidence Interval, State	Area 34 Totals 1977	Area 52 Totals 1977	State Totals 1977	+ or - Confidence Interval, State
GAME FISH								
Trout	138,440	14,777	2,628,309	220,844	254,507	10,598	8,677,781	794,642
Warmwater fish	20,736	6[illegible],888	540,211	76,065	153,458	5,221	4,529,783	1,166,686
Total	159,176	82,665	3,168,520	296,909	407,965	15,819	13,207,564	1,961,328
PERCENT OF STATE TOTAL								
Trout	5.3%	0.6%	100.0%	8.4%	2.9%	0.1%	100.0%	9.2%
Warmwater fish	3.8%	12.6%	100.0%	14.1%	3.4%	0.1%	100.0%	25.8%
Total	5.0%	2.6%	100.0%	9.4%	3.1%	0.1%	100.0%	14.9%

Source: Berry, Richard, Memorandum of 19 December 1977; Lowry, Helen M, Report of the 1977 Oregon Angler Survey, Federal Aid ProjectF-83-R-4, Corvallis, Oregon: Oregon State University, 1978.

Notes: Only a small sample of license holders were actually sampled.

company operating under the umbrella of Southern Pacific) for public use, after logging operations were completed at Quartz Mountain (Tonsfeldt 1987b). The company built railroad grades throughout the Quartz Mountain area to access the timber.

The company established a family camp known today as Ewauna Camp, in the saddle between Quartz Mountain and Quartz Butte, which provided housing for the families of those men who worked seasonally on the logging operations (there was no logging in the winters). Many families lived at the camp in "mobile homes" that were brought in by rail, and there was a school. The camp was in operation from 1929 to 1936, after which time the company moved its operations elsewhere.

There are numerous remains of the camp and the railroad logging operations throughout the project area. These remains represent aspects of a rural industrial pattern and of Depression-era life which are significant aspects of this region's history.

10.3.3.3 Mining

Mining and prospecting for gold and cinnabar has occurred for at least the last fifty years in the Quartz Valley area. In 1936-40, prospectors looked for mercury ore by digging shallow pits and trenches. In 1949, small amounts of gold were presumably recovered from two, eighty-foot shafts on Crone Hill and Quartz Butte; the shafts have since caved in. A nationwide mercury "boom" between 1957-59 led to dozens of claims in the area, with production mainly coming from Angel Peak Mine. A mercury retort, built during this period, is located in the project area. Serious exploration for gold in the area began in 1980; in 1982, the Anaconda Mining Company became involved. In 1985, Wavecrest consolidated holdings in the project area and embarked on the aggressive exploration program which has led to the present project (Rohtert et al. 1987).

10.3.3.4 Other Historic Sites

During the 1930s the Klamath Forest Protective Association, a group of private landowners organized to protect private lands, operated a lookout on top of Quartz Butte (Bennett, pers. comm., 14 August 1987). Dendroglyphs (carvings on trees) occur on aspen trees in the vicinity of the project area, and are often associated with early ranching or herding. Recreation, particularly hunting, has also been an important activity in the project area. Remains of the lookout, historic dendroglyphs, and hunting camps may occur in the project area, but have not yet been clearly identified.

to be licensed, but must have spark arresters. Snowmobiles are allowed on existing roads (Oregon, 1983, SCORP, 144).

The BLM allows ORV use in any areas designated as open; BLM Wilderness is closed (Oregon, 1983, SCORP, 144).

period of use, beginning about 5,000 B.P. (Aikens and Minor 1978), which showed an early adaptation to aquatic resources; many fish, bird, and mussel shells, for example, were contained in the midden. Cressman's study also indicated the possibility of cultural change, from a relatively casual use of aquatic foods in the early level to a more intensive exploitation of the lake and riverine resources in later periods.

Hughes (1986) synthesizes research on obsidian procurement patterns at two Klamath Basin sites, Nightfire Island and Kawumkan Springs, and at Surprise Valley, southeast of Quartz Mountain. According to Hughes (1986), projectile point styles in this area can be assigned a chronology, providing time markers for comparison of these archaeological sites. By combining stylistic dating with trace element identification of obsidian sources, change over time in the distance and direction of obsidian procurement can be determined. A shift in obsidian procurement patterns appears to have occurred about the time that the atlatl is superseded by the bow and arrow (e.g., as indicated by the shift from Elko to smaller Gunther and Rosegate series points), about 1700 B.P. (Hughes 1986).

During the time period indicated by Elko series points (3300 - 1700 B.P), obsidian sources relatively distant from these sites were utilized more frequently; before and after this period, obsidian sources nearer the archaeological sites were more heavily used (Hughes 1986). Furthermore, the direction of obsidian sources also changed. At Nightfire Island a redirection of obsidian procurement toward the northeast took place during the Elko period (Hughes 1986), while in the same period at Kawumkan Springs more distant sources to the east and southeast were used. According to Hughes, such shifts in obsidian procurement probably reflected changes in subsistence patterns, and possibly changes in exchange and social organization as well (Hughes 1986). At Nightfire Island the Elko/Gunther series transition coincides with a relatively high incidence of burials exhibiting death by violence (Hughes 1986).

The Drews Creek/Butcher Flat source near Quartz Mountain is one of the distant sources represented at both Klamath Basin sites. Although never a major source (absolute numbers of points from this source are small), use of the Drews Creek/ Butcher Flat obsidian appears to be part of a wider procurement pattern in the Elko point period. This source is also represented among the projectile point types preceding the Elko series (Humboldt, Gatecliff and Northern Side-notched series points) at the Klamath Basin sites, dating to about 5,000 B.P. Aboriginal use of the Quartz Valley area is therefore of considerable antiquity.

12.5 PUBLIC AND AGENCY CONTACTS

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U.S. Forest Service, Region 6
Bly, OR

thrown darts, appear about 8000 years ago and lasted until the introduction of small points associated with the bow and arrow, after 2000 B.P. Cascade, Northern Side-Notched, and Elko-eared points are characteristic of the middle range points; the Rose Spring and Eastgate patterns are characteristic of small point styles (Hughes 1986). In the Northern Great Basin the Archaic tradition persisted until its destruction by historic (Euro-American) cultures in the last century.

During the Pleistocene, the landscape of much of the northern Great Basin was characterized by vast pluvial lakes. Fort Rock and Christmas Valleys, Summer Lake, Abert Lake, and Goose Lake are all sites of Pleistocene lakes now either entirely vanished, or greatly reduced in size (Aikens 1982). The Fort Rock Valley, some 75 miles north of Quartz Mountain, contains several early occupation sites: there are well established radiocarbon dates of 11,950 B.P. for Cougar Mountain Cave, and 11,200 B.P. for Connley Caves. The Paisley Five-Mile Point Caves overlooking Summer Lake, 30 miles north of Quartz Mountain, contains stone tools buried beneath Mt. Mazama ash, i.e., earlier than 7000 B.P. Many sites have been recorded on the eastern shore of Lake Abert, 35 miles northeast of Quartz Mountain. This includes numerous village sites (with several hundred housepits), and many petroglyphs. This array of sites appears to date between 4500 and 500 B.P. (Aikens 1984).

In the Warner Valley, some 45 miles east of Quartz Mountain, archaeological surveys have identified numerous settlements, dated on the basis of diagnostic artifacts to a long chronology beginning about 7000 B.P. Recent research suggests a shifting sequence of activity patterns for the valley. In this view, settlement was concentrated in upland areas from perhaps 7000 to 3500 B.P., with greater use of the valley floor in a second period, from perhaps 3500 to 1500 B.P., and increasing use of upland at the expense of valley sites from 1500 B.P. to the historic period (Minor et al. 1979). This shift in occupation patterns over time has been explained largely in terms of adaptation to changing temperature and moisture regimes in the region: a warmer Altithermal (7000 - 4500 B.P.) giving way to the cooler Medithermal (4500 B.P. to present) (O'Connell and Madsen 1982). However, cultural factors may also be involved. The suggestion has been made that lifeways in the Warner Valley in this middle period would have been similar to that of the proto-historic Klamath. The shift in settlement that appears to have occurred between the middle and late periods could reflect the withdrawal of lake-oriented peoples (possibly the ancestors of the Klamath and Modoc) as a result of environmental change, and their succession by the widerranging Paiute (Minor et al. 1979).

Lake County Chamber of Commerce. [n.d.]a. Easy day trips from Lakeview.

Lake County Chamber of Commerce. [n.d.]b. Oregon: Natural wonders abound in Lake County.

Lake County Chamber of Commerce. [n.d.]c. Recreation: Modoc County.

Lilienthal, C. Winema National Forest, U.S. Forest Service, Klamath Falls, Oregon, personal communications. Phone call to Elaine Taylor on 10 February 1988.

Modoc County Chamber of Commerce. n.d. Modoc County California: "Where the west still lives." Pamphlet.

Mitchell, D. 1988. Oregon Department of Transportation, Salem, Oregon, personal communications. Phone call to Elaine Taylor on 11 March 1988.

Oregon Department of Fish and Wildlife. [n.d.]a. Fishing and hunting license sales statistics, 1981 through 1986.

Oregon Department of Fish and Wildlife, Wildlife Division. [n.d.]b. 1987 Big game statistics.

Oregon Department of Fish and Wildlife, Wildlife Division. 1981. Map, Oregon wildlife management units.

Oregon Department of Transportation, Highway Division. n.d. Oregon: Historic and Scenic Highway Program.

Oregon Department of Transportation, Parks and Recreation Division. 1985. Day use parks & recreation areas, July 1, 1984 - June 30, 1985.

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Oregon Department of Economic Development, Tourism Division. n.d. Oregon Regional Fishing Areas.

Oregon Economic Development Department, Tourism Division, n.d. Oregon: The official Oregon state travel guide.

Oregon State Marine Board. n.d. A Guide to Oregon Boating Facilities. 32pp.

Oregon [State Parks and Recreation Division] 1983. Oregon outdoor recreation: SCORP '83. Salem, OR.

shifting, winter locations were fixed, and politically meaningful (Spier 1930).

At the time of contact with Euro-Americans and prior to the establishment of the reservation in the 1860s, the Klamath inhabited the Klamath Basin, with major settlements around Upper Klamath Lake and Klamath Marsh, and along the Williamson River and its tributaries (Silvermoon and Kaiser 1985). Stern (1966) describes six political groupings ("tribelets"), defined geographically, within the cultural unity of the Klamath tribe. The group closest to the Quartz Mountain project area would have been the upper Klamath of the Sprague River Valley, whose winter villages were near the confluence of the Sprague and Sycan Rivers.

10.3.1.2 The Northern Paiute

In contrast to the Klamath/Modoc of the Plateau, the Northern Paiute form part of the Great Basin culture area, a region extending from the eastern portions of California and Oregon through Nevada, Idaho, Utah, and western Wyoming. The Northern Paiutes (earlier known as Snakes, Paviotso, or simply Paiutes) occupied a broad band within the western Great Basin, including areas of eastern Oregon, eastern California, and western Nevada. Much of this area can be characterized as a sagebrush-juniper semidesert (Kroeber 1939). Hunting, gathering and, in certain areas, fishing provided the basis for subsistence throughout the aboriginal Great Basin. Technology was simple, the environment harsh, and population densities very low. In general, a scarcity of resources was counterbalanced by an extremely sophisticated utilization of the environment. The diet typically included a broad range of seeds, grasses, roots, insects, and small game (Steward 1938). The Great Basin pattern thus contrasts with that of the Plateau in terms of its arid environment, low population densities, and relatively simple social organization.

The food quest for the Northern Paiutes was complex, involving many microenvironments, and major shifts in elevation between mountains, foothills, and valleys. Economic and social life was organized primarily through small groups. As Whiting (1950) has noted regarding the Harney Valley (Oregon) Paiute, few economic activities required a group larger than an extended family.

The Northern Paiute's hunting and gathering subsistence pattern allowed aggregation primarily in the winter, when three to ten families (in the case of Harney Valley) would share a camp located near reliable sources of water. Often but not invariably the households were linked by close kin ties (Whiting 1950). During the spring, summer, and fall, they dispersed into small family groups, searching the stream

12.7 LIST OF PRINCIPAL PREPARERS

12.7.1 George F. Blankenship

Mr. Blankenship is a principal and founder of Planning Information Corporation and is responsible for project management, local government liaison, socioeconomic analyses for impact assessments.

Mr. Blankenship received his Master of Urban and Regional Planning from the University of Colorado in 1980, after completing undergraduate degrees in both social work (Colorado State University, 1978) and anthropology (University of Nebraska, 1970).

In 1979 he joined Briscoe, Maphis, Murray and Lamont, Inc., a growth management consulting firm in Boulder, Colorado, where he performed socioeconomic analysis and growth management and planning services for energy, mining, and defense projects in Colorado, Nevada, Montana, and Wyoming. In 1982 he joined Denver Research Group, where he assumed the position of Coordinator for the Overthrust Industrial Association (OIA), a voluntary organization formed to help local governments accommodate industry-related growth in a five-county region of Wyoming, Utah, and Idaho. As Director of Community Development at Denver Research Group, he coordinated five Wyoming Industrial Siting Administration (WISA) applications and served as principal witness at the WISA hearings. Since the founding of Planning Information Corporation, he has served as project administrator, coordinated socioeconomic analyses, and been responsible for preparing mitigation plans and strategies for mining, energy, and nuclear waste projects in several western states.

12.7.2 Elaine A. Taylor

Ms. Taylor is a planner who has worked in environmental planning and engineering for nearly ten years. Her contributions at Planning Information Corporation (PIC) have included writing sections on Housing and land use, labor force and income, and employment and local economy for the Yucca Mountain Socioeconomic Study; preparing the recreation resource analysis and socioeconomic analysis for the five project sites in the Amoco Wyoming CO2 Projects Environmental Impact Statement; and writing or editing major sections of the Amoco Elk Basin Project Plan of Development. Her experience at other firms has included participation in several major environmental planning projects (URS Company, (1979-85), including a study of the ability of municipalities to finance wastewater construction projects.

group with distinctive traits, beliefs and social forms" (BGRS 1984). While prehistoric or historic archaeological sites listed on the National Register of Historic Places (36 CFR 800) would clearly be protected, "other sites determined to be significant by the local jurisdiction" fall within the intent of Goal 5 as well (BGRS 1984). Lake County has prepared a set of comprehensive plan policies implementing LCDC Goal 5.

10.2.3 Native American Consultation

The Quartz Mountain project area includes both Forest Service and private lands. Consequently both federal and state regulations governing Native American consultation procedures and protections for prehistoric sites are potentially applicable.

Federal land management policy (e.g., 43 CFR 7.7) requires consultation with American Indian groups in cases where a proposed project may cause harm to sites of cultural or religious importance to Native Americans. The Klamath Tribe (Chiloquin, Oregon), including among its members people of Klamath, Modoc, and Paiute descent, is the Native American group most obviously affected, and the Klamath tribal chairman, Mr. Chuck Kimbol, has been kept informed of the progress of research. Mr. Kimbol has requested that he be kept informed of any mitigation plans proposed for Native American sites in the project area, so that the Tribe can offer comments (Kimbol, pers. comm., 28 September 1987). In addition to the Klamath Tribe, the Fort Bidwell Indian Community Council (Fort Bidwell, California), the Burns Paiute Tribe (Burns, Oregon), and the Oregon Commission on Indian Services have been notified of the project, and their comments have been requested.

The importance of protecting Native American sacred sites on federal lands has been emphasized by the American Indian Religious Freedom Act (42 USC 1996), and by case-law resulting from litigation brought under that act, e.g., Northwest Indian Protective Association v. Peterson (565 F. Supp. 586,591 [N.D. Cal. 1983; 9th Cir. 1985]).

Sites of burials or cremations are matters of considerable sensitivity for Native American groups. Such sites are protected as archaeological materials under federal law (16 USC 470 (bb)(1); 43 CFR 7.3 (a)(3)). Native American burials or cremations on private lands in Oregon are subject to strong protections under state law (ORS 97.740-760). Oregon law also governs the excavation of other archaeological sites (i.e., without human remains) on private lands (ORS 358.905-955). No evidence of any Native American burials or cremations on the project area has been detected.

APPENDIX 12.A

RECREATION OPPORTUNITY SPECTRUM CLASSES

2. Section 1, Township 38 South, Range 16 East, Mount Diablo Base and Meridian;

3. Sections 30, 31, and the western half of Sections 29 and 32, Township 37 South, Range 17 East, Mount Diablo Base and Meridian; and

4. Section 6 and the western half of Section 5, Township 38 South, Range 17 East, Mount Diablo Base and Meridian.

- Some obvious on-site control of users.

- Access and travel is conventional motorized, including sedan and trailers. RV's and some motor homes.

- Vegetative alterations done to maintain desired visual and recreation characteristics.

<u>Roaded Modified</u>

- Opportunity to get away from other but with easy access. Some selfreliance in building own camp site and use of motorized equipment. Feeling of independence and freedom. Little challenge and risk.

- Substantially modified natural environment except for campsites. Roads, landings, slash, and debris may be strongly dominant from within yet remain subordinate from distant sensitive roads and highways.

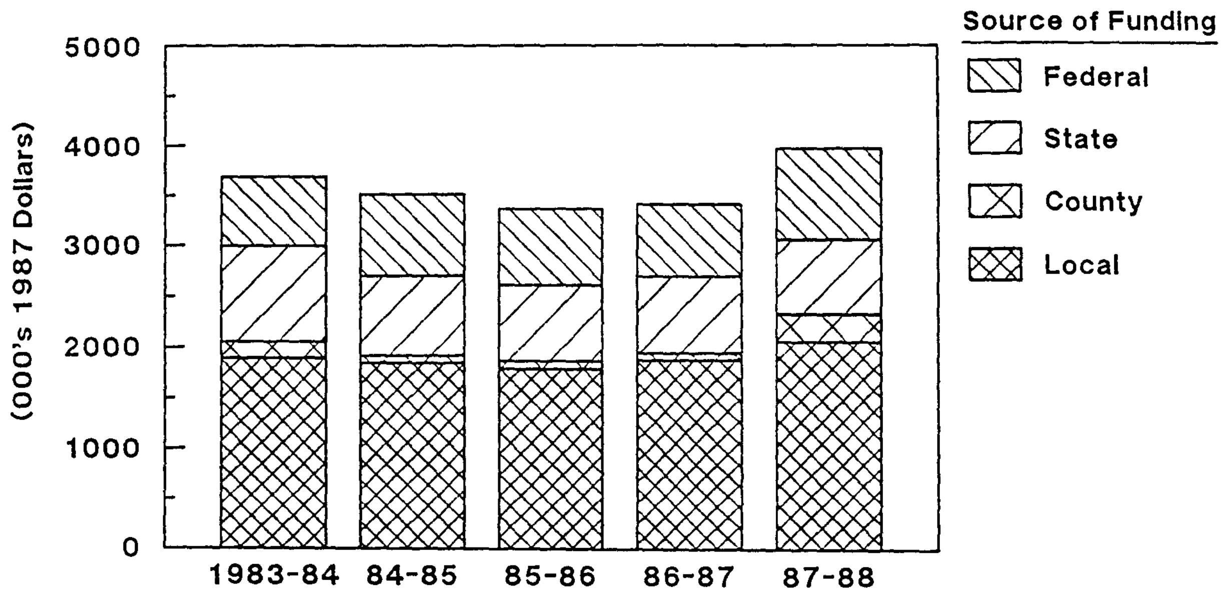
- Moderate evidence of other users on roads. Little evidence of others or interaction at camp sites.

- Little on-site controls of users except for some gated roads.

- Conventional motorized access, including sedan and trailers. RV's, ORV's and motor bikes.

- Shape and blend vegetative alternations. Maintain campsites and immediate foregrounds to site in natural appearing state.

Figure 11.4-7
Lakeview School District #7, Oregon
General Fund Revenues



Source: Lakeview School District #7;
Planning Information Corporation, January 1988.

13.0 VISUAL RESOURCES

LIST OF TABLES

TECHNICAL REPORT NO. 13

VISUAL RESOURCES

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

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USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

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Revised December 1988

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FOREWORD

This report was prepared by Design Workshop, Inc. and Steffen Robertson and Kirsten (Colorado) Inc. for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
J.A. Porter	Principal in Charge	SRK
C.A. Adams	Project Manager	SRK
D.A. Seely	Simulation Specialist	SRK
L.M. Takeuchi	Project Landscape Architect	SRK

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SUMMARY

The Quartz Mountain Gold project area is located in south-central Oregon, in the Basin and Range physiographic province. The landscape is typified by forested, volcanic landforms such as buttes and lava domes with northwest trending valleys or drainages between the landforms.

The methods used to evaluate the baseline conditions of the Quartz Mountain project site are described in detail in the report and included a combination of the United States Forest Service's Visual Management System and computer simulation technology. Previous visual analysis mapping by the Forest Service for the Bly Ranger District of the Fremont National Forest was consulted and modified as needed to reflect a more detailed level of mapping appropriate for project scale analysis. The current Draft Environmental Impact Statement for the Proposed Land and Resources Management Plan was also consulted to identify Forest Service visual concerns for the area.

Visual Quality Objectives were identified for the site, and Visual Absorption Capability was mapped based on a number of landform and vegetation characteristics. These were then combined to identify areas on the site that could provide visual opportunities or constraints for development. These areas are shown both in map form and overlaid onto site photographs to indicate how these zones fit on the landscape.

There are several visually sensitive areas on the site due to either the scenic quality of the area, the number and/or types of viewers, and the ability of the area to absorb visual change. These sensitive areas are located primarily along Drews Creek and State Highway (SH) 140. Areas that provide opportunity for development occur primarily to the north and east of Quartz Butte. These areas have low visual sensitivity and high ability to absorb change.

Ms. Riley's experience includes air emissions evaluation including criteria pollutants and toxics, dispersion modeling, and meteorological and air quality monitoring. She is familiar with federal regulations governing ambient air quality and plant performance standards. Ms. Riley has also been responsible for the environmental aspects of process plant design for numerous engineering projects. Of particular significance: the recent impact analysis and permitting of another heap leach and refining project in Nevada.

13.0 VISUAL RESOURCES

13.1 INTRODUCTION

This section of the baseline report describes investigations of the visual resources of the Quartz Mountain Gold Project study area shown in Figure 1.1-1.

13.1.1 Objectives

The objectives of the baseline portion of the visual resources studies are to describe and assess the existing visual character of the landscape of the Quartz Mountain project area and the ability of the landscape to absorb change. This assessment resulted in the identification of opportunities and constraints for the visual resources of the project area and a basis upon which impacts of the proposed project can be assessed and mitigation measures recommended. This was accomplished using a combination of the U.S. Department of Agriculture Forest Service (USFS) Visual Management System (VMS) and computer simulation technology.

13.1.2 Study Area

The visual resources study area includes the entire Quartz Mountain Gold project area (approximately 7000 acres) shown in Figure 13.1-1. This project area was evaluated within a larger context area of approximately 270 square miles that includes Fishhole Mountain to the south, portions of the Gearhart Wilderness Area to the north, and several miles to the east and west of the project area. In order to assess the visual resources of the project site and the ability of that site to absorb change, the site has been evaluated in relationship to the visual character of the immediate region, and the areas in that region where people will likely view the project.

PUMICE - Frothy, volcanic glass; an excessively cellular, light-colored, volcanic ejecta.

PUMICEOUS - Containing pumice properties. Pumiceous volcanic ash is pumice material that is less than 4 mm in diameter.

PYROCLASTIC - A general term applied to rocks formed form volcanic material that has been explosively or aerially ejected from a volcanic vent.

RHYOLITE - A light-colored, fine-grained, acidic, extrusive rock.

RESIDUUM - Soil material formed from rock weathering in place.

RAVEL - The movement of individual particles down a slope by gravitational force.

RUNOFF - That part of the precipitation which appears in surface streams of either perennial or intermittent form.

SAND - A soil separate between .05 and 2.0 millimeters in diameter.

SEDIMENTARY ROCK - Rock formed by deposition of soil and rock particles by water, ice, or wind that later solidifies through cementation, ionic exchange or compression.

SHIELD VOLCANO - A volcanic dome with gentle slopes built up by repeated eruptions of basaltic lava.

SILT - A soil separate consisting of particles between 0.002 and 0.05 millimeters in diameter.

SLOPE CLASSES - Terms to indicate relative range of slope gradients.

A (0 to 15%) -- Gentle
B (16 to 40%) -- Moderately Steep
C (> 40%) -- Steep

SLUMP - A deep-seated, slow-moving, rotational failure occurring in plastic materials, resulting in vertical and lateral displacement.

SOIL - The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. The unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental

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TOESLOPE - That portion of a slope that is transitional between the valley floor and the upper slope.

TUFF - A rock formed of compacted volcanic fragments, generally smaller than 4 mm in diameter.

UNIFIED SOIL CLASSIFICATION SYSTEM (ENGINEERING) - A classification system based on the identification of soils according to their particle size, gradation, plasticity index, and liquid limit. (See Appendix 3.E).

VESICULAR CRUST - A dense, structureless, and highly porous surface soil layer from 2 to 4 inches thick and usually associated with arid or semiarid rangelands.

VOLCANIC EJECTA - Any and all material forcibly blown out of volcanic cones, fissures, and vents.

WELDED TUFF - A tuff that has been indurated (hardened) by the combined action of the heat retained by the particles and the enveloping hot gases.

PM10 - see particulate less than 10 um

SIGMA THETA - a measure of wind direction variation, calculated as the standard deviation of horizontal wind direction fluctuation. Used to determine atmospheric stability for dispersion modeling purposes.

SOLID STATE STORAGE DEVICE - a piece of equipment which employs semiconductors to store digital data.

STABILITY CLASSIFICATIONS - a standard method of classifying atmospheric stability using six categories, A through F, with A being the most unstable and F being the most stable.

TOTAL SUSPENDED PARTICULATE - a measure of the concentration of particulate matter suspended in the atmosphere. Usually given in the units of micrograms per standard cubic meter (ug/m^3).

TSP - see Total Suspended Particulate

ug - see microgram

um - see micrometer

13.2 LITERATURE REVIEW

Several studies prepared by the Forest Service were consulted in preparing this baseline study. Several Forest Service publications and related literature outline their Visual Management System (USFS 1974 and Coates 1980 and Smardon 1986) and detail the process for determining Visual Quality Objectives and Visual Absorption Capability. The Visual Management System is described later in this report.

Other sources consulted relate specifically to the Fremont National Forest. These include the Visual Quality Objectives Map for the Bly Ranger District (ca. 1981), the Visual Absorption Capability Map for the Bly Ranger District (ca. 1981), and the Draft Environmental Impact Statement and Proposed Land and Resources Plan (USFS 1987) that establishes management objectives for the Forest for the next ten years.

The Bly Ranger District VQO Map, explained thoroughly later in this report, represents the most detailed mapping of Forest Visual Objectives for the Quartz Mountain project site and will provide a basis for evaluating impacts of project alternatives in the analysis phase. The Draft Land and Resources Plan contains goals and recommendations for managing scenic travel corridors under alternative forest management schemes, particularly for the Forest Service's preferred management plan, are documented in this study as they relate to the Quartz Mountain Gold Project. They are policy level visual quality objectives for scenic travel corridors (Management Area 6) and as such, are general in nature.

The Bly Ranger District VAC Map has been updated in this study for the Quartz Mountain site based on current site specific studies relating to vegetation, soils,and slope for the specific project site.

3.9 REFERENCES CITED

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9.3.2.1 Total Suspended Particulates

TSP samples collected during the period November 1987 - October 1988 are presented in Table 9.3-1. The arithmetic mean TSP concentration for the period was 20.1 ug/m^3, with a maximum of 85 ug/m^3. The second highest reading was 60 ug/m^3, significantly lower than the maximum. The maximum particulate value occurred simultaneously with substantial dirt moving activity on Crone Hill. Geometric mean concentration was 12.6 ug/m^3.

9.3.2.2 Particulates Less Than 10 Micrometers

PM10 data collected during the period November 1987 - October 1988 are presented in Table 9.3-2. The arithmetic mean PM10 concentration for the period was 11.5 ug/m^3, with a maximum of 86 ug/m^3. The second highest value was 42 ug/m^3 and the third was 36 ug/m^3. Geometric mean concentration was 7.3 ug/m^3. The maximum PM10 concentration of 86 ug/m^3 occurred on September 4, a day when several forest fires were reported in the area. No TSP data was collected on this day, and this PM10 reading is greater than the maximum value for TSP. The value of 42 ug/m^3 was collected on July 20, which is also the day when the greatest TSP value was collected. On the average, the PM10 concentrations are approximately 50 percent as high as the TSP concentrations.

Figure 13.3-1 Typical View from Highway 140

APPENDIX 3.A

SOIL PARTICLE SIZE ANALYSIS

TABLE 9.3-1
TOTAL SUSPENDED PARTICULATE CONCENTRATIONS
QUARTZ MOUNTAIN GOLD PROJECT - QUARTZ MOUNTAIN, OREGON
(µg/m3)

	1987		1988									
Day	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	-	-	-	-	-	-	-	-	-	28	-	-
2	-	-	-	-	-	-	-	8	28	-	-	-
3	-	-	-	14	-	10	10	-	-	-	-	-
4	-	-	2	-	4	-	-	-	-	-	-	-
5	5	2	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	34	47
7	-	-	-	-	-	-	-	-	-	20	-	-
8	-	-	-	-	-	-	-	5	37	-	-	-
9	-	-	-	-	-	7	7	-	-	-	-	-
10	-	-	2	8	8	-	-	-	-	-	-	-
11	6	10	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	36	45
13	-	-	-	-	-	-	-	-	-	16	-	-
14	-	-	-	-	-	-	-	17	37	-	-	-
15	-	-	-	6	-	6	12	-	-	-	-	-
16	-	-	2	-	9	-	-	-	-	-	-	-
17	8	5	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	27	57
19	-	-	-	-	-	-	-	-	-	58	-	-
20	-	-	-	-	-	-	-	32	85	-	-	-
21	-	-	-	6	-	2	27	-	-	-	-	-
22	-	-	3	-	13	-	-	-	-	-	-	-
23	6	17	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	29	42
25	-	-	-	-	-	-	-	-	-	60	-	-
26	-	-	-	-	-	-	-	29	51	-	-	-
27	-	-	-	12	-	12	10	-	-	-	-	-
28	-	-	11	-	6	-	-	-	-	-	-	-
29	**	4	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	47	22
31	-	-	-	-	-	-	-	-	-	40	-	-
Arithmetic mean	6	8	4	9	8	7	13	18	48	37	34	43
Geometric mean	6	6	3	9	7	6	11	14	44	33	34	41
Maximum	8	17	11	14	13	12	27	32	85	60	47	57
Number of obs.	4	5	5	5	5	5	5	5	5	6	5	5

Annual arithmetic average = 20.1
Annual geometric average = 12.6
Number of observations = 60
**Indicates invalid or missing data

Along the north side of SH 140 near Quartz Valley, there is a mature stand of ponderosa pine, an important feature in terms of the scenic quality of the drive along SH 140 because of the enframement and screening qualities of these trees. The Oregon Department of Transportation is currently improving SH 140 through this area but should not significantly affect the scenic quality (ODOT 1987).

Logging activity commonly occurs in the area and is accessed by numerous forest roads of varying classifications. These roads crisscross throughout the wooded portion of the site. Additionally, areas on the site have been recently drilled for mineral exploration and many drill pads and roads are located in the vicinity of Crone Hill. Most of this drilling activity is not visible from off site, in particular from SH 140, due to the screening capacity of the existing vegetation. Several abandoned mercury mines are located on the site and one is particularly visible from the highway due to the contrast of the very light color of the exposed soil, bedrock, and remaining tailings with the dark green color of the existing vegetation. A power line runs roughly parallel to SH 140 through the flatter portion of the site. Several houses are located directly south of the project site along SH 140 and are the closest dwellings to the project site.

The highest point in the immediate region is Fishhole Mountain (elevation 7089 ft) which is visible from the site to the south. Gearhart Mountain Wilderness Area, located approximately ten miles to the north of the project site, contains elevations ranging from 5800 to 8380 feet along Gearhart Mountain. This broad, sloping mountain can be seen from the Quartz Mountain area. Immediately to the west of the site is Quartz Mountain Pass, which marks the descent into a large, broad valley where the city of Bly is located. Directly to the east of the site, the road descends through the forest into Drews Valley and toward the city of Lakeview.

13.3.1.2 Observer Characteristics

The primary visitors to this area are the people travelling east and west along SH 140. This highway is the major transportation link between Lake County and the regional commercial center in Klamath Falls. It also provides access to the outdoor recreation resources in south central Oregon for residents of south western Oregon and north western California. People that are travelling along SH 140 for the above-mentioned reasons are judged to have a high concern for scenic quality and the Forest Service has labelled this route a Scenic I travel route (USFS 1987). Additionally, SH 140 is used heavily for the logging and timber products industry.

TABLE 3.A-2

PARTICLE SIZE ANALYSIS - SECOND SERIES LAB DATA

Observ. Point #	Sample #	Soil Depth (In.)	%Sand	%Silt	%Clay	Textural Class
24	1	00-18	40.2	41.2	18.6	LOAM
25	2	00-18	36.3	27.6	36.1	CLAY LOAM
26	3	19-46	43.9	30.1	26.0	LOAM
27	4	00-15	41.3	36.0	22.7	LOAM
27	5	15-31	42.1	30.6	27.2	CLAY LOAM/ LOAM
27	6	31-60	25.6	35.4	39.0	CLAY LOAM
28	7	00-08	45.9	35.0	19.0	LOAM
29	8	00-08	49.3	38.8	11.9	LOAM
29	9	08-24	47.6	36.6	15.9	LOAM
29	10	24-45	42.6	36.6	20.8	LOAM
31	11	00-08	54.0	33.5	12.5	SANDY LOAM
31	12	08-39	43.7	39.7	16.6	LOAM
36	13	00-10	57.7	32.6	9.7	SANDY LOAM
36	14	10-52	60.7	31.6	7.7	SANDY LOAM
39	15	00-14	51.9	32.[illegible]	15.8	LOAM/ SANDY LOAM
39	16	14-35	56.5	28.4	15.0	SANDY LOAM
40	17	00-41	47.4	31.2	18.4	LOAM
40	18	41-77	49.4	21.6	29.0	SANDY CLAY LOAM
42	19	00-11	52.0	29.6	18.4	LOAM/ SANDY LOAM
43	20	00-12	39.5	38.4	22.1	LOAM
43	21	12-38	37.5	40.8	21.7	LOAM
44	22	00-10	52.2	36.3	11.4	SANDY LOAM/ LOAM
44	23	10-25	39.6	43.1	17.3	LOAM
44	24	25-52	52.1	32.5	15.3	SANDY LOAM/ LOAM
45	25	00-13	49.9	33.7	16.4	LOAM

TABLE 9.2-8

FREQUENCY OF WINDS BY DIRECTION AND STABILITY
QUARTZ MOUNTAIN PROJECT - QUARTZ MOUNTAIN, OREGON
NOVEMBER 1987-OCTOBER

DIRECTION	A	B	C	D	E	F	ALL
N	0.4	0.1	0.0	0.0	0.1	0.5	1.2
NNE	0.4	0.1	0.0	0.0	0.0	0.3	0.8
NE	0.4	0.1	0.0	0.0	0.1	0.3	0.9
ENE	0.4	0.3	0.0	0.0	0.1	0.3	1.1
E	0.4	0.2	0.1	0.1	0.1	0.3	1.2
ESE	1.1	0.6	0.6	1.8	0.3	0.7	5.1
SE	1.6	1.0	1.6	6.1	0.5	0.9	11.7
SSE	1.0	0.7	0.5	1.4	0.3	0.9	4.8
S	1.7	0.4	0.0	0.5	0.4	0.9	3.9
SSW	1.9	0.0	0.0	0.1	0.2	0.6	2.8
SW	1.4	0.0	0.0	0.0	0.1	0.6	2.1
WSW	1.6	0.0	0.0	0.0	0.0	0.8	2.4
W	1.8	0.6	0.0	0.1	0.5	2.6	5.6
WNW	2.8	2.2	1.2	3.4	4.4	8.0	21.9
NW	2.0	1.9	1.4	2.7	2.5	2.5	12.9
NNW	0.4	0.2	0.1	0.3	0.4	0.8	2.1
All	21.9	8.8	5.9	18.3	12.6	32.5	100.0
Calm	2.8	0.4	0.2	1.8	2.9	11.5	19.6
Mean Speed (knts)	4.4	5.4	5.4	5.1	2.7	1.7	3.6

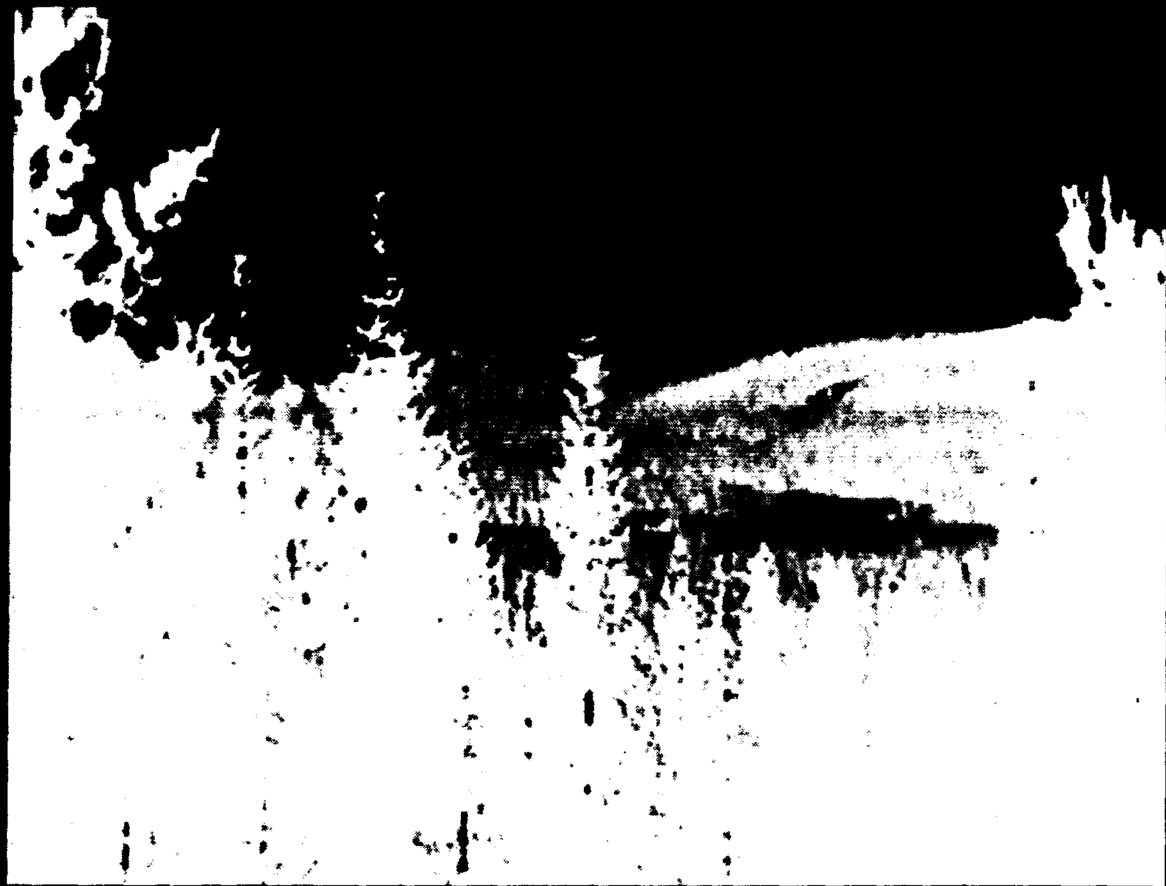

Figure 13.3-2 Typical View from Forest Road 3715

APPENDIX 3.B

SOIL CHEMICAL ANALYSIS

9.2.2.3 Winds and Dispersion Potential

Winds and atmospheric stability control the dispersion of emissions to the atmosphere. Wind speed, wind direction and atmospheric stability data for the Quartz Mountain Project site for the period of November 1987 through October 1988 are presented as frequency distributions in Tables 9.2-7 and 9.2-8.

Table 9.2-7 is a frequency distribution of winds by speed and direction. Winds are generally light shown by over 99 percent of the period the speeds were below 10 knots. The period also had calms (speeds less than one knot) 20 percent of the time. The table also shows that winds blow predominantly from the west-northwest with a secondary frequency peak from the southeast. Strongest winds blow from the southeast. Mean wind speed for the period was 3.6 knots (4.1 mph).

Table 9.2-8 is a frequency distribution of winds by direction and stability. Daytime dispersion is indicated by the frequency of unstable winds, classes A, B and C. Daytime wind directions are nearly the same as the average conditions. These winds are predominantly from the west-northwest, with a secondary peak from the southeast. These winds are along the axis of the valley. Nighttime dispersion is indicated by the frequency of stable winds, classes E and F. Nighttime winds are predominantly from the west-northwest and are usually light. Wind speeds are higher during the day than at night.

some point, either on the ground or in the air, all land is classified with a viewer sensitivity level.

The corridor along SH 140 through the Quartz Mountain project site up to the ridgeline of Quartz Butte, and the corridor along Drews Creek have been classified as Sensitivity Level 1 because of the probable high level of concern for scenic quality of the visitors to these areas. The foreground corridor along Forest Road 3660 is Sensitivity Level 2, because it is primarily a logging route and less travelled than SH 140. All other areas on site have been identified as Sensitivity Level 3 because they are areas not readily visible from existing roads, trails, or use areas.

13.3.2.3 Distance Zones

Visual changes to the landscape are generally more dominant and provide a greater contrast with the landscape the closer the viewer is to the proposed changes. To account for this in the VMS system, distance zones (foreground, middleground and background) are identified to aid in determining management objectives for Forest land. These zones indicate how far viewed landscapes are from travel routes, use areas, or other typical viewpoints.

There are three foreground zones identified on the Quartz Mountain project site, located along SH 140, Forest Road 3660, and Drews Creek. The middleground zone is located along SH 140 from the edge of the foreground zone to the ridgeline along Quartz Mountain, North Butte, and Quartz Butte. The rest of the site is classified as background.

13.3.2.4 Visual Quality Objectives

Visual Quality Objectives represent the level of scenic quality at which a given portion of the landscape is to be managed or maintained and identifies degrees of acceptable change to the natural landscape. These objectives are established by combining the previously established variety classes, sensitivity levels and distance zones. There are five categories of objectives in the Visual Management System: Preservation, Retention, Partial Retention, Modification, and Maximum Modification. These objectives identify the acceptable levels of modification of the landscape based upon the importance of scenic quality (USFS 1974).

Three of these visual quality objectives (Retention, Partial Retention, and Modification) are found on the Quartz Mountain project site (Figure 13.3-3). The Retention Objective, found along SH 140 in the foreground and middleground zone and along Drews Creek, allows for management

TABLE 3.B-2

SOIL CHEMICAL ANALYSIS - SECOND SERIES LAB DATA

Observ. Point #	Sample # - Pit #	Soil Depth (In.)	pH	P ppm	K ppm	Ca meq/100g	Mg meq/100g	NA meq/100g	SS mohms/cm	NO_3 ppm	OM %	SO_4 ppm	SAR
24	1- 1	00-18	6.3	28	647	10.5	2.7	0.06	0.15	0.3	2.33	1.5	0.02
25	2- 6	00-18	6.2	3	347	8.6	3.90	0.21	0.15	0.4	1.70	1.3	0.05
26	3- 6	19-46	6.5	5	351	8.6	4.10	0.20	0.20	0.4	0.53	3.0	0.05
27	4- 7	00-15	6.1	9	433	9.0	2.30	0.05	0.15	0.3	3.02	3.2	0.02
27	5- 7	15-31	6.3	9	374	7.8	2.90	0.17	0.15	0.4	1.54	2.6	0.05
27	6- 7	31-60	6.6	3	484	9.8	4.60	0.31	0.15	0.8	0.32	2.6	0.07
28	7-11	00-08	6.2	2	269	6.9	2.80	0.15	0.15	0.2	0.37	2.2	0.05
29	8-20	00-08	6.4	52	675	12.2	1.60	0.14	0.20	0.3	3.60	4.3	0.04
29	9-20	08-24	6.4	23	589	9.0	1.60	0.13	0.15	0.2	0.95	2.7	0.05
29	10-20	24-45	6.6	14	534	11.1	2.60	0.14	0.15	0.4	0.37	2.9	0.04
31	11-22	00-08	5.9	20	468	6.9	1.30	0.26	0.15	0.2	2.92	1.8	0.12
31	12-22	08-39	6.2	2	398	5.0	1.40	0.13	0.15	0.2	0.53	1.2	0.07
36	13-23	00-10	6.5	4	468	5.0	1.00	0.06	0.15	0.2	1.33	1.8	0.04
36	14-23	10-52	6.7	1	296	3.1	0.86	0.12	0.15	0.3	0.32	1.8	0.10
39	15-34	00-14	6.3	2	499	6.2	2.60	0.25	0.20	0.3	0.27	1.4	0.09
39	16-34	14-35	6.5	2	484	5.2	2.60	0.36	0.20	0.2	0.37	2.0	0.14
40	17-35	00-41	6.3	32	569	9.5	1.30	0.10	0.15	0.3	1.48	2.1	0.04
40	18-35	41-77	6.6	9	413	9.2	4.60	0.20	0.20	0.4	0.48	1.4	0.04
42	19-37	00-11	6.4	11	733	11.1	2.40	0.09	0.15	0.6	3.98	1.6	0.02
43	20-40	00-12	6.4	18	772	11.3	2.00	0.06	0.20	0.3	4.40	3.2	0.02
43	21-40	12-38	6.5	3	406	7.3	2.70	0.18	0.20	0.5	1.11	2.7	0.06
44	22-39	00-10	6.3	24	569	4.8	0.93	0.18	0.15	0.2	1.22	1.5	0.12
44	23-39	10-25	6.4	3	452	8.2	1.70	0.11	0.15	0.3	0.32	2.1	0.04
44	24-39	25-52	6.7	5	343	7.7	3.70	0.31	0.15	0.3	0.32	1.1	0.08
45	25-41	00-13	6.3	10	402	11.5	1.90	0.11	0.20	0.3	3.39	4.3	0.03

TABLE 9.2-4

AVERAGE MONTHLY PRECIPITATION
ROUND GROVE, OREGON (1951-1980)

Month	Inches
JAN	2.25
FEB	1.70
MAR	1.75
APR	1.25
MAY	1.65
JUN	1.35
JUL	0.50
AUG	0.72
SEP	0.76
OCT	1.59
NOV	1.93
DEC	2.59
ANN	18.04

TABLE 9.2-5

AVERAGE MONTHLY PAN EVAPORATION
QUARTZ MOUNTAIN GOLD PROJECT
MAY - OCTOBER 1988
(inches)

Month	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL
Evaporation	5.61	5.49	9.28	7.16	4.75	2.90	35.19

APPENDIX 3.C

SOIL DESCRIPTION

TABLE 9.2-1

AVERAGE MONTHLY TEMPERATURES
QUARTZ MOUNTAIN GOLD PROJECT SITE
NOVEMBER 1987 - OCTOBER 1988
(deg F)

Month	Average Daily Maximum	Average Daily Minimum	Daily Average	Monthly Maximum	Monthly Minimum
NOV 87	45.9	22.3	33.3	63.3	3.7
DEC 87	34.0	16.7	25.3	46.2	- 1.1
JAN 88	35.8	11.8	23.7	51.6	-13.5
FEB 88	48.0	14.4	28.9	57.9	- 7.2
MAR 88	46.8	21.4	33.6	63.1	9.5
APR 88	53.2	27.3	40.5	71.8	13.1
MAY 88	57.4	29.1	43.7	77.4	19.4
JUN 88	67.6	38.1	54.0	87.8	24.8
JUL 88	82.0	41.7	64.2	93.6	25.2
AUG 88	81.3	38.7	61.7	90.0	31.5
SEP 88	73.2	31.6	52.9	93.0	17.8
OCT 88	70.9	28.9	47.7	82.4	23.0
ANNUAL	58.1	26.8	42.4	93.6	-13.5

activities that are not visually apparent, repeating the elements of form, line, color, and texture found in the surrounding characteristic landscape (USFS 1974). The foreground along Forest Road 3660 is classified as partial retention , which allows for visual change that is subordinate to the natural landscape and does not necessarily repeat form, line, color, and texture of the surrounding landscape. The remainder of the site is classified as Modification, allowing for visual changes that can dominate the landscape but should at least borrow somewhat from existing form, line, color, and texture (USFS 1974).

13.3.2.5 Visual Absorption Capability

The next step in the Visual Management System is to identify the amount of change that a particular landscape, or portion of the landscape, can absorb without significantly affecting the visual character of that landscape. In VMS terminology, this is known as Visual Absorption Capability (VAC). Natural resource characteristics of the landscape are mapped and evaluated along with observer-related characteristics such as viewer sensitivity and position, to produce a composite map that indicates the landscape's ability to absorb change. There are numerous natural resource factors that can affect VAC but the most important ones for the Quartz Mountain site include slope, aspect, vegetative diversity, vegetative screening capability, vegetation regeneration potential, and soil characteristics such as color, productivity, and erosion potential.

VAC's for the Fremont National Forest were mapped in ca. 1981. This was done on a scale appropriate for overall forest management, and was not necessarily intended to provide enough detail for a project scale analysis. In order to provide more detailed information relating to the specific site, the VAC's were re-mapped for the Quartz Mountain site at 1" = 1000' based on current studies prepared by vegetation and soils specialists (Figure 13.3-4).

13.3.2.6 Forest Management Area Six

The Fremont National Forest, in their 1987 Draft Environmental Impact Statement for the Proposed Land and Resource Management Plan, has identified a number of different management areas with a variety of management objectives based on landform and landcover characteristics. Management Area Six, are areas identified as "scenic viewsheds". The goal of this management area is to maintain or enhance the existing appearance of the landscape along selected travel routes. This management area directly relates to the Quartz Mountain project in that most of the EIS alternative plans identify a Management Area Six along the foreground corridor of Highway

APPENDIX 3.D

TAXONOMY OF MODAL SOILS

9.2 CLIMATOLOGY

9.2.1 Methods

Twelve months of site-specific meteorological data were available for analysis and inclusion in this report. Eight months of precipitation data and six months of evaporation data are also included. The parameters of wind speed, wind direction and sigma theta are measured at 30 feet and temperature is measured at the 6 foot level. All meteorological data is recorded by a digital data acquisition system (DAS).

Wind speed is measured continuously using a Met One, Inc. Model 014 sensor interfaced directly to the DAS. Wind direction is measured continuously using a Met One, Inc. Model 024 sensor interfaced directly to the DAS. The variation in wind direction, or sigma theta, is calculated in software by the DAS based on the wind direction sensor inputs. The DAS samples the analog data every 10 seconds and uses an algorithm to produce 15-minute averages of wind speed, mean vector magnitude, mean vector direction and standard deviation. Temperature is measured continuously using a Campbell Scientific Model 207 temperature probe interfaced to the DAS.

The precipitation gage used is the Qualimetrics Model 6021-A electrically heated rain and snow gage. Precipitation is totalized by the DAS every 15 minutes. Evaporation at the site was measured for the period from April through October using a Qualimetrics Model 6820 standard evaporation pan equipped with a Qualimetrics Model 6844 evaporation gage which provides a continuous record. The evaporation station is equipped with a Campbell Scientific Model 107 temperature probe to measure water temperature. The water level in the pan and the water temperature are recorded by the data logger every 15 minutes.

The Campbell Scientific, Inc. Model 21X datalogger is the DAS used on the project. The Model 21X samples the analog data, performs calculations when necessary, and stores the results in its own internal memory and in an external solid state storage device.

Regional temperature and precipitation information presented in this report was taken from 30 year (1951-1980) climatic summaries for the Round Grove weather station (4,880 ASL), which is about 4 miles west-northwest of the project site. Evaporation information in this report was from evaporation summaries for Tulelake, California (4,035 ASL) and Summer Lake, Oregon (4,500 ASL). Tulelake is about 45 miles

Mapping Unit No.	Classification
63B	coarse-loamy, mixed, frigid Entic Haploxerolls
64	fine-loamy, mixed, frigid Typic Xerochrepts
64A*	fine-loamy, mixed, mesic Typic Xerochrepts
64B*	fine-loamy, mixed, mesic Typic Xerochrepts
65	fine-loamy, mixed, frigid Typic Xerochrepts
348	complex of 34A and 30A
417	complex of 41B and ashy over loamy-skeletal, mixed, frigid Typic Xerorthents

[1] Some classifications from Fremont N.F. SRI (USFS 1979), Others estimated from best information available.

140. This land management objective at the Forest Planning scale does not conflict with the identified VQO's for the site, but is somewhat less restrictive and more general in nature.

13.3.3 Key Viewpoint Analysis and Photo Point Selection

Key public viewpoints of the project area will include foreground and middleground views from the roadways adjacent or proximate to the site, and background views from distant high points.

SH 140 will have the most sensitive views of the site because of the proximity to these and the number and type of travellers on this road. It has been identified as a scenic travel route by the Forest Service (see Figure 13.3-1). There are views from the site from Forest Roads 3660 and 3715 but these roads have fewer travellers and are less sensitive travel routes, but should still be considered sensitive. Road 3715 winds up the opposite butte (south of the site) and currently there are only several gaps in the trees along the roadway that allow middleground views toward the site. If logging were to occur adjacent to the roadway on the north site, substantially more views of longer duration would open up toward the site. Other viewpoints that may be important include several more distant highpoints such as Gearhart Mountain in the Gearhart Wilderness Area.

As project alternatives become available for study, specific key viewpoints from these areas will be identified and become the points from which project alternatives will be evaluated. The view from these points will provide a basis for comparison of the existing visual environment and the modifications that may occur with the various alternatives.

13.3.4 Computer Simulation Process

The primary computer used for the simulation process is an IRIS Silicon Graphics 2400 Workstation. This sophisticated computer's capabilities include three-dimensional simulation of landform and structures with interactive real time display that makes it possible to move quickly from one viewpoint to another. A second PC-based image processing or "paint system" computer combines these three-dimensional simulations with site photographs to create quick, accurate, and realistic portrayals of project alternatives from any viewpoint.

This computer simulation technology has been added to the VMS process for the following reasons: (1) It allows the VMS classifications to be illustrated three-dimensionally from any viewpoint and to be combined with site photographs to test the classifications as they appear on the landscape and to make it

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SUMMARY

The Quartz Mountain Gold Project site is located in south central Oregon on the high plateau to the east of the Cascade Mountains. Climate in the project area is moderate with warm summer days and cool nights, and cool winter days and cold nights. Air quality is generally good as the site is in a rural area far from sources of atmospheric pollutants. Particulate matter is the only contaminant present in moderate quantities because it is generated naturally.

Data from a meteorological and air quality monitoring station located at the Quartz Mountain Gold Project site for the period 1 November 1987 through 31 October 1988 is summarized in this report. Thirty-year averaged data from three weather stations near the site are also included in the climatology. The parameters of wind speed, wind direction, sigma theta, temperature, precipitation, evaporation, concentration of total suspended particulate, and concentration of particulate less than 10 micrometers in diameter are presented. Methods used to determine these parameters are described.

Average annual temperature near the site over 30 years is 44.1 degrees F. Temperature data collected at the site in 1987 and 1988 was an average of 42.4 degrees F. This data showed January as the coldest month with an average temperature of 23.7 degrees F and July as the warmest month with an average temperature of 64.2 degrees F.

Average annual precipitation near the site over 30 years is approximately 18 inches as water. Precipitation data was collected at the site from 1 January 1988 through 31 October 1988. Total precipitation for this 10-month period was 12.4 inches as water. Maximum monthly precipitation occurred in January and April. Minimum monthly precipitation occurred during July and October.

Average May through October pan evaporation near the site ranges from 44.6 to 47.3 inches. May through October pan evaporation at the site was approximately 35 inches. Maximum monthly evaporation occurred during July and August.

Winds at the site for the period are predominantly from the west-northwest with a secondary frequency peak from the southeast. Strongest winds blow from the southeast. The mean wind speed for the period was 3.6 knots (4.1 mph). Wind speeds are higher during the day than at night.

Particulate concentrations in the atmosphere were measured at the site. The arithmetic mean concentration of

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The alternatives will be evaluated in terms of existing VQO's, VAC's, and management area objectives to determine if project alternatives are compatible with the Forest Service objectives. Mitigation techniques will be determined that will aid in reducing impacts to meet identified Forest Service objectives.

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which he mapped and sampled the project area in detail and contributed to the geologic interpretation of the area.

Mr. Thomas received his B.A. in Geology from the University of Wyoming, Laramie, Wyoming in 1979 and his M.S. in Geology from the University of Nevada-Reno, Nevada in 1985.

Mr. Thomas prior work experience includes positions as a geologist with FMC Corporation and Noranda Exploration, Inc.

include: (1) Retention/ High VAC; (2) Retention/ Medium VAC; (3) Partial Retention/ High VAC; (4) Partial Retention/ Medium VAC; (5) Modification/ High VAC, and; (6) Modification/ Medium VAC (Figure 13.4-1).

The areas where it will be most difficult to meet management objectives are the Retention/ Medium VAC and the Partial Retention/ Medium VAC zones. These areas are found primarily along SH 140, Drews Creek and some of the steeper areas along Forest Road 3660. The most visually desirable areas for project components are the Modification/ High VAC areas found primarily to the north and east of Quartz Butte.

At the project planning level, individual factors that made up the VAC ratings will be evaluated to determine which were visually crucial for a particular area. For example, an area might have a lower VAC due to vegetation screening potential or to soil color contrast. This type of information will be useful in determining the desirability of developing a particular site or the difficulty in mitigating limiting factors such as soil color.

13.4.4 Recommendations

In general, the most visually sensitive areas on the site are along Drews Creek and along SH 140. The trees along the north side of SH 140 provide visual interest along the road and help screen portions of the visually sensitive areas by directing the viewer's attention along the road itself. Wherever possible, these trees should be left in place. Additionally, the trees along the north side of Forest Road 3715 also screen potential views toward the site. This area should be managed carefully by the Forest Service to maintain this screening effect. Typically, mining projects are either highly visible and/or require major changes to the landscape. However, the dominant features of the landscape, particularly the buttes, may allow a sympathetic design form for the various project components.

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10.7 SIGNIFICANCE OF ARCHAEOLOGICAL FINDS: INTERIM CONCLUSIONS

10.7.1 Introduction

The cultural resource survey has identified numerous prehistoric and historic remains within the project area. Many of these remains may be destroyed or modified by the proposed mining operations. The following two sections briefly summarize the next steps necessary in managing the cultural resources within the project area.

10.7.2 Prehistoric Sites

All of the prehistoric sites located within the project area are lithic scatters, and are considered significant under the conditions established by the PMOA on lithic scatters, as noted above (Section 10.5.1). Further work at these sites is needed to evaluate each site's specific potential for contributing to our knowledge of the prehistory of the area. A plan for evaluating these sites should detail: (1) the specific research areas to which data from the sites could apply; and (2) the specific fieldwork and analyses necessary to test each site's potential to contribute to those research questions. The evaluation plan should also consider the projected impacts from the mining project, with sites in those areas of imminent activity tested first. The plan should also consider the information potential of the entire range of sites, taken together, rather than evaluating the potential of each site in isolation from the others. Lithic scatters have a high degree of redundancy (Davis 1986) in terms of cultural materials recovered; consideration of the entire collection of sites could allow for cost-effective sampling procedures in both the testing and evaluation phases.

Analysis of isolated finds will be included in the final report. Further work will not be necessary.

10.7.3 Historic Sites

Numerous historic sites, of various types, as well as historic isolated finds are located in the project area. All of these finds may require additional evaluation. The most important category of historic finds are those remains associated with the railroad logging operations of the 1930s. A plan for evaluating these remains (Ewauna Camp, the railroad grades, associated features) should be prepared. A second category of historic finds are those relating to prospecting and mining for cinnabar and gold (the mercury retort, Angel Peak mine, the mining shaft). A plan for evaluating these remains also needs to be prepared. A third category of historic finds are the isolated dumps located throughout the

2.5 GLOSSARY

APHANTIC - Texture of an igneous rock in which in the crystalline components are not distinguishable with the unaided eye.

ARGILLIC ALTERATION - A form of hydrothermal alteration in which certain minerals of a rock are converted to clay minerals.

ASH-FLOW TUFF - A tuff, or unconsolidated pyroclastic rock, deposited by an ash flow or gaseous cloud.

BASALT - A general term for fine-grained, dark-colored mafic igneous rocks, commonly extrusive but locally intrusive.

BRECCIA - A coarse-grained clastic rock composed of angular broken rock fragments held together by a mineral cement or in a fine-grained matrix.

DIKTYTAXITIC - A high alumina olivine tholeiite.

ENDOGENOUS - Derived from within; geologic processes originating from internal causes within the earth or magma.

EPITHERMAL - A hydrothermal mineral deposit formed within about one kilometer of the earth's surface and in the temperature range of 50° to 200° C.

EXOGENOUS - Geologic processes originating at or near the surface of the earth or magma.

HYDROTHERMAL - Of or pertaining to hot water; a mineral deposit precipitated from a hot aqueous solution.

NORMAL FAULT - A fault in which the hanging wall appears to have moved downward relative to the footwall.

OPALIZED - A rock whose original constituents are replaced by opaline silica, a form of silica containing varying percentages of water.

PERLITIC - The texture of a glassy igneous rock that has cracked due to contraction during cooling, the cracks forming small spheruloids.

PHENOCRYST - Large crystals of the earliest generation in a porphyritic igneous rock.

PHREATO-MAGMATIC - A magma being in contact with ground water which is converted to the vapor phase.

10.8 GLOSSARY

BIFACE - Stone artifacts which have had flakes removed from both dorsal (exterior) and ventral (interior) surfaces, in the process of forming a tool.

CCS - An abbreviation of cryptocrystalline, a term referring to the fine crystalline structure of a number of types of rock, which makes such stones relatively easy to shape into tools.

CORE - A chunk of rock from which flakes have been removed in the process of manufacturing stone tools.

DEBITAGE - The pieces of stone that are left over after a stone tool has been made.

ETHNOBOTANY - The study of the ways specific cultural groups use plants.

FEATURE - Any physical remain of a past human activity which includes relationships among various parts, which cannot be removed intact from the site, e.g., a firehearth, a house foundation, an activity area.

FLAKE - A chip of stone removed from a rock in the process of making a stone tool.

ISOLATE - A single artifact or small collection of artifacts which is not apparently associated with other cultural materials within a bounded area.

LITHIC SCATTER - An open-area concentration of prehistoric or protohistoric cultural debris, consisting mainly of chipped stone tools and debitage, with limited quantities of other cultural materials and few, if any, features.

PROJECTILE POINT - The tip of any projectile, including spears points, atlatl darts points, and arrowheads.

SIGNIFICANCE - Specific criteria established in 36 CFR 604 for determining the eligibility of archaeological and historic sites to the National Register of Historic places.

SITE - A location which has material remains of human activities. In the region covered by the PMOA on lithic scatters, a prehistoric site is specifically defined as more than 10 artifacts (flakes or tools) occurring together in a discrete location.

13.5 GLOSSARY

BACKGROUND - the area located from 3-5 miles to infinity from the viewer.

COLOR - the hue (for example, red or blue) and value (for example, light or dark) of the light reflected or emitted by an object.

CONTRAST - the diversity of adjacent parts, as in color or tone; the difference in appearance between two (or More) elements and/or an element and its background.

FOREGROUND - the detailed landscape found within 0 to 1/4- 1/2 mile from the viewer.

FORM - the mass or shape of an object, such as the shape of the land surface or pattern placed on the landscape.

HORIZON LINE - the line along which the sky seems to touch the earth; the visible horizon.

KEY VIEWPOINT - the point(s) commonly in use or potentially in use where the view of a management activity is the most disclosing. The locations which provide the means of studying the visual impact of alternatives to the landscape

LANDSCAPE - the sum total of the characteristics that distinguish a certain area on the earth's surface from other areas. These characteristics are a result not only of natural forces but of human occupancy and use of the land.

LAND USE - various human activities which impact the landscape in a variety of ways.

LINE - a boundary between patterns in the landscape such as ridges, or changes in vegetative types.

MIDDLEGROUND - the area located from 1/4-1/2 to 3-5 miles from the viewer.

MODIFICATION - a visual quality objective meaning man's activities may dominate the characteristic landscape but must, at the same time, utilize naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.

PARTIAL RETENTION - a visual quality objective which in general means man's activities may be evident but must remain subordinate to the characteristic landscape.

2.4 GEOLOGIC HAZARDS

2.4.1 Seismicity

The Quartz Mountain Gold Project is located in the northwest portion of the Basin and Range Geomorphic Province near the transition to the Columbia River Plateau Geomorphic Province to the north and the Cascade Geomorphic Province to the west. In the seismically active Basin and Range Province, movement on high-angle normal faults has occurred from the Tertiary to Present as a result of regional extensional strain. Where the Basin and Range Province intersects the relatively inactive Columbia River Plateau and Cascade Provinces in southern Oregon, this extension is translated into right-lateral strike-slip faults along which much of the historic seismic activity has occurred (Lawrence 1976).

Although situated between two states, Washington and California, that have had many violent earthquakes, Oregon is much less active seismically. Since the beginning of the historical record in 1841, 34 earthquakes of intensity V, Modified Mercali Scale, and greater have occurred within Oregon or near its borders. The majority of these earthquakes occurred in the northern portion of the state near the Washington border, and a few lower-intensity earthquakes were centered in the southern portion of the state. These portions of the state where the site is located, have been rated in terms of earthquake hazard by the USGS as Zone 2, a region where moderate earthquake damage could occur (von Hake 1976). Central Oregon, underlain by the Columbia River Plateau, has experienced very few earthquakes and is relatively inactive seismically, and has been rated as Zone 1, an area where minor earthquake damage can be expected.

The south-central portion of the state in the vicinity of the Quartz Mountain Gold Project study area has experienced five intensity V and one intensity VI earthquakes. Three shocks (intensity V) were felt in Fort Klamath on 14 April 1920, and another near Lakeview on 11 January 1968. Between 26 May 1968 and 11 June 1968, a series of earthquakes called the Warner Valley Earthquake Swarm shook the area along the Oregon-California border near Adel, Oregon. The largest and most damaging of these was a magnitude 4.7 tremor on 3 June 1968, which was felt over an area of 11,00 square miles.

2.4.2 SLOPE STABILITY

Surface soil erosion and mass movement can occur in the natural state and as a result of man's activities. Mass movement is soil and bedrock movement which occurs below the soil surface, such as landslips, slumps, slides rockfall, and

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VISUAL SENSITIVITY LEVELS - a three-level rating system used to delineate areas receiving different amounts of exposure (present or potential) to user groups with differing attitudes towards changes in scenic quality. When combined with distance zones and Variety Class, make up Visual Quality Objectives.

3.0 SOILS

3.1 INTRODUCTION

3.1.1 Objectives

Steffen Robertson and Kirsten (Colorado) Inc. (SRK) was retained by Galactic Services, Inc. (GALACTIC) to conduct environmental baseline studies for the proposed Quartz Mountain Gold Mine in Lake County, Oregon. Soil studies are described in this Soils Baseline Report which is intended to serve as a technical support document for the Environmental Impact Statement (EIS) currently being prepared by SRK under the direction of the USDA Forest Service, Fremont National Forest (USFS). This EIS is being prepared in accordance with USFS guidelines for implementing the Council of Environmental Quality Regulations (40 CFR 1500-1508) related to the National Environmental Policy Act of 1969 (NEPA).

The soil baseline study was designed to accomplish the following objectives:

1. Describe soils occurring within the study area and prepare a soils map showing the study area occurrence of these soils: and

2. Describe study area soil characteristics which will affect reclamation planning for disturbed areas associated with the proposed Quartz Mountain Gold Mine.

3.1.2 Study Area

The Quartz Mountain Gold Project study area (Figure 1.1-1) is transitional between great basin and mountain geography and includes a diversity of geology (Plate 2.1) and soils. The study area is approximately 30 miles west-northwest of Lakeview, Oregon, with elevations ranging from 5,400 to 6,600 feet. The topography is dominated by round to oval-shaped buttes of moderate relief. These buttes have a general northwestern alignment and are dominantly composed of intrusive rhyolitic rocks.

Climate in the project area is moderate with warm summer days and cool nights, and cool winter days and cold nights. The project area receives approximately 20 to 25 inches of precipitation on an average annual basis. Most of this precipitation is in the form of winter snows and locally intense summer thunderstorms.

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rock units include the pyroclastic heterolithic tuff unit (Tht) and scoriaceous and vesicular portions of the basalt sequences.

Drill holes sited in rhyolite and tuff distal to the ore bodies and those penetrating the lower basalt section cut mostly unaltered rock. Portions exhibit weak propylitic alteration, but most rocks are fresh or merely stained with iron oxides. Coarse-grained vein calcite is locally present in drill chips. The common mineral assemblage of weakly propylitically altered basalt on the perimeter of the ore deposits is montmorillonite ± illite ± chlorite ± quartz.

2.3.4.2 Mineralization

The Quartz Mountain district hosts epithermal mercury and gold mineralization, both of which are spatially and probably genetically related to emplacement of rhyolitic volcanic rocks. While gold mineralization is the target of current exploration activity, mercury was produced from the district in the late 1950s. However, the mercury zones are separated from zones of significant gold mineralization by 80 to 150 feet of barren or only weakly mineralized rock.

2.3.4.2.1 Mercury Deposits

Mercury occurrences within opalized rhyolite overlie both the Crone Hill and Quartz Butte gold deposits. Cinnabar and metacinnabar are disseminated and coat fractures in strongly altered rocks. Native sulfur has been noted at Quartz Butte, and some black chalcedony veins and pods on Crone Hill contain stibnite ± marcasite ± pyrite. The mercury occurrences are vapor-phase deposits formed in the upper portions of fossil hot spring systems. Significant, economically exploitable mercury values were found only within this acid-leached cap.

2.3.4.2.2 Gold Deposits

The surface projections of the Crone Hill and Quartz Butte gold deposits are shown in Figure 2.3-2. The Crone Hill deposit is horseshoe shaped and measures 3,000 feet in width and up to 300 feet in thickness. The Quartz Butte deposit measures up to 1,000 feet in diameter and 100 feet in thickness. Ore zones typically consist of coalescing or stacked masses of higher-grade material within disseminated, lower-grade rock. Ore zones are better developed where thick intervals of porous host rock are cut by faults.

Gold distribution within the ore zones is confined to certain alteration assemblages, which are in turn determined by host rock lithology. The Crone Hill ore body and

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Steward, J.H. and Erminie Wheeler-Voegelin. 1954. The Northern Paiute Indians. U.S. Indian Claims Commission, Dockets 17 and 87. Reprinted in: David A. Horr, ed., American Indian ethnohistory: Paiute Indians, vol. 3. Garland, New York. [reprint 1974].

large open pit mines. His involvement in the Quartz Mountain project has included the preparation and entry of project database information into the simulation computer. He is also responsible for database management and development of custom visual assessment software tools and processes.

Mr. Seely received a Bachelor of Arts in Art and Photography in 1976 from Rockford College. His experience also includes six years of civil engineering and six years of three-dimensional simulation and computer animation production and development.

Mr. Seely has been responsible for computer simulation production in television advertising, aviation litigation, weather forecasting, architecture, urban planning and landscape architecture. His main goal is to continue to develop and improve the computer as a design and visual communication tool.

13.8.4 Lin M. Takeuchi

Ms. Takeuchi has been involved in a number of visual assessment projects and has specialized in open pit mining projects. Her involvement in these projects has included field survey and photography, analysis, computer simulation, and graphic preparation for permit applications and Environmental Impact Statements.

Ms. Takeuchi received a Bachelor of Arts in Geography in 1977 from the University of Colorado in Boulder and a Masters in Landscape Architecture in 1986 from the University of Colorado in Denver.

Ms. Takeuchi has previously participated in preparation of baseline studies and impact assessments for various engineering and environmental consulting firms in the Denver area. These projects have included: Environmental Impact Statements for several mineral and coal mines within Colorado, Wyoming, Utah, Arizona, and Texas. She has also been involved in mapping coal resources in Colorado, Wyoming, Utah, and New Mexico for the U.S. Geological Survey.

tuff breccias imply that multiple overlap of mineralizing and hydrothermal processes occurred.

2.3.2.2.3 <u>Rhyolite</u>

Silicic volcanics of the Quartz Mountain district include two types of rhyolite dome complexes:

1. Exogenous, glassy flows and flow breccias; and

2. Endogenous quartz-eye rhyolite porphyry domes with genetically related, proximal tephra tuff accumulations (Plate 2-1).

Previous mapping in the district (Johns 1949, Haddock 1959) identified the glassy exogenous domes as andesite vitrophyres on the basis of petrographic examination. The vitrophyric rhyolites bordering Crone Hill are part of the imposing Quartz Mountain and Quartz Butte edifices. These are exogenous domes built by multiphase, non-explosive extrusion of glassy rhyolite flows. These rocks display diverse phenocryst populations including biotite, plagioclase, sanidine, hornblende and rare quartz, and exhibit widely varying textures. Textural diversity is particularly notable in rhyolite flows in the eastern half of the district, but is less prominent in the domes in the western half of the district. Flow bands are very conspicuous in Quartz Butte and Quartz Mountain vitrophyres, and some flows are perlitic.

Porphyritic rhyolite, typified by the Crone Hill and Quartz Butte rhyolites, is volumetrically less significant than vitrophyric rhyolite and forms relatively small endogenous domes. Portions of these rocks are flow banded, contain glassy margins, and have a matrix that is partially glassy. These rhyolites typically contain small quartz phenocrysts, and may contain biotite. Abundant feldspar phenocrysts (mostly sanidine) are now present as alteration pseudomorphs or corrosion casts. Feldspar is also present in fine-grained groundmass aggregates with quartz and glass (Dudas 1986).

2.3.2.2.4 <u>Undifferentiated Alluvium/Colluvium</u>

Over ninety percent of Crone Hill and Quartz Butte is covered with five to ten feet of unconsolidated, fragmental rocky soil. This soil is poorly developed and consists mostly of underlying rock fragments, fine silt and clay-size particles, and some tree and shrub roots. Along drainages, the alluvium contains more rock and sand size fragments of mixed rock lithologies, less silt and clay, and more organic material. There is no apparent association of colluvium

Winthrop Associates. 1987c. Test excavations: sites SRK/HL 1 and SRK/HL 4, Quartz Mountain, Fremont National Forest (interim report letter). Submitted to the U.S. Forest Service, Fremont National Forest, Lakeview, Oregon. (Winthrop Associates, Ashland, Oregon).

14.0 NOISE

3.2 LITERATURE REVIEW

The USFS publication Fremont National Forest Soil Resource Inventory (SRI) (USFS, 1979), provides the technical framework for this study. The Soil Taxonomy Handbook (USDA 1975), The National Soils Handbook (USDA 1974), and The Soil Survey Manual (Revised) (USDA 1979) provide technical guidance in conducting soil survey investigations. The SRI report was reviewed in detail and much of the information included in this report was obtained or modified from this document.

APPENDIX 10.A

SURVEY MEMORANDUM OF AGREEMENT

TECHNICAL REPORT NO. 14

NOISE

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

MARLATT & ASSOCIATES
3611 Richmond Drive
Fort Collins, Colorado 80526

and

STEFFEN ROBERTSON AND KIRSTEN (COLORADO) INC.
1755 East Plumb Lane Suite 230
Reno, Nevada 89502

Revised December 1988

2.3 GEOLOGY - PROJECT AREA

2.3.1 Methods

The Anaconda Minerals Company conducted the initial acquisition and exploration program at Quartz Mountain. WRI followed up with a reconnaissance program that identified areas of gold mineralization within the Quartz Mountain project area based on detailed geologic mapping, sampling and limited exploratory drilling. Following the assessment of these geologic data, an extensive exploratory core and reverse circulation drilling program and other related development work were conducted in the Crone Hill and Quartz Butte areas to provide a database for an accurate geologic and reserve evaluation of these deposits.

2.3.2 Results and Discussion

2.3.2.1 Geologic Setting - Project Areas

The geology of the Quartz Mountain gold-mercury district is dominated by widespread high-alumina olivine tholeiite lava flows and pyroclastic rocks (5-10 million years (m.y.) informally named the Devils Garden lava field (McKee et al. 1983, Hart et al. 1984). Within the Devils Garden volcanic field, linear belts of silicic volcanism coincide with the prominent northwest-trending, right-lateral fault zones which may have acted as conduits for rhyolitic magma derived from crustal melting. Rhyolite domes in the vicinity of Quartz Mountain occupy the McLoughlin lineament (6.4 to 8.1 m.y.). Sub-parallel normal faults and a conjugate set of north- to northeast-trending faults are also present in the project area (Figure 2.3-1). Hydrothermal alteration and gold mineralization are spatially and genetically related to endogenous, quartz-eye rhyolite porphyry domes. Northwest and northeast-trending faults controlled the movement of mineralizing fluids in the dynamic hydrothermal system which deposited gold and related trace elements.

2.3.2.2 Stratigraphy

2.3.2.2.1 Basalt

The basalt section, which is part of a regional basalt sequence, is several thousand feet thick. Within the project area, three petrographically distinct basalt units were identified:

1. A pre-rhyolite sequence of very fine-grained to trachytic flows;

11.0 SOCIOECONOMICS

FOREWORD

This report was prepared by Marlatt and Associates and Steffen Robertson and Kirsten (COLORADO) Inc. (SRK) for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
W.E. Marlatt	Noise Task Leader	SRK
P.J. Marlatt	Noise Technical Assistant	SRK

TECHNICAL REPORT NO. 11

SOCIOECONOMICS

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

PLANNING INFORMATION CORPORATION
1801 Broadway Suite 920
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and

STEFFEN ROBERTSON AND KIRSTEN (COLORADO) INC.
1755 East Plumb Lane Suite 230
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Revised December 1988

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3.4 RESULTS AND DISCUSSIONS

3.4.1 Mapping Unit Delineations (modified from SRI report)

Soil mapping units are delineated by identifying soils with similar characteristics. Mapping unit identification is shown on the soils map as numbers and letters (Figure 3.3-1). The most dominant soil type accounts for at least 70 percent of the mapping unit delineation.

The dominant soil of the mapping unit is described in the mapping unit description. Within the mapping unit other soils occur. Those most commonly associated with the dominant soil are listed in the descriptions as inclusions. These inclusions normally account for no more than 30 percent of the unit.

Soil map unit and other map units are defined as land types that have a definable range of characteristics based on similar soil, geology, landform, slope, and vegetation types. Three types of mapping units were defined in the study area:

1. Standard Mapping Units: These map units contain at least 70 percent of one land type that have similar characteristics, such as dominant soil type; common land type inclusions; bedrock; landform and slope; elevation; vegetation type; drainage type; permeability rates; and profile characteristics, including coarse fragment content. These units are labeled with a two digit number, commonly followed by the suffix A, B, or C. These letters denote the slope categories of the soil types and are defined as: A (0-15 percent slopes), B (16-40 percent slopes), and C (greater than 40 percent slope).

2. Mapping Unit Complexes: These map units, shown on the map with three digits, are used in areas where two or more mapping units are present but cannot be distinguished from each other in the scale used in the soils map.

3. Miscellaneous Map Units: Map units or land types that are too variable to be described by a definable range of characteristics are labeled with a single digit number on the soils map.

There are 32 mapping units recognized in this survey. Four (4) are miscellaneous mapping units, two (2) are mapping unit complexes, and twenty-six (26) are standard mapping units (Appendix 3.D).

FOREWORD

This report was prepared by Planning Information Corporation and Steffen Robertson and Kirsten (COLORADO) Inc. (SRK) for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
G. Blankenship	Socioeconomics, Land Use, Recreation, Transportation Task Leader	SRK
J.M. Goldstein	Planner	SRK
J.T. Sebesta	Planner	SRK
E.A. Taylor	Planner	SRK

14.0 NOISE

14.1 INTRODUCTION

Galactic Services, Inc. is conducting exploration and feasibility studies for the development of a gold mine in Lake County, just north of the village of Quartz Mountain, Oregon. While it was recognized that, due to the rural nature of the area, the sparse population in the village and the limited traffic passing through the study area, that the background noise level was very low, no quantitative information exists on ambient noise levels in the project area. As part of the environmental studies for the project, therefore, monitoring of the ambient noise at potentially noise-sensitive locations around Quartz Mountain and nearby communities was conducted during January 1988.

14.1.1 Objectives

The objective of the baseline study of the noise in the Quartz Mountain study area was to determine the ambient (present background) noise levels prior to the construction and operation of the gold mine. This report presents the results of the monitoring program and identifies the probable baseline of noise in the area.

14.1.2 Study Area

The Quartz Mountain Project is located approximately 0.5 miles northeast of the intersection of SH 140 and USFS Road 3660 in southwestern Lake County as shown on Figure 1.1-1. This intersection is located near the Quartz Mountain pass on SH 140. The village of Quartz Mountain, consisting of only three houses, several unoccupied small, old cabins and a few outbuildings, is located approximately 0.25 miles southeast of this intersection along the south side of SH 140.

Noise monitoring sites were selected at locations approximately 25 feet from the three houses in the village, along the logging road just south of the houses, just off SH 140 at the Quartz Mountain pass, and, due to heavy snow which occurred during the monitoring period, directly on SH 140 just to the east and to the west of the village. A few measurements were also made in the towns of Lakeview, approximately 30 miles east of Quartz Mountain, and Bly, approximately 13 miles west of Quartz Mountain. Measurements were made during the period Thursday 14 January 1988 through Monday 14 January 18 1988.

2.2 REGIONAL GEOLOGIC SETTING

The project area is located in south-central Oregon in the northwest portion of the Basin and Range Province near the transition to the Columbia River Plateau Province to the north and the Cascade Province to the west (Figure 2.2-1). The area is characterized by northwest-trending extensional, right-lateral fault zones and north-trending normal faults which form a series of fault-block mountain ranges capped by volcanic rocks, intervening pluvial basins filled with alluvium and fans marginal to the range fronts, and volcanic highlands commonly capped by basalt flows. Overall displacement of 6 to 12 miles has been demonstrated along the McLoughlin fault zone (Lawrence 1976). Major north-trending, normal range-front faults with several thousand feet of vertical offset form spectacular escarpments (Figure 2.2-2).

2.2.1 Geologic History

During Oligocene to early Miocene time, wide-spread basalt flows and related tuffs and rhyolite dome complexes were deposited in a widespread composite volcanic field in south-central Oregon. These rocks are part of the westward-sweeping Cascade arc volcanism related to the continent-margin subduction zone. (McKee et al. 1983, Hammond 1979).

Mid-Miocene and younger basalts and bimodal volcanics were deposited upon and within this "basement" volcanic complex. They include and rhyolitic dome complexes and associated tephra deposits, ash-flow tuffs, and tuffaceous sediments. These rocks represent the transition from subduction-related volcanism to bimodal volcanism related to Basin and Range extensional tectonics. Silicic rocks within this sequence are characterized by exogenous and endogenous rhyolite domes and flows, and a variety of tephra and pyroclastic deposits. Tuff and tuffaceous sediments occur locally in and around these domes.

The youngest rocks in the region are interbedded Quaternary basalts, Plio-Pleistocene lake beds, and recent alluvial deposits. Alluvial silts, sands, and gravels are present along present-day and paleo-stream channels and in alluvial fans (Walker 1963, Peterson and McIntyre 1970).

South-central Oregon was extensively prospected for mercury and uranium in the 1950s and 1960s, and has been a target for precious metal exploration in recent years. Mercury deposits found in the area are small, with reported production of less than five to a few tens of flasks (Brooks 1963). Two uranium deposits were mined from 1955 to 1965, with 400,000 pounds of U_3O_8 produced. Some active uranium

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per unit area (A) perpendicular to the direction of flow. Since the energy is assumed to be transmitted uniformly over a sphere of area 4 pi r^2, the intensity I thus decreases as a function of $1/r^2$. This means that the sound decreases as a square of the distance between the source and the receiver.

The human ear can tolerate a rather large range of sound wave intensities. Table 14.2-1 provides examples of the sound pressure levels of representative sounds and noises (Tipler 1976). Data from this table can be used for comparison between recommended acceptable sound levels and the sound levels monitored at the study area.

Since the dB scale is nonlinear, sound levels from individual sources cannot be added directly. For example two sound sources operating alone producing 75 and 80 dB respectively, when combined will produce a sound level of only 81.2 dB.

14.2.3 Time Weighting of Sound Levels

The volume of environmental sound almost always varies with time. The most frequent method of describing the time weighted average of time involves the percentage of observations of sound which exceed specified levels during a given time period. For example L_1, L_{10}, L_{50} and L_{90} are used to define the level exceeded 1, 10, 50 and 90 percent of the time.

While the State of Oregon appears to favor the use of L_{10} and L_{50} [Noise Regulation 340-35-035 (1)(b)(B)(i)], the equivalent sound level (L_{eq}) concept has been advanced by the federal government and other state governments to supersede other cumulative measures (Lipscomb and Taylor 1978). This term, representing the time weighted average sound level is defined as:

$$L_{eq} = 10 \log_{10} (1/t \quad 10^{L/10} dt) \qquad (3)$$

This equation is often simplified by the use of the near equivalent:

$$L_{10} - L_{eq} = 01.28s - 0.115s^2 \qquad (4)$$

where s is the standard deviation of the sound levels measured. Equation (4) however, assumes that the measurement data follow a normal distribution (Gordon et al. 1971). For completeness, the data gathered at Quartz Mountain and vicinity are summarized for each of the above levels.

TABLE 3.4-1

ACREAGES OF EACH MAPPING UNIT
IN THE QUARTZ MOUNTAIN GOLD PROJECT STUDY AREA

MAP UNIT1	ACREAGE[2]	MAP UNIT	ACREAGE
3	27.27	37B/R.O.	73.56
4	10.29	37C	22.88
4A	14.15	40A	222.00
6	35.54	40B	1041.02
16*	261.22	41A	540.65
18*	9.25	41B	806.22
30A	31.18	41C	141.86
31A	153.32	63A	218.43
34A	318.54	63B	20.25
34B	72.00	64	631.36
34B/R.O	11.89	64A*	369.82
34A*	243.01	64B*	125.32
34B*	168.32	65	98.09
34C/R.O.*	5.12	348	186.76
37A	1008.53	417	24.91
37B	555.32		

[1]Map units identified in the study area are described in accompanying text and their distribution shown on Figure 3.3-1.

[2]Acreage calculations by Wilsey & Ham, Portland, Oregon.

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SUMMARY

The study area for the socioeconomic analysis is the Town of Lakeview and southern Lake County, Oregon, and the Bly rural center which is in Klamath County, Oregon. These areas were selected due to their proximity to the Quartz Mountain Gold Project site suggests that most inmigrants, or workers who move into the area to take jobs with the project, would probably move to one of these communities.

Local Economy

The economy of Lake County is dominated by government employment and the timber industry, and to a lesser extent, agriculture and the retail and service sectors. Employment has increased in Lake County during the 1980 to 1986 period, as has total labor income. Although Klamath County employment data is not disaggregated for the Bly area, interviews with local officials indicated that the local economy is based on government employment (primarily the USFS Bly Ranger District) and timber employment (Weyerhauser cutting crews). Many Bly area residents commute to Klamath Falls or Lakeview to work. Weyerhauser has closed two mills in Bly since 1980.

There are considerable number of unemployed or underemployed workers with skills appropriate for the Quartz Mountain Gold Project who currently live in Lake and Klamath counties. The Oregon Division of Employment had 37 workers with heavy equipment skills in Lake County and 396 such workers in Klamath County registered for work in the July 1986 through June 1987 period.

Population

Lake County population (estimated at 7300 in 1986) has decreased by 232 people over the 1980-1986 period. At the same time, Lakeview (estimated at 2785 in 1986) and the Lakeview urban growth area (estimated at 1191 in 1986) have grown by 15 and 1001 people respectively. In the Bly area, population has decreased from 246 in 1980 to 238 in 1986 according to Portland State University (1987). This population stability is of interest, considering the closure of Weyerhauser's mills.

Housing

All though there were approximately 100 houses for sale in the Lakeview area, there have been an average of only 16 for rent in recent months. In January 1988 there were only 30 mobile homes spaces for rent.

TABLE 14.3-1 Continued.

SITE 2.
Galactic Services, Inc. Co. office house

Date/Day Time	Number of Observations	Sound Pressure Level L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1/14 (Thu) 2000	250	60.8	47.7	42.2	37.8	44.3

Environmental Conditions:

In yard of house rented by the Galactic Services Co. in Quartz Mountain. Snow covered. Air Temperature: 35°F, Relative Humidity: 85%, Sky Cover: Total, low clouds. Rain turning to snow shortly after completion of data collection. Wind: 2-10 mph from S, W, N. Gusty.

SITE 3.
B. Stone's house driveway[1]

Date/Day Time	Number of Observations	Sound Pressure Level L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1/15 (Fri) 1440	258	60.5	46.5	39.0	35.5	43.0

Environmental Conditions:

25 feet North of B. Stone's house in Quartz Mountain. Snow covered. Air Temperature: 25°F, Relative Humidity: 70%, Sky Cover: Total, low clouds. Wind: 0-7 mph from S, W, N. Gusty.

[1]Because of the frequency of snowfall and the depth of the snow on each side of the driveway into Ms. Stone's house, it was not possible to obtain acceptable measurements within 25 feet of her house during all measurement periods. It was believed that the snowbanks on each side of the drive would serve as sound absorbers of traffic noises from the highway. From the summarized data it appears that the noise levels measured in the yards of each of the three houses were essentially the same with the L_{50} and L_{90} values reflecting primarily the breezes in the trees.

The soil is moderately well to poorly drained. Permeability is moderate in the surface soils and slow or very slow in the subsoils.

Range of Profile Characteristics of Soil 16*

Litter: Leaves and stems; 0 to 0.25 inches thick.

Surface layers: Very dark gray to dark grayish brown silt loam or clay loam; weak to moderate, medium, granular structure; soft to hard; slightly plastic; pH ranges from 5.6 to 6.6; 5 to 10 inches thick.

Subsoil layers: Very dark gray to black clay loam or silty clay loam; strong, fine to medium subangular blocky structure; lower subsoil is strongly mottled, gleyed, and has massive structure; very hard; plastic to very plastic; pH ranges from 6.0 to 7.0; over 40 inches thick; intermittent hardpan is hard and strongly cemented.

3.4.2.6 Mapping Unit 18*

Mapping unit 18* consists dominantly of Landtype 18* and minor amounts of Landtypes 17 and 19. Landtype 18* is similar to Landtype 17 with the exception of internal drainage soil color and vegetation. It is similar to Unit 16 with the exception of elevation and position in the landscape.

Landtype 18* has deep to very deep alluvial over residual soils which have developed in tuff, breccia, and lava sediments. Surface layers are thin and medium to moderately fine textured. Subsoil layers are thick to very thick and fine textured. Sand and gravel lenses occur locally.

Bedrock is soft to moderately hard, massive rhyolite-dacite ash-flow tuff, tuffaceous sedimentary rock, and breccia. Depth to bedrock ranges from 40 to 144 inches.

Typically, Landtype 18* occurs on wide alluvial valleys adjacent to major streams and rivers. Slopes are less than 5 percent.

This landtype ranges in elevation above 5,000 feet and of sedges, rushes, meadow foxtail, and bluegrass, and scattered patches of stands of mixed conifers.

The soil is moderately well to somewhat poorly drained. Permeability is moderate in the surface soils and slow or very slow in the subsoils.

school in Bonanza. Currently Bonanza has capacity for 14 additional students.

Fiscal Conditions

Both Lake County and the Town of Lakeview are in sound fiscal condition according to recent budgets and audits. Revenues have exceeded expenditures in both of these jurisdictions in recent years, and both have had substantial positive annual balances.

Lakeview School District #7 has been in a precarious fiscal condition in recent years, owing primarily to the peculiarities of Oregon school finance mechanisms and the district's inability to receive voter approval of a new tax base. The Lake County Commissioners transferred Forest Receipt funds from the county road fund to the school district to cover a projected $207,600 shortfall in operating funds.

Union School District #5 is required to pay $4,860 in tuition for each high school student it sends to the Lakeview District. If more than 11 new high school students were to move into the Westside area, the Union District would have to ask county taxpayers to approve a new tax base.

TABLE 14.3-1 Continued.

SITE 5.
State Highway 140 east of Quartz Mountain

Date/Day Time	Number of Observations	Sound Pressure Level L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1/16 (Sat) 1615	336	68.0	38.0	27.5	21.0	35.2

Environmental Conditions:

Directly on SH 140 about 1/2 mi east of 'A'frame house in Quartz Mountain village. Deep snow covered. Road plowed and sanded. Air Temperature: 24°F, Relative Humidity: 60%, Sky Cover: Partly Cloudy, Wind: Calm.

SITE 6.
Lakeview Hospital

Date/Day Time	Number of Observations	Sound Pressure Level L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1/15 (Fri) 1615 (A)	239	68.0	53.5	43.6	39.7	50.5
1/17 (Sun) 1230 (B)	150	58.0	47.5	45.0	43.5	45.4
1/18 (Mon) 2230 (C)	160	36.1	35.2	31.6	29.6	32.5

Environmental Conditions:

(A) In parking lot on SE side of Lakeview Hospital. Parking lot plowed and sanded. Children playing at school playground 1 block away. Air Temperature: 40°F, Relative Humidity: 70%, Sky Cover: Cloudy, Wind: 0-1 mph.

(B) In parking lot on SE side of Lakeview Hospital. Parking lot plowed and sanded. Air Temperature: 33°F, Relative Humidity: M, Sky Cover: Clear, Wind: 2-5 mph from W.

(C) In parking lot on SE side of Lakeview Hospital. Parking lot plowed and sanded. Air Temperature: 16°F, Relative Humidity: M, Sky Cover: Clear, Wind: Calm.

sage, bitterbrush, phlox, bottlebrush squirreltail, Idaho fescue, and mountain mahogany.

The soil is well drained. Permeability is moderate to slow in the surface soils and slow or very slow in the subsoils. Coarse fragment content average less than 35 percent in the textural control section.

Range of profile Characteristics of Soil 30A

Litter: None

Surface layers: Dark brown or dark grayish brown loam or clay loam; weak, fine granular structure; 10 to 30 percent coarse fragments by volume; soft; slightly by plastic to plastic; pH ranges from 5.0 to 7.0; 6 to 16 inches thick.

Subsoil layers: Dark reddish brown to dark brown stony clay loam, silty clay loam or silty clay; moderate, fine to medium subangular blocky structure with occasional moderate, coarse prismatic structure; 5 to 50 percent coarse fragments by volume; very hard; very plastic; hard, and massive; pH ranges from 5.0 to 7.0; 9 to 29 inches thick.

3.4.2.8 Mapping Unit 31A

Mapping Unit 31A consists dominantly of Landtype 31A and minor amounts of Landtypes 28, 30B, 56A, and 34A. Landtype 31A is similar to Landtype 28 with the exception of soil depth and vegetative type. It is similar to Landtype 30B with the exception of slope range coarse fragment content, and position in the landscape.

Landtype 31A has shallow to moderately deep, stony residual soils located primarily on lower elevations. Surface soils are thin and medium to moderately fine textured. Subsoils are thin and moderately fine or fine textured. Surface vesicular basalt boulders commonly cover up to 50 percent of the surface. Rock outcrops and boulder parches are common within some areas.

Bedrock is interbedded soft, reddish brown tuff or hard, gray basalt or andesite. Depth to bedrock ranges from 15 to 25 inches.

Typically, Landtype 31A occurs on gently rolling basalt lava and tuff tablelands on slopes from 0 to 15 percent slopes. It occurs on a wide range of elevations but primarily on lower elevations or forest fringe areas.

11.0 SOCIOECONOMIC TECHNICAL REPORT

11.1 INTRODUCTION

11.1.1 Objectives

The primary purpose of this technical report is to identify and analyze the potential socioeconomic effects of the proposed Quartz Mountain Gold Project.

This includes the following objectives:

A) To determine the potential effects of both the no action and proposed action alternatives on the following socioeconomic elements:

1) Local Economy;

2) Population;

3) Housing;

4) Local Government Facility, Services, and Fiscal Conditions;

5) Land Use;

6) Transportation; and

7) Resource Based Recreation.

B) To provide an information base concerning these effects for the USFS, local officials, and Galactic Services officials so they may work to enhance the positive socioeconomic effects of the project and avoid, manage, or mitigate any negative socioeconomic effects.

11.1.2 Study Area

The primary socioeconomic study area for the Quartz Mountain Gold Project includes the following areas:

1) Lake County (southern portion);

2) Town of Lakeview;

3) Lakeview School District #7;

4) Town of Bly; and

TABLE 14.3-2

OCTAVE BAND ANALYSIS

Frequency (Hertz)	1/15/88 1630 Site 1.	1/17/88 1300 Site 7.
25.	21	23
50	40	42
100	44	49
200	46	40
400	44	42
800	54	44
1600	41	34
3200	35	41
6300	--	36
12500	--	22

unit occurs primarily on lower elevations but includes some units at higher elevations.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, big sage, wax currant, mules ear, bottlebrush squirreltail, squawcarpet, Ross sedge, serviceberry, Idaho fescue, lupine, bluegrass, phlox, and Oregon grape. Some units also contain manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 34A

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown or dark brown loam; weak, fine granular structure; 10 to 50 percent gravel, cobbles, and stones by volume; soft; slightly plastic; pH ranges from 5.5 to 6.8; 5 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark brown stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 35 to 70 percent gravel, cobbles, and stone by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 36 inches thick.

3.4.2.10 Mapping Unit 34B

Mapping Unit 34B consists dominantly of Landtype 34B and minor amounts of Landtypes 34A, 34C, and 37B. Landtype 34B is similar to Landtype 34A with the exception of landforms, slope range, and position in the landscape. It is similar to Unit 34C with the exception of slope range. Unit 37B differs by vegetative type.

Landtype 34B has moderately deep, stony residual and colluvial reddish brown soils with ponderosa pine timber types. Surface soils are very thin or thin and medium or moderately fine textured. Subsoil layers are moderately thick and moderately fine textured. Large vesicular basalt boulders up to 3 feet long are common.

Bedrock is interbedded soft, reddish brown tuff or hard gray basalt. They are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches. Some areas are deeper than 48 inches to bedrock.

Bly School

Children of project workers residing in Bly would attend Bly schools.

Union School District #5

Union School District #5 serves the Westside rural center. High school children from the Union district attend school in Lakeview.

Although a full quantitative analysis will not be performed for Union District, the study will provide a qualitative discussion of potential project impacts on the district.

Bonanza High School

High school students from the town of Bly are transported to the Bonanza High School.

City of Klamath Falls

Klamath Falls labor force data is used in this study to determine the availability of workers with skills appropriate for the project.

14.5 CONCLUSIONS

Measurements made in the vicinity of Quartz Mountain during January 1988 indicated that the area experiences very little background sound. Not more than 20 to 40 vehicles passed through the area during the "busiest" hour with many hours each day when no traffic occurred. The highway is reasonably straight with only a moderate grade allowing for most vehicles to pass through the area at speeds near the legal limit.

Even in the towns of Lakeview and Bly, the baseline noise levels are very low. Only one L_1 value above 70 dB was recorded in downtown Lakeview and this was associated with the fire siren from the station less than one block away at 11:00 PM. Ninety percent of all sounds monitored in downtown Lakeview even at noon on a weekday were below 63 dB.

It is recognized that the presence of the deep snow including a considerable amount on the branches of the trees tended to muffle the sounds in the area. Of the 2185 sound measurements made in and around the village of Quartz Mountain, only 22 were of >70 dB while 961 were < 30 dB, the level identified as being "very quiet".

Bedrock is interbedded soft, reddish brown tuff or hard gray basalt. They are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches. Some areas are deeper than 48 inches to bedrock.

Typically, Landtype 34B occurs on basaltic eruptive centers, shield volcanoes, and block fault scarps on slopes from 16 to 40 percent. It occurs on a wide range of elevations but is most typically found on lower elevations.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, Oregon grape, mules ear, Ross sedge, Idaho fescue, mountain mahogany, big sage, wax currant, squawcarpet, serviceberry, lupine, and occasionally manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Coarse fragment content average greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 34B

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown on dark brown loam or clay loam; weak to moderate, fine granular structure; 10 to 50 percent gravel, cobbles, and stone by volume; soft; slightly plastic; pH ranges from 5.5 to 6.8; 5 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark brown stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 35 to 70 percent gravel, cobbles, and stones by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 36 inches thick.

3.4.2.12 Mapping Unit 34A*

Mapping Unit 34A* consists dominantly of Landtype 34A* and minor amounts of Landtypes 34B*, and 35. Landtype 34A* is similar to Landtype 34B* with the exception of slope range. It is different from Unit 35 in vegetative type. Landtype 34A* is found on south slopes and has a mesic temperature regime. 34A is found at higher elevation and on north slopes. They are frigid.

Landtype 34A* has moderately deep to deep, stony and residual reddish brown soils with ponderosa pine timber types.

11.3 METHODS

11.3.1 Agency Contacts

A scoping meeting was held by the U. S. Forest Service (USFS) for the Quartz Mountain Project Team and affected agencies. One of the items discussed was the socioeconomic issues of concern for the project and the area of potential impact. The scoping process suggested areas for emphasis in information collection and socioeconomic assessment. The resulting scope was then reviewed by the agencies.

11.3.2 Data Collection

The information needed to describe existing socioeconomic conditions includes employment and earnings; population; housing; local government facilities, services, and fiscal conditions; human services; land use; and transportation.

11.3.2.1 Employment and Earnings

The purpose of collecting employment and earnings information is to describe the current local economy, recent local economic trends, local labor force characteristics, and potential qualified workers available to a project.

Employment and earnings data collected include:

- number of employees by sector for Lake County,
- employment earnings by sector for Lake County,
- persons in labor force, by sex and age group,
- employed persons, by sex and age group,
- labor force participation rates by sex and age groups,
- unemployment and unemployment rates, and
- local labor force availability, by occupation and skill.

Sources of employment and earnings data include:

- U.S. Bureau of Economic Analysis (BEA). This data is only available through 1984; 1985 and 1986 data will not be available until later in 1988 (BEA 1986).
- State of Oregon, Department of Human Resources, Employment Division, Labor Market Information Office (LMI), Klamath Falls. Employment and wage data from LMI

L_{dn} (day/night equivalent sound level) - the equivalent (see L_{eq}) A-weighted sound level during a 24-hour period with a 10 decibel weighting applied to the nighttime hours of 2200 to 0700.

L_{eq} (equivalent sound level) - a method for combining the noise (measured (dBA) from both individual events and quasi-steady state sources into a measure of average noise exposure over a given time period. L_{eq} is formulated in terms of the equivalent steady noise level which, in a stated time period, would contain the same noise energy as the time-varying noise during the same period.

L_n (nighttime equivalent sound level) - the equivalent (see L_{eq}) A-weighted sound level during a nine hour period from 2200 to 0700.

NOISE - a sound of any kind, especially any unwanted sound; an erratic, intermittent, or statistically random sound pressure oscillation.

NOISE LEVEL (SOUND LEVEL) - weighted sound pressure level measured by the use of a metering characteristic and weighting (A, B, C, or D) as specified in the American National Standard Specifications for Sound Level Meters S1.4-1971 or the latest approved revision thereof. The weighting employed must be indicated, otherwise the "A" weighing is understood. The reference pressure is 20 microNewtons per square meter (2×10^{-4} microbar).

OCTAVE BAND - a frequency band with an upper frequency limit equal to twice that of the lower limit.

SOUND FIELDS - three types of sound fields are distinguishable: the near field, far field, and diffuse field. The near field is that region where the source cannot be treated as a single point and is a region in which the inverse square law does not apply (usually a few diameters of the source). The far field is defined as that region beyond the near field where the inverse square law is obeyed. Far fields normally occur outdoors away from barriers and reflections. Diffuse field is produced when there are multiple reflectors and/or barriers resulting in the acoustic energy per unit volume being essentially constant.

SOUND INTENSITY LEVEL (L_I) - Using the decibel scale:

$$L_I = 10 \log_{10} (I/I_o)$$

where I is the sound intensity in W/m^2 and I_o is the reference intensity, usually taken as 10^{-12} W/m^2.

mesic temperature regime. Landtypes 34A, 34B, and are found at higher elevations and on north slopes. They are frigid.

Landtype 34B has moderately deep to deep, stony residual and colluvial reddish brown soils with ponderosa pine timber types. Surface soils are very thin or thin and medium or moderately fine textured. Subsoil layers are moderately thick and moderately fine textured. Large vesicular basalt boulders up to 3 feet long are common.

Bedrock is interbedded soft, reddish brown tuff or hard gray basalt. They are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches.

Typically, Landtype 34B occurs on basaltic eruptive centers, shield volcanoes, and block fault scarps on slopes from 16 to 40 percent. It occurs on a wide range of elevations but is most typically found on lower elevations.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, Oregon grape, mules ear, Ross sedge, Idaho fescue, mountain mahogany, big sage, wax currant, squawcarpet, serviceberry, lupine, and occasionally manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Coarse fragment content average greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 34B*

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown or dark brown loam or clay loam; weak to moderate, fine granular structure; 10 to 50 percent gravel, cobbles, and stone by volume; soft; slightly plastic; pH ranges from 5.5 to 6.8; 5 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark brown stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 35 to 70 percent gravel, cobbles, and stones by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 36 inches thick.

3.4.2.14 Mapping Unit 34C*/R.O.

Mapping Unit 34C*/R.O. consists dominantly of Landtype 34C* and minor amounts of Landtypes 34B and 37C. Landtype

type, to analyze recent housing trends, and to assess the housing available for people who may move into the area.

Information collected includes:

- 1980 housing units by type,
- 1980 to 1987 building permits by type,
- spaces and occupancy in mobile home parks and recreational vehicle parks,
- units and occupancy in hotels and motels, and
- current local housing availability.

Sources of housing information include:

- 1980 U.S. Census (Bureau of Census 1983b),
- Lake County Planning and Building Office,
- Interviews with local realtors and other knowledgeable people,
- Lake County Examiner (Newspaper),
- Telephone interviews with owners of local mobile home parks, recreation vehicle parks, and motels.

11.3.2.4 Local Government Facilities, Services, and Fiscal Conditions

An inventory of existing conditions for local government facilities, services, and fiscal conditions was conducted. The purpose of collecting this information is to describe the local services offered, the current service levels, the capacity of local services and facilities, the plans for changes in the services or facilities, and the fiscal condition of each jurisdiction. Information was collected by contacting, in person or by phone, local officials, staff, and other knowledgeable people responsible for providing key local services in the following jurisdictions: Lake County, Town of Lakeview, Lakeview School District #7, Town of Bly, and the Gearhart School in Bly. (See Public and Agency Contacts.)

Information was collected at the department level. It included the number and type of staff, facility size, special equipment, and the type of services the department provides. The department representative was also asked if the department, as it currently exists, is able to meet the

14.7 PUBLIC AND AGENCY CONTACTS

Mr. Radtke
U. S. Forest Service
Fremont National Forest
Lakeview, Oregon

Mr. Terry Obteske
Air Quality Division
Oregon DEQ
Portland, Oregon

3.4.2.15 Mapping Unit 37A

Mapping Unit 37A consists dominantly of Landtype 37A and minor amounts of Landtypes 28, 30A, 34A, and 37B. Landtype 37A is similar to Landtype 34A with the exception of timber type, and it is similar to Unit 37B with the exception of slope range and landforms.

Landtype 37A has moderately deep to deep, stony and residual reddish brown soils with mixed timber types. Surface soils layers are very thin or thin and medium or moderately coarse textured. Subsoils are moderately thick to thick and moderately fine or medium textured. Large basalt boulders commonly occupy a large part of the soil surface.

Bedrock is interbedded hard, red to gray basalt or soft, reddish brown tuff. The tuff rock is soft and massive. The basalt layers are hard and highly fractured. Depth to bedrock ranges from 25 to 48 inches. Some areas are greater than 48 inches to bedrock.

Typically, Landtype 37A occurs on gently rolling plateaus and tablelands on medium or high elevations. Slopes range from 0 to 15 percent.

This landtype ranges in elevation above 5,500 feet and supports mixed conifers, snowbrush, manzanita, squawcarpet, serviceberry, mules ear, Ross sedge, wax currant, phlox, bottlebrush squirreltail, Oregon grape, lupine, and big sage.

The soil is well drained. Permeability is moderate to rapid in the surface soils and moderate to slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 37A

Litter: Needles, leaves, twigs, and decomposing organic matter; 0.5 to 3 inches thick.

Surface layers: Dark brown to black loam or sandy loam; weak, medium granular and weak, fine subangular blocky structure; 5 to 35 percent coarse fragments by volume; soft; friable; pH ranges from 5.5 to 7.0; 5 to 16 inches thick.

Subsoil layers: Dark reddish brown or dark brown gravelly, cobbly, or stony clay loam, silty clay loam, or occasionally loam; moderate, fine or medium subangular blocky structure; 35 to 80 percent coarse fragments by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 32 inches thick.

- ambulance service.

For Lakeview School District #7, information was collected from the superintendent on the following items:

- staff,
- enrollment,
- facilities,
- school capacities, and
- fiscal conditions.

For the Gearhart School in Bly (Part of the Klamath Falls School District), a partial inventory was conducted that included:

- staff,
- enrollment,
- facilities, and
- school capacities.

11.3.2.5 Human Services

Human service agencies were contacted by phone. Agency representatives were asked about the services provided, staff levels, facilities, numbers and types of users, and types of funding. Agencies contacted included:

- Adult and Family Services,
- Children Services,
- Mental Health Center,
- Public Health Department,
- Senior Services,
- Crisis Intervention Center,
- Employment Training, and
- Day Care.

APPENDIX 14.A

Existing Industrial and Commercial Noise Source Standards

LIST OF PLATES

11.4 EXISTING CONDITIONS

11.4.1 Local Economy

This section describes recent Lake County trends in employment, earnings, labor force, and unemployment rates, four important measures of an area's economy.

11.4.1.1 Employment

Figure 11.4-1 displays total Lake County employment by place of work for the 1980 through 1986 period. Table 11.4-1 presents total employment, employment by sector, sector employment as a percent of total, and percent annual change data for the same six year period.

Lake County total employment decreased from the 1980 level of 3,981 to 3,767 in 1982, a 5 percent decrease. Total employment then increased slightly during the next four years, ending the period at 3,935, 1 percent less than 1980 total employment.

The government sector is the largest employment category in Lake County, averaging about 25 percent of total employment over the six year period. The government sector experienced a large drop in employment in 1982, losing 58 workers or five percent of government employment in 1981. The government sector in Lake County includes the USFS Fremont National Forest Headquarters and the BLM regional headquarters, as well as state and local government, and school district employment.

The farm sector is the second largest employment category in Lake County, averaging about 23 percent of total employment over the period. Farm employment fluctuated slightly during the first four years of the period, ending 3 percent below the 1980 level. Livestock, hay, and grain are the primary products of the Lake County farm sector.

Manufacturing is the third largest employment sector in Lake County, averaging almost 14 percent of total employment from 1980 to 1986. Manufacturing employment decreased slightly during 1981 and 1982 but grew by almost 17 percent in 1983. Lumber and wood products comprised 94 percent of the manufacturing sector in 1986 (Mahan 1987).

There are currently three major lumber mills in Lakeview.

1) Fremont Sawmill Company, which recently acquired the defunct Louisiana Pacific Mill. Fremont currently has approximately 140 employees (Evans, pers. comm., 14 January 1987).

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Table 11.4-1
Employment by Place of Work 1980-1986
Lake County, Oregon

Sector	1980	1981	1982	1983	1984	1985	1986	Average 1980-86
Farm	907	892	927	904	877	877	877	894
Mining	42	45	42	40	41	40	39	41
Construction	160	153	121	131	130	119	147	137
Manufacturing	508	503	480	560	567	556	578	536
TCPU	103	89	85	85	80	80	93	88
Wholesale Trade	64	67	62	61	62	59	45	60
Retail Trade	553	535	472	490	519	505	564	520
FIRE	133	129	120	119	117	112	116	121
Services,Inc Ag Srv	489	477	478	492	541	561	527	509
Government	1,022	1,038	980	1,012	982	964	950	993
Total Employment	3,981	3,928	3,767	3,894	3,916	3,874	3,935	3,899

Percent by Sector

Sector	1980	1981	1982	1983	1984	1985	1986	Average 1980-86
Farm	22.8%	22.7%	24.6%	23.2%	22.4%	22.6%	22.3%	22.9%
Mining	1.1%	1.1%	1.1%	1.0%	1.1%	1.0%	1.0%	1.1%
Construction	4.0%	3.9%	3.2%	3.4%	3.3%	3.1%	3.7%	3.5%
Manufacturing	12.8%	12.8%	12.7%	14.4%	14.5%	14.4%	14.7%	13.7%
TCPU	2.6%	2.3%	2.3%	2.2%	2.0%	2.1%	2.4%	2.3%
Wholesale Trade	1.6%	1.7%	1.7%	1.6%	1.6%	1.5%	1.1%	1.5%
Retail Trade	13.9%	13.6%	12.5%	12.6%	13.3%	13.0%	14.3%	13.3%
FIRE	3.3%	3.3%	3.2%	3.1%	3.0%	2.9%	2.9%	3.1%
Services,Inc Ag Srv	12.3%	12.1%	12.7%	12.6%	13.8%	14.5%	13.4%	13.1%
Government	25.7%	26.4%	26.0%	26.0%	25.1%	24.9%	24.1%	25.5%
Total Employment	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Percent Yearly Change by Sector

Sector	1980	1981	1982	1983	1984	1985	1986	Average 1980-86
Farm	NA	-1.7%	3.9%	-2.5%	-3.0%	0.0%	0.0%	-0.5%
Mining	NA	5.7%	-7.1%	-2.9%	2.0%	-2.5%	-2.1%	-1.2%
Construction	NA	-4.4%	-20.9%	8.3%	-0.8%	-8.5%	23.8%	-0.4%
Manufacturing	NA	-1.0%	-4.6%	16.7%	1.3%	-1.9%	3.9%	2.4%
TCPU	NA	-13.6%	-4.5%	0.0%	-5.9%	-0.4%	16.3%	-1.3%
Wholesale Trade	NA	5.7%	-7.1%	-2.9%	2.0%	-5.0%	-23.5%	-5.1%
Retail Trade	NA	-3.3%	-11.8%	3.8%	5.9%	-2.6%	11.5%	0.6%
FIRE	NA	-3.0%	-7.0%	-0.8%	-1.7%	-4.1%	3.2%	-2.2%
Services,Inc Ag Srv	NA	-2.5%	0.2%	2.9%	10.0%	3.8%	-6.2%	1.4%
Government	NA	1.6%	-5.6%	3.3%	-3.0%	-1.8%	-1.4%	-1.2%
Total Employment	NA	-1.3%	-4.1%	3.4%	0.6%	-1.1%	1.6%	-0.2%

Source: Bureau of Economic Analysis; State of Oregon Employment Division, Dept of Human Resources. Planning Information Corporation, January 1988.

coarse fragments by volume; hard; plastic; pH ranges from 5.5 to 7.5; 20 to 33 inches thick.

3.4.1.17 Mapping Unit 37B/R.O.

Mapping Unit 37B consists dominantly of Landtype 37B and minor amounts of Landtypes 37A, 37C, 34B and 26. Landtype 37B is similar to Landtype 37A and 37C with the exception of landforms and slope range. Unit 34B differs by timber type, and Landtype 26 contains deep, colluvial soils.

Landtype 37B has moderately deep to deep, reddish brown, stony residual and colluvial soils with mixed conifer timber types. Surface soil layers are very thin or thin and medium or moderately coarse textured. Subsoil layers are moderately thick to thick and moderately fine or medium textured. Large, vesicular basalt boulders make up a large part of the soil surface and profile, and rock outcrops make up 10 to 20 percent of the unit.

Bedrock is interbedded, soft, reddish brown tuff and hard, gray basalt or andesite. These rocks are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches. Some areas are deeper than 48 inches to bedrock.

Typically, Landtype 37B occurs on moderately steep lands consisting of basaltic eruptive centers, block faults, and shield volcanoes. Slopes range from 16 to 40 percent.

This landtype ranges in elevation above 5,500 feet and supports mixed conifers, snowbrush, manzanita, squawcarpet, mules ear, serviceberry, wax currant, Ross sedge, Oregon grape, bottlebrush squirreltail, phlox, lupine, and sagebrush.

The soil is well drained. Permeability is moderate to rapid in the surface soils and moderate to slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

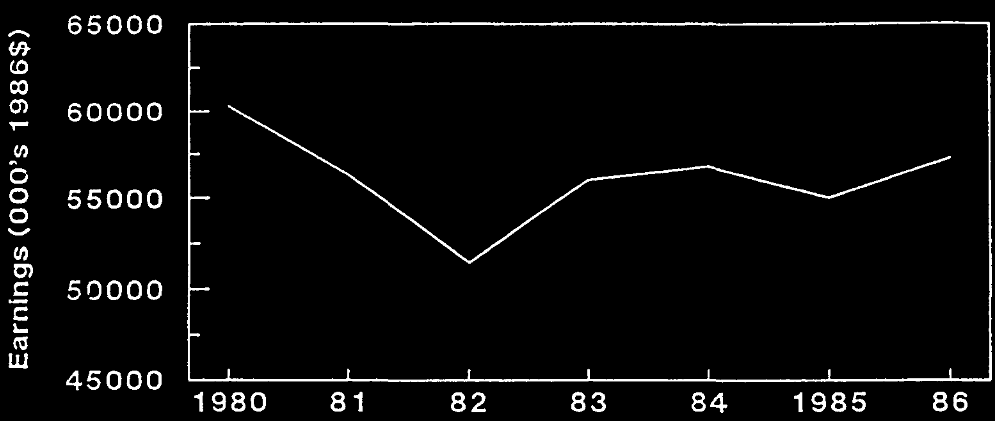
Range of Profile Characteristics of Soil 37B

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 3 inches thick.

Surface layers: Dark brown loam or sandy loam; weak, medium granular and weak, fine subangular blocky structure; 5 to 15 inches thick.

Subsoil layers: Dark brown to dark reddish brown gravelly, cobbly, or stony clay loam, silty clay loam, or occasionally loam; moderate or weak, fine,

Figure 11.4-2
Earnings by Place of Work 1980-1986
Lake County, Oregon



Note: Scale does not begin at zero.

Source: Bureau of Economic Analysis; State of Oregon Employment Division, Dept of Human Resources; Planning Information Corporation, January 1988.

APPENDIX 14-A

Table A-1. Existing industrial and commercial noise source standards. Table 7 of Chapter 340, Oregon Administrative Rules. Division 35. Amended April 1983. (340-35-035)

ALLOWABLE STATISTICAL NOISE LEVELS IN ANY ONE HOUR.

7 a.m. - 10 p.m.	10 p.m. - 7 a.m.
L50 - 55 dBA	L50 - 50 dBA
L10 - 60 dBA	L10 - 55 dBA
L1 - 75 dBA	L1 - 60 dBA

Table A-2. New industrial and commercial noise source standards. Table 8 of Chapter 340, Oregon Administrative Rules. Division 35. Amended April 1983. (340-35-035)

ALLOWABLE STATISTICAL NOISE LEVELS IN ANY ONE HOUR

7 a.m. - 10 p.m.	10 p.m. - 7 a.m.
L50 - 55 dBA	L50 - 50 dBA
L10 - 60 dBA	L10 - 55 dBA
L1 - 75 dBA	L1 - 60 dBA

(same as values in Table 7).

Table A-3. Industrial and commercial noise source standards for quiet areas. Table 9 of Chapter 340, Oregon Administrative Rules. Division 35. Amended April 1983. (340-35-035)

ALLOWABLE STATISTICAL NOISE LEVELS IN ANY ONE HOUR

7 a.m. - 10 p.m.	10 p.m. - 7 a.m.
L50 - 50 dBA	L50 - 45 dBA
L10 - 55 dBA	L10 - 50 dBA
L1 - 60 dBA	L1 - 55 dBA

loam; moderate or weak, fine, subangular blocky structure; 35 to 80 percent coarse fragments by volume; hard; plastic; pH ranges from 6.0 to 7.5; 20 to 40 inches thick.

(40-49) Residual and Colluvial Soils From Rhyolite

3.4.2.19 Mapping Unit 40A

Mapping Unit 40A consists dominantly of Landtype 40A and minor amounts of Landtypes 34A and 40B. Landtype 40A is similar to Landtype 34A with the exception of soil type and landform and it is similar to Unit 40B with the exception of slope range.

Landtype 40A had moderately deep to deep, brown and gravelly residual soils associated with rhyolitic eruptive centers. Surface soils are thin and moderately coarse or medium textured. Subsoil layers are moderately thick, gravelly, and moderately coarse or coarse textured. This landtype is often characterized by exposed mineral soil and no organic litter or ground cover vegetation.

Bedrock consists mostly of moderately hard, competent, highly fractured, light gray rhyolite. Soft tuff, welded tuff, obsidian, rhyolitic breccia, and andesites occur locally -- primarily along the perimeter of the landform. Depth to bedrock ranges from 30 to 50 inches.

Typically, Landtype 40A occurs on gentle slopes associated with dome-shaped uplifts which consist of rhyolitic lava. Slopes are less than 15 percent.

This landtype ranges in elevation above 4,500 feet and supports ponderosa pine, manzanita, Ross sedge, bottlebrush squirreltail, squawcarpet, phlox, snowbrush, mules ear, mountain mahogany, and Oregon grape.

The soil is excessively well drained. Permeability is rapid in the surface soils and rapid to very rapid in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 40A

Litter: Needles, leaves, twigs, and decomposing organic matter; 0 to 2 inches thick.

Surface layers: Very dark gray to dark brown, sandy loam or loam; weak, fine granular structure; 5 to 50 percent angular and subround gravels and cobbles by volume; soft; nonplastic to

It is of interest that manufacturing (primarily timber) earnings increased 15 percent during this period of general decline, from the 1980 level of $12,307,000 to $14,180,000 in 1986. This reflects the stability of the Lakeview timber industry generated by the Lakeview Working Circle.

The government sector averaged about 31 percent of total earnings with only 25 percent of total employment, reflecting the relatively high level of wages in that sector. Similarly, manufacturing earnings averaged about 23 percent of total earnings with only 14 percent of total employment.

The farm sector averaged about 18 percent of total earnings with 23 percent of total employment, the retail sector averaged about 9 percent of total earnings with 13 percent of total employment, and the service sector averaged about 7 percent of total earnings with 13 percent of total employment, reflecting the lower wages in those sectors.

11.4.1.3 Labor Force, Employment and Unemployment

Table 11.4-3 presents labor force, employment, unemployment, and unemployment rate data for Lake County from 1980 through 1986.

It is interesting to note that the Lake County labor force increased by 590 persons or 16 percent during the same time that county population decreased by 232 people or three percent. This phenomena may be caused by more Lake County residents entering the labor force, i.e., more high school and college graduates, more spouses taking jobs, senior citizens working longer, etc.

Lake County employment increased by 550 people or 17 percent over the period at the same time that unemployment increased by 40 people or 10 percent.

However, because of the expanding labor force, the unemployment rate actually decreased from 10.8 to 10.3 or four percent over the period. The average annual Lake County unemployment rate over the period was 11.3, compared to 9.6 for the state of Oregon and 7.9 for the United States.

11.4.1.4 Labor Availability

Table 11.4-4 presents job applicants in selected occupations from Lake and Klamath counties registered for work with the state employment office during July 1986 through June 1987.

There were 37 workers from Lake County and 396 workers from Klamath County with heavy equipment skills.

Surface layers: Very dark gray to dark brown sandy loam; weak medium granular and weak, fine subangular blocky structure; 10 to 50 percent angular and subround gravels and cobbles by volume; soft; nonplastic to slightly plastic; pH ranges from 6.0 to 7.0; 6 to 12 inches thick.

Subsoil layers: Yellowish brown to dark brown, gravelly and cobbly sandy loam or loamy sand; weak, fine subangular blocky structure; 20 to 70 percent angular and subround gravels and cobbles by volume; soft; nonplastic; pH ranges from 6.2 to 7.2; 20 to 50 inches thick.

3.4.2.21 Mapping Unit 40C

Mapping Unit 40C consists dominantly of Landtype 40C and minor amounts of Landtypes 40B, 41C, and 42. Landtype 40C is similar to Landtype 40B with the exception of slope range, and it is similar to unit 41C with the exception of timber type.

Landtype 40C has moderately deep to deep, gravelly, residual and colluvial soils which occur on steep slopes on rhyolitic domes. Surface soils are thin and moderately coarse textured. Subsoils are moderately thick to thick, gravelly or cobbly, and coarse to moderately coarse textured. Some areas are characterized by a high portion of exposed mineral soil.

Bedrock consists mostly of highly fractured, competent, and moderately hard rhyolite which may be foliated. Rhyolitic breccia, andesite, welded tuff, tuff, and obsidian occur locally along the perimeter of the landform. The bedrock layers are primarily vertically jointed. Depth to bedrock ranges from 30 to 60 inches.

Typically, Landtype 40C occurs on steep slopes usually on south aspects and associated with rhyolitic dome uplifts. Slopes are greater than 40 percent.

This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, snowbrush, manzanita, mules ear, squawcarpet, Ross sedge, Oregon grape, mountain mahogany, and bottlebrush squirreltail.

The soil is excessively well drained. Permeability is rapid in the surface soils and rapid or very rapid in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Table 11.4-4
Select Occupation Job Applicants July 1986 thru June 1987
Lake and Klamath Counties, Oregon

Occupation	July 1986 - June 1987		
	Lake	Klamath	Total
Farm Equipment Operators	1	16	17
Mobile Heavy Equipment Mechanics	0	13	13
Paving/Surfacing Equip Operators	8	5	13
Other Constuction Trade Workers	2	96	98
Earth Drillers	0	5	5
Truck Drivers - Heavy	17	179	196
Material Moving Equipment Operator			
Excavating & Load Mach Operators	1	3	4
Dragline Operators	0	1	1
Grader, Dozer, Scraper Operators	2	9	11
Operating Engineers	6	56	62
Other Matl Moving Equip Operators	0	4	4
Helpers: Construction	0	9	9
TOTAL	37	396	433

Source: Labor Market Information, Employment Division, State of Oregon; Planning Information Corporation, January 1988.

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Range of Profile Characteristics of Soil 41A

Litter: Needles, leaves, twigs, and decomposing organic matter; 0.5 to 3 inches thick.

Surface layers: Very dark gray to dark yellowish brown loam or sandy loam; very weak, medium granular structure; 10 to 40 percent angular and subround gravels and cobbles by volume; loose, nonplastic; pH ranges from 6.0 to 7.0; 6 to 12 inches thick.

Subsoil layers: Dark yellowish brown or dark grayish brown gravelly and cobbly sandy loam or loamy sand; single grain or very weak, fine subangular blocky structure; 20 to 70 percent angular and subround gravels and cobbles by volume; loose; nonplastic, pH ranges from 6.2 to 7.4; 24 to 50 inches thick.

3.4.2.23 Mapping Unit 41B

Mapping Unit 41B consists dominantly of Landtype 41B and minor amounts of Landtypes 41A, 41C, 40B, and 42. Landtype 41B is similar to Landtype 40B with the exception of timber type, and it is similar to units 41A and 41C with the exception of slope ranges.

Landtype 41B has moderately deep to deep, gravelly and cobbly residual and colluvial soils on rhyolitic domes with mixed timber types. Surface soils are thin and moderately coarse or medium textured. Subsoils are moderately thick to thick, moderately coarse or coarse textured, and gravelly or cobbly.

Bedrock is mainly vertically jointed, moderately hard, and highly fractured rhyolite which is often foliated. Welded tuff, tuff, andesite, obsidian, and breccia may occur locally but primarily along the perimeter of the landform. Depth to bedrock ranges from 30 to 60 inches.

Typically, Landtype 41B occurs on dome-shaped lava uplifts on north aspects on slopes from 16 to 40 percent.

This landtype ranges in elevation above 5,200 feet and supports mixed conifers, snowbrush, manzanita, Ross sedge, bottlebrush squirreltail, lupine, snowberry, Oregon grape, squawcarpet, and needlegrass.

The soil is excessively drained. Permeability is rapid in the surface soils and rapid or very rapid in the subsoils.

Table 11.4-5
1986 Annual Estimated Unemployed
Lake and Klamath Counties, Oregon

	1986 Ave Annual Est Unemployed
Office:	
Bookkeeping	67
Typing & General Office	166
Clerk Typist	16
Receptionist & Communication	49
Secretaries	46
Mechanics:	
Heavy Equipment Maintenance	76
Diesel Engine Mechanics	25
Mechanics & Repair, Other	35
Construction:	
Civil Technology	22
Construction Equipment Operation	62
Custodial Services	47
Services	
Truck Drivers	139
Industrial Truck Operator	46
Personnel Training Programs	4
Guards & Doorkeepers	32
Forest Products	
Heavy Equipment Operation	34
TOTAL	866

Source: OPPS Research & Statistics, State of Oregon, Employment Division; Planning Information Corporation, January 1988.

SOUND POWER LEVEL (L_W) - Using the decibel scale:

$$L_W = 10 \log_{10}(W/W_o)$$

where W is the power in watts of the sound source, and W_o is the reference power level, usually 10^{-12} W.

SOUND PRESSURE LEVEL (L_P) - acoustic intensity I is directly proportional to the maximum acoustic pressure squared. Based on this relationship,

$$L_P = 10\log_{10}(P^2/P_o{}^2)$$

where P is the maximum acoustic pressure in N/m^2, and P_o is the reference acoustic pressure. Note that an increase in acoustic pressure by a factor of 10 results in a change in sound pressure level of 20 dB. Sound level meters used in environmental assessment normally measure time averaged sound pressure, called root-mean-square pressure.

THRESHOLD OF HEARING - on the sound intensity level scale, the threshold of hearing $I = I_o = 10^{-12}\ W/m^2$. This occurs at

$$L_I = 10\log_{10}\ (I/I_o) = 10\ \log_{10} = 1 = 0\ dB$$

THRESHOLD OF ACOUSTICAL PAIN - on the sound intensity level scale, the point when most persons experience pain due to excess sound occurs at $I = 1\ W/m^2$. In decibels

$$L_I = 10\log_{10}(1/10^{-12}) = 10\log_{10}(10^{12}) = 10(12) = 120\ dB$$

The soil is excessively drained. Permeability is rapid in the surface soils and rapid or very rapid in the subsoils. Coarse fragment content average greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 41C

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 3 inches thick.

Surface layers: Very dark grayish brown to dark yellowish brown loam or sandy loam; single grain or very weak, medium granular structure; 10 to 60 percent angular and subround gravels and cobbles by volume; loose; nonplastic; pH ranges from 6.0 to 7.0; 8 to 14 inches thick.

Subsoil layers: Dark grayish brown, dark brown, or dark yellowish brown gravelly and cobbly sandy loam or loamy sand; single grain or very weak, fine subangular blocky structure; 30 to 80 percent angular and subround gravels and cobbles by volume; loose; nonplastic; pH ranges from 6.0 to 7.5; 20 to 50 inches thick.

(50-76) Residual and Colluvial Soils from Pyroclastic Rocks and Vesicular Basalt

3.4.2.25 Mapping Unit 63A

Mapping Unit 63A consists dominantly of Landtype 63A and minor amounts of Landtypes 62A and 63B. Landtype 63A is similar to Landtype 62A with the exception of soil texture. It is similar to Unit 63B with the exception of slope range and position in the landscape.

Landtype 63A has moderately deep and deep brown to yellowish brown loamy residual soils with ponderosa pine vegetation. Surface soils are thin and moderately coarse or medium textured. Subsoils are thin to moderately thick and medium to moderately coarse textured.

Bedrock is massive and soft to moderately hard brown or yellowish brown tuff or breccia. Depth to bedrock ranges from 22 to 40 inches. Bedrock weathers rapidly when exposed and becomes highly fractured.

Typically, Landtype 63A occurs on gently sloping ridges and sideslopes at lower elevations and above juniper associated vegetation. Slopes range from 0 to 15 percent.

Table 11.4-6
Population 1980-1986
Lake County, Town of Lakeview, Lakeview Area, Oregon

	1980	1981	1982	1983	1984	1985	1986	% Change 1980-86	% Average Annual Change 1980-86
Lakeview	2770	2740	2810	2750	2755	2755	2785	0.5%	0.1%
Urban Growth Area*	1001	1093	1127	1150	1178	1187	1191	19.1%	3.0%
Total Urban Lakeview	3771	3833	3937	3900	3933	3942	3976	5.5%	0.9%
Remainder of County	3762	3768	3688	3600	3667	3508	3324	-11.6%	-2.0%
Total Lake County	7532	7600	7625	7500	7600	7450	7300	-3.1%	-0.5%

*1980 population estimate was obtained from the 1982 amendment to The City of Lakeview Comprehensive Plan. Remaining years have been estimated based on the number of new building permits multiplied by 2.3.

Source: Center for Population and Research, Portland State University; Lake County Planning Department; Lake County Assessor's Office; Planning Information Corporation, January 1988.

14.6 GLOSSARY

AMBIENT NOISE LEVEL - the characteristic sound which exists without the introduction of any external noise source.

CALIBRATOR - a reference sound level source traceable to the National Bureau of Standards for calibration of a sound level meter.

DECIBEL (dB) - a unit of measure used to express the loudness of a sound. (See Sound Intensity Level).

DECIBELS (A-Weighted) (dBA) - sound level measured on a sound level meter using an A-weighting filter. The attenuation characteristic of this filter approximates the hearing spectrum of the human ear.

DECIBELS (C-Weighted) (dBC): sound level measured on a sound level meter using a C-weighting filter. The C-weighing network, generally assumed to be a good approximation to a linear response to sound pressure level, is used when there is reason to believe that there is low frequency roll-off of the A-weighted filter. Certain annoying noise sources (such as a diesel locomotive) have a large percentage of their energy below 200-250 Hz. For this type of source, a C-weighted sound level is very informative.

IMPULSE SOUND - (or impact sound) - transient acoustical events of short duration (usually <0.5 sec) and involve a change of sound pressure level above some minimum reference value (usually 40 dB). Examples are mine blasts, aircraft sonic booms and gunshots.

INVERSE SQUARE LAW - Consider a point source of power W emitting periodic waves in three dimensions. Energy from the source is assumed to be transmitted equally in all directions. At a distance r from the source, the energy is uniformly distributed over a sphere of area. 4 pi r^2. The intensity I at this distance from the source will be $I = W/4 \text{ pi } r^2$. The intensity thus decreases as $1/r^2$. This result is called the inverse square law for wave intensity.

L_1, L_{10}, L_{50}, L_{90} - sound levels exceeded only be a percentage (as indicated by the subscript numeral) of all sounds measured.

L_d (daytime equivalent sound level) - the equivalent (see L_{eq}) A-weighted sound level during a 15-hour time period from 7 a.m. to 10 p.m. (0700 hours to 2200 hours).

lupine, Ross sedge, bottlebrush squirreltail, and some juniper, mountain mahogany, and bitterbrush.

The soil is well drained. Permeability is rapid in the surface soils and rapid in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

<u>Range of Profile Characteristics of Soil 63B</u>

Litter: Needles, leaves, twigs, and decomposing organic matter; 0.25 to 2 inches thick.

Surface layers: Dark brown or very dark grayish brown loam or sandy loam; weak, medium granular structure; 0 to 5 percent gravel by volume; soft; slightly plastic; pH ranges from 6.5 to 7.2; 5 to 12 inches thick.

Subsoil layers: Dark brown or brown sandy loam; weak, fine subangular blocky structure; 0 to 50 percent gravels and cobbles by volume; soft to slightly hard; slightly plastic; pH ranges from 6.5 to 7.5; 15 to 30 inches thick.

3.4.2.27 <u>Mapping Unit 64</u>

Mapping Unit 64 consists dominantly of Landtype 64 and minor amounts of Landtypes 30A, 35, 56A, and 63A. Landtype 64 is similar to Landtype 63A with the exception of soil parent material and plant community type.

Landtype 64 has moderately deep to deep, brown and yellowish brown gravelly residual soils with ponderosa pine-bitterbrush vegetation. Surface soils are very thin to thin and moderately coarse or medium textured. Subsoil layers are moderately thick to thick and moderately fine to moderately coarse textured.

Bedrock is soft and massive rhyolitic ash-flow tuff, ashy diatomite, and lacustrine tuffaceous siltstone and sandstone. Depth to bedrock ranges from 25 to 45 inches.

Typically, Landtype 64 occurs on gently rolling tablelands at lower elevations along the forest fringe. Slopes are less than 15 percent.

This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, bitterbrush, Idaho fescue, Ross sedge, bottlebrush squirreltail, squawcarpet, and some manzanita and mountain mahogany.

Table 11.4-8
Building Permits
Lake County, Town of Lakeview, Lakeview Area, Oregon

	Census 1980	1980	1981	1982	1983	1984	1985	1986	1987	Annual* Average 1980-87
Town of Lakeview										
Total Housing Units	1148	9	15	14	3	2	2	6	4	7
Single Family	975	6	9	0	1	0	0	1	0	2
Multi Family	133	0	0	0	0	0	0	0	0	0
Mobile Homes	40	3	6	14	2	2	2	5	4	5
Lakeview Urban Growth Area										
Total Housing Units**	345	38	21	27	18	22	13	13	9	20
Single Family	NA	7	1	2	0	0	0	0	2	2
Multi Family	NA	0	0	0	0	0	0	0	0	0
Mobile Homes	NA	31	20	25	18	22	13	13	7	19
Remainder of County**										
Total Housing Units	1682	56	78	28	52	40	26	23	31	42
Single Family	NA	17	14	11	9	5	1	7	6	9
Multi Family	NA	0	0	0	0	0	0	0	0	0
Mobile Homes	NA	39	64	17	43	35	25	16	25	33
Lake County										
Total Housing Units	3175	103	114	69	73	64	41	42	44	69
Single Family	2210	30	24	13	10	5	1	8	8	12
Multi Family	329	0	0	0	0	0	0	0	0	0
Mobile Homes	636	73	90	56	63	59	40	34	36	56
Mobile Home Moves***	NA	28	28	28	28	28	28	28	28	28
Outside County	NA	13	13	13	13	13	13	13	13	13
Within County	NA	14	14	14	14	14	14	14	14	14

*Subject to rounding error.
**1980 Census Lakeview Urban Growth Area has been estimated from the 1982 Lakeview Comprehensive Plan.
***Outside the County is based on average number of Mobile homes moved outside the County between 1982 and 1987. Within the County is based on average number of Mobile homes moved within the County between 1982 and 1985. Subject to rounding error.

Source: Lake County Planning Department; Lake County Assessor's Office; Planning Information Corporation, January 1988.

14.4 RESULTS AND DISCUSSION

14.4.1 Significance of Noise Measurements

According to the Environmental Protection Agency (1974), a yearly average L_{eq} of more than 70 dB is identified as requisite to protect the public health against hearing loss. An L_{eq} of 80 dB for eight hours is considered acceptable in industrial situations so long as the exposure over the remaining 16 hours per day is low enough to result in a 24-hour L_{eq} of 60 dB.

The L_1 level in the vicinity of Quartz Mountain ranged from 22 to 74 dB. The significance of this value is that only one percent of all sounds monitored during the sampling period exceeded this level. Thus, for all practical purposes, this value represents the maximum sound measured. Each of the measurements >70 dB were associated with the passing of a large truck on SH 140 and usually lasted only a few seconds. Eighty per- cent of all sound measurements occurred between 16 dB (L_{90}) and 51 dB (L_{10}).

Only three sources of sound were identified - wind in the trees, airplanes flying overhead and vehicles on SH 140. Nearly all differences between measurement values were related to the presence or absence of one of these three sources. During the monitoring period on Sunday morning under calm, clear conditions, the background noise was generally near 17 dB, increasing to 60 dB when a plane passed over at approximately 30,000 ft msl, then decreasing back to 17 dB. On occasion, the two residents of the village used small tractors to clear the snow, however this activity did not take place during measurement periods.

sedge, bottlebrush squirreltail, squawcarpet, and some manzanita and mountain mahogany.

The soil is well drained. Permeability is rapid or moderate in the surface soils and slow or moderate in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 64A*

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 2 inches thick.

Surface layers: Very dark grayish brown or dark brown sandy loam or loam; weak, fine granular structure; 2 to 25 percent subround and angular gravel by volume; soft, slightly plastic; pH ranges from 6.0 to 7.0; 4 to 7 inches thick.

Subsoil layers: Dark yellowish brown, dark brown, or dark reddish brown gravelly clay loam, loam, or sandy loam; weak to moderate, medium granular and weak to moderate, fine subangular blocky structure; 3 to 60 percent gravels and cobbles by volume; slightly hard; slightly plastic; pH ranges from 6.4 to 7.2, 25 to 40 inches thick.

3.4.2.29 Mapping Unit 64B*

Mapping Unit 64B* consists dominantly of Landtype 64B* and minor amounts of Landtypes 30A, 35, 56A, and 63A. Landtype 64B* is similar to Landtype 63A with the exception of soil parent material and plant community type. Landtype 64B* is similar to these other Landtypes except that 64B* is mesic, not frigid, and is found at lower elevations and on south slopes.

Landtype 64B* moderately deep to deep, brown and yellowish brown gravelly residual soils with ponderosa pine-bitterbrush vegetation. Surface soils are very thin to thin and moderately coarse or medium textured. Subsoil layers are moderately thick to thick and moderately fine to moderately coarse textured.

Bedrock is soft and massive rhyolitic ash-flow tuff, ashy diatomite, and lacustrine tuffaceous siltstone and sandstone. Depth to bedrock ranges from 25 to 45 inches.

Typically, Landtype 64B* occurs on gently rolling tablelands at lower elevations along the forest fringe. Slopes are less than 16 to 40 percent.

Table 11.4-9
Housing Units*
Lake County, Town of Lakeview, Lakeview Area, Oregon

	Census 1980	1980	1981	1982	1983	1984	1985	1986	1987
Town of Lakeview									
Total Housing Units	1148	1156	1169	1177	1179	1180	1180	1183	1184
Single Family	975	981	990	990	991	991	991	992	992
Multi Family	133	133	133	133	133	133	133	133	133
Mobile Homes*	40	42	46	54	55	56	56	58	59
Lakeview Urban Growth Area									
Total Housing Units**	345	371	387	402	412	424	428	431	433
Single Family	NA	NA	NA	NA	NA	NA	NA	NA	NA
Multi Family	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mobile Homes	NA	NA	NA	NA	NA	NA	NA	NA	NA
Remainder of County									
Total Housing Units	1682	1723	1781	1798	1832	1855	1865	1873	1886
Single Family	NA	NA	NA	NA	NA	NA	NA	NA	NA
Multi Family	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mobile Homes	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lake County									
Total Housing Units	3175	3250	3336	3378	3423	3459	3472	3487	3503
Single Family	2210	2240	2264	2277	2287	2292	2293	2301	2309
Multi Family	329	329	329	329	329	329	329	329	329
Mobile Homes*	636	681	743	772	807	838	850	857	865

*Adjusted for mobile home moves.

**The 1980 total housing units is from the Lake County Comprehensive Plan Amendment (1982) No housing by type estimates are available. Therefore housing by type for both the Urban Growth Area and the Remainder of County are not available.

Source: Lake County Planning Department; Lake County Assessor's Office; Planning Information Corporation, January 1988.

TABLE 14.3-1 Continued.

SITE 7.
Lakeview SAFEWAY Parking Lot

Date/Day Time	Number of Observations	Sound Pressure Level L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1/15 (Fri) 1200 (A)	193	68.5	62.5	54.5	50.6	59.0
1/17 (Sun) 1250 (B)	155	60.2	54.7	47.7	41.1	51.1
1/18 (Mon) 2310 (C)	168	73.2	60.5	45.1	38.1	61.8

Environmental Conditions:

(A) In parking lot near information booth in downtown Lakeview. Snow berm in center of street. Normal noontime traffic. Air Temperature: 40°F, Relative Humidity: 80%, Sky Cover: Cloudy, Wind: 0-3 mph.

(B) In parking lot near information booth in downtown Lakeview. Snow berm in center of street. Normal Saturday noontime traffic. Air Temperature: 36°F, Relative Humidity: 70%, Sky Cover: Clear, Wind: 0-1 mph.

(C) In parking lot near information booth in downtown Lakeview. Snow berm in center of street. Monday night traffic with several large trucks parked running 50-75 feet away. L_1 was the fire siren. Air Temperature: 16°F, Relative Humidity: M, Sky Cover: Cloudy, Wind: Calm.

SITE 8.
Bly School

Date/Day Time	Number of Observations	Sound Pressure Level L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1/15 (Fri) 1600	199	64.0	46.8	36.1	29.0	44.1

Environmental Conditions:

On street just off elementary school property in village of Bly. Street dry with ice patches. Air Temperature: 25°F, Relative Humidity: 75%, Sky Cover: Total, low clouds. Wind: 4-5 mph from SW. Gusty.

This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, aspen, bitterbrush, Idaho Fescue, Ross sedge, bottlebrush squirreltail, squawcarpet, and some manzanita and mountain mahogany.

The soil is somewhat poorly to moderately well drained. Permeability is rapid or moderate in the surface soils and slow or moderate in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

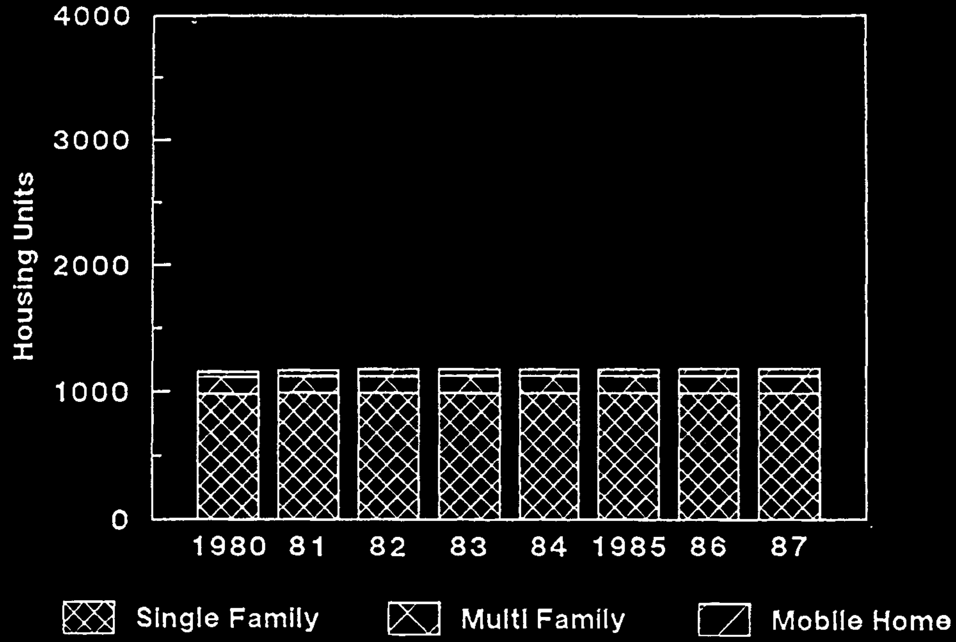
Range of Profile Characteristics of Soil 65

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 2 inches thick.

Surface layers: Very dark grayish brown or dark brown sandy loam or loam; weak, fine granular structure; 2 to 25 percent subround and angular gravel by volume; soft, slightly plastic; pH ranges from 6.0 to 7.0; 4 to 7 inches thick.

Subsoil layers: Dark yellowish brown, dark brown, or dark reddish brown gravelly clay loam, loam, or sandy loam; weak to moderate, medium granular and weak to moderate, fine subangular blocky structure; 3 to 60 percent gravels and cobbles by volume; slightly hard; slightly plastic; pH ranges from 6.4 to 7.2, 25 to 40 inches thick.

Figure 11.4-5
Housing Units by Type 1980-1987
City of Lakeview, Oregon



Source: Lake County Planning Department; Lake County Assessor's Office; Planning Information Corporation, January 1988

TABLE 14.3-1 Continued.

SITE 4.
Logging road just off Quartz Mountain Pass

Date/Day Time	Number of Observations	Sound Pressure Level L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1/15 (Fri) 0940 (A)	131	64.8	50.2	22.5	18.2	56.4
1/15 (Fri) 1400 (B)	197	41.0	34.7	29.8	25.1	31.5
1/17 (Sun) 0900 (C)	150	22.0	18.0	16.6	16.1	16.8
1/17 (Sun) 2230 (D)	150	61.0	22.5	17.6	16.8	19.3
1/18 (Mon) 1400 (E)	197	74.0	40.5	24.4	20.8	42.6

Environmental Conditions:

(A) 25 feet south of SH 140 on logging road at top of Quartz Mountain pass west of village. Deep snow covered. Air Temperature: 35°F, Relative Humidity: 60%, Sky Cover: Clear, Wind: Calm.

(B) On logging road just south of company office house in Quartz Mountain village. Deep snow covered. Air Temperature: 30°F, Relative Humidity: 80%, Sky Cover: Cloudy, Wind: Calm.

(C) 25 feet south of SH 140 on logging road at top of Quartz Mountain pass west of village. Deep snow covered. Air Temperature: 15°F, Relative Humidity: M, Sky Cover: Clear, Wind: Calm.

(D) Directly on SH 140 at top of Quartz Mountain pass west of village. Deep snow covered. Air Temperature: -5°F, Relative Humidity: 50%, Sky Cover: Clear, Wind: Calm.

(E) About 12 feet off SH 140 at top of Quartz Mountain pass west of village. Deep snow covered. Air Temperature: 30°F, Relative Humidity: 80%, Sky Cover: Partly Cloudy, Wind: Calm.

TABLE 3.5-1

INTERPRETATIONS FOR EROSION AND COMPACTION

Land-type No.	Natural Stability and Type of Mass Movement	Expected Mass Movement as a Result of Man's Activities	Surface Soil Erosion Potential (Sheet)	Soil Erosion Potential (Rill & Gully)	Compac-tion Hazard	Displace-ment Hazard
Miscellaneous landtypes 1-8 and 11-12 are not rated due to highly variable characteristics.						
16*	N.A.	N.A.	Moderate	High	High	High
18*	N.A.	N.A.	Moderate	High	High	High
30A	Very Stable	Unchanged	High	Moderate-High	Low-Summer High-Winter	Low
31A	Very Stable	Unchanged	High	Moderate-High	Low-Summer High-Winter	
34A	Very Stable	Unchanged	Low	Low	High	Low
34B	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
34B/R.O.	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
34A*	Very Stable	Unchanged	Low	Low	High	Low
34B*	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
34C*	Stable-Rotational Slumps	Unchanged	Moderate	Moderate	High	Moderate
37A	Very Stable	Unchanged	Low	Low	High	Low
37B	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
37B/R.O.	Stable-Rotational Slumps	Unchanged	Low-Moderate	Low-Moderate	High	Low
37C	Stable-Rotational Slumps	Unchanged	Moderate	Moderate	High	Moderate
40A	Very Stable	Unchanged	Low	Low	Low	Moderate
40B	Very Stable	Unchanged	Moderate	Moderate-High	Low	High
40C	Very Stable	Unchanged	High	Severe	Low	High
41A	Very Stable	Unchanged	Low	Low	Low	Low-Moderate
41B	Very Stable	Unchanged	Moderate	Moderate-High	Low	Moderate-High
41C	Very Stable	Unchanged	High	Severe	Low	High
63A	Very Stable	Unchanged	Low	Low	Moderate	Low
63B	Stable-Rotational Slumps	Unchanged	Moderate	Moderate	Moderate	Moderate
64	Very Stable	Unchanged	Low	Low	Moderate	Low
64A*	Very Stable	Unchanged	Low	Low	Moderate	Low
64B*	Very Stable	Unchanged	High	High	Moderate	Moderate
65	Very Stable-	Unchanged	Low	Low	Moderate	Low

NOTE: Land types are described in accompanying text.

Table 11.4-11
Motel Rooms
Lakeview Area, Oregon

	# of Rooms	Summer % Occupied	Summer # of Vacant Units	Winter % Occupied	Winter # of Vacant Units
AA Motel*	19	100%	0	50%	10
Bestwestern Skyline Motor Lodge	38	99%	0	58%	16
Hunter's Hot Springs	18	100%	0	80%	4
Interstate 8 Motel*	32	100%	0	50%	16
Lakeview Lodge Motel	40	100%	0	20%	32
Rim Rock Motel	26	85 - 95%	3	20 - 30%	20
Snyder' Motel*	7	100%	0	50%	4
TOTAL	180		3		100

* Estimated Winter Occupancy.

Source: Planning Information Corporation, January 1988.

TABLE 14.3-1

SOUND LEVEL ANALYSIS

SITE 1.
'A' frame house

Date/Day Time	Number of Observations	Sound Pressure Level L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1/14 (Thu) 1000 (A)	152	74.0	51.0	37.2	33.5	50.6
1/14 (Thu) 1500 (B)	201	75.0	54.0	40.5	36.2	53.3
1/15 (Fri) 1630 (C)	220	62.6	41.5	31.5	21.9	33.5
1/18 (Mon) 1430 (D)	204	70.2	34.0	21.5	18.7	32.5

Environmental Conditions:

(A) 25 feet from 'A' frame house in Quartz Mountain. 50 feet fro edge of pavement of SH 140. Road slushy, snow covered, sanded. Air Temperature: 40°F, Relative Humidity: 65%, Sky Cover: Total, low clouds. Wind 0-4 mph from S.

(B) Same location as (A). Road slushy, snow covered, sanded. Air Temperature: 45°F, Relative Humidity: 75%, Sky Cover: Total, low clouds. Wind: 3-10 mph. Dir. Variable.

(C) Same location as (A). Following heavy new snow overnight. Road snow covered, sanded. Air Temperature: 20°F, Relative Humidity: 65%, Sky Cover: Total, low clouds. Wind: Calm.

(D) About 12 feet from the edge of the highway in the parking lot of the 'A' frame house. Heavy snow (15") the previous night precluded parking closer to the house. Road snow covered, plowed and sanded. Air Temperature: 30°F, Relative Humidity: 80%, Sky Cover: Total, low clouds. Very light snow. Wind : Calm.

3.5.1.5 <u>Compaction Hazard</u>

This interpretation refers to the relative ease soils of the landtypes can be compacted when wet or moist. (Compaction, as used here, is defined as the point at which the soil macroscopic pore space is reduced by one-half, or more, or when the bulk density is increased by twenty percent, or more, above the natural state.) Factors considered include: Texture, structure, coarse fragments, position, drainage, and precipitation. Several units are rated according to season of use.

Moderate - Factors indicate a moderate risk of soil compaction.

High - Factors indicate a high risk of soil compaction.

3.5.1.6 <u>Displacement Hazard</u>

This interpretation rates the landtypes as to the ease with which its soil material can be loosened and moved. Mixing and displacement can be done by hoof, foot, vehicular, or log traffic. Factors considered are soil texture, soil structural strength, bulk density, organic matter, slope gradient, and coarse fragments.

Low - Factors indicate that these soils are not easy to loosen and/or displace.

Moderate - Factors indicate that these soils are moderately easy to loosen and/or displace.

High - Factors indicate that these soils are easy to loosen and/or displace.

Table 11.4-12
RV Parks
Lakeview Area, Oregon

Name of RV Park	# of Spaces	# of Spaces Occupied (Peak Season - Summer)	# of Spaces Vacant (Peak Season - Summer)	Year Built	Contact
Hunter's	23	23	0	1986	Mona
Parkway RV*	23	23	0		Smith
Juniper's Reservoir	20	15	5	1986	Treva Kelly
	66	61	5		

*Parkway RV Park also has two motel rooms and 3 mobile home spaces.

Source: Planning Information Corporation, January 1988.

14.3 DATA ACQUISITION

14.3.1 Monitoring Equipment

The data acquisition equipment consisted of a Bruel & Kjaer Model 2230 Precision Integrating Sound Level Meter and a Bruel & Kjaer Model 1625 1/3-1/1 octave filter set (Anon. 1984). The 2230 sound level meter is a Type 1 precision instrument complying with the IEC recommendations for integrating and impulse sound measurements and with the American National Standards Institute (ANSI SI.4.2972 Type 1 standards) (1971). Pre- and post-measurement calibrations were performed with a Bruel & Kjaer Sound Level Calibrator Type 4230. For this instrument, the adjustment for barometric pressure (reflecting elevation) was done as part of the calibrations. Each instrument was certified as being calibrated traceable to National Bureau of Standards by the company from which it was rented.

The liquid crystal display of the 2230 sound level meter comprises four digits giving a 0.1 dB resolution. The display is updated once per second. Six attenuator settings provide six overlapping 70 dB measuring ranges from 24 dB to 130 dB. For the lowest range, the lower limit for S/N ratio >5 dB is 24 dB. The display, however indicated sound levels down to at least 15 dB. Values below the 24 dB indicated bottom limit were recorded in the data sets.

14.3.2 Data Collection Procedures

A short measurement program to determine ambient noise was conducted during January 1988. Measurements were made during both day and nighttime hours during the week and on the weekend. The sampling periods over which the sound level measurements were obtained were generally 20 to 30 minutes with data recorded at five to 15 second intervals. This resulted in a data base of 150 to 330 observations used in each of the statistical analyses.

Both ambient noise levels and octave band data were obtained. The octave band data, as presented in this report, represents instantaneous readings for each of the frequency levels being recorded. Measurements were made for the Quartz Mountain area and also for downtown Lakeview. Because the background noise level at Quartz Mountain was generally so low, with the primary sound resulting only from the light breeze in the trees, it was difficult to obtain consistent observations for each frequency band. Since there was no significant anthropogenic noise source, it can be assumed that the octave band measurements are representative of the background sound levels for a quiet, rural, forested area.

3.7 GLOSSARY

A-HORIZON - Zone of eluviation. The uppermost zone in the soil profile, from which soluble salts and colloids are leached, and in which organic matter has accumulated. Generally the most fertile soil layer.

ALLUVIAL - Pertaining to material that is transported and deposited by running water.

ALLUVIUM - A general term for all detrital and unconsolidated material deposited or in transit in streams, including gravel, sand, silt, clay, and all variations and mixtures of these.

ANDESITE - A dark gray to black, dense, fine-grained extrusive igneous rock. Very similar to basalt.

ASH - Uncemented volcanic ejecta less than 4.0 mm in diameter.

AVAILABLE WATER - The portion of water in a soil that can be absorbed by plant roots, usually considered to be that water held in the soil against a tension of up to approximately 15 bars.

AVAILABLE WATER HOLDING CAPACITY - The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil. Commonly defined as the difference between the percentage of soil water at field capacity and the percentage at wilting point. This difference multiplied by the bulk density and divided by 100 gives a value in surface inches of water per inch depth of soil.

BASALT - A very dark to black, dense, fine-grained extrusive igneous rock. Very similar to andesite.

BEARING CAPACITY - The maximum load that a soil can support before failing.

BEDROCK - The more or less solid rock in place either on or beneath the surface of the earth. It may be soft or hard and have a smooth or irregular surface.

B-HORIZON - Illuvial horizon. The lower soil zone which is enriched by the deposition or precipitation of material from the overlying zone or A-horizon.

BRECCIA - A rock composed of coarse angular fragments cemented together.

Since the inventory for the Comprehensive Plan was completed, a number of units have been built in both Lakeview and the Lakeview urban growth boundary. Therefore, the buildable land area is some what smaller than the amounts listed here. Not all of the buildable land, particularly in the urban growth area, is served with sewer, water, and roads. Therefore, considerable lead time would be required to develop this currently unserviced land (Cannon, pers. comm., 10 November 1987).

11.4.4 Local Government Facilities, Services, and Fiscal Conditions

11.4.4.1 Lake County

Lake County provides the following services: general government; Clerk; Assessor; Treasurer; Tax Collector; Sheriff; roads; library; landfill; courts; youth advisor; Watermaster; emergency service; county extension; and mental health.

11.4.4.1.1 Lake County General Government

Courthouse

The Lake County Courthouse is located in the center of Lakeview. It was constructed in the 1950's and consists of three stories including the basement. Based on dimensions shown in the building's construction plan, there are 23,200 square feet of office, storage, and mechanical space available for use. Attached to the Courthouse is Memorial Hall, a two story, 7,960 square foot building that currently houses the County Library on the first floor and the County Museum and meeting room on the lower level. The sheriff's office and county jail are also located in the courthouse and occupy an estimated 1,000 square feet of the facility, leaving 22,200 square feet available for general government and other county departments.

The courthouse is in good structural condition, however, available space is becoming a problem for the agencies located in the building. A possible solution to the space problem would include converting part of the lower level of Memorial Hall from meeting room to office space. Plans for this conversion have not been finalized at this time.

The following county departments and agencies are located in the courthouse: County Commissioners and Assistant; Planning Office; Clerk; Assessor; Treasurer; Tax Collector; County Court; Circuit Court; Sheriff; Justice of the Peace; Youth Adviser; Corrections; Mental Health; Watermaster; Emergency Services; and County Extension.

TABLE 14.2-1

DECIBEL LEVELS OF COMMON SOUNDS

Source of Sound	dB	Description
Large rocket engine (nearby)	180	
Jet airplane takeoff (nearby)	150	
Pneumatic riveter; machine gun	130	
Rock concert with amplifiers (2m)	120	Threshold of Pain
Jet takeoff (60m)	120	
Construction noise (3m)	110	
Subway train	100	
Heavy truck (15m); Niagara Falls	90	Constant exposure endangers hearing
Noisy office machines, ave. factory	80	
Busy traffic	70	
Normal conversation (1m)	60	
Quiet office	50	Quiet
Library	40	
Soft whisper (5m)	30	Very Quiet
Rustling leaves	20	
Normal breathing	10	Barely audible
	0	Hearing threshold

SOURCE: Tipler 1976.

COMPOSITE CONE - A volcanic cone built of alternating layers of rhyolitic and andesitic lava and pyroclastic material, with moderately steep or steep slopes.

CREEP - Slow mass movement of soil and soil material down relatively steep slopes primarily under the influence of gravity but facilitated by saturation with water and by alternate freezing and thawing.

CRITICAL SOIL - The term "critical soil" is frequently used by laymen, but it is a meaningless term unless it is related to a specific function. Many soils may be critical for one reason or another, but different soils may not be critical for the same reasons. For example, a deep, wet, plastic and unstable soil will be critical in relation to road location and stability. This soil is not critical in relations to regeneration and droughtiness problems. Another soil may be very shallow over hard bedrock. This soil is not critical from the standpoint of road stability, but may be critical as to regeneration problems resulting from droughtiness and low fertility. It may also be critical in relation to surface erosion. The term "critical soil" must be defined by the user in relation to its intended purpose.

DEBRIS SLIDE - A rapidly moving slide composed of soil, bedrock, or both.

DISPLACEMENT - Soil displacement refers to the repositioning or removal of the surface soil layers by mechanical action.

DUFF - The more or less firm organic layer on top of mineral soil, consisting of fallen vegetative matter in the process of decomposition, including everything from litter on the surface to pure humus. Duff is a general, nonspecific term.

DURIPAN - A subsurface horizon that is cemented by silica.

EOLIAN SOIL MATERIAL - Soil material accumulated through wind action.

EROSION - (1) The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep; (2) detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:

Acceleration Erosion - Erosion much more rapid than normal, natural, or geologic erosion primarily as a am on Fridays and Saturdays. In the north-end the deputies use their best judgement on patrols, balancing their hours within the week.

Staff

The Sheriff's Department has 11 staff positions.

1 Sheriff
4 Deputies
1 Administrative Staff
4 Jailers
1 Cook

In addition, there are two relief positions, one jailer and one cook.

The Sheriff's Department has difficulty recruiting new deputies, especially in the north end of the county. Of the two deputies in the north end, one has been with the department for one year and one has been with the department for two and one half years. Because there are only two deputies in the south, there is no provision for coverage during days off, vacation, or in case of illness. The turnover rate in the north end is high. The two deputies stationed out of Lakeview have been with the department five to six years. The county provides the deputy's uniforms; they must provide their own guns. It costs the county an average of $800 to equip a new deputy.

Facilities

The Sheriff's Department contains an estimated 1000 square feet of office space. This includes two small offices.

Jail

The Lake County Jail is operated by the Sheriff's Department and is located in the courthouse in Lakeview. The jail has seven cells, two of which are used primarily to house females. The jail has no facilities for juveniles, consequently juvenile offenders must be transported directly to Klamath County. The capacity of the jail is 18 persons, including an eight person drunk tank. Average occupancy for the jail is eight prisoners. The sheriff thinks that 5 more prisoners or an average occupancy of 13 is about maximum. The Lake District Hospital has one secure room for prisoners with psychiatric problems. There are no holding facilities in other parts of the county, therefore, all prisoners must be directly transported to jail. The jail holds female prisoners for Harney County and occasionally holds prisoners for Wasco

14.2 LITERATURE REVIEW

14.2.1 Noise Fundamentals

Noise is most often and most simply defined as unwanted sound (Lipscomb and Taylor 1978). Noise problems almost always involve three elements: the source of the sound, the transmission path and the receiver. The consideration of environmental noise can also be divided into three separate categories: the characteristics of the noise source, the attenuation of sound along the transmission path and the exposure characteristics of the potential receivers. The description of noise sources include the physical characteristics of the sound itself, its loudness, time(s) of occurrence, duration, frequency, and the source location. The transmission losses are normally determined using the inverse square law and the presence and location of barriers and reflectors. The noise environment of the receiver is considered in relation to sleep disturbance, interference with speech communication and interruption of, or interference with, other human activities (Rau and Wooten 1980).

The physical description of sound is usually based on its loudness as a function of its frequency. Noise, in general, is sound composed of many frequencies of various loudness distributed over the audible frequency range. A common method used to compare one loudness (Q) to another (Q_o) is their ratio in bels where:

$$\text{Bel} = \log_{10} (Q/Q_o) \qquad (1)$$

Because the bel represents large difference in Q, a smaller unit, the decibel (dB), is more commonly used.

$$\text{Decibel} = 10 \log_{10}(Q/Q_o) \qquad (2)$$

Since $\log_{10} = 1$, $\log_{10} (100) = 2$, $\log_{10} (1000) = 3$, etc., a 10 dB increase corresponds to an increase in Q by a factor of 10 times. For most environmental studies, the A-weighted scale (dBA) is used. This scale has been designed to weight the various components of noise according to the response of the human ear. Since the ear does not perceive low frequency or high frequency sounds as well as those in the middle frequencies, the dBA scale assigns greater "loudness" impact to the middle frequencies.

14.2.2 Sound Intensity and the Inverse Square Law

Traveling sound waves transmit energy in the direction of propagation of the wave. The intensity (I) of a traveling wave is the time average rate at which energy is transmitted

GEOMORPHOLOGY - The study of landforms as they relate to geologic composition and history.

GLACIATED VALLEY - U-shaped valley formerly occupied by a glacier.

GRAVEL - A rock fragment between 2.0 millimeters and 3 inches in diameter.

GROUND COVER - Litter, slash, grasses, forbs, or low-growing reproduction which absorbs rainfall energy, reduces overland flow, and keeps soil from being washed or blown away.

HUMMOCKY - Hilly, uneven landscape resulting from deep-seated soil movement, usually of a rotational nature.

HYDROPHOBIC - lacking a strong affinity for water, water repellent.

INCLUSION - Landtype found within a mapping unit that is not extensive enough to be mapped separately or as part of a complex.

INFILTRATION - The gradual downward flow of water from the surface through the soil to ground water and water table reservoirs.

INTRUSIVE BEDROCK - This applies to those igneous rocks derived from magmas that have been injected into older rocks at depth without reaching the surface. These magmas are slow-cooling and form coarse-textured rocks, such as granite.

LACUSTRINE DEPOSIT - Material deposited in lake water and later exposed either by lowering the water level or by the elevation of the land.

LANDFORM - Structural configuration of the topography as a result of past and present geological activity.

LANDSLIDE - A mass of material that has slipped downhill under the influence of gravity, frequently occurring when the material is saturated with water.

LANDTYPE - A land system with a designated soil, vegetation, geology, topography, climate, and drainage situation. The basic taxonomic unit in the Soil Resource Inventory.

LAPILLI - Volcanic ejecta between 4 mm and 32 mm in diameter.

LAVA DOME - Lava domes are masses of lava which have issued from central vents to build a dome-shaped pile of lava.

Table 11.4-14
Lake County, Oregon Major Crime Statistics
1984-86

Year	Crimes Against Persons	Percent Change	Crimes Against Property	Percent Change	Behavioral Crimes	Percent Change	Total	Percent Change	Index Crime Total	Percent Change
1984	23	--	107		131		261		86	
1985	23	--	80	-25.2	107	-18.3	210	-19.5	80	-7.0
1986	34	47.8	147	83.8	114	6.5	295	40.5	130	62.5

Note: Lakeview P.D. missing eight months of 1984 and 12 months of 1985.

Source: Oregon Law Enforcement Data System "Report of Criminal Offenses 1984-86"

SUMMARY

The affected environment for noise, according to the regulations of the State of Oregon, is the Quartz Mountain townsite, presently a small village of three residences locate about 0.5 miles below Quartz Mountain Pass. Secondary noise due to the proposed mining operation may impact lakeview and Bly, the two nearest towns, and baseline or existing noise measurements were collected in those towns as well.

The background noise level at the Quartz Mountain townsite was generally very low, with the primary sounds resulting from a light breeze in the trees, occasional vehicles on the highway, and airplanes passing overhead. Of the 2185 noise measurements taken, 961 measurements were below 30 dB, or "very quiet". Trucks on Oregon State Highway (SH) 140 were responsible for the 22 noise measurements greater than 70 dB. The measurements taken are representative of a quite, rural, forested area in winter. Traffic noise in the summer may be slightly higher. In the towns of Bly and Lakeview, baseline noise levels are very low.

PUMICE - Frothy, volcanic glass; an excessively cellular, light-colored, volcanic ejecta.

PUMICEOUS - Containing pumice properties. Pumiceous volcanic ash is pumice material that is less than 4 mm in diameter.

PYROCLASTIC - A general term applied to rocks formed form volcanic material that has been explosively or aerially ejected from a volcanic vent.

RHYOLITE - A light-colored, fine-grained, acidic, extrusive rock.

RESIDUUM - Soil material formed from rock weathering in place.

RAVEL - The movement of individual particles down a slope by gravitational force.

RUNOFF - That part of the precipitation which appears in surface streams of either perennial or intermittent form.

SAND - A soil separate between .05 and 2.0 millimeters in diameter.

SEDIMENTARY ROCK - Rock formed by deposition of soil and rock particles by water, ice, or wind that later solidifies through cementation, ionic exchange or compression.

SHIELD VOLCANO - A volcanic dome with gentle slopes built up by repeated eruptions of basaltic lava.

SILT - A soil separate consisting of particles between 0.002 and 0.05 millimeters in diameter.

SLOPE CLASSES - Terms to indicate relative range of slope gradients.

A (0 to 15%) -- Gentle
B (16 to 40%) -- Moderately Steep
C (> 40%) -- Steep

SLUMP - A deep-seated, slow-moving, rotational failure occurring in plastic materials, resulting in vertical and lateral displacement.

SOIL - The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. The unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental county. The Lakeview shop includes a 9,600 square foot office and maintenance building and an 8 to 10 bay equipment storage building. The maintenance building was constructed in 1980 and is in very good condition. There are no plans for additions to the shop facility at this time.

The county road-fund is a separate fund in the Lake County budget. Revenues for the fund are obtained chiefly from federal forest receipts and carryovers from previous years budgets. Total revenues for the 1987-88 fiscal year are budgeted at $6.1 million with $2.3 million (38 percent) from cash carryover and $3.2 (52 percent) million from forest receipts. These two sources provide 90 percent of department revenues.

Budgeted expenditures for the current year total $4.9 and are presented in Table 11.4-15 by category.

Although the Quartz Mountain Mine site is in Lake County, it is located on Forest Service land and not accessed by roads under the jurisdiction of the Road Department. In the past, the department has loaned maintenance equipment for road work in the forest area. The department felt that this type of cooperation would continue into the future. Oregon Highway 140 between Lakeview and the mine site is maintained by the State Highway Department; increased travel on the road would not increase maintenance expenditures by the county road department (Robinson, pers. comm., 15 December 1987). See Section 11.4.6 for a discussion of state Highway 140.

11.4.4.1.4 Lake County Parks and Recreation

Lake County maintains three recreation-related facilities at Drew's Reservoir, Cottonwood Reservoir and Plush. Drew's Reservoir park provides picnic tables, 3 boat docks and a ramp. Cottonwood Reservoir facilities are operated jointly by the county and a bass fisherman's association. Facilities at Cottonwood include picnic tables and a boat ramp. The park in Plush serves as the town park, however the county pays a maintenance man to mow and water the grounds.

Maintenance of the reservoir parks is provided by part time employees of the Road Department during the summer months. The county does not operate a parks and recreation department, nor is parks maintenance a separate category in the annual budget (Robinson, pers. comm., 15 December 1987). See section 11.4.7 for a detailed discussion on Recreational Resources in the study area.

TABLE OF CONTENTS

TOESLOPE - That portion of a slope that is transitional between the valley floor and the upper slope.

TUFF - A rock formed of compacted volcanic fragments, generally smaller than 4 mm in diameter.

UNIFIED SOIL CLASSIFICATION SYSTEM (ENGINEERING) - A classification system based on the identification of soils according to their particle size, gradation, plasticity index, and liquid limit. (See Appendix 3.E).

VESICULAR CRUST - A dense, structureless, and highly porous surface soil layer from 2 to 4 inches thick and usually associated with arid or semiarid rangelands.

VOLCANIC EJECTA - Any and all material forcibly blown out of volcanic cones, fissures, and vents.

WELDED TUFF - A tuff that has been indurated (hardened) by the combined action of the heat retained by the particles and the enveloping hot gases.

11.4.4.1.5 Lake County Library

The Lake County Library is located within the county courthouse in Lakeview and is open Monday through Saturday. The library currently contains 31,000 volumes.

The County Library operates three branch libraries, located in Paisley, Silver Lake, and Christmas Valley. Each branch library is open 15 hours per week.

In Lakeview there are three full time librarians. Staffing is adequate according to the Head Librarian. The Head Librarian also stated that the library could accommodate considerable growth (Price, pers. comm., 7 November 1987).

11.4.4.1.6 Lake County Landfill

Lake County's sanitary landfill is located north of the town of Lakeview. The landfill is approximately 10 acres in area, however after having been operated for over 15 years, only four acres remain unused. The Oregon Department of Environmental Quality has estimated that the landfill has about five to seven years of useful service remaining if the site is used very efficiently. The landfill consists of two burn pits, six open pits, and a metal waste area. One burn pit and 2.5 open pits remain to be filled.

The landfill site is owned by the county and operated by a private firm on a 10-year contract. Management of dumping at the site is minimal, there is no one stationed at the landfill to insure that materials are deposited in the appropriate areas or that hazardous materials are properly disposed. No fees are charged for persons using the landfill; operating revenues are generated from the county's general fund property tax levy. Solid waste collection is provided by a private company that charges customers for services. No general fund subsidies for collection services are required. The landfill operations budget for fiscal year 1987-88 totals $21,621.

The Oregon DEQ requires that a closure plan be submitted 5 years before actual closure of the existing landfill takes place. Lake County is therefore beginning the process of developing a closure plan as well as a plan for a new landfill site. Due to new national Environmental Protection Agency requirements for landfills, it is thought that development and operation of a new landfill site will be quite expensive. Before a new site is considered acceptable, groundwater and hydrologic studies must be completed; the use of liners must be investigated; and monitoring systems requirements must be evaluated. Once constructed, attended operations must be

3.9 REFERENCES CITED

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United States Department of Agriculture. Forest Service. 1979. Soil Resource Inventory, Fremont National Forest. USDA, For. Serv., PNW Region. 282 pp. illus.

Table 11.4-16
Lake County, Oregon Fiscal Analysis
General Fund Revenues

Nominal Dollars

Department	85-86	% Total Revenues	86-87	% Total Revenues	87-88	% Total Revenues	Average 85/86-87/88	% Total Revenues
Property Tax	640,888	25.0%	543,518	23.1%	605,560	23.8%	596,655	24.0%
Previous Year	125,169	4.9%	85,081	3.6%	92,000	3.6%	100,750	4.1%
Interest	69,771	2.7%	37,598	1.6%	50,000	2.0%	52,456	2.1%
Other Local	173,867	6.8%	127,908	5.4%	70,450	2.8%	124,075	5.0%
Permits	11,710	0.5%	8,747	0.4%	20,900	0.8%	13,786	0.6%
Fees	56,919	2.2%	54,587	2.3%	58,300	2.3%	56,602	2.3%
Miscellaneous	276	0.0%	12,177	0.5%	10,000	0.4%	7,484	0.3%
Total Local	1,078,600	42.1%	869,616	37.0%	907,210	35.7%	951,809	38.3%
State-General	167,768	6.5%	209,778	8.9%	172,528	6.8%	183,358	7.4%
State-Pub.Health	37,866	1.5%	35,796	1.5%	37,936	1.5%	37,199	1.5%
State-Misc.	10,000	0.4%	0	0.0%	97,000	3.8%	35,667	1.4%
Total State	215,634	8.4%	245,574	10.4%	307,464	12.1%	256,224	10.3%
Federal Sources	327,349	12.8%	320,825	13.7%	326,800	12.9%	324,991	13.1%
Mental Health	104,531	4.1%	115,296	4.9%	166,212	6.5%	128,680	5.2%
Transfers In	93,502	3.6%	98,709	4.2%	84,277	3.3%	92,163	3.7%
Beginning Bal.	743,856	29.0%	700,000	29.8%	750,000	29.5%	731,285	29.4%
Total Revenues	2,563,472 -0.84%	100.0%	2,350,020	100.0%	2,541,963	100.0%	2,485,152	100.0%

Source: Lake County 1987-88 budget;
Planning Information Corporation, January 1988.

APPENDIX 3.A

SOIL PARTICLE SIZE ANALYSIS

Table 11.4-18
Lake County, Oregon Fiscal Analysis
General Fund Revenues

Per Capita (1987 Dollars)

Department	85-86	% Total Revenues	86-87	% Total Revenues	87-88	% Total Revenues	Average 85/86-87/88	% Total Revenues
Population	7,450		7,300		7,300			
Property Tax	$90.82	25.0%	$77.36	23.1%	$82.95	23.8%	$83.71	24.0%
Previous Year	$17.74	4.9%	$12.11	3.6%	$12.60	3.6%	$14.15	4.1%
Interest	$9.89	2.7%	$5.35	1.6%	$6.85	2.0%	$7.36	2.1%
Other Local	$24.64	6.8%	$18.21	5.4%	$9.65	2.8%	$17.50	5.0%
Permits	$1.66	0.5%	$1.24	0.4%	$2.86	0.8%	$1.92	0.6%
Fees	$8.07	2.2%	$7.77	2.3%	$7.99	2.3%	$7.94	2.3%
Miscellaneous	$0.04	0.0%	$1.73	0.5%	$1.37	0.4%	$1.05	0.3%
Total Local	$152.85	42.1%	$123.77	37.0%	$124.28	35.7%	$133.63	38.3%
State-General	$23.77	6.5%	$29.86	8.9%	$23.63	6.8%	$25.76	7.4%
State-Pub.Health	$5.37	1.5%	$5.09	1.5%	$5.20	1.5%	$5.22	1.5%
State-Misc.	$1.42	0.4%	$0.00	0.0%	$13.29	3.8%	$4.90	1.4%
Total State	$30.56	8.4%	$34.95	10.4%	$42.12	12.1%	$35.88	10.3%
Federal Sources	$46.39	12.8%	$45.66	13.7%	$44.77	12.9%	$45.61	13.1%
Mental Health	$14.81	4.1%	$16.41	4.9%	$22.77	6.5%	$18.00	5.2%
Transfers In	$13.25	3.6%	$14.05	4.2%	$11.54	3.3%	$12.95	3.7%
Beginning Bal.	$105.41	29.0%	$99.63	29.8%	$102.74	29.5%	$102.60	29.4%
Total Revenues	$363.28	100.0%	$334.48	100.0%	$348.21	100.0%	$348.66	100.0%

Source: Lake County 1987-88 budget;
Planning Information Corporation, January 1988.

TABLE 3.A-2

PARTICLE SIZE ANALYSIS - SECOND SERIES LAB DATA

Observ. Point #	Sample #	Soil Depth (In.)	%Sand	%Silt	%Clay	Textural Class
24	1	00-18	40.2	41.2	18.6	LOAM
25	2	00-18	36.3	27.6	36.1	CLAY LOAM
26	3	19-46	43.9	30.1	26.0	LOAM
27	4	00-15	41.3	36.0	22.7	LOAM
27	5	15-31	42.1	30.6	27.2	CLAY LOAM/ LOAM
27	6	31-60	25.6	35.4	39.0	CLAY LOAM
28	7	00-08	45.9	35.0	19.0	LOAM
29	8	00-08	49.3	38.8	11.9	LOAM
29	9	08-24	47.6	36.6	15.9	LOAM
29	10	24-45	42.6	36.6	20.8	LOAM
31	11	00-08	54.0	33.5	12.5	SANDY LOAM
31	12	08-39	43.7	39.7	16.6	LOAM
36	13	00-10	57.7	32.6	9.7	SANDY LOAM
36	14	10-52	60.7	31.6	7.7	SANDY LOAM
39	15	00-14	51.9	32.[illegible]	15.8	LOAM/ SANDY LOAM
39	16	14-35	56.5	28.4	15.0	SANDY LOAM
40	17	00-41	47.4	31.2	18.4	LOAM
40	18	41-77	49.4	21.6	29.0	SANDY CLAY LOAM
42	19	00-11	52.0	29.6	18.4	LOAM/ SANDY LOAM
43	20	00-12	39.5	38.4	22.1	LOAM
43	21	12-38	37.5	40.8	21.7	LOAM
44	22	00-10	52.2	36.3	11.4	SANDY LOAM/ LOAM
44	23	10-25	39.6	43.1	17.3	LOAM
44	24	25-52	52.1	32.5	15.3	SANDY LOAM/ LOAM
45	25	00-13	49.9	33.7	16.4	LOAM

Table 11.4-20
Lake County, Oregon Fiscal Analysis
General Fund Expenditures

1987 Dollars

Department	85-86	% Total Expend	86-87	% Total Expend	87-88	% Total Expend	Average 85/86-87/88	% Total Expend
General Government								
Assessor	200,852	33.0%	186,701	30.7%	205,802	31.1%	197,785	31.6%
Central Services	43,875	7.2%	44,819	7.4%	45,774	6.9%	44,823	7.2%
Clerk	103,204	16.9%	97,518	16.0%	114,713	17.4%	105,145	16.8%
Commissioners	76,313	12.5%	83,894	13.8%	74,455	11.3%	78,221	12.5%
Courthouse	142,529	23.4%	151,710	24.9%	174,431	26.4%	156,223	24.9%
Treasurer	35,863	5.9%	38,214	6.3%	39,649	6.0%	37,909	6.1%
Surveyor	6,856	1.1%	5,657	0.9%	5,961	0.9%	6,158	1.0%
Total Gen. Gov't	609,493	32.7%	608,514	33.2%	660,785	28.6%	626,264	31.3%
Judicial								
Dist. Atty	35,304	24.6%	43,038	26.7%	42,913	25.5%	40,418	25.6%
Early Intervention	0	0.0%	7,237	4.5%	6,660	4.0%	4,632	2.9%
Justice Ct.-South	34,444	24.0%	36,049	22.4%	38,512	22.9%	36,335	23.1%
Justice Ct.-North	10,556	7.4%	10,691	6.6%	10,742	6.4%	10,663	6.8%
Juvenile	48,211	33.6%	47,256	29.4%	52,631	31.3%	49,366	31.3%
Public Defender	7,004	4.9%	6,417	4.0%	6,833	4.1%	6,751	4.3%
County Counsel	7,908	5.5%	10,274	6.4%	10,105	6.0%	9,429	6.0%
Total Judicial	143,426	7.7%	160,962	8.8%	168,396	7.3%	157,595	7.9%
Emergency Services	33,969	1.8%	34,349	1.9%	38,276	1.7%	35,531	1.8%
Library	111,380	6.0%	105,317	5.7%	110,010	4.8%	108,902	5.4%
Mental Health								
Mental Health	64,863	68.5%	80,617	64.4%	84,721	69.9%	76,734	67.5%
Alcohol	29,858	31.5%	38,555	30.8%	36,428	30.1%	34,947	30.7%
School Psych.	0	0.0%	5,962	4.8%	0	0.0%	1,987	1.7%
Total Mental Health	94,721	5.1%	125,134	6.8%	121,149	5.3%	113,668	5.7%
Activity Center	46,291	2.5%	50,569	2.8%	57,280	2.5%	51,380	2.6%
Sheriff	275,496	14.8%	287,072	15.6%	311,680	13.5%	291,416	14.6%
Planning/Building	120,326	6.4%	121,808	6.6%	143,491	6.2%	128,542	6.4%
Comm./Senior Center	46,444	2.5%	45,338	2.5%	48,573	2.1%	46,785	2.3%
Watermaster	12,415	0.7%	8,823	0.5%	16,764	0.7%	12,667	0.6%
Soil/Water Cons.	0	0.0%	0	0.0%	22,697	1.0%	7,566	0.4%
Miscellaneous	206,394	11.1%	123,274	6.7%	388,381	16.8%	239,350	12.0%
Economic Dev.	17,834	1.0%	24,266	1.3%	55,000	2.4%	32,367	1.6%
Veterans Svc.	0	0.0%	0	0.0%	12,322	0.5%	4,107	0.2%
County Health								
Medical Exam.	6,544	6.1%	5,624	5.0%	7,181	6.1%	6,450	5.7%
General	68,390	63.3%	78,369	70.1%	80,752	68.6%	75,837	67.4%
MCH Grant	15,239	14.1%	11,170	10.0%	12,674	10.8%	13,027	11.6%
Per Capita	3,047	2.8%	3,337	3.0%	3,720	3.2%	3,368	3.0%
Prenatal	5,041	4.7%	4,556	4.1%	4,792	4.1%	4,796	4.3%
WIC	9,566	8.9%	8,606	7.7%	8,365	7.1%	8,846	7.9%
TB Program	226	0.2%	204	0.2%	227	0.2%	219	0.2%
Total County Health	108,053	5.8%	111,867	6.1%	117,711	5.1%	112,544	5.6%
Computer	39,305	2.1%	28,243	1.5%	34,100	1.5%	33,883	1.7%
Total Expenditures	1,865,546	100.0%	1,835,535	100.0%	2,306,615	100.0%	2,002,566	100.0%
Ending Balance	837,177		605,751		235,348			

Source: Lake County 1987-88 budget;
Planning Information Corporation, January 1988.

13.8 LIST OF PRINCIPAL PREPARERS

13.8.1 Joe A. Porter

Mr. Porter is the founding partner of a forty-five person landscape architecture firm specializing in environmental analysis, visual resource management, land planning, landscape architecture, and design management. Mr. Porter has extensive knowledge and experience in dealing with critical visual issues and preservation of environmental quality. He has been at the forefront of pursuing technology in computer simulation as a tool to accurately depict impacts of proposed projects where visual issues are of concern.

Mr. Porter received a Bachelor of Landscape Architecture in 1964 from Utah State University and a Masters in Landscape Architecture in 1968 from the University of Illinois. He was a professor of Landscape Architecture at several major universities for 8 years before founding his own firm.

Mr. Porter has been in charge of a number of visual assessment projects including open pit gold mines, quarries, highways, ski areas, and large scale community development projects. An emphasis throughout his career has been on developing a logical and systematic design approach to increase credibility and accuracy in considering visual issues.

13.8.2 Carol A. Adams

Ms. Adams has been project manager on a number of visual assessment projects for large mining projects throughout the United States, including Colorado, South Dakota, and South Carolina. She has been involved in every phase of visual assessment projects and has incorporated sophisticated computer simulation technology extensively in these and other visual resource projects.

Ms. Adams received a Bachelor of Arts in Anthropology from Colorado College in 1981 and a Masters in Landscape Architecture from the University of Colorado in 1986. Her Masters Thesis was written on visual impact assessment and visual mitigation techniques for mining in mountainous areas and was recognized for excellence on a national level by the National Sand and Gravel Association and the American Society of Landscape Architecture.

13.8.3 Dan A. Seely

Mr. Seely is a computer simulation specialist and has participated in numerous visual assessment projects including

APPENDIX 3.B

SOIL CHEMICAL ANALYSIS

provide a measure of safety in determining the amount of revenues needed to balance the budget. In reality, expenditures in the current fiscal year will most likely be lower than budgeted.

In 1987 dollars, total expenditures decreased from $1.87 million in 1985-86 to $1.84 million in 1986-87 and remain at $2.31 million in the current year.

General government (which includes the Assessor, Central Services, Clerk, Commissioners, Courthouse, Treasurer, and Surveyor) has been the largest single expenditure category, averaging 31 percent of total expenditures since 1985-86. Expenditures for the Sheriff's Department has averaged 15 percent of total expenditures over the same period. Except for miscellaneous expenditures (a catchall for one-time expenditures in each year) which averaged 12 percent of the total, no other single expenditure category accounted for more than eight percent of total expenditures, on average.

Per capita GFEs have averaged $273 over the three year period, $76 less than average per capita revenues.

<u>Fiscal Balances</u>

Despite the decreasing flow of revenues, the county has shown positive ending balances of nearly $750,000 in each fiscal year since 1985-86. Although ending balances have been budgeted to decrease in each year, actual expenditures have been controlled to maintain a steady revenue surplus. In nominal dollars, ending balances were budgeted at $793,000 in 1985-86, $583,000 in 1986-87, and $235,000 in the current year. Actual ending balances were $743,000 in 1985-86, $700,000 in 1986-87, and $750,000 in the current budget.

The fiscal balances shown indicate that the county is exercising sound management policies in its budgeting process. Expenditures have been controlled at a fairly constant level while maintaining adequate levels of service in operating departments.

11.4.4.2 <u>Town of Lakeview</u>

Lakeview provides the following services: general government; Police Department; Fire Department; parks and recreation; street maintenance; water; and sewer.

11.4.4.2.1 <u>Lakeview General Government</u>

General Government functions are located in Lakeview's town hall which was constructed in the early 1900's. The building is small, consisting of approximately 750 square feet

13.6 PUBLIC AND AGENCY CONTACTS

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Salem, OR

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Robin Monrue
Landscape Architect
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Seattle, WA

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Tim Thex
Planning Analysis Engineer
Oregon Department of Transportation
Salem

Richard Woodward
Forester
U.S. Forest Service
Lakeview, OR

TABLE 3.B-2

SOIL CHEMICAL ANALYSIS - SECOND SERIES LAB DATA

Observ. Point #	Sample # - Pit #	Soil Depth (In.)	pH	P ppm	K ppm	Ca meq/100g	Mg meq/100g	NA meq/100g	SS mohms/cm	NO_3 ppm	OM %	SO_4 ppm	SAR
24	1- 1	00-18	6.3	28	647	10.5	2.7	0.06	0.15	0.3	2.33	1.5	0.02
25	2- 6	00-18	6.2	3	347	8.6	3.90	0.21	0.15	0.4	1.70	1.3	0.05
26	3- 6	19-46	6.5	5	351	8.6	4.10	0.20	0.20	0.4	0.53	3.0	0.05
27	4- 7	00-15	6.1	9	433	9.0	2.30	0.05	0.15	0.3	3.02	3.2	0.02
27	5- 7	15-31	6.3	9	374	7.8	2.90	0.17	0.15	0.4	1.54	2.6	0.05
27	6- 7	31-60	6.6	3	484	9.8	4.60	0.31	0.15	0.8	0.32	2.6	0.07
28	7-11	00-08	6.2	2	269	6.9	2.80	0.15	0.15	0.2	0.37	2.2	0.05
29	8-20	00-08	6.4	52	675	12.2	1.60	0.14	0.20	0.3	3.60	4.3	0.04
29	9-20	08-24	6.4	23	589	9.0	1.60	0.13	0.15	0.2	0.95	2.7	0.05
29	10-20	24-45	6.6	14	534	11.1	2.60	0.14	0.15	0.4	0.37	2.9	0.04
31	11-22	00-08	5.9	20	468	6.9	1.30	0.26	0.15	0.2	2.92	1.8	0.12
31	12-22	08-39	6.2	2	398	5.0	1.40	0.13	0.15	0.2	0.53	1.2	0.07
36	13-23	00-10	6.5	4	468	5.0	1.00	0.06	0.15	0.2	1.33	1.8	0.04
36	14-23	10-52	6.7	1	296	3.1	0.86	0.12	0.15	0.3	0.32	1.8	0.10
39	15-34	00-14	6.3	2	499	6.2	2.60	0.25	0.20	0.3	0.27	1.4	0.09
39	16-34	14-35	6.5	2	484	5.2	2.60	0.36	0.20	0.2	0.37	2.0	0.14
40	17-35	00-41	6.3	32	569	9.5	1.30	0.10	0.15	0.3	1.48	2.1	0.04
40	18-35	41-77	6.6	9	413	9.2	4.60	0.20	0.20	0.4	0.48	1.4	0.04
42	19-37	00-11	6.4	11	733	11.1	2.40	0.09	0.15	0.6	3.98	1.6	0.02
43	20-40	00-12	6.4	18	772	11.3	2.00	0.06	0.20	0.3	4.40	3.2	0.02
43	21-40	12-38	6.5	3	406	7.3	2.70	0.18	0.20	0.5	1.11	2.7	0.06
44	22-39	00-10	6.3	24	569	4.8	0.93	0.18	0.15	0.2	1.22	1.5	0.12
44	23-39	10-25	6.4	3	452	8.2	1.70	0.11	0.15	0.3	0.32	2.1	0.04
44	24-39	25-52	6.7	5	343	7.7	3.70	0.31	0.15	0.3	0.32	1.1	0.08
45	25-41	00-13	6.3	10	402	11.5	1.90	0.11	0.20	0.3	3.39	4.3	0.03

TABLE 11.4-22

LAKEVIEW, OREGON GENERAL FUND BUDGET
1987-88

Category	Salaries	Supplies	Capital	Total
Recorder	46,000	7,000	7,000	60,000
General Govt	19,000	99,000[1]	60,000[2]	178,000
Attorney	11,000	0	0	11,000

SOURCE: Town of Lakeview Fiscal Year 1987-88 Budget

RETENTION - a visual quality objective which in general means man's activities are not evident to the casual forest visitor.

SCENIC CORRIDOR - the visible land area outside the highway right-of-way and generally described as "the view from the road."

SCENIC QUALITY - the degree of harmony, contrast, and variety within a landscape; the overall impression retained after driving through, walking through, or flying over an area of land and/or water.

SIMULATION - the realistic visual portrayal which demonstrates the perceivable changes in the landscape of a proposed activity; an abstraction of a real-world situation, designed to represent the most important features of some existential conditions.

TEXTURE - the visual or tactile surface characteristics of something.

VARIETY CLASS - a rating system that classifies the landscape into different degrees of variety. This determines those landscapes which are most important and those which are of lesser value from the standpoint of scenic quality.

VISUAL ABSORPTION CAPABILITY - the physical capacity of a landscape to screen proposed development and still maintain its inherent visual character.

VISUAL IMPACT - the degree of change in visual resources.

VISUAL LANDSCAPE CHARACTER (CHARACTERISTIC LANDSCAPE) - the overall impression created by a landscape's unique combination of visual features (such as land, vegetation, water, structures) as seen in terms of form, line, color, and texture.

VISUAL MANAGEMENT SYSTEM - the system devised by the USFS in the early 1970's to incorporate visual values into their forest management system. It involves classifying landscapes, determining visual quality objectives, understanding how much change a landscape can absorb, and mitigating impacts so that visual quality objectives are met.

VISUAL QUALITY OBJECTIVE - degrees of acceptable alteration of the natural landscape. These include retention, partial retention, modification.

VISUAL RESOURCE(S) - those natural and cultural features of the environment which can potentially be viewed.

APPENDIX 3.C

SOIL DESCRIPTION

Staffing of the department is provided by a combination of paid employees and volunteers. The paid staff consists of 6 firemen/dispatchers, who answer the phones and drive the trucks to the scene of the fire or emergency. Two dispatchers are on duty at all times; during a fire or emergency response one of the dispatchers remains at the station to provide dispatch services if another emergency occurs. Non-paid staff includes 40 volunteer fire fighters and 30 medical emergency team members, some of whom are also fire fighters. All firemen are trained in CPR and have Red Cross certification. The medical emergency team includes 8 certified Emergency Medical Technicians, 3 of whom are also volunteer fire fighters.

Fire fighters are notified of an emergency through a Plectron pocket pager system. Any fire call results in all volunteers responding to the scene. Medical team members will drive the town's ambulance to the scene of the fire. Over the past years, the department has averaged 60 fire calls and 350 medical calls per year. Average response time to calls is under five minutes in the town and seven to eight minutes in rural areas.

Fire department offices, meeting room and equipment storage facilities are located in the new Emergency Services building in the center of Lakeview. A total of 4,500 square feet is used by the department, which includes 1,600 square feet of indoor vehicle and equipment storage. This space is considered adequate for the foreseeable future.

Fire department equipment consists of 3 Class A 1000 GPM pumpers, 1 85-foot aerial truck, 3 brush rigs and a 4000 gallon tank truck with a low pressure 250 GPM pump. One of the Class A trucks and the 4,000 gallon tanker are owned by the Lakeview Rural Fire District and operated by the town under contract with the district. The Class A trucks are older models (1949, 1967, and 1970) but have low mileage and are in good condition. The aerial truck is a 1951 model but is also in very good condition. The tank truck is being considered for replacement in 2 to 3 years; funds are currently being set aside for this purpose. The Fire Chief stated that he would eventually like to replace the brush rigs with a crash management vehicle, which would cost approximately $50,000 to purchase. Plans for this purchase have not been formulated at this time.

Medical emergency equipment is maintained by the Lakeview Disaster Unit, a volunteer organization funded entirely by private contributions and charges to insurance companies for services provided. The Unit operates 3 ambulances which are fully equipped with emergency medical gear and communications

APPENDIX 3.D

TAXONOMY OF MODAL SOILS

Club built the swimming pool and has contributed substantial funds toward its maintenance (Nichols, pers. comm., 25 January 1987).

The town does not provide indoor recreation facilities or organized outdoor recreation programs. Suggestions have been made by local residents that the town hire a full time recreation director. At present, funds are not available to support the estimated $30,000 per year that would be required to fund such a position. The town is investigating the possibility of obtaining grants to provide needed funds. Indoor recreation is provided at the local high school gymnasium where basketball and volleyball facilities are available.

There are no organized adult softball leagues in the town. Lakeview provides land for baseball fields that are used for T-ball, girls softball, Babe Ruth, and Little League. The Lions Club provided irrigation for two fields at a cost of $16,000. The fields also have restrooms, storage, and snack bar facilities. Lakeview provides water and sewer services for the fields.

For the past six years, the formation of a park district in the southern part of the county has been discussed as a means to provide revenues needed to improve or expand parks and recreation facilities and programs in the town. To date no action to form such a district has been initiated due to the difficulty of getting voter approval of a tax increase.

Private recreation facilities available in Lakeview include a bowling alley, movie theater, golf course, and a teen center at the Presbyterian Church. Hunter's Lodge, north of the town is planning to build a racquetball court that would be available to the public.

The rural setting of Lakeview provides recreation opportunities that complement the activities available inside the town. A ski area is located on federal forest land east of the town. The ski area has a T bar lift and a warming hut and averages about 50,000 skier days per season. Goose Lake, south of the town, provides recreation opportunities in winter and summer. Hiking and camping areas are also located in National Forests near the town (Nunn, pers. comm., 15 December 1987). See section 11.4.7 for a discussion of other recreational resources in the study area.

The Park Fund budget for the 1987-88 fiscal year totals $61,000, including $19,000 in salaries, $17,000 in materials, supplies, and services, $13,000 for capital improvements and $12,000 contingency reserve. The Park Fund is maintained as an enterprise fund with its own sources of revenues

Mapping Unit No.	Classification
63B	coarse-loamy, mixed, frigid Entic Haploxerolls
64	fine-loamy, mixed, frigid Typic Xerochrepts
64A*	fine-loamy, mixed, mesic Typic Xerochrepts
64B*	fine-loamy, mixed, mesic Typic Xerochrepts
65	fine-loamy, mixed, frigid Typic Xerochrepts
348	complex of 34A and 30A
417	complex of 41B and ashy over loamy-skeletal, mixed, frigid Typic Xerorthents

[1] Some classifications from Fremont N.F. SRI (USFS 1979), Others estimated from best information available.

capital improvements and equipment, and $55,000 contingency reserve (Town of Lakeview Fiscal Year 1987-88 Budget).

11.4.4.2.6 Lakeview Water System

The town of Lakeview operates a municipal water system that serves residents of the town and certain residents in the unincorporated areas of the county adjacent to the town limits. Approximately 1,400 hookups into the system are currently in place.

Lakeview obtains its water from the Goose Lake sub-basin aquifer. The town maintains six wells, using them alternately as demand requires. Four of the wells can produce a maximum of 350 gallons per minute (GPM) each and two can produce 500 GPM. Total production possible is 2,050 GPM or 2.95 million gallons per day (MGPD). Supplemental water supply is obtained from a spring in the canyon east of the town which flows into the water storage tanks. This supply is sporadic and the town does not rely on it as a primary source. Water supply is not constrained by availability of water in the aquifer.

Water from the wells is pumped to two storage tanks with a combined capacity of 3.5 million gallons. The water is chlorinated but not otherwise treated. The storage tanks are in good condition and provide adequate capacity for peak usage demands.

Information concerning peak water demand was not available. Average daily demand is highest during the summer months, reaching a maximum of 2 MGD in August. Winter demand averages 0.5 to 1 MGD. The combination of wells and storage tanks provides sufficient water to meet all demands and maintain a reserve of 1 to 1.5 million gallons for emergency uses.

Water is distributed by a system of 6" and 8" mains. The town is replacing the smaller mains, located in older sections of town, on a continual basis. The system has adequate pressure for fire fighting requirements. In general, the water system's condition was characterized as being "better than average" (Lakeview Draft Public Facilities Plan, September 1987).

User fees for the water system cover operating expenditures and provide some contribution to a capital improvement fund. Rates are reduced during the summer months to encourage lawn watering and irrigation, and are raised during the winter when usage is lower. For example, a household using 5,000 gallons of water per month would pay $18.00 during the summer and $45.00 during the winter. Similarly, customers outside of the town limits pay higher

3.5.1.3 Surface Soil Erosion Potential (Sheet)

This rating is based on expected losses of surface soil by sheet erosion when all vegetative cover is removed. Factors considered in making the ratings are soil characteristics, slope gradient and length, hydrologic characteristics of the soil and bedrock, and climate.

Low - Little loss of soil materials is expected but some minor sheet erosion may occur.

Moderate - Some loss of surface soil materials can be expected. Sheet erosion can be determined by some soil pedestals and observable accumulation of soil materials along the upslope edge of rocks and debris. At this level of erosion there is a possible fertility loss.

High - Considerable loss of surface soil materials can be expected. Sheet erosion is indicated by frequent occurrence of soil pedestals and considerable accumulation of soil materials along the upslope edge of rocks and debris. This is accompanied by a probable fertility loss.

Severe - Large loss of surface soil material can be expected. Sheet erosion loss is exhibited by numerous soil pedestals and extensive accumulation of soil materials along the upslope edge of rocks and debris. This is accompanied by a fertility loss.

3.5.1.4 Soil Erosion Potential (Rill & Gully)

This rating is based on expected soil losses by rill and gully erosion when all vegetative cover is removed. It rates potential soil losses as a result of management activities which concentrate water - such as landings, spur roads, and skidtrails. Factors considered in making the ratings are soil characteristics, slope gradient and length, and climate.

Low - Little loss of soil materials is expected. Some minor rill erosion may occur.

Moderate - Some loss of surface soil materials can be expected. Rill erosion and some small gullies may occur.

High - Considerable loss of surface soil materials can be expected. Rill erosion and numerous small gullies are evidence that considerable loss from erosion is occurring.

Severe - Large loss of surface soil material can be expected in the form of many large gullies and/or numerous small gullies.

Table 11.4-30
Lakeview School District #7, Oregon
Enrollment by School 1980-81 thru 1987-88 School Year

School	School Year 1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	Max. Capacity
Fremont/Hay Elementary	570	539	530	534	525	424	442	434	485
% Maximum Cap.	117.5%	111.1%	109.3%	110.1%	108.2%	87.4%	91.1%	89.5%	
Daly Middle	145	170	165	174	141	199	201	205	350
% Maximum Cap.	41.4%	48.6%	47.1%	49.7%	40.3%	56.9%	57.4%	58.6%	
Lakeview High School	364	322	329	327	296	320	312	327	380
% Maximum Cap.	95.8%	84.7%	86.6%	86.1%	77.9%	84.2%	82.1%	86.1%	
Total Enrollment	1079	1031	1024	1035	962	943	955	966	1215
% Maximum Cap.	88.8%	84.9%	84.3%	85.2%	79.2%	77.6%	78.6%	79.5%	

Source: Lakeview School District #7;
Planning Information Corporation, January 1988.

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3.5 SOIL CHARACTERISTICS - EROSION AND COMPACTION

3.5.1 Definitions of Interpretations for Erosion and Compaction

Table 3.5-1 presents erosion and hydrologic interpretations. Interpretations for erosion include the two major kinds of erosion-surface and mass movement. Surface erosion pertains only to soil loss by runoff and overland flow. Mass movement pertains to all types of soil and bedrock movement which occurs below the soil surface such as landslips, slumps, slides, rockfall, and land flow.

3.5.1.1 Natural Stability and Type of Mass Movement

This rating is based on the relative stability of the mapping units as they occur in the natural state. This includes any movement or loss by all types of deep-seated failures. Type of movement includes slumps, slides, rockfall, landflows, and landslips.

I. Very Stable - No evidence of failure.

II. Stable - Occasional failures are observed.

III. Moderately Stable - Several failures are observed.

IV. Unstable - Many failures are observed.

V. Very Unstable - Entire area shows evidence of recent and past failures.

3.5.2.1 Expected Mass Movement as a Result of Man's Activities

This rating indicates the expected mass movement resulting from man's activities as compared to stability under natural conditions. Ratings are based on soil and bedrock characteristics, slopes, revegetation potential, and effects of timber removal, road construction, and fire.

Unchanged - The expected mass movement is relatively unchanged from that of the natural state.

Increased - The expected mass movement is greater than that of the natural state.

Greatly Increased - The expected mass movement is much greater than that of the natural state.

TABLE 11.4-29

LAKEVIEW SCHOOL DISTRICT #7, OREGON
FACILITY STATUS

School	Condt.	Class-rooms	Maximum Capacity	Current Enrollment	% Maximum Capacity
Fremont Elementary	Good	9	207	196	94%
Hay Elementary	Good	13	338	238	70%
Daly Middle	Fair	15.5	275	205	74%
Lakeview High	Good	23.5	450	327	72%

SOURCE: Superintendent Howard Ottman, pers. comm., 2 February 1988.

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This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, bitterbrush, Idaho Fescue, Ross sedge, bottlebrush squirreltail, squawcarpet, and some manzanita and mountain mahogany.

The soil is well drained. Permeability is rapid or moderate in the surface soils and slow or moderate in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 64B*

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 2 inches thick.

Surface layers: Very dark grayish brown or dark brown sandy loam or loam; weak, fine granular structure; 2 to 25 percent subround and angular gravel by volume; soft, slightly plastic; pH ranges from 6.0 to 7.0; 4 to 7 inches thick.

Subsoil layers: Dark yellowish brown, dark brown, or dark reddish brown gravelly clay loam, loam, or sandy loam; weak to moderate, medium granular and weak to moderate, fine subangular blocky structure; 3 to 60 percent gravels and cobbles by volume; slightly hard; slightly plastic; pH ranges from 6.4 to 7.2, 25 to 40 inches thick.

3.4.2.30 Mapping Unit 65

Mapping Unit 65 consists dominantly of Landtype 65 and minor amounts of Landtypes 30A, 35, 56A, and 63A. Landtype 65 is similar to Landtype 63A with the exception of soil parent material and plant community type, and is similar to Landtype 64 except for drainage and plant community type.

Landtype 65 has moderately deep, brown and yellowish brown gravelly residual soils with ponderosa pine-bitterbrush vegetation. Surface soils are very thin to thin and moderately coarse or medium textured. Subsoil layers are moderately thick to thick and moderately fine to moderately coarse textured.

Bedrock is soft and massive rhyolitic ash-flow tuff, ashy diatomite, and lacustrine tuffaceous siltstone and sandstone. Depth to bedrock ranges from 25 to 45 inches.

Typically, Landtype 65 occurs on gently rolling tablelands at lower elevations along the forest fringe. Slopes are less than 15 percent.

Table 11.4-28
Town of Lakeview, Oregon Fiscal Analysis
General Fund Expenditures

Per Capita (1987 Dollars)

Department	84-85	% Total Expend	85-86	% Total Expend	86-87	% Total Expend	87-88	% Total Expend	Average 84/85-87/88	% Total Expend
Population	2,755		2,755		2,785		2,785			
Police										
O&M	$65.47	95.8%	$70.22	99.3%	$76.31	94.5%	$77.16	97.1%	$72.29	96.6%
Capital	$2.85	4.2%	$0.49	0.7%	$4.40	5.5%	$2.33	2.9%	$2.52	3.4%
Total	$68.32	37.1%	$70.71	33.2%	$80.71	29.8%	$79.49	25.9%	$74.81	30.7%
Fire/Disaster										
O&M	$65.70	100.0%	$76.17	100.0%	$78.57	97.0%	$76.79	95.1%	$74.31	97.9%
Capital	$0.00	0.0%	$0.00	0.0%	$2.43	3.0%	$3.95	4.9%	$1.59	2.1%
Total	$65.70	35.7%	$76.17	35.8%	$81.00	29.9%	$80.74	26.3%	$75.90	31.1%
Recorder										
O&M	$19.00	100.0%	$19.35	95.5%	$19.93	77.0%	$18.63	88.1%	$19.23	89.1%
Capital	$0.00	0.0%	$0.92	4.5%	$5.97	23.0%	$2.53	11.9%	$2.35	10.9%
Total	$19.00	10.3%	$20.27	9.5%	$25.90	9.6%	$21.16	6.9%	$21.58	8.9%
Attorney										
O&M	$5.57	100.0%	$5.76	100.0%	$6.51	100.0%	$6.34	100.0%	$6.04	100.0%
Capital	$0.00	0.0%	$0.00	0.0%	$0.00	0.0%	$0.00	0.0%	$0.00	0.0%
Total	$5.57	3.0%	$5.76	2.7%	$6.51	2.4%	$6.34	2.1%	$6.04	2.5%
General Gov't										
O&M	$22.96	97.2%	$21.39	100.0%	$40.17	59.6%	$42.39	67.2%	$31.73	72.3%
Capital	$0.67	2.8%	$0.00	0.0%	$27.23	40.4%	$20.65	32.8%	$12.14	27.7%
Total	$23.63	12.8%	$21.39	10.1%	$67.40	24.9%	$63.04	20.5%	$43.87	18.0%
Transfers to Other Funds										
Build. & Fire Truck	$0.00	0.0%	$16.21	87.7%	$8.92	95.1%	$10.77	19.1%	$8.98	41.6%
Planning	$0.00	0.0%	$0.35	1.9%	$0.45	4.9%	$0.36	0.6%	$0.29	1.4%
Park	$0.79	39.6%	$1.92	10.4%	$0.00	0.0%	$4.61	8.2%	$1.83	8.5%
HUD	$0.00	0.0%	$0.00	0.0%	$0.00	0.0%	$0.00	0.0%	$0.00	0.0%
Street	$1.21	60.4%	$0.00	0.0%	$0.00	0.0%	$40.63	72.1%	$10.46	48.5%
Total Transfers	$2.00	1.1%	$18.49	8.7%	$9.37	3.5%	$56.37	18.4%	$21.56	8.8%
Total General Fund										
O&M	$178.70	97.0%	$192.88	90.6%	$221.49	81.8%	$221.31	72.1%	$203.60	83.5%
Capital	$3.52	1.9%	$1.41	0.7%	$40.03	14.8%	$29.46	9.6%	$18.60	7.6%
Transfers	$2.00	1.1%	$18.49	8.7%	$9.37	3.5%	$56.37	18.4%	$21.55	8.8%
Total	$184.23	100.0%	$212.78	100.0%	$270.89	100.0%	$307.14	100.0%	$243.76	100.0%

Source: City of Lakeview 1987-88 budget;
Planning Information Corporation, January 1988.

The soil is well drained. Permeability is rapid or moderate in the surface soils and slow or moderate in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

<u>Range of Profile Characteristics of Soil 64</u>

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 2 inches thick.

Surface layers: Very dark grayish brown or dark brown sandy loam or loam; weak, fine granular structure; 2 to 25 percent subround and angular gravel by volume; soft, slightly plastic; pH ranges from 6.0 to 7.0; 4 to 7 inches thick.

Subsoil layers: Dark yellowish brown, dark brown, or dark reddish brown gravelly clay loam, loam, or sandy loam; weak to moderate, medium granular and weak to moderate, fine subangular blocky structure; 3 to 60 percent gravels and cobbles by volume; slightly hard; slightly plastic; pH ranges from 6.4 to 7.2, 25 to 40 inches thick.

3.4.2.28 <u>Mapping Unit 64A*</u>

Mapping Unit 64A* consists dominantly of Landtype 64A* and minor amounts of Landtypes 30A, 35, 56A, and 63A. Landtype 64A* is similar to Landtype 63A with the exception of soil parent material and plant community type. Landtype 64A* is similar to Landtype 64 and those listed above except that 64A* is mesic, not frigid, and is found at lower elevations on south slopes.

Landtype 64A* has moderately deep to deep, brown and yellowish brown gravelly residual soils with ponderosa pine-bitterbrush vegetation. Surface soils are very thin to thin and moderately coarse or medium textured. Subsoil layers are moderately thick to thick and moderately fine to moderately coarse textured.

Bedrock is soft and massive rhyolitic ash-flow tuff, ashy diatomite, and lacustrine tuffaceous siltstone and sandstone. Depth to bedrock ranges from 25 to 45 inches.

Typically, Landtype 64A* occurs on gently rolling tablelands at lower elevations along the forest fringe. Slopes are less than 15 percent.

This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, bitterbrush, Idaho Fescue, Ross

Table 11.4-26
Town of Lakeview, Oregon Fiscal Analysis
General Fund Expenditures

Nominal Dollars

Department	84-85	% Total Expend	85-86	% Total Expend	86-87	% Total Expend	87-88	% Total Expend	Average 84/85-87/88	% Total Expend
Police										
O&M	164,961	95.8%	183,228	99.3%	204,545	94.5%	214,883	97.1%	191,904	96.6%
Capital	7,188	4.2%	1,286	0.7%	11,800	5.5%	6,500	2.9%	6,694	3.4%
Total	172,149	37.1%	184,514	33.2%	216,345	29.8%	221,383	25.9%	198,598	30.5%
Fire/Disaster										
O&M	165,558	100.0%	198,758	100.0%	210,603	97.0%	213,857	95.1%	197,194	97.8%
Capital	0	0.0%	0	0.0%	6,500	3.0%	11,000	4.9%	4,375	2.2%
Total	165,558	35.7%	198,758	35.8%	217,103	29.9%	224,857	26.3%	201,569	31.0%
Recorder										
O&M	47,881	100.0%	50,497	95.5%	53,422	77.0%	51,896	88.1%	50,924	88.9%
Capital	0	0.0%	2,392	4.5%	16,000	23.0%	7,040	11.9%	6,358	11.1%
Total	47,881	10.3%	52,889	9.5%	69,422	9.6%	58,936	6.9%	57,282	8.8%
Attorney										
O&M	14,039	100.0%	15,021	100.0%	17,440	100.0%	17,654	100.0%	16,039	100.0%
Capital		0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Total	14,039	3.0%	15,021	2.7%	17,440	2.4%	17,654	2.1%	16,039	2.5%
General Gov't										
O&M	57,849	97.2%	55,827	100.0%	107,678	59.6%	118,066	67.2%	84,855	72.0%
Capital	1,686	2.8%	0	0.0%	72,989	40.4%	57,500	32.8%	33,044	28.0%
Total	59,535	12.8%	55,827	10.1%	180,667	24.9%	175,566	20.5%	117,899	18.1%
Transfers to Other Funds										
Build. & Fire Truck	0	0.0%	42,312	87.7%	23,902	95.1%	30,000	19.1%	24,054	40.9%
Planning	0	0.0%	910	1.9%	1,225	4.9%	1,000	0.6%	784	1.3%
Park	2,000	39.6%	5,012	10.4%	0	0.0%	12,841	8.2%	4,963	8.4%
HUD	0	0.0%	4	0.0%	0	0.0%	0	0.0%	1	0.0%
Street	3,047	60.4%	0	0.0%	0	0.0%	113,153	72.1%	29,050	49.4%
Total Transfers	5,047	1.1%	48,238	8.7%	25,127	3.5%	156,994	18.4%	58,852	9.1%
Total General Fund										
O&M	450,288	97.0%	503,331	90.6%	593,688	81.8%	616,356	72.1%	540,916	83.2%
Capital	8,874	1.9%	3,678	0.7%	107,289	14.8%	82,040	9.6%	50,470	7.8%
Transfers	5,047	1.1%	48,238	8.7%	25,127	3.5%	156,994	18.4%	58,852	9.1%
Total	464,209	100.0%	555,247	100.0%	726,104	100.0%	855,390	100.0%	650,238	100.0%

Source: City of Lakeview 1987-88 budget;
Planning Information Corporation, January 1988.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, bitterbrush, Idaho fescue, lupine, mules ear, big sage, Ross sedge, bottlebrush squirreltail, some juniper and mountain mahogany.

The soil is well drained. Permeability is rapid in the surface soils and moderate to rapid in the subsoils. Coarse fragment content averages less than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 63A

Litter: Needles, leaves, twigs, and decomposing organic matter; 0.25 to 2 inches thick.

Surface layers: Dark brown or very dark grayish brown sandy loam or loam; weak, medium granular structure; 0 to 5 percent gravel by volume; soft; slightly plastic; pH ranges from 6.5 to 7.2; 10 to 18 inches thick.

Subsoil layers: Dark brown or brown loam or sandy loam; weak to moderate, fine to medium subangular blocky structure; 0 to 50 percent blocky and subround gravels and cobbles by volume; soft to slightly hard; slightly plastic; pH ranges from 6.5 to 7.5; 10 to 25 inches thick.

3.4.2.26 Mapping Unit 63B

Mapping Unit 63B consists dominantly of Landtype 63B and minor amounts of Landtypes 62B and 63A. Landtype 63B is similar to Landtype 62B with the exception of soil texture; and it is similar to unit 63A with the exception of slope range and position in the landscape.

Landtype 63B has moderately deep, brown to yellowish brown loamy residual soils with ponderosa pine timber types. Surface soil layers are very thin to thin and moderately textured. Subsoil layers are thin to moderately thick and moderately coarse textured.

Bedrock is soft to moderately hard and massive, brown and yellowish brown tuff or breccia. Depth to bedrock ranges from 22 to 40 inches. Bedrock weathers rapidly when exposed.

Typically, Landtype 63B occurs on dissected topography on moderately steep ridges and sideslopes at lower elevations. Slope range from 16 to 40 percent.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, big sage, Idaho fescue, mules ear,

Table 11.2-23
Town of Lakeview, Oregon Fiscal Analysis
General Fund Revenues

Nominal Dollars

Category	84-85	% Total Revenues	85-86	% Total Revenues	86-87	% Total Revenues	87-88	% Total Revenues	Average 84/85-87/88	% Total Revenues
Property Tax	287,985	46.7%	366,091	47.9%	370,800	51.1%	395,910	46.3%	355,197	48.0%
Previous Levied Tax	40,310	6.5%	40,000	5.2%	40,000	5.5%	62,500	7.3%	45,703	6.2%
Fines & Bail	8,980	1.5%	7,423	1.0%	7,200	1.0%	10,000	1.2%	8,401	1.1%
License & Franchise	63,430	10.3%	70,271	9.2%	65,000	9.0%	65,000	7.6%	65,925	8.9%
Cigarette Tax	5,632	0.9%	6,991	0.9%	11,075	1.5%	10,193	1.2%	8,473	1.1%
Liquor Tax	19,311	3.1%	18,799	2.5%	19,229	2.6%	19,355	2.3%	19,174	2.6%
Animal License	13,922	2.3%	8,964	1.2%	11,000	1.5%	12,000	1.4%	11,472	1.5%
Rural FD	7,449	1.2%	11,372	1.5%	11,000	1.5%	12,000	1.4%	10,455	1.4%
F. Serv. Contract	400	0.1%	0	0.0%	300	0.0%	300	0.0%	250	0.0%
9-1-1 Fund	9,515	1.5%	9,857	1.3%	44,000	6.1%	10,832	1.3%	18,551	2.5%
Other	6,981	1.1%	941	0.1%	5,000	0.7%	8,300	1.0%	5,306	0.7%
Transfers In	48,500	7.9%	48,500	6.4%	48,500	6.7%	42,500	5.0%	47,000	6.3%
Revenue Sharing	25,000	4.1%	0	0.0%	0	0.0%	0	0.0%	6,250	0.8%
Interest	7,891	1.3%	7,473	1.0%	6,000	0.8%	6,000	0.7%	6,841	0.9%
Beginning Balance	70,974	11.5%	166,883	21.9%	87,000	12.0%	200,500	23.4%	131,339	17.7%
Total Revenues	616,280	100.0%	763,565	100.0%	726,104	100.0%	855,390	100.0%	740,335	100.0%

Source: City of Lakeview 1987-88 budget;
Planning Information Corporation, January 1988.

Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 41B

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 3 inches thick.

Surface layers: Very dark grayish brown to dark yellowish brown loam or sandy loam; single grain or very weak, medium granular structure; 10 to 50 percent angular and subround gravels and cobbles by volume; loose; nonplastic; pH ranges from 6.0 to 7.0; 8 to 14 inches thick.

Subsoil layers: Dark grayish brown, dark brown, or dark yellowish brown gravelly and cobbly sandy loam or loamy sand; single grain or very weak, fine subangular blocky structure; 30 to 70 percent angular and subround gravels and cobbles by volume; loose; nonplastic; pH ranges from 6.0 to 7.5; 20 to 50 inches thick.

3.4.2.24 Mapping Unit 41C

Mapping Unit 41C consists dominantly of Landtype 41C and minor amounts of Landtypes 41B, 40C, and 42. Landtype 41C is similar to Landtype 41B with the exception of slope range. It is similar to unit 40C with the exception of timber type.

Landtype 41C has moderately deep to deep gravelly and cobbly residual and colluvial soils which occur on steep slopes and which have mixed conifer timber types. Surface soil layers are thin and moderately coarse or medium textured. Subsoil layers are moderately thick to thick, gravelly and cobbly, and coarse or moderately coarse textured.

Bedrock is moderately hard, highly fractured, and vertically jointed rhyolite and foliated rhyolite. Other rocks associated with the unit are tuff, welded tuff, breccia, andesite, and obsidian. Depth to bedrock ranges from 30 to 60 inches.

Typically, Landtype 41C occurs on north aspects of dome-shaped rhyolitic lava eruptive centers. Slopes are greater than 40 percent.

This landtype ranges in elevation above 5,200 feet and supports mixed conifers, needlegrass, Oregon grape, manzanita, snowberry, mules ear, Ross sedge, lupine, and squawcarpet.

supplemented by transfers from the general fund. For the current year revenues are obtained from 5 major sources: cash on hand ($10,000; 16 percent of total revenues), pool revenues ($14,500; 24 percent), state revenue sharing ($12,100; 20 percent), matching grants from the Collins-McDonald fund ($10,000; 16 percent) and transfers from the general fund ($13,000; 21 percent) (Town of Lakeview Fiscal Year 1987-88 Budget).

11.4.4.2.5 Lakeview Street Maintenance

Street maintenance in Lakeview is provided by a five person utilities crew that also maintains the town's water and sewer systems. The permanent crew is supplemented by part time employees hired on an as-needed basis. The current staffing level is considered to be adequate for existing demands and for the foreseeable future.

The town maintains a fleet of vehicles and equipment used for maintaining the streets and utilities. The equipment includes 3 dump trucks, a front end loader, a backhoe, two graders, plows for the dump trucks, patching and crack sealing equipment, and miscellaneous hand tools. All equipment except for the backhoe are in good condition. The backhoe is planned to be replaced within two years.

Town shop and storage facilities consist of a 2,800 square foot shop building used for equipment maintenance and indoor storage of the town's water truck. Other equipment is stored outdoors at the shop site. The town also maintains another storage building for pipes and fittings. This building is not on town land and the possibility of building a new storage facility to consolidate all activities at the town shop site is being investigated. No plans for construction have been developed at this time. Existing shop and storage space is considered adequate for the present.

The town is currently spending between $50,000 and $100,000 per year in a continuing upgrading program. The program includes overlays, asphalt paving and chip and seal work on older streets. Growth and new developments within the town limits have minimal impact on street maintenance activities because new construction must meet town standards before the town will assume maintenance responsibilities. Increases in street maintenance costs from new development will occur well after increased revenues have been generated by the new property tax base (Anderson, pers. comm., 4 January 1988).

Street maintenance expenditures during the 1987-88 fiscal year are budgeted at $322,000, including $36,000 for salaries, $91,000 for materials, services, and supplies, $140,000 for

Range of Profile Characteristics of Soil 40C

Litter: Needles, leaves, twigs, and decomposing organic matter; 0 to 2 inches thick.

Surface layers: Very dark gray to dark brown sandy loam; weak, medium granular and weak, fine subangular blocky structure; 10 to 50 percent angular and subround gravels and cobbles by volume; soft; nonplastic to slightly plastic; pH ranges from 6.0 to 7.0; 6 to 12 inches thick.

Subsoil layers: Yellowish brown to dark brown, gravelly and cobbly sandy loam or loamy sand; weak, fine subangular blocky structure; 30 to 70 percent angular and subround gravels and cobbles by volume; soft; nonplastic; pH ranges from 6.2 to 7.2; 20 to 50 inches thick.

3.4.2.22 Mapping Unit 41A

Mapping Unit 41A consists dominantly Landtype 41A and minor amounts of Landtypes 40A and 41B. Landtype 41A is similar to Landtype 40A with the exception of timber type and is similar to Unit 41B with the exception of slope range.

Landtype 41A has moderately deep to deep, gravelly and cobbly, yellowish brown residual soils with mixed timber types. Surface soil layers are thin and moderately coarse or medium textured. Subsoil layers are moderately thick to thick, gravelly and cobbly, and coarse or moderately coarse textured.

Bedrock is moderately hard, highly fractured, and competent light gray rhyolite. Other rocks occurring locally within the unit are tuff, welded tuff, obsidian, andesite, and rhyolitic breccia. Depth to bedrock ranges from 30 to 55 inches.

Typically, Landtype 41A occurs on gentle slopes on rhyolitic dome-shaped landforms. Slopes range from 0 to 15 percent.

This landtype ranges in elevation above 5,000 feet and supports mixed conifers, lupine, snowbrush, manzanita, squawcarpet, sedge, needlegrass, rabbitbrush, and bottlebrush squirreltail.

The soil is excessively drained. Permeability is rapid in the surface soils and rapid to very rapid in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

equipment. One ambulance is equipped as a cardiac emergency unit with an oscilloscope and defibrillation unit which can transmit data directly to the Lake District Hospital's emergency room.

The Fire Chief thinks that growth in the Lakeview area could be easily served with existing equipment and manpower. The department is installing a computer-aided 911 emergency dispatch system in 1988 which will improve response time to calls for assistance (Lepley, pers. comm., 14 December 1987).

Department expenditures for the 1987-88 fiscal year are budgeted at $225,000 which includes $188,000 payroll, $26,000 materials, services, and operations, and $11,000 capital. Capital expenditures include $2,000 for furnishings, $3,000 for radios and pagers and $6,000 for a new air compressor (Town of Lakeview Fiscal Year 1987-88 Budget).

11.4.4.2.4 Lakeview Parks and Recreation

The town operates and maintains two parks in Lakeview, known locally as the "Big Park" and the "Kiddie Park". The Big Park, located east of the center of the town provides a picnic area, two tennis courts, restrooms, and a geothermally heated swimming pool. The Kiddie Park is located on land occupied by a building that is owned by town but operated by a non-profit day care center (see section 11.4.4.6.8 for a discussion of the day care center). This park has a wading pool, swings, restrooms, and a small picnic area. Some of the equipment located in the park is fenced off for day care center use only. Total park area available in Lakeview is estimated to be approximately two acres.

Maintenance of park grounds is provided by contract employees hired each year from May 1 to October 30. No maintenance is provided during the winter months. Generally two people are hired to mow and water lawns and perform minor repairs using town owned equipment. The swimming pool employs a pool manager and assistant manager during the summer months. Pool fees are $1.00 per day for children and $1.50 per day for adults. The fees generate revenues sufficient to cover salaries for lifeguards and pool managers. In the past, other pool operating expenses were funded by federal revenue sharing income. Since the elimination of revenue sharing, general fund revenues are used for this purpose.

Major improvements or repairs to parks and the swimming pool have been funded by grants from the Collins-McDonald Fund, a local foundation established by a family that was instrumental in providing land for parks in the town. Recently the town obtained a $27,000 grant from the fund to repair the bottom of the swimming pool. The Lakeview Lions slightly plastic; pH ranges from 6.0 to 7.0; 6 to 15 inches thick.

Subsoil layers: Yellowish brown to dark brown, gravelly and cobbly sandy loam or loamy sand; weak, fine subangular blocky structure; 20 to 60 percent angular and subround gravels and cobble by volume; soft; nonplastic; pH ranges from 6.3 to 7.5; 18 to 35 inches thick.

3.4.2.20 Mapping Unit 40B

Mapping Unit 40B consists dominantly of Landtype 40B and minor amounts of Landtypes 40A, 40C, 41B, and 42. Landtype 40B is similar to Landtype 41B with the exception of timber type. It is similar to Units 40A and 40C with the exception of slope ranges.

Landtype 40B has moderately deep to deep, brown and gravelly residual and colluvial soils which have developed on rhyolitic lava domes. Surface soil layers are thin and moderately coarse textured. Subsoil layers are moderately thick to thick, gravelly or cobbly, and moderately coarse or coarse textured. Exposed mineral soil is common on some areas within this unit.

Bedrock is mainly moderately hard, competent, and highly fractured rhyolite or foliated rhyolite which is vertically jointed. Other rocks occurring locally are welded tuff, soft tuff, obsidian, andesite, and rhyolitic breccia. These rocks tend to occur more commonly along the perimeter of the landform. Depth to bedrock ranges from 30 to 60 inches.

Typically, Landtype 40B occurs primarily on south aspects of rhyolitic dome-shaped uplifts on slopes from 16 to 40 percent.

This landtype ranges in elevation above 4,600 feet and supports ponderosa pine, snowbrush, manzanita, Ross sedge, squawcarpet, Oregon grape, bottlebrush squirreltail, mountain mahogany, and mules ear.

The soil is excessively well drained. Permeability is rapid in the surface soils and rapid to very rapid in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 40B

Litter: Needles, leaves, twigs, and decomposing organic matter; 0 to 2 inches thick.

11.4.4.2.2 Lakeview Police

Lakeview's Police Department provides 24-hour patrol and emergency response coverage within the town limits. Staffing consists of 5 officers: the Chief of Police, one Sergeant and 3 patrol officers. The sworn staff is supplemented by 5 volunteer reserves who have arrest powers and can be used to fill in for regular police shifts. Two man patrol coverage is provide on Fridays and Saturdays between 8 pm and 4 am. One man patrols are provided at all other times. The level of sworn staff has remained constant over the past 15 years. Turnover is not a problem; the officer with the least seniority has been on the force for 10 years. The department would like to add one more officer, but budget constraints have not allowed hiring additional staff.

The department uses 4 patrol cars purchased used from the State Police. One car is replaced each year. All vehicles are in good condition. Dispatch services are provided by the Lakeview Fire Department.

The police station is located in the new Emergency Services building near the center of town. Police space includes two offices, an interrogation room and a storage room, totalling 340 square feet. This space was felt to be adequate for current needs. The department uses the county jail for detention of prisoners.

Lakeview has had the lowest crime rate in the state for the past several years; an indication that the police department is adequate for current needs (Bush, pers. comm., 7 November 1987).

Police Department expenditures are budgeted at $221,000 for the 1987-88 fiscal year, which includes $182,000 for salaries, $32,000 for supplies and materials, and $7,000 for capital equipment (Town of Lakeview Fiscal Year 1987-88 Budget).

11.4.4.2.3 Lakeview Fire Department

The Lakeview Fire Department provides responses to emergency calls within the town limits and contracts with the Lakeview Rural Fire Protection District to provide service in the unincorporated areas of Lake County surrounding the town. The department also has mutual aid agreements with the Thomas Creek/Westside and New Pine Creek Rural Fire Departments, west and south of Lakeview, respectively. The department has provided assistance as far south as Willow Ranch, California, 20 miles south of the California-Oregon border. Within Lake County, the department provides response or assistance in an area comprising approximately 300 square miles.

subangular blocky structure; 35 to 80 percent coarse fragments by volume; hard; plastic; pH ranges from 5.5 to 7.5; 20 to 33 inches thick.

3.4.2.18 <u>Mapping Unit 37C</u>

Mapping Unit 37C consists dominantly of Landtype 37C and minor amounts of Landtypes 26, 37B, and 34C. Landtype 37C is similar to Landtype 37B with the exception of slope range, and it is similar to 34C with the exception of timber type. Unit 26 contains deep, colluvial soils.

Landtype 37C has moderately deep to deep, stony, reddish brown residual and colluvial soils with mixed conifer timber sites. Surface soils are very thin or thin and medium or moderately coarse textured. Subsoils are moderately thick to thick and moderately fine or medium textured. Large vesicular basalt boulders occupy a large part of the soil surface and profile.

Bedrock is interbedded, hard, gray basalt and andesite or soft, reddish brown tuff. They are massive to highly fractured and competent. Depth to bedrock ranges from 24 to 38 inches.

Typically, Landtype 37C occurs on shield volcanoes basaltic eruptive centers and block faults on steep lands with slopes over 40 percent.

This landtype ranges tin elevation above 5,500 feet and supports mixed conifers, snowbrush, manzanita, squawcarpet, serviceberry, wax currant, mules ear, Ross sedge, phlox, lupine, sagebrush, Oregon grape, and bottlebrush squirreltail.

The soil is well drained. Permeability is moderate to rapid in the surface soils and moderate to slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

<u>Range of Profile Characteristics of Soil 37C</u>

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 3 inches thick.

Surface layers: Dark brown loam or sandy loam; weak, medium granular and weak, fine subangular blocky structure; 10 to 50 percent coarse fragments by volume; soft; friable; pH ranges from 6.0 to 7.2; 3 to 15 inches thick.

Subsoil layers: Dark brown to dark reddish brown gravelly, cobbly, or stony clay loam, silty clay loam or of office and meeting space, and is in fair to poor condition. Approximately one and one-half years ago, plans were developed to add general government office space to the new Emergency Services building. The estimated cost of the 2,500 square foot addition was $150,000 . These funds were to be obtained through a combination of reserved funds and a bond issue, however, the bond issue was defeated by the town's voters. The Town Council is currently studying solutions to the problems with the existing town hall. In all probability, sufficient building fund reserves will have to be available before construction of a new building or renovation of the existing facility can be undertaken. No estimate of when improvements may be made is currently available (Harlan, pers. comm., 12 December 1987).

Town hall staff consists of the recorder and a utility clerk. The current staff is considered adequate to meet existing demands and there are no plans to add new positions at this time. Other general government positions are part-time and do not occupy town hall offices. These positions include the mayor, four council members, a municipal judge and a town attorney (Grisel, pers. comm., 12 December 1987).

Budgeted expenditures for general government functions totals $256,000 in the 1987-88 fiscal year and are presented in Table 11.4-22 by category.

3.4.2.16 Mapping Unit 37B

Mapping Unit 37B consists dominantly of Landtype 37B and minor amounts of Landtypes 37A, 37C, 34B, and 26. Landtype 37B is similar to Landtype 37A and 37C with the exception of landforms and slope range. Unit 34B differs by timber type, and landtype 26 contains deep, colluvial soils.

Landtype 37B has moderately deep to deep, reddish brown, stony residual and colluvial soils with mixed conifer timber types. Surface soil layers are very thin or thin and medium or moderately coarse textured. Subsoil layers are moderately thick to thick and moderately fine or medium textured. Large, vesicular basalt boulders make up a large part of the soil surface and profile.

Bedrock is interbedded, soft, reddish brown tuff and hard, gray basalt or andesite. These rocks are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches. Some areas are deeper than 48 inches to bedrock.

Typically, Landtype 37B occurs on moderately steep lands consisting of basaltic eruptive centers, block faults, and shield volcanoes. Slopes range from 16 to 40 percent.

This landtype ranges in elevation above 5,500 feet and supports mixed conifers, snowbrush, manzanita, squawcarpet, mules ear, serviceberry, wax currant, Ross sedge, Oregon grape, bottlebrush squirreltail, phlox, lupine, and sagebrush.

The soil is well drained. Permeability is moderate to rapid in the surface soils and moderate to slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 37B

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 3 inches thick.

Surface layers: Dark brown loam or sandy loam; weak, medium granular and weak, fine subangular blocky structure; 5 to 40 percent coarse fragments by volume; soft; friable; pH ranges from 5.5 to 7.2; 5 to 15 inches thick.

Subsoil layers: Dark brown to dark reddish brown gravelly, cobbly, or stony clay loam, silty clay loam, or occasionally loam; moderate or weak, fine, subangular blocky structure; 35 to 80 percent

Table 11.4-21
Lake County, Oregon Fiscal Analysis
General Fund Expenditures

Per Capita (1987 Dollars)

Department	85-86	% Total Expend	86-87	% Total Expend	87-88	% Total Expend	Average 85/86-87/88	% Total Expend
Population	7,450		7,300		7,300			
General Government								
Assessor	$26.96	33.0%	$25.58	30.7%	$28.19	31.1%	$26.91	31.6%
Central Services	$5.89	7.2%	$6.14	7.4%	$6.27	6.9%	$6.10	7.2%
Clerk	$13.85	16.9%	$13.36	16.0%	$15.71	17.4%	$14.31	16.8%
Commissioners	$10.24	12.5%	$11.49	13.8%	$10.20	11.3%	$10.64	12.5%
Courthouse	$19.13	23.4%	$20.78	24.9%	$23.89	26.4%	$21.27	25.0%
Treasurer	$4.81	5.9%	$5.23	6.3%	$5.43	6.0%	$5.16	6.1%
Surveyor	$0.92	1.1%	$0.77	0.9%	$0.82	0.9%	$0.84	1.0%
Total Gen. Gov't	$81.81	32.7%	$83.36	33.2%	$90.52	28.6%	$85.23	31.3%
Judicial								
Dist. Atty	$4.74	24.6%	$5.90	26.7%	$5.88	25.5%	$5.50	25.7%
Early Intervention	$0.00	0.0%	$0.99	4.5%	$0.91	4.0%	$0.63	3.0%
Justice Ct.-South	$4.62	24.0%	$4.94	22.4%	$5.28	22.9%	$4.95	23.1%
Justice Ct.-North	$1.42	7.4%	$1.46	6.6%	$1.47	6.4%	$1.45	6.8%
Juvenile	$6.47	33.6%	$6.47	29.4%	$7.21	31.3%	$6.72	31.3%
Public Defender	$0.94	4.9%	$0.88	4.0%	$0.94	4.1%	$0.92	4.3%
County Counsel	$1.06	5.5%	$1.41	6.4%	$1.38	6.0%	$1.04	4.8%
Total Judicial	$19.25	7.7%	$22.05	8.8%	$23.07	7.3%	$21.46	7.9%
Emergency Services	$4.56	1.8%	$4.71	1.9%	$5.24	1.7%	$4.84	1.8%
Library	$14.95	6.0%	$14.43	5.7%	$15.07	4.8%	$14.82	5.4%
Mental Health								
Mental Health	$8.71	68.5%	$11.04	64.4%	$11.61	69.9%	$10.45	67.5%
Alcohol	$4.01	31.5%	$5.28	30.8%	$4.99	30.1%	$4.76	30.7%
School Psych.	$0.00	0.0%	$0.82	4.8%	$0.00	0.0%	$0.27	1.8%
Total Mental Health	$12.71	5.1%	$17.14	6.8%	$16.60	5.3%	$15.48	5.7%
Activity Center	$6.21	2.5%	$6.93	2.8%	$7.85	2.5%	$7.00	2.6%
Sheriff	$36.98	14.8%	$39.32	15.6%	$42.70	13.5%	$39.67	14.6%
Planning/Building	$16.15	6.4%	$16.69	6.6%	$19.66	6.2%	$17.50	6.4%
Comm./Senior Center	$6.23	2.5%	$6.21	2.5%	$6.65	2.1%	$6.37	2.3%
Watermaster	$1.67	0.7%	$1.21	0.5%	$2.30	0.7%	$1.72	0.6%
Soil/Water Cons.	$0.00	0.0%	$0.00	0.0%	$3.11	1.0%	$1.04	0.4%
Miscellaneous	$27.70	11.1%	$16.89	6.7%	$53.20	16.8%	$32.60	12.0%
Economic Dev.	$2.39	1.0%	$3.32	1.3%	$7.53	2.4%	$4.42	1.6%
Veterans Svc.	$0.00	0.0%	$0.00	0.0%	$1.69	0.5%	$0.56	0.2%
County Health								
Medical Exam.	$0.88	6.1%	$0.77	5.0%	$0.98	6.1%	$0.88	5.7%
General	$9.18	63.3%	$10.74	70.1%	$11.06	68.6%	$10.33	67.4%
MCH Grant	$2.05	14.1%	$1.53	10.0%	$1.74	10.8%	$1.77	11.6%
Per Capita	$0.41	2.8%	$0.46	3.0%	$0.51	3.2%	$0.46	3.0%
Prenatal	$0.68	4.7%	$0.62	4.1%	$0.66	4.1%	$0.65	4.3%
WIC	$1.28	8.9%	$1.18	7.7%	$1.15	7.1%	$1.20	7.9%
TB Program	$0.03	0.2%	$0.03	0.2%	$0.03	0.2%	$0.03	0.2%
Total County Health	$14.50	5.8%	$15.32	6.1%	$16.12	5.1%	$15.32	5.6%
Computer	$5.28	2.1%	$3.87	1.5%	$4.67	1.5%	$4.61	1.7%
Total Expenditures	$250.41	100.0%	$251.44	100.0%	$315.97	100.0%	$272.61	100.0%
Ending Balance	$112.37		$82.98		$32.24			

Source: Lake County 1987-88 budget;
Planning Information Corporation, January 1988.

34C* is similar to Landtype 34B with the exception of slope, and is similar to 37C with the exception of timber type and temperature regime. Landtype 34C* is found on south slopes and at lower elevations, and has a mesic temperature regime. Landtypes 34B and 37C are frigid, and are at higher elevation sand on north slopes.

Landtype 34C has moderately deep to deep, stony residual and colluvial reddish brown soils with ponderosa pine timber types. Surface soils are very thin or thin and medium textured. Subsoils are moderately thick and moderately fine textured. The soil commonly contains large vesicular basalt boulders up to three feet in length, and bedrock outcrops on 10 to 25 percent of the unit.

Bedrock is interbedded soft, reddish brown tuff or hard, gray basalt. These rocks are massive to highly fractured and competent. Depth to bedrock ranges from 20 to 48 inches.

Typically, Landtype 34C* occurs on basaltic eruptive centers, block fault scarps, and shield volcanoes on slopes over 40 percent. Most units occur on lower elevations.

This landtype ranges in elevation above 5,000 feet and supports ponderosa pine, big sage, wax currant, Oregon grape, mules ear, Ross sedge, Idaho fescue, squawcarpet, serviceberry, lupine, and occasionally manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Course fragment content averages greater than 35 percent in the textural control section.

<u>Range of Profile Characteristics of Soil 34C*</u>

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown or dark brown loam; weak, fine granular structure; 10 to 40 percent gravel, cobbles, and stone by volume; soft; slightly plastic; pH ranges from 6.0 to 7.0; 4 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark brown stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 20 to 60 percent gravel, cobbles, and stones by volume; hard; plastic; pH ranges from 6.0 to 7.0; 20 to 36 inches thick.

Table 11.4-19
Lake County, Oregon Fiscal Analysis
General Fund Expenditures

Nominal Dollars

Department	85-86	% Total Expend	86-87	% Total Expend	87-88	% Total Expend	Average 85/86-87/88	% Total Expend
General Government								
Assessor	190,244	33.0%	179,689	30.7%	205,802	31.1%	191,912	31.6%
Central Services	41,558	7.2%	43,136	7.4%	45,774	6.9%	43,489	7.2%
Clerk	97,753	16.9%	93,855	16.0%	114,713	17.4%	102,107	16.8%
Commissioners	72,282	12.5%	80,743	13.8%	74,455	11.3%	75,827	12.5%
Courthouse	135,001	23.4%	146,012	24.9%	174,431	26.4%	151,815	25.0%
Treasurer	33,969	5.9%	36,779	6.3%	39,649	6.0%	36,799	6.1%
Surveyor	6,494	1.1%	5,445	0.9%	5,961	0.9%	5,967	1.0%
Total Gen. Gov't	577,301	32.7%	585,659	33.2%	660,785	28.6%	607,915	31.2%
Judicial								
Dist. Atty	33,439	24.6%	41,422	26.7%	42,913	25.5%	39,258	25.6%
Early Intervention	0	0.0%	6,965	4.5%	6,660	4.0%	4,542	3.0%
Justice Ct.-South	32,625	24.0%	34,695	22.4%	38,512	22.9%	35,277	23.0%
Justice Ct.-North	9,998	7.4%	10,289	6.6%	10,742	6.4%	10,343	6.8%
Juvenile	45,665	33.6%	45,481	29.4%	52,631	31.3%	47,926	31.3%
Public Defender	6,634	4.9%	6,176	4.0%	6,833	4.1%	6,548	4.3%
County Counsel	7,490	5.5%	9,888	6.4%	10,105	6.0%	9,161	6.0%
Total Judicial	135,851	7.7%	154,916	8.8%	168,396	7.3%	153,054	7.9%
Emergency Services	32,175	1.8%	33,059	1.9%	38,276	1.7%	34,503	1.8%
Library	105,497	6.0%	101,361	5.7%	110,010	4.8%	105,623	5.4%
Mental Health								
Mental Health	61,437	68.5%	77,589	64.4%	84,721	69.9%	74,582	67.5%
Alcohol	28,281	31.5%	37,107	30.8%	36,428	30.1%	33,939	30.7%
School Psych.	0	0.0%	5,738	4.8%	0	0.0%	1,913	1.7%
Total Mental Health	89,718	5.1%	120,434	6.8%	121,149	5.3%	110,434	5.7%
Activity Center	43,846	2.5%	48,670	2.8%	57,280	2.5%	49,932	2.6%
Sheriff	260,945	14.8%	276,290	15.6%	311,680	13.5%	282,972	14.5%
Planning/Building	113,971	6.4%	117,233	6.6%	143,491	6.2%	124,898	6.4%
Comm./Senior Center	43,991	2.5%	43,635	2.5%	48,573	2.1%	45,400	2.3%
Watermaster	11,759	0.7%	8,492	0.5%	16,764	0.7%	12,338	0.6%
Soil/Water Cons.	0	0.0%	0	0.0%	22,697	1.0%	7,566	0.4%
Miscellaneous	195,493	11.1%	118,644	6.7%	388,381	16.8%	234,173	12.0%
Economic Dev.	16,892	1.0%	23,355	1.3%	55,000	2.4%	31,749	1.6%
Veterans Svc.	0	0.0%	0	0.0%	12,322	0.5%	4,107	0.2%
County Health								
Medical Exam.	6,198	6.1%	5,413	5.0%	7,181	6.1%	6,264	5.7%
General	64,778	63.3%	75,426	70.1%	80,752	68.6%	73,652	67.4%
MCH Grant	14,434	14.1%	10,750	10.0%	12,674	10.8%	12,619	11.6%
Per Capita	2,886	2.8%	3,212	3.0%	3,720	3.2%	3,273	3.0%
Prenatal	4,775	4.7%	4,385	4.1%	4,792	4.1%	4,651	4.3%
WIC	9,061	8.9%	8,283	7.7%	8,365	7.1%	8,570	7.8%
TB Program	214	0.2%	196	0.2%	227	0.2%	212	0.2%
Total County Health	102,346	5.8%	107,665	6.1%	117,711	5.1%	109,241	5.6%
Computer	37,229	2.1%	27,182	1.5%	34,100	1.5%	32,837	1.7%
Total Expenditures	1,767,014	100.0%	1,766,595	100.0%	2,306,615	100.0%	1,946,741	100.0%
Ending Balance	792,960		583,000		235,348			

Source: Lake County 1987-88 budget;
Planning Information Corporation, January 1988.

Surface soils are very thin or thin and medium textured. Subsoils are moderately thick and moderately fine textured. These soils often contain large vesicular basalt boulders from 1 to 3 feet long.

Bedrock is gray, hard basalt or interbedded, soft, reddish brown tuff. They are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches.

Typically, Landtype 34A* occurs on gently sloping lava tablelands and plateaus on slopes from 0 to 15 percent. They unit occurs primarily on lower elevations but includes some units are higher elevations.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, big sage, wax currant, mules ear, bottlebrush squirreltail, squawcarpet, Ross sedge, serviceberry, Idaho fescue, lupine, bluegrass, phlox, and Oregon grape. Some units also contain manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Coarse fragment content average great than 35 percent in the textural control section.

<u>Range of Profile Characteristics of Soil 34A*</u>

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown or dark brown loam; weak, fine granular structure; 10 to 50 percent gravel, cobbles, and stones by volume; soft; slightly plastic; pH ranges from 5.5 to 6.8; 5 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 35 to 70 percent gravel, cobbles, and stone by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 36 inches thick.

3.4.2.13 <u>Mapping Unit 34B*</u>

Mapping Unit 34B* consists dominantly of Landtype 34B* and minor amounts of Landtypes 34A*, 34C*, and 37B. Landtype 34B* is similar to Landtype 34A with the exception of land-forms, slope range, and position in the landscape. It is similar to units 34A* and 34C* with the exception of slope range. Unit 37B differs by vegetative type and temperature regime. Landtype 34B* is found on south slopes and has a

Table 11.4-17
Lake County, Oregon Fiscal Analysis
General Fund Revenues

1987 Dollars

Department	85-86	% Total Revenues	86-87	% Total Revenues	87-88	% Total Revenues	Average 85/86-87/88	% Total Revenues
Property Tax	676,625	25.0%	564,728	23.1%	605,560	23.8%	615,638	24.0%
Previous Year	132,149	4.9%	88,401	3.6%	92,000	3.6%	104,183	4.1%
Interest	73,662	2.7%	39,065	1.6%	50,000	2.0%	54,242	2.1%
Other Local	183,562	6.8%	132,900	5.4%	70,450	2.8%	128,971	5.0%
Permits	12,363	0.5%	9,088	0.4%	20,900	0.8%	14,117	0.6%
Fees	60,093	2.2%	56,717	2.3%	58,300	2.3%	58,370	2.3%
Miscellaneous	291	0.0%	12,652	0.5%	10,000	0.4%	7,648	0.3%
Total Local	1,138,745	42.1%	903,552	37.0%	907,210	35.7%	983,169	38.4%
State-General	177,123	6.5%	217,964	8.9%	172,528	6.8%	189,205	7.4%
State-Pub.Health	39,977	1.5%	37,193	1.5%	37,936	1.5%	38,369	1.5%
State-Misc.	10,558	0.4%	0	0.0%	97,000	3.8%	35,853	1.4%
Total State	227,658	8.4%	255,157	10.4%	307,464	12.1%	263,427	10.3%
Federal Sources	345,603	12.8%	333,345	13.7%	326,800	12.9%	335,249	13.1%
Mental Health	110,360	4.1%	119,795	4.9%	166,212	6.5%	132,122	5.2%
Transfers In	98,716	3.6%	102,561	4.2%	84,277	3.3%	95,185	3.7%
Beginning Bal.	785,335	29.0%	727,317	29.8%	750,000	29.5%	754,217	29.4%
Total Revenues	2,706,417	100.0%	2,441,728	100.0%	2,541,963	100.0%	2,563,369	100.0%
	-6.08%							

Source: Lake County 1987-88 budget;
Planning Information Corporation, January 1988.

Typically, Landtype 34B occurs on basaltic eruptive centers, shield volcanoes, and block fault scarps on slopes from 16 to 40 percent. It occurs on a wide range of elevations but is most typically found on lower elevations.

This landtype ranges in elevation above 4,800 feet and supports ponderosa pine, Oregon grape, mules ear, Ross sedge, Idaho fescue, mountain mahogany, big sage, wax currant, squawcarpet, serviceberry, lupine, and occasionally manzanita.

The soil is well drained. Permeability is moderate in the surface soils and slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 34B

Litter: Needles, leaves, twigs, and decomposing organic matter; 1 to 4 inches thick.

Surface layers: Dark reddish brown or dark brown loam or clay loam; weak to moderate, fine granular structure; 10 to 50 percent gravel, cobbles, and stone by volume; soft; slightly plastic; pH ranges from 5.5 to 6.8; 5 to 12 inches thick.

Subsoil layers: Dark reddish brown or dark brown stony clay loam or silty clay loam; moderate, fine subangular blocky structure; 35 to 70 percent gravel, cobbles, and stones by volume; hard; plastic; pH ranges from 5.5 to 7.0; 20 to 36 inches thick.

3.4.2.11 Mapping Unit 34B/R.O.

Mapping Unit 34B/R.O. consists dominantly of Landtype 34B and minor amounts of Landtypes 34A, 34C, and 37B. Landtype 34B is similar to Landtype 34A with the exception of landforms, slope range, and position in the landscape. It is similar to Unit 34C with the exception of slope range. Unit 37B differs by vegetative type. This unit has 10 to 20 percent rock outcrops, on slopes breaks, and spur ridges.

Landtype 34B has moderately deep to deep, stony residual and colluvial reddish brown soils with ponderosa pine timber types. Surface soils are very thin and medium or moderately fine textured. Subsoil layers are moderately thick and moderately fine textured. Large vesicular basalt boulders up to 3 feet long are common, and bedrock outcrops occupy 10 to 20 percent of this unit.

provided, which will increase the costs of landfill operations (Gray, pers. comm., 16 December 1987).

11.4.4.1.7 Lake County Fiscal Analysis

General Fund Revenues (GFRs)

Table 11.4-16 present Lake County GFRs by major category and major category as a percent of total in nominal dollars for fiscal years 1985-86 through 1987-88, as well as the three year average. Nominal dollars are "as spent" dollars, unadjusted for inflation. Table 11.4-17 presents the same information in constant 1987 dollars. Constant dollars are adjusted for inflation. Table 11.4-18 presents GFRs per capita.

In nominal dollars (unadjusted for inflation), Lake County received basically stable total revenues since the 1985-86 fiscal year. Revenues totalled $2.56 million in 1985-86, $2.35 million in 1986-87 and are budgeted at $2.54 million in the current year. When inflation is taken into account and revenues are expressed in terms of 1987 dollars, total Lake County Fiscal Analysis GFRs (1987 Dollars) are seen to decrease from $2.71 million in 1985-86 to $2.54 million in the current budget. While nominal revenues decreased by less than one percent since 1985-86, the purchasing power of the revenues decreased by 7 percent.

Historically, locally generated revenues and carryovers from previous budget years have been the major revenue sources for the county. On average, these sources have combined to produce nearly 60 percent of yearly revenues. Property tax has been the largest single local resource, averaging 24 percent of total revenues since 1985-86. Carryovers have averaged 29 percent of total revenues during the same period. State and federal revenues have averaged 10 percent and 13 percent of total revenues, respectively. Per capita GFRs averages $349 over the three year period.

General Fund Expenditures (GFEs)

Tables 11.4-19, 11.4-20, and 11.4-21 present Lake County GFEs by major category and major category as a percent of total for fiscal years 1985-86 through 1987-88, as well as the three year average, in nominal dollars, constant 1987 dollars and GFEs per capita, respectively.

Total GFEs have remained nearly constant since 1985-86, when expressed in nominal dollars. Expenditures totalled $1.77 million in 1985-86 and 1986-87 and are budgeted at almost $2.31 million in the current fiscal year. It should be noted that budgeted expenditures tend to be overestimated to

This landtype ranges in elevation above 4,500 feet and supports scattered juniper, ponderosa pine and big sage, low sage, bitterbrush, phlox, bottlebrush squirreltail, Idaho fescue, and mountain mahogany.

The soil is well drained. Permeability is moderate to slow in the surface soils and slow or very slow in the subsoils. Coarse fragment content averages greater than 35 percent in the textural control section.

Range of Profile Characteristics of Soil 31A

Litter: Patch areas with fine needle mat, 1/2" thick.

Surface layers: Dark brown or dark grayish brown loam or clay loam; weak, fine granular structure; 10 to 50 percent coarse fragments by volume; soft; slightly plastic to plastic; pH ranges from 5.0 to 7.0; 6 to 16 inches thick.

Subsoil layers: Dark reddish brown to dark brown stony clay loam or silty clay; moderate, fine to medium subangular blocky structure with occasional moderate, coarse prismatic structure; 35 to 50 percent coarse fragments volume; very hard; very plastic; hard, and massive; pH ranges from 5.0 to 7.0; 9 to 29 inches thick.

3.4.2.9 Mapping Unit 34A

Mapping Unit 34A consists dominantly of Landtype 34A and minor amounts of Landtypes 28, 30A, 34B, and 35. Landtype 34A is similar to Landtype 34B with the exception of slope range and position in the landscape. It is different from unit 35 in vegetative type.

Landtype 34A has moderately deep to deep, stony and residual reddish brown soils with ponderosa pine timber types. Surface soils are very thin or thin and medium textured. Subsoils are moderately thick and moderately fine textured. These soils often contain large vesicular basalt boulders from 1 to 3 feet long.

Bedrock is gray, hard basalt or interbedded, soft, reddish brown tuff. They are massive to highly fractured and competent. Depth to bedrock ranges from 25 to 48 inches. Some areas are deeper than 48 inches to bedrock.

Typically, Landtype 34A occurs on gently sloping lava tablelands and plateaus on slopes from 0 to 15 percent. The

TABLE 11.4-15

LAKE COUNTY, OREGON ROAD DEPARTMENT
BUDGETED EXPENDITURES FISCAL YEAR 1987-88

Category	Amount	% of Total
Salaries	1,140,973	23.2%
Shop	85,000	1.7%
Parts	175,000	3.6%
Fuel	190,200	3.9%
Road Materials	2,206,500	44.8%
Other Supplies	321,500	6.5%
Capital	115,000	2.3%
Other	690,999	14.0%
Total	4,925,172	100.0%
Ending Balance	1,147,595	

SOURCE: Lake County Fiscal Year 1987-88 Budget

Range of Profile Characteristics of Soil 18*

Litter: Leaves and stems; 0 to 0.5 inches.

Surface layers: Dark brown silt loam, clay loam, or silty clay loam; moderate to strong, medium granular and subangular blocky structure; friable; plastic; pH ranges from 5.5 to 6.5; 10 to 15 inches thick.

Subsoil layers: Yellowish brown clay or silty clay becoming strongly mottled or gleyed in the lower part; moderate, medium subangular blocky structure becoming very coarse prismatic with depth; 0 to 35 percent gravel; firm; plastic; pH ranges from 6.0 to 7.8; over 30 inches thick.

The one unit of 18* mapped on this project occurs along a narrow drainageway east of Crone Hill in between two hydric soil units.

(25-39) Residual and Colluvial Soils from Basalt, Andesite, and Interbedded Tuffs

3.4.2.7 Mapping Unit 30A

Mapping Unit 30A consists dominantly of Landtype 30A and minor amounts of Landtypes 28, 30B, 56A. Landtype 30A is similar to Landtype 28 with the exception of soil depth and vegetative type. It is similar to land type 30B with the exception of slope range and position in the landscape.

Landtype 30A has shallow to moderately deep, stony residual soils located primarily on lower elevations. Surface soils are thin and medium to moderately fine textured. Subsoils are thin and moderately fine or fine textured. Surface vesicular basalt boulders commonly cover up to 50 percent of the surface. Rock outcrops and boulder patches are common within some areas.

Bedrock is interbedded soft, reddish brown tuff or hard, gray basalt or andesite. Depth to bedrock ranges from 15 to 45 inches.

Typically, Landtype 30A occurs on gently rolling basalt lava and tuff tablelands on slopes from 0 to 15 percent slopes. It occurs on a wide range of elevations but primarily on lower elevations or forest fringe areas.

This landtype ranges in elevation above 4,500 feet and supports scattered juniper, ponderosa pine and big sage, low

Examination of the detailed crime statistics for the Lake County Sheriff's Department and the Oregon Highway Patrol suggests little change in criminal activity for those agencies during these years.

Search and Rescue

Lake County has an active search and rescue unit with 40 search and rescue volunteers. The unit has two four wheel drives, three snowmobiles and a mobile kitchen vehicle.

11.4.4.1.3 Lake County Road Department

The Lake County Road Department maintains a total of 675 miles of roadway. Of the total mileage, 238 miles are paved, 362 miles are gravel and 75 miles are dirt. The department tries to maintain a schedule of improvements that include chip and seal of 30 miles of roads and 30 to 40 miles of new pavement and overlays each year. Gravel and dirt roads are repaired on an as-needed basis. For unpaved roads, the county is divided into 5 districts with a motor grader operator in each district who is responsible for continual upkeep of the roads.

Department staff currently stands at 30 full time and 7 to 9 part time seasonal employees. Full time position categories include department superintendent, administrator, office staff, heavy equipment operator, grader operator, light equipment operator, shop mechanic, and truck driver.

The department operates 113 pieces of equipment including the following:

17	Pickup trucks
8	Dump trucks
10	Graders
13	Tractors
3	Water trucks
14	Trailers
1	Snow truck
8	Snow plows
4	Loaders
6	Miscellaneous trucks
2	Cars
27	Other (scrapers, pavers, welders, etc.)

The equipment is replaced on a regular schedule and is in very good condition.

Equipment storage and maintenance is provided at the main county shop in Lakeview and in small, storage only shops in Silver Lake and Fort Rock in the northern section of the

3.4.2.3 Mapping Unit 6 - Rugged rocky landforms at higher elevations

This mapping unit consists of steep, rocky, and stony slopes and ridges at higher elevations with stringers and patches of white fir, lodgepole pine, and whitebark pine. Trees are generally sparse, and manzanita and snowbrush may be present. Soils are shallow, stony, and loamy. Bedrock outcrops are common and consist of basalt, andesite, rhyolite, and breccia. Talus areas and outcrops dominate the unit. Vegetation includes sagebrush, shrubby penstemon, ocean spray, pin cherry, pine mat, and mahogany. Slopes range up to 80 percent, and elevations range above 6,000 feet.

(13-24) Deep, Transported Soils of Alluvial or Lacustrine Origin

3.4.2.5 Mapping Unit 16*

Mapping Unit 16* consists dominantly of Landtype 16* and minor amounts of landtypes 16, 17, and 25. Landtype 16* is similar to Landtype 25 with the exception of internal drainage and plant community types. It is similar to unit 18 with the exception of elevation and position in the landscape. It is similar to 16 except that it has variable textural classes.

Mapping Unit 16, in the SRI report is classified as fine textured. Mapping Unit 16* includes fine-loamy, fine-silty and loamy-skeletal textural family classes in a complex of soils not separable at the order 2 level of mapping.

Landtype 16* has deep to extremely deep soils derived from alluvial and colluvial deposits on upland basins. Surface soils are thin and medium to moderately fine textured. Subsoils are thick to very thick and moderately fine to fine textured. Lower part of subsoil is mottled, gleyed, and may have a hardpan and sand or gravel lenses locally.

Bedrock is interbedded soft, reddish brown or brown tuff and hard, gray basalt or andesite. Depth to consolidated bedrock ranges from 60 to over 144 inches.

Typically, Landtype 16* occurs on broad, gently sloping upland basins. Slopes are less than 5 percent.

This landtype ranges in elevations above 5,300 feet supports semi-moist or moist meadow vegetation consisting of sedges, meadow foxtail, Kentucky bluegrass, rushes, tufted hairgrass, and big sage (along the boundaries of the unit).

County. If circumstances warrant, the sheriff can refuse to hold prisoners from outside the county.

The county jail is currently obsolete and does not meet federal jail standards. At present no funds have been identified to build a new jail facility.

Vehicles

The Sheriff's Department has a total of six patrol vehicles, and operates on a one deputy per vehicle basis. The four deputies all have four wheel drive vehicles; all of the vehicles are fairly old. The department buys vehicles from the state patrol at an average cost of $1,000 per vehicle.

Crime Statistics

Table 11.4-14 presents Lake County major crime statistics for the 1984-86 period.

It is difficult to determine trends because the data does not include Town of Lakeview statistics for eight months of 1984 and all of 1985. The apparent increase in crime in 1986 is due to the addition of Lakeview crime statistics.

Spot symbols represent land features important to land management which are too small to delineate at the scale used for this inventory. A representative of the symbol used in this survey is shown below.

Rock outcrop V

3.4.2 Mapping Unit Descriptions

This section describes each mapping unit. Acreages of each mapping unit are listed in Table 3.4-1. Total acreage is 7480.

The first paragraph states the primary landtype and the most common landtype inclusions found within the mapping unit. The second paragraph gives a brief generalized description of the primary soil. The third paragraph briefly describes the bedrock occurring in the landtype. The fourth paragraph describes the landform and slope. The fifth paragraph describes the elevation and vegetation type. The sixth paragraph describes the drainage class and permeability rates. And the seventh paragraph describes the range of profile characteristics which have been established for the dominant soil. Reference should be made to the glossary (Section 3.5) for definitions of terms used in these descriptions and to Appendix 3.C on soil and landtype characteristics.

(1-12) Miscellaneous Mapping Units

3.4.2.1 Mapping Unit 3 - Rock outcrops and talus

This mapping unit consists of steep, rocky lands which are made up mostly of basalt, rhyolite and breccia outcrops and talus. This unit contains little or no soil or vegetation. It also includes a few areas involving landfills and areas disturbed by mining and tailings.

3.4.2.2 Mapping Unit 4 - Steep lands with shallow soils and rock outcrops

This mapping unit consists of lands dominated by outcrops, talus, steep slopes, shallow soils, and sparse vegetation. Soils are gravelly, stony, and loamy. Vegetation is big sage, low sage, rabbitbrush, mahogany, bitterbrush, and juniper. Bedrock consists of breccia, tuff, or basalt. Slope range up to 80 percent.

3.4.2.3 Mapping Unit 4A - Gently sloping lands with shallow soils and rock outcrops

This mapping unit is the same as mapping unit 4 except it is found on slopes of 0-15%.

Staff

Currently, Lake County general government staff totals 27 full time equivalent employees. The following departments are included in this total:

Department	Staffing
Assessor	7
Central Services	1
Clerk	3
Commissioners	3
Maintenance	3
Treasurer	1.5
Surveyor	1
Planning/Building	4
Watermaster	2.5
Service Officer	1
Total	27

All of the above departments except the county surveyor are located in the Courthouse.

Staff levels for other agencies and departments located in the Courthouse are:

Department	Staffing
Judicial	6.5
Mental Health	5.5
Sheriff	10.5
Extension	2.5
Total	25

Staff levels for general government departments are considered adequate to meet current demands. No plans to add staff in any department were noted (O'Conner, pers. comm., 11 November 1987).

11.4.4.1.2 Lake County Sheriff's Department

The Lake County Sheriff's Department provides law enforcement services to all of the unincorporated portions of Lake County. The Sheriff's Department is headquartered in Lakeview, in the county courthouse. Two resident officers are stationed in the north end of the county, one in Paisley, and one in Silver Lake. Dispatch services for the Sheriff's Department are provided by the Lakeview Fire Department.

The department provides 24 hour on-call coverage. In the south end of the county, the department patrols until 10:00 pm, Sunday through Thursday and until midnight or 2:00

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TABLE 11.4-13

HOUSING AVAILABILITY LAKEVIEW, OREGON AREA
JANUARY 1988

Type of Unit	Number of Units
Houses for sale	100[1]
Houses for rent	16[2]
Mobile Home Spaces	30
Motel Rooms	180
Summer	3
Winter	100
RV	
Summer	5
Winter	Closed

[1]High Country Reality January 1988.
[2]Average listings, Lake County Examiner 11/12/87-01/07/88.

3.3 METHODS

The soils study consisted of compilation of SRI data accompanied by on-site investigations including several weeks of field work. The SRI report includes geologic, topographic and soils information and interpretations. The scale of soil mapping is one inch per mile (1:63,360), and provides a good, general level of detail.

Data was collected for mapping by digging pits with a backhoe or by hand shovel, and then recording soils observations. Data was collected at over 200 sites. Soil and map unit boundaries were observed by on-the-ground transects throughout most of the project area. Various base maps were used during the mapping, and the final base map is a topographic base (Figure 3.3-1).

SRI author David Wenzel aided in the recognizing of parent material and soils on the project site, and provided input on the type of data needed and desired.

Lab data was collected on samples of 60 soil horizons in the study area taken at the observation points labeled in Figure 3.3-1. Soil particle size analysis (Appendix 3.A) and chemistry (Appendix 3.B) was run on each sample.

Report format is structured to follow the SRI standards with Soil Conservation Service (SCS) mapping techniques being incorporated for Order II level soil mapping. This should provide for better understanding of this report.

Recreational Vehicle Parks

Table 11.4-12 presents the results of a Recreational Vehicle Park inventory conducted in January 1988. The three parks had a total of 66 spaces. The Junipers Reservoir Park is intending to add 15 spaces during the coming season. At the present, about five spaces are vacant during the summer. The parks are closed during the winter months.

Housing Availability

Table 11.4-13 presents January 1988 Lakeview area housing availability.

As of January 1988 there were 100 houses for sale in the Lakeview area. Of these, it was estimated that 25 were occupied by renters, 25 were occupied by owners who would leave the area if their house sold, and 50 were occupied by owners who would build or purchase a new house in the Lakeview area if their house were sold (Leach, pers. comm., 7 January 1988).

During the two months period between November 12, 1987, and January 7, 1988, there was an average of 16 Lakeview area houses per week listed for rent in the Lake County Examiner. There may be other vacant rental units in Lakeview that are not listed in the Lake County Examiner, however, few rental units are thought to be currently vacant (Leach, pers. comm., 7 January 1987).

According to the housing inventory results presented in Tables 11.4-10, 11.4-11, and 11.4-12, there were 30 mobile home spaces currently available, 100 motel rooms available in the winter, but virtually none in the summer, and five R.V. spaces available in the summer but none in the winter months in the Lakeview area.

Buildable Land

There were 104.5 buildable acres designated for residential use within Lakeview at the time the Lake County Comprehensive Plan (Steiger 1979b) was prepared.

Of these, 100 acres were zoned R-1 and 4.5 were zoned R-2. At that time there were 376 buildable acres zoned for residential use in the urban growth boundary. Of them 43 were designated R-1 and 333 were designated R-2 (Steiger 1979b).

Vegetation in most of the project area is comprised of species characteristic of the Ponderosa Pine Zone, or dry forest environment. Typical species include ponderosa pine, white fir, juniper, mountain mahogany, bitterbrush, big sagebrush, manzanita, Oregon grape, and fescue. Vegetation in the Quartz Valley area is comprised of a wet meadow community.

Table 11.4-10
Mobile Home Parks
Lakeview Area, Oregon

Name of Mobile Home Park	# of Spaces	# of Spaces Occupied	# of Spaces Vacant	Year Built	Contact
Western Villa	47	41	6	1972	Milda Wilke
Rental Subdivision	13	8	5	1972	Milda Wilke
Town & Country	15	14	1	1980	Dr. Berry
Mile-Hi Trailer Park	21	18	3	1970	Shirley Byle
Pine Hollows	24	23	1	1975	Mary Steward
Siebert	18	12	6	1985	Duane Siebert
Caswell	14	8	6	1975	Mrs. Caswell
Richardsons	6	4	2	1975	Mrs. Richardson
Reed	4	4	0		Patty Clemons
Barrett	4	4	0		Patty Clemons
Total	166	136	30		

Source: Planning Information Corporation, January 1988.

SUMMARY

A soil survey was performed in the Quartz Mountain Gold Project study area to determine study area soil characteristics which will affect reclamation planning. Existing soil survey information was supplemented by on-site investigations involving observation and description of soil characteristics in shallow pits. Soil chemistry and physical characteristics were determined in the laboratory.

Soils mapping units were classified to the Order II level using Soil Conservation Survey standards, and their distribution within the study area was mapped. The mapping units defined here fall into four catagories based on the lithology of the underlying rock units and the geomorphic landforms associated with each rock type.

Deep transported soils that formed in upland basins or in alluvial valleys are very deep, are composed of silty or clayey loam, and support meadow communities and scattered conifers.

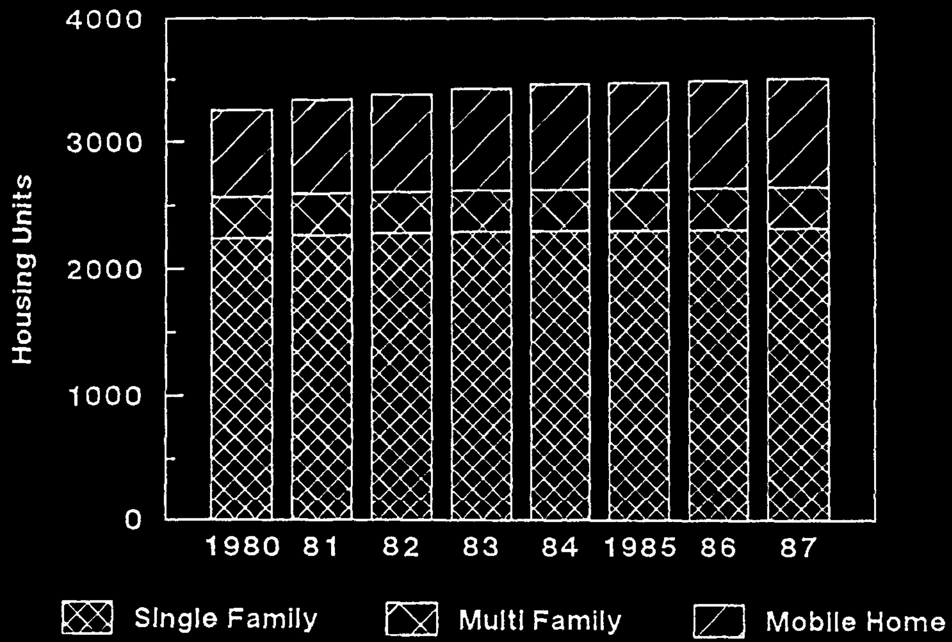
Soils formed on basalt lava and tuff tablelands and plateaus are composed of silty loam or clay loam, are moderately deep to shallow, and are stony, with up to 70 percent gravels, stones, and cobbles. Rock outcrops and boulders are common.

Residual and colluvial soils formed on rhyolite flow domes are composed of sandy loam. They are deep to moderately deep, and are stony, with as much as 80 percent gravels, stones, and cobbles. They typically support mixed vegetative communities.

Soils formed on gently rolling tablelands of pyroclastic rocks and vesicular basalts are moderately deep to deep and are composed of loam or sandy loam. Up to 60 percent of the soil profile may be gravels and cobbles. These soils typically support ponderosa pine and shrub-steppe communities.

The relative stability of the soil mapping units in terms of mass movement such as landslides or slope failure is high. Most soils are very stable or stable, with occasional rotational slumps observed. Slightly less stable soils occur on the steeper slopes of basalt lava landforms. Potential surface erosion by sheet erosion or rill and gully erosion is primarily a function of the steepness of the slope on which the soils occur. Soils on slopes of 15 percent or greater slope will experience moderate to considerable soil loss, whereas soils on slopes less than 15 percent will experience minor soil loss.

Figure 11.4-4
Housing Units by Type 1980-1987
Lake County, Oregon



Source: Lake County Planning Department; Lake County Assessor's Office; Planning Information Corporation, January 1988

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In 1980, 36 percent of the total of Lake County housing units were located in Lakeview. Lakeview averaged seven building permits per year over the period, two of which were single family and five were mobile homes. For the Lakeview urban growth area, an average of 20 building permits were issued annually, 19 for mobile homes and 2 for single family homes. In the remainder of the county an average of 65 permits were issued annually, 9 for single family and 33 for mobile homes.

Table 11.4-9 provides an annual estimate of Lakeview, the remainder of the county, and Lake County total housing units, by adding the building permit data from Table 11.4-8 to the 1980 census housing count and adjusting for an estimate of the number of mobile homes moved. Figure 11.4-4 present this information in graphic form.

Lakeview added 35 units over the six year period or 3 percent of 1980 housing stock. The urban growth area added 88 units or 25 percent of 1980 housing stock. The remainder of the county added 204 units or 12 percent of 1980 housing stock.

Figures 11.4-4 and 11.4-5 display housing units by type for Lakeview and the county for the 1980 through 1986 period. On a county wide basis mobile homes have increased from 20 percent of total housing stock in 1980 to 26 percent in 1986. In Lakeview mobile homes have increased from 3 percent to 4 percent of total housing stock.

Mobile Home Parks

Table 11.4-10 presents the results of a Lakeview area mobile home park inventory conducted by PIC in January of 1988. At that time there were nine mobile home parks in the area with a total of 166 mobile home spaces. Of those, 136 were occupied and 30 were vacant.

Motel Rooms

Table 11.4-11 presents the results of a January 1988 motel inventory. At that time there were seven motels with a total of 180 rooms.

Almost all motel rooms are occupied during the summer months, but an estimated 100 units are available during November through April.

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TABLE 11.4-7

1980 CENSUS HOUSING COUNTY BY TYPE
LAKE COUNTY AND THE TOWN OF LAKEVIEW, OREGON

Lake County	
Single Family	2,210
Multi-family	329
Mobile Home	636
TOTAL	3,175
Lakeview	
Single Family	975
Multi-family	133
Mobile Home	40
TOTAL	1,148

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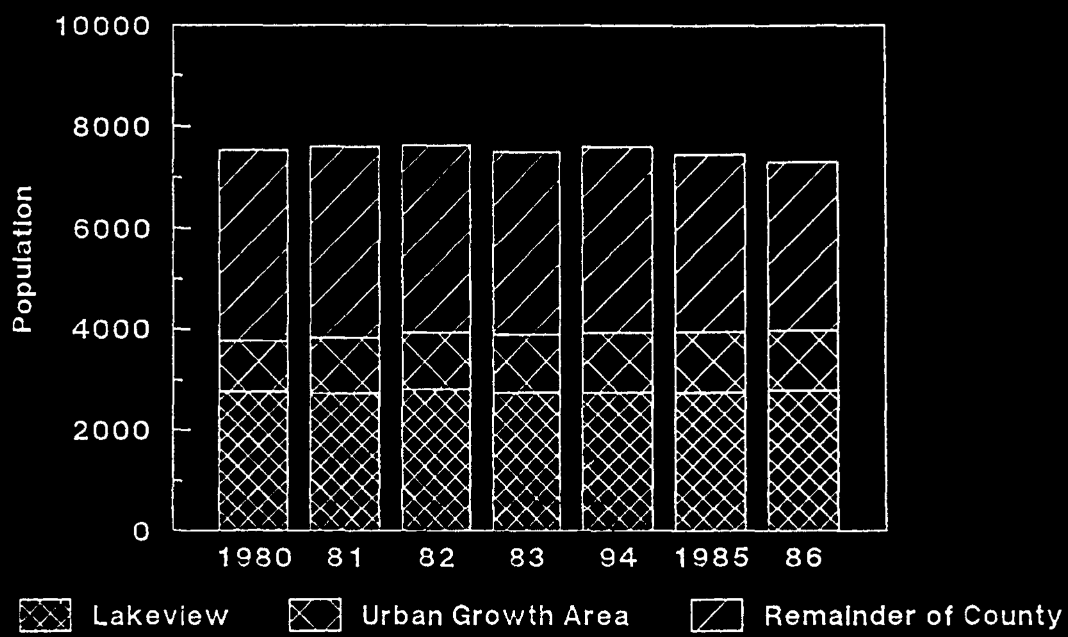
Figure 11.4-3

Population 1980-1986

Lakeview, Urban Growth Area, Remainder of County, Oregon



Source: Center for Population and Research, Portland State University; Lake County Planning Department; Lake County Assessor's Office; Planning Information Corporation, January 1988 western juniper. Modern fire control practices have also modified the composition of the forest, increasing the abundance of the fire-sensitive white fir relative to the more fire-resistant ponderosa pine.

The Pothole Allotment is and has been the only grazing allotment in the area, and about 15 percent of the entire allotment is in the study area. Sheep were the primary livestock from 1908 to 1962, and the allotment was then converted to cattle use. The USFS assessed forage production and current utilization by range type in 1980, and found that vegetation condition was fair to good. It was noted that many stream bottoms and meadows were heavily used or overused, and were degraded.

Table 11.4-5 presents Lake and Klamath counties' 1986 annual estimated unemployed persons in selected skills categories.

Neither registered workers nor projected unemployed workers represents the total number of workers who would constitute the Lake and Klamath county local hire pool. There are an unknown number of unemployed and under employed workers who are not registered with the State Division of Employment (Mahan 1988).

Please Note: These job categories and numbers of workers will change once detailed workforce skill requirements data is developed by Galactic.

11.4.2 Population

Figure 11.4-3 presents annual population for Lake County and the Town of Lakeview from 1980 through 1986. Table 11.4-6 presents 1980 census counts and annual population estimates for Lake County, Lakeview, the Lakeview urban growth area, and the remainder of the county.

In Lake County as a whole, population declined 3 percent over the six year period, from 7532 in 1980 to 7300 in 1986. However, the town of Lakeview grew by an estimated 15 people from 2,770 in 1980 to 2,785 in 1986. The Lakeview urban growth area grew from 1,001 in 1980 to 1,191, an increase of 19 percent. The population loss occurred in the remainder of the county, which decreased from 3,762 to 3,324, a loss of 448 people.

The decline in Lake County population was driven primarily by outmigration, which totaled 625 persons over the six year period. Net natural increase (the excess of births over deaths) totaled 393 persons, which softened the effect of the outmigration (Mahan 1987).

11.4.3 Housing

Table 11.4-7 present 1980 census housing counts, total and by type, for Lakeview, the remainder of the county, and Lake County as a whole.

Table 11.4-8 displays annual building permits total and by type for Lakeview, the Lakeview urban growth area, the remainder of the county and Lake County as a whole. The table also presents an estimate of mobile homes moved both within and out of the county. This estimate was provided by the Lake County Assessors Office.

4.0 VEGETATION

4.1 INTRODUCTION

4.1.1 Objectives

Steffen Robertson and Kirsten (Colorado) Inc. (SRK) was retained by Galactic Services, Inc. (GALACTIC) to conduct environmental baseline studies for the proposed Quartz Mountain Gold Mine in Lake County, Oregon. Vegetation studies are described in this Vegetation Baseline Report which is intended to serve as a technical support document for the Environmental Impact Statement (EIS) currently being prepared by SRK under the direction of the USDA Forest Service, Fremont National Forest (USFS). This EIS is being prepared in accordance with USFS guidelines for implementing the Council of Environmental Quality Regulations (40 CFR 1500-1508) related to the National Environmental Policy Act of 1969 (NEPA).

Vegetation baseline studies were conducted to obtain information in four general categories: (1) plant community types, (2) wetlands, (3) forest and range resources, and (4) threatened, endangered, or sensitive plant species and habitats.

4.1.2 Study Area

The Quartz Mountain Gold Project study area (Figure 1.1-1) is located in Lake County, Oregon, near the summit of Quartz Mountain Pass approximately 30 miles west-northwest of Lakeview, Oregon. This area occurs within the Basin and Range physiographic province described in Franklin and Dyrness (1973). Elevations within the project area range from 5,400 ft to 6,600 ft, and the topography is dominated by round to oval-shaped buttes of moderate relief.

Climate in the project area is moderate with warm summer days and cool nights, and cool winter days and cold nights. The annual average precipitation in the project area ranges from approximately 20 to 25 inches. Most of this precipitation is in the form of winter snows and locally intense summer thunderstorms. Vegetation reflects this climate and consists primarily of species characteristic of the Ponderosa Pine Vegetation Zone (Franklin and Dyrness 1973).

Table 11.4-3
Labor Force, Employment, Unemployment 1980-1986
Lake County, Oregon

	1980	1981	1982	1983	1984	1985	1986
Labor Force	3600	3680	3540	3650	4210	4040	4190
Employment	3210	3260	3080	3220	3760	3600	3760
Unemployment	390	420	460	430	450	440	430
Unemployment Rate	10.8	11.4	13.0	11.8	10.7	10.9	10.3

Source: State of Oregon Employment Division;
Planning Information Corporation, January 1988.

4.3 PLANT COMMUNITY TYPES

4.3.1 Methods

Plant community mapping, field observations, and a literature review were conducted to provide site-specific information about the vegetation of the Quartz Mountain Project study area in terms of community structure and species composition, extent of plant communities, vegetation condition, and successional stage. Literature consulted is summarized in Section 4.2.

Identifying plant communities on the study area was simplified by two existing documents: (1) plant communities on the Fremont National Forest had been named and described by Hopkins (1979), and (2) forest communities in the study area had been mapped using Hopkins' plant community types (USFS 1985). Copies of each of these documents were obtained. Aerial photographs of the study area were also obtained. These were color stereo pairs at a scale of 1:24,000.

Aerial photointerpretation of the study area vegetation was conducted using techniques described in Avery (1968) and Kuchler (1967). This information was used in conjunction with the USFS maps to prepare a draft vegetation map of the study area. Then the draft map was ground truthed in order to check the accuracy of the map units and boundaries. Any areas about which there was a question were also investigated. Particular attention was paid to shrub-steppe and meadow communities. They had not been assigned community type designations on the USFS map which was confined to forest community types. Finally, all field observations of the vegetation task leader, the reclamation task leader, and the soils task leader were used to assign community types to the shrub-steppe sites and to verify the accuracy of forest community type designations on the draft map. This refined draft was used to prepare the final vegetation map at a scale of 1" = 1,000'.

4.3.2 Results

Plant communities present on the Quartz Mountain Gold Project study area are described below. Descriptions include information from field surveys as well as data included in Hopkins (1979) which are applicable to the study area.

There are nine forested communities and seven non-forested communities that occur in large enough areas to be mapped. Several additional communities are present but too small to map accurately. Figure 4.3-1 and Plate 4-1 show the vegetation map of the study area. Table 4.3-1 gives total acreages for each of the mapped community types. Each

Table 11.4-2
Earnings by Place of Work 1980-1986 (000's 1986$)
Lake County, Oregon

Sector	1980	1981	1982	1983	1984	1985	1986	Ave 1980-86
Farm	12,568	10,229	8,650	10,041	9,614	9,614	9,614	10,047
Mining	843	853	698	649	713	730	750	748
Construction	2,660	2,230	1,516	1,876	1,949	1,425	2,208	1,981
Manufacturing	12,307	11,967	11,275	13,126	13,803	13,325	14,180	12,855
TCPU	2,072	1,958	2,082	1,991	1,898	1,880	2,177	2,008
Wholesale Trade	1,030	1,043	853	794	871	755	592	848
Retail Trade	5,627	5,371	4,690	4,753	5,048	4,695	5,246	5,061
FIRE	995	851	829	846	786	725	763	828
Services,Inc Ag Srv	4,297	3,801	3,757	3,789	4,063	4,163	4,017	3,984
Government	17,896	18,035	17,133	18,204	18,088	17,732	17,729	17,831
Total Earnings	60,295	56,339	51,484	56,070	56,833	55,045	57,277	56,192

Percent by Sector

Sector	1980	1981	1982	1983	1984	1985	1986	Ave 1980-86
Farm	20.8%	18.2%	16.8%	17.9%	16.9%	17.5%	16.8%	17.9%
Mining	1.4%	1.5%	1.4%	1.2%	1.3%	1.3%	1.3%	1.3%
Construction	4.4%	4.0%	2.9%	3.3%	3.4%	2.6%	3.9%	3.5%
Manufacturing	20.4%	21.2%	21.9%	23.4%	24.3%	24.2%	24.8%	22.9%
TCPU	3.4%	3.5%	4.0%	3.6%	3.3%	3.4%	3.8%	3.6%
Wholesale Trade	1.7%	1.9%	1.7%	1.4%	1.5%	1.4%	1.0%	1.5%
Retail Trade	9.3%	9.5%	9.1%	8.5%	8.9%	8.5%	9.2%	9.0%
FIRE	1.7%	1.5%	1.6%	1.5%	1.4%	1.3%	1.3%	1.5%
Services,Inc Ag Srv	7.1%	6.7%	7.3%	6.8%	7.1%	7.6%	7.0%	7.1%
Government	29.7%	32.0%	33.3%	32.5%	31.8%	32.2%	31.0%	31.7%
Total Earnings	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

% Yearly change by Sector

Sector	1980	1981	1982	1983	1984	1985	1986	Ave 1980-86
Farm	NA	-18.6%	-15.4%	16.1%	-4.3%	0.0%	0.0%	-3.2%
Mining	NA	1.2%	-18.2%	-6.9%	9.7%	2.4%	2.8%	-1.3%
Construction	NA	-16.2%	-32.0%	23.7%	3.8%	-26.8%	54.9%	1.1%
Manufacturing	NA	-2.8%	-5.8%	16.4%	5.2%	-3.5%	6.4%	2.3%
TCPU	NA	-5.5%	6.3%	-4.4%	-4.7%	-0.9%	15.8%	1.0%
Wholesale Trade	NA	1.2%	-18.2%	-6.9%	9.7%	-13.3%	-21.6%	-7.0%
Retail Trade	NA	-4.6%	-12.7%	1.3%	6.2%	-7.0%	11.7%	-0.7%
FIRE	NA	-14.5%	-2.6%	2.1%	-7.1%	-7.8%	5.2%	-3.5%
Services,Inc Ag Srv	NA	-11.5%	-1.2%	0.9%	7.2%	2.5%	-3.5%	-0.8%
Government	NA	0.8%	-5.0%	6.2%	-0.6%	-2.0%	-0.0%	-0.1%
Total Earnings	NA	-6.6%	-8.6%	8.9%	1.4%	-3.1%	4.1%	-0.6%

Source: Bureau of Economic Analysis; State of Oregon Employment Division, Dept of Human Resource Planning Information Corporation, January 1988.

2) Goose Lake Lumber Company, a new company in Lakeview, which has 120 year-round employees. (Green, pers. comm., 14 January 1987).

3) Lakeview Lumber Products which has approximately 95 year-round employees (West, pers. comm., 14 January 1987).

In addition there are several logging, building material, and other independent timber related companies (firewood, fence posts, etc.) operating in the southern part of the county.

The Lake County timber industry has been remarkably stable as compared to the timber industry in the northwest in general. The reason for this stability is the Lakeview Working Circle established by the USFS under the provisions of the Federal Sustained Forest Management Act. The working circle restricts outside competition in Lake County. Only mills operating in Lakeview and Paisley are allowed to process timber from the Lakeview Working Circle. In turn, these mills are not allowed to process timber from outside the circle. While the federal sustained yield unit may decrease federal and county government revenues (in terms of less competition for timber sales and lower payment in lieu of taxes to the county) it has generated considerable stability for the Lake County lumber industry (Mahan, pers. comm., 8 February 1987).

The retail and service sectors are also major employment categories in Lake County, averaging about 13 percent of total employment each over the six year period. This reflects both Lakeview's role as a county wide agriculture and timber service center and the tourism and recreation influence on these sectors.

11.4.1.2 Earnings

Figure 11.4-2 displays Lake County total earnings by place of work from 1980 through 1986. Table 11.4-2 presents total earnings and earnings by sector, sector earnings as a percent of total, and percent annual increase for the same period. All figures are presented in constant 1986 dollars. Constant dollars are adjusted for inflation.

Total Lake County earnings fell from $60,295,000 in 1980 to $57,277,000 in 1986, a 5 percent decrease over the six year period.

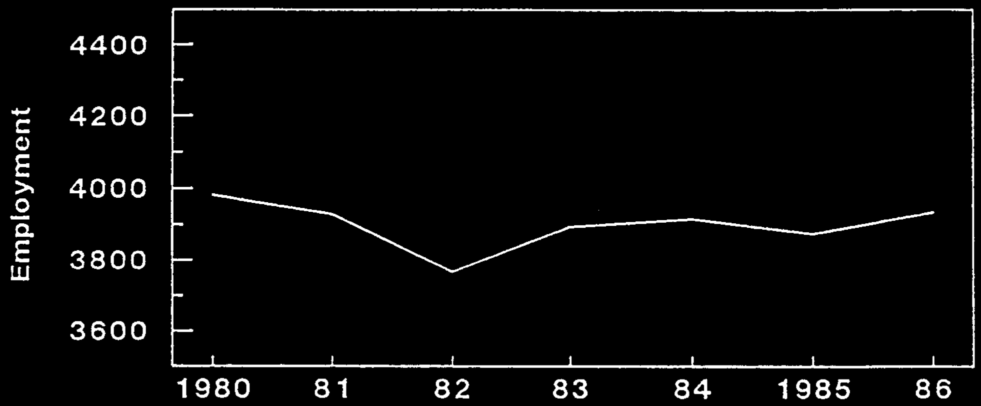
Farm earnings experienced the largest decline in this period, decreasing from $12,568,000 in 1980 to $9,614,000 in 1986, a 30 percent decrease over the six year period.

TABLE 4.3-1

ACREAGES OF EACH COMMUNITY TYPE
IN THE QUARTZ MOUNTIAN GOLD PROJECT STUDY AREA

Map Unit	Community Name	Acres	Percent of Total
Forest Types			
1	Lodgepole pine/strawberry-fescue	39	0.5
2	Ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/ fescue	352	4.7
3	Ponderosa pine/bitterbrush-manzanita/fescue	451	6.0
4	Ponderosa pine/wooly wyethia	1964	26.3
5	Ponderosa pine-quaking aspen/ bluegrass	33	0.4
6 7	White fir-ponderosa pine/ snowberry/starwort White fire-ponderosa pine/ manzanita/oregongrape	1577	21.1
8	White fir-ponderosa pine-sugar pine/manzanita	144	1.9
9	White fir-ponderosa pine-incense cedar/serviceberry	2230	29.8
	Total Forest Types	6790	90.7
Non-forest Types			
10 11	Juniper/low sagebrush/fescue Low sagebrush/onespike oatgrass and low sagebrush/ fescue-squirreltail	198	2.7
12	Big sagebrush/bunchgrass	139	1.9
13	Dry meadow	27	0.4
14 15	Hairgrass-sedge-moist meadow Sedge-wet meadow	301	4.0
16	Disturbed	25	0.3
	Total Non-forest Types	690	9.3
	TOTAL STUDY AREA	7480	100.0

Figure 11.4-1
Employment by Place of Work 1980-1986
Lake County, Oregon



Note: Scale does not begin at zero.

Source: Bureau of Economic Analysis; State of Oregon Employment Division, Dept of Human Resources; Planning Information Corporation, January 1988.

mountain mahogany (<u>Cercocarpus</u> <u>ledifolius</u>) and antelope bitterbrush (<u>Purshia</u> <u>tridentata</u>). Commonly occurring herbaceous species include Idaho fescue, bottlebrush squirreltail, western needlegrass (<u>Stipa</u> <u>occidentalis</u>), and western yarrow (<u>Achillea</u> <u>millefolium</u> <u>lanulosa</u>). Gray rabbitbrush (<u>Chrysothamnus</u> <u>nauseosus</u>) often is present on disturbed sites.

4.3.2.3 <u>Ponderosa Pine/Bitterbrush-Manzanita/Fescue Community</u>

There are three stands of this ponderosa pine community on the study area. Two occupy south-facing slopes on Quartz Valley Mountain and Quartz Mountain. The third is on the flats adjacent to Highway 45 along the southwestern boundary of the study area.

Ponderosa pine is the major tree species, with some western juniper regeneration in the understory. Scattered white fir (<u>Abies</u> <u>concolor</u>) occurs in some areas within this community. In other areas of the Fremont, bitterbrush and greenleaf manzanita (<u>Arctostaphylos</u> <u>patula</u>) are usually co-dominant. On the study area, however, manzanita is the dominant understory shrub with little bitterbrush present. Squawcarpet (<u>Ceanothus</u> <u>prostratus</u>), snowbrush (<u>Ceanothus</u> <u>velutinus</u>), and mountain mahogany are common associates, and gray rabbitbrush also occurs frequently. Dominant grasses include bottlebrush squirreltail, Idaho fescue, and Wheeler's bluegrass. Other common herbaceous species are strawberry, yarrow, and Ross' sedge.

4.3.2.4 <u>Ponderosa Pine/Wooly Wyethia Community</u>

This open ponderosa pine community is one of the dominant communities on the study area (Table 4.3-1). It occurs throughout the study area, usually on flats or gentle slopes, but occasionally on steeper slopes.

Ponderosa pine dominates the tree layer in this community, but western juniper is usually present also. There may be scattered white fir or incense cedar (<u>Calocedrus</u> <u>decurrens</u>) as well. The shrub layer varies considerably from site to site, and may include serviceberry (<u>Amelanchier</u> <u>alnifolia</u>), squawcarpet, manzanita, snowbrush, basin big sagebrush, bitterbrush and creeping Oregongrape (<u>Berberis</u> <u>repens</u>). Wooly wyethia (<u>Wyethia</u> <u>mollis</u>) is the dominant species in the herbaceous layer. Other common forbs include yarrow, white hawkweed (<u>Hieracium</u> <u>albiflorum</u>), longstalk clover (<u>Trifolium</u> <u>longipes</u>), heartleaf arnica (<u>Arnica</u> <u>cordifolia</u>), and strawberry. Major grasses and sedges include squirreltail, Wheeler's bluegrass, Ross' sedge, and long-stolon sedge (<u>Carex</u> <u>pensylvanica</u>).

11.3.2.6 Land Use

Local economic and demographic characteristics are reflected in the uses of land -- forest, manufacturing, and community development for residential and commercial purposes. For Lake County, information on the different types and amounts of land use was collected. The land where the proposed Quartz Mountain Project would be located was examined for its current zoning and the uses allowed in the relevant zone. Land use information was collected from secondary sources that included A Socioeconomic Overview of the Fremont National Forest Influence Zone (Silvermoon 1982), and the Lake County Comprehensive Plan (Steiger 1979b).

11.3.2.7 Transportation

The purpose of collecting transportation data for Lake County is to describe the current modes of transportation serving Lake County, and the current usage of roads in the impacted area. Transportation information was primarily compiled from the Lake County Transportation Plan (Steiger 1979a).

11.3.3 Review of Data

An important part of preparing the existing socioeconomic conditions section was the review of the data collected from a wide variety of primary and secondary sources with local officials, staff, and other knowledgeable people. The review allowed the local citizens and officials to verify the information, to understand what will be included in socioeconomic assessment models, and to suggest any other information that might be considered.

squirreltail, and long-stolon sedge. Commonly occurring forbs are tuber starwort, heartleaf arnica, and strawberry.

Canopy closure varies considerably within this community, affecting the composition and density of understory species. In more open stands, the understory is well developed and diverse. In very dense stands, understory species are sparse and scattered or eliminated altogether. This relationship between canopy and understory is discussed further in Section 4.3.3.2.

4.3.2.7 White Fir-Ponderosa Pine/Manzanita-Oregongrape Community

This mixed conifer community occurs throughout the study area. It is usually mapped in conjunction with the white fir-ponderosa pine/snowberry/starwort community as discussed in Section 4.3.2.6 above. In two stands in the northwestern part of the study area, field observations showed that this community was the predominant plant association in the stands and the sites were mapped accordingly.

In this community ponderosa pine and white fir share dominance, although pine is usually more abundant on lower slopes and fir more abundant on higher slopes. Lodgepole pine often occurs at scattered sites in a stand. Manzanita and Oregongrape dominate the shrub layer. Other common shrub species include snowbrush, squawcarpet, and snowberry. Grasses and sedges such as Wheeler's bluegrass, squirreltail, needlegrass (Stipa), Ross' sedge and long-stolon sedge are the major herbaceous understory species. A wide variety of forbs may be present in this community type. The most commonly occurring ones are strawberry, heartleaf arnica, and western hawkweed (Hieracium albertinum).

4.3.2.8 White Fir-Ponderosa Pine-Sugar Pine/Manzanita Community

On the study area, this mixed conifer community occurs on upper north and northwest slopes on all three major peaks: Quartz Mountain, Quartz Butte, and Angel Peak.

White fir is the dominant tree species in this community, with ponderosa pine and sugar pine (Pinus lambertiana) as subdominants. Incense cedar also is present but at lower densities than the three major species. Shrub composition is an indicator of stand disturbance history. More recently disturbed stands are dominated by manzanita, while more stable stands support shrub communities of Oregongrape, creeping snowberry, and prince's pine (Chimaphila umbellata) (Hopkins 1979). Herbaceous species commonly include Wheeler's demands of the community and if they had any future plans for expansion or consolidation.

Fiscal analysis is based on actual revenues and expenditures for years for which actual data is available. Budgeted revenue and expenditure data is used in analysis for the current year. Revenues and expenditures were examined by categories and compared to local population.

In Lake County existing information was collected from responsible local officials and staff on the following local government functions:

- general government,
- sheriff's department,
- road department,
- parks and recreation,
- county library, and
- county landfill.

The Town of Lakeview's inventory included information collected from responsible local officials on the following departments:

- general government,
- police,
- fire,
- parks and recreation,
- street maintenance,
- water system,
- sewer system, and
- water district.

For Bly, an unincorporated town in Klamath County, a partial inventory collected information on the following functions:

- the water and sanitary district,
- fire protection, and

4.3.2.11 Low Sagebrush/Bluegrass-Onespike Oatgrass and Low Sagebrush/Fescue-Squirreltail Communities

These two low sagebrush/bunchgrass communities are very similar in appearance and species composition, the primary difference being the dominance of either onespike oatgrass (Danthonia unispicata) or Idaho fescue. The field surveys required to separate these two communities was beyond the scope of this study, so they are mapped as one unit. However, both communities are described below.

Both these communities occur on very rocky sites. They are both dominated by low sagebrush and bunchgrasses. Major grasses common to both are Sandberg's bluegrass and squirreltail. Disturbance such as burning or overgrazing causes an increase in forbs such as biscuitroot, pussytoes, sandwort (Arenaria congesta), and cheatgrass.

The low sagebrush/fescue-squirreltail community occurs on more xeric (dry) sites. The dominant grass is Idaho fescue, with bluebunch wheatgrass and western needlegrass also present in addition to squirreltail and Sandberg's bluegrass.

The low sagebrush/bluegrass-oatgrass community occupies more mesic (moist) sites than the fescue community. The dominant grasses are Sandberg's bluegrass, onespike oatgrass, and squirreltail. This community often occurs in more mesic microsites in the larger low sagebrush/fescue community (Hopkins 1979). This type of distribution is apparent in the large shrub-steppe area between Crone Hill and Quartz Meadow. The juniper/low sagebrush/fescue community is also part of the mosaic on this site.

4.3.2.12 Big Sagebrush/Bunchgrass Community

As with the low sagebrush communities described above, this shrub-steppe community also occurs as a transitional community between the valley bottom meadows and upland forests on the study area. There are a few small stands at the upper end of the Angel Creek drainage and the small tributary drainage between Crone Hill and Quartz Butte. Some stands are also present along edges of the eastern half of Quartz Meadow. This community occupies sites that are much less rocky than the low sagebrush communities.

Basin big sagebrush is the dominant shrub, with occasional bitterbrush and mountain mahogany as associates. Juniper may be scattered over a site. Bunchgrasses such as Idaho fescue, bluebunch wheatgrass, Sandberg's bluegrass, and squirreltail dominate the understory. Other common species are Ross' sedge, yarrow, and spreading phlox (Phlox diffusa). Gray rabbitbrush, green rabbitbrush (Chrysothamnus represents wage and salary employees covered by unemployment insurance. LMI employment does not include proprietors, self employed, and other persons not covered by unemployment insurance. Relationships between BEA and LMI data for the period 1980-1984 were used to adjust 1985 and 1986 data to reflect total employment and earnings (Oregon Department of Human Resources 1987).

The LMI also provided data on labor force. This includes labor force employment, unemployment, and trends.

As a basis for analysis of local hiring, detailed information was collected from LMI on the number of persons registered for jobs in various occupations and skill categories.

- U. S. Bureau of the Census. 1980 Census information provided data on 1980 employment and labor force by age and sex. This information was used to calculate 1980 labor force participation rates by age and sex (Bureau of Census 1983).

11.3.2.2 <u>Population</u>

The purpose of collecting population data for Lake county and the City of Lakeview is to describe the 1980 demographic characteristics in some detail and to look at recent trends. The information is used to establish relationships between local government facilities and services and the population served.

Information collected includes:

- 1980 population by age and sex for Lake County and Lakeview, and

- trends in total population since 1980 for Lake County and Lakeview.

Sources for population information include:

- 1980 U.S Census (Bureau of Census 1982), and

- Portland State University, Department of Urban and Public Affairs, Center for Population Research and Census.

11.3.2.3 <u>Housing</u>

Housing information was collected for Lake County, Lakeview, and the Lakeview Urban Growth Area. The purpose of collecting information was to produce a total housing count by amounts of pullup muhley and wetland forbs may occur on the edges of these communities. A few willows (Salix) are present in Angel Creek meadow.

Vegetation in this community is not as desirable to livestock, so damage from overgrazing is not as frequent a problem as it is in the moist meadow community.

4.3.2.16 Disturbed Sites

These disturbed areas are remnants of old mercury mining activities. The sites are primarily rocky cuts and tailings material which are being invaded by the species in the adjacent communities. More detailed history of mining on the study area is presented in Section 10.0 Archaeology and Cultural Resources (SRK 1988a).

4.3.2.17 Other Plant Communities

Several other types of plant communities occur in the study area, but in sites too small to map accurately. These are for the most part associated with wetter sites. A general term for these communities is "riparian," meaning on the banks of a stream or other water body. In the project study area, this includes streams, ponds, springs, and seeps. The wetland meadows described in Sections 4.3.2.14 and 4.3.2.15 are also considered riparian communities since they are associated with streams.

Herbaceous riparian communities are found along stream channels in the study area. These communities develop in both the forested and non-forested areas. They support of diversity of sedges (Carex, Eleocharis), rushes (Juncus), and hydrophytic grasses as well as a wide variety of hydrophytic forbs such as primrose monkey (Mimulus primuloides), buttercup (Ranunculus), American bistort (Polygonum bistortoides), speedwell (Veronica peregrina), and white bogorchid (Habenaria dilitata). Willow thickets may also occur in these communities.

There are also small aspen groves and wet lodgepole pine stands on the study area. These are usually found associated with stream channels or springs. For example, small aspen groves are located at Quartz Mountain Spring, at the west end of Quartz Creek Meadow, and at the south end of the small meadow east of Crone Hill. Some of the wet lodgepole pine stands are located in the drainage bottom east of Crone hill, the southern end of Angel Creek drainage, and in the tributary drainage east of Angel Camp.

11.2 SETTING

Figure 1.1-1 presents the Quartz Mountain project location and study area.

Lake County is located in south central Oregon, on the California and Nevada borders. The county also borders Harney County on the east, Deschutes County on the north and Klamath County on the west. Lake county is the third largest county in Oregon in land area and the sixth smallest county in the state in population. Lake County has a population density of one person per square mile (Mahan 1987).

There are two incorporated cities in Lake County: Lakeview and Paisley. Lakeview, the Lake County seat, is located 96 road miles east of Klamath Falls, and 15 miles north of the California border. Over 50 percent of all Lake County residents live in Lakeview and the Lakeview urban growth area. The town of Paisley is located 39 miles north of Lakeview and has an estimated 1986 population of 315 people.

The unincorporated town of Bly is located at the western base of Quartz Mountain Pass, 54 miles east of Klamath Falls. Figure 1.1-1 displays road distances from the Quartz Mountain mine site to the communities in the study area. The Quartz Mountain Gold Project is located 29 miles north west of Lakeview along Highway 140. Bly is 14 miles west of the Quartz Mountain project and Klamath Falls is 68 miles west of the project.

vegetation colonization of a disturbed area to the establishment of climax vegetation (Raven et al. 1976). In a given habitat type, successional patterns tend to repeat themselves following disturbance. For instance, in a recently logged area an initial weedy stage (dominated by invading annual herbs) gives way to a shrubby stage in which seedling trees are common. As the trees increase in size, the character of the shrub and herb components changes. Some species disappear and others become established. Each of these transitional communities is called a seral stage or seral community. When the trees achieve such a size that the understory is shaded, the only tree species that can reproduce are those which are shade-tolerant. These are the climax tree species. Whenever a disturbance such as fire or logging occurs, the level of succession is set back to a previous seral stage, but in general the pattern will repeat. The end result of succession is the climax community.

When a community is subject to repeated disturbance, the successional patterns are sometimes modified. Hall (1970) states that species composition of a seral community that is grazed by cattle will differ from the same community grazed by sheep, which will be different from one grazed by elk, and still different if grazed by deer. Logging and grazing are the two major disturbance factors in the project study area. These are discussed in more detail in Sections 4.6 and 4.7. Alien plant species often invade disturbed areas and frequently replace the native species which cannot compete successfully with the aliens, thus altering the natural successional patterns (Franklin and Dyrness 1973). In shrub-steppe and steppe communities, native perennials are replaced most frequently by cheatgrass or Kentucky bluegrass (Franklin and Dyrness 1973). Gray rabbitbrush, a native shrub, often replaces the more palatable (to wildlife) antelope bitterbrush.

Successional patterns in ponderosa pine forests have been summarized by Franklin and Dyrness (1973). Where it is the climax tree species, ponderosa pine usually occurs in small patches of even aged stands. It is thought that this may be due to heavy seed establishment after fire. Fire has been very important in influencing community structure and species composition. Seral ponderosa pine stands are sometimes maintained where otherwise Douglas-fir (<u>Pseudotsuga menziesii</u>), white fir, or other less fire-resistant climax tree species would dominate. Fire has also been reported to have increased grass cover at the expense of shrub understory cover. On the other hand, grazing reportedly favors shrub understory cover. Logging does not appear to favor alien species in ponderosa pine forests. Studies have shown that within about 14 years after logging, the understory returns to

5) Bly School.

In addition, the study will consider the specific elements in the following areas for limited socioeconomic analyses:

1) Union School District #5 (high school students);

2) Bonanza School (Bly High School students); and

3) Klamath Falls (available labor force).

These areas have been selected for the following reasons.

Lake County

The Quartz Mountain Gold Project site is located in southern Lake County. As a result, many of the economic, population, and housing effects generated by the mine and mine employees would occur in Lake County. The project would create certain demands on Lake County facilities, services, and fiscal conditions, and generate property tax revenues to county government.

Town of Lakeview

Lakeview, the incorporated community nearest the mine site, offers a variety of commercial, medical and recreational facilities, and public services. It is likely that a portion of the inmigrant workforce associated with the mine would chose to live in Lakeview, which would generate certain demands on housing, community facilities, services, and fiscal conditions. The project would also generate non-direct employment in Lakeview, which would also create facility, service, and housing demands.

Lakeview School District #7

Children of inmigrant project workers residing in Lakeview and southern Lake County (except for elementary students in the Westside area) would attend Lakeview School District #7. District #7 will receive property tax revenues from the project.

Town of Bly

Bly is the nearest community to the project. Bly is not an incorporated town but it does provide limited public and commercial services. It is likely that a portion of the inmigrant project workforce will reside in Bly.

ponderosa pine-incense cedar/serviceberry with ponderosa pine/wooly wyethia communities occupying the open areas.

On the study area, lodgepole pine seems to occur at the more moist end of the species' ecologic range, on cold, wet, poorly drained sites. It appears that it can survive on these extreme sites, but is outcompeted by ponderosa pine on more favorable sites. Lodgepole pine communities have very limited distribution on the project study area. The largest community is located south of Drews Creek on the flats adjacent to the stream. There are small pockets of lodgepole pine, often associated with ponderosa pine, scattered over the rest of the study area. Most of these sites are at least seasonally wet. For example, lodgepole pine is present in the forest stands along the edges of Quartz Creek Meadow and Angel Creek Meadow. They occur in association with aspen in the drainage bottom between Crone Hill and Quartz Butte, and in the Angel Creek drainage north of Quartz Creek Meadow. A narrow stringer of wet lodgepole pine follows the creek bottom wetlands created by a series of old beaver dams along the tributary of Angel Creek east of Angel Camp.

Shrub-steppe communities are found in areas too dry to support forest vegetation. The term "shrub-steppe" is applied to a variety of sagebrush/grass communities in the arid west (Daubenmire 1968, Kuchler 1975). Scattered shrubs grow above an herbaceous layer in which grasses dominate and forbs are poorly represented. Basin big sagebrush communities occupy less rocky sites with deeper soils while low sagebrush communities occur on very rocky sites called scablands or scab flats (Franklin and Dyrness 1973, USFS 1987a). These communities occupy five percent of the study area.

There has been a long history of grazing in these shrub-steppe communities. Heavy grazing use tends to modify the species composition of these communities, decreasing grasses such as Idaho fescue and bluebunch wheatgrass, while increasing Sandberg's bluegrass, gray rabbitbrush, and forbs (Franklin and Dyrness 1973, Hopkins 1979). They are currently grazed by cattle in the summer months. Grazing use and effects are discussed in more detail in Section 4.7, Range Resources.

The grass-sedge meadows of the study area are classified as wetland communities. These are discussed in Section 4.4, Wetlands.

4.3.3.3 Vegetation/Soil Interactions

In many areas in southern Oregon, there are soil conditions which produce plant communities different from the common vegetation of the area. Serpentine, calcareous, or

4.4 WETLANDS

4.4.1 Methods

USFWS has been systematically mapping all the wetlands of the United States using the classification system described in Cowardin et al. (1979). The USFWS National Wetlands Inventory maps of the project study area (USFWS 1986) were obtained and a draft wetlands map was prepared. During vegetation map ground truthing and all other vegetation task field visits, observations of all wetland sites were recorded. These observations were compiled with those of the soils task leader, reclamation task leader, aquatic biology task leader, and surface water task leader, and augmented by aerial photointerpretation to refine and finalize the wetlands map.

4.4.2 Results and Discussion

A map of the wetlands of the project study area is given in Figure 4.4-1. These wetlands are comprised largely of moist or wet meadows, which occupy slightly more than four percent of the study area. The remaining wetlands are along stream channels, seeps, springs, and small ponds. These communities are described in Section 4.3.2.

Wetlands have many names and occur in a wide variety of settings. Common ones in Oregon are marshes, swamps, bogs, sloughs, wet meadows and bottomlands. Historically wetlands were considered waste areas which were valuable only after draining and developing the land for farming, housing, or industry. Recent increased understanding of environmental interactions has revealed that wetlands are extremely important parts of the ecosystem. Some functions they provide include fish and/or wildlife habitat, food chain production, water purification, storm and floodwater storage, sediment trapping, groundwater discharge and recharge, and shoreline protection (Mitsch and Gosselink 1986, Weinmann et al. 1984). Many wetlands (e.g. Malheur Wildlife Refuge) have been set aside as sanctuaries for fish and wildlife. Wetlands also have aesthetic and recreational value for people.

In order to protect wetlands, federal, state, and in some areas local legislation has been enacted to preserve these values and functions. At the federal level, the U.S. Corps of Engineers (USCOE) has jurisdiction over filling of wetlands through the Clean Water Act. The Environmental Protection Agency (EPA) is responsible for reviewing all USCOE permitting decisions regarding wetlands. The USFS also is providing management guidelines to protect wetlands and other riparian areas (USFS 1987b). At the state level, Oregon Division of State Lands (DSL) has jurisdiction over Oregon's removal-fill

There is no shortage of buildable residentially zoned land in Lakeview and the Lakeview Urban Growth Area, with total of 104.5 acres and 376 acres available in each, respectively. However, neither the town nor the county has an inventory of the number of those lots that are served by sewer, water, and streets; consequently it is not known how many lots would be available for immediate construction.

In Bly, the Bley-was subdivision, developed by Weyerhauser has sewer, water, and streets in place with a total of 80 vacant lots. The Pinecrest subdivision, northeast of Bly, has 95 vacant lots served by streets, wells, and septic systems.

Although there are 100 motel rooms available in Lakeview for occupancy in November through May, there are virtually no vacant motel rooms in summer. Similarly, there are 66 recreational vehicle spaces that are typically filled in summer and closed in winter. There are no motels or RV parks in Bly.

Public Facilities and Services

Lake County provides a range of facilities and services similar to that of other rural counties in the western United States. These facilities and services are generally adequate with regard to existing population levels with the exception of the county jail, which is currently obsolete relative to federal jail standards. There has also been recent discussion concerning the formation of a recreation district to raise funds for a variety of recreation activities. No formal proposal has emerged relative to this concept to date.

The Town of Lakeview also provides a range of facilities and services that is common to rural communities in the West. These facilities and services are, in general, adequate for the current level of population. The one exception to this statement is the Town Hall, which is currently in need of refurbishing. A bond issue has been put before the voters in recent years; however, it was not passed.

Lakeview School District #7 has capacity for 111 additional children in the elementary grades, 70 additional children in the junior high school and 123 additional children in the high school. However, a large increase in enrollment in any one elementary grade could cause overcrowding.

The facilities and services available in Bly are all generally adequate for current levels of population. The Gearhart school in Bly currently has capacity for 30 additional students. Bly High School students attend high

permit program in wetlands. DSL coordinates its regulatory role with that of the USCOE regarding wetlands in the state.

Although wetland communities occupy a very limited part of the project study area, they are exceptionally important sites. They play an important role in water quality and quantity. Since they are moist or wet areas in a generally dry environment, they support some of the most lush and diverse communities in the area. As a result they are excellent habitat for a wide variety of birds and animals, as well as the preferred grazing areas for livestock.

Changes in structure and composition in the wetlands as a result of grazing is apparent in the study area. Species composition, particularly invasion of falsehellebore, indicate poor condition (Hopkins 1979, Kovalchik 1987). Changes in community composition may be influenced by factors other than actually grazing of the vegetation. Trampling results in soil compaction. Erosion potential increases with soil disturbance and vegetation removal. Subsequent erosion of the stream channel may result in lowering of the water table, and dewatering of the meadow community, which would reduce the wetland plant community on the site.

The new Proposed Land and Resource Plan (USFS 1987b) for the Fremont National Forest includes techniques for significantly improving conditions of wetland and other riparian areas in order to decrease erosion and protect water quality, stream flow, and fish and wildlife habitat.

LIST OF TABLES CONTINUED

The plant species which were searched for during field surveys are given in Table 4.5-1. Seven of these taxa are listed as candidate species under review by the USFWS (USFS 1986a). The remaining 11 are listed as sensitive species by the ONHDB (USFS 1986a, Soper 1984).

Only one plant species from the list of sensitive species was located during field searches. This was mountain lady's slipper (Cypripedium montanum). USFS asked that the sighting be reported directly to ONHDB (M. Morrison, pers. comm., 27 Aug 1988). ONHDB was notified of the sighting; however, they are no longer tracking this species. There seems to be enough information regarding its distribution to remove it from their list of sensitive species (S. Vrilakis, pers. comm., 24 Sep 1988). They requested that the sighting information be sent to ONHDB for their files as part of their "watch list."

LIST OF FIGURES

4.6 FOREST RESOURCES

4.6.1 Methods

The USFS routinely examines national forest stands early in the process that leads to a timber sale. During the 1987 field season, silviculture crews on the Bly Ranger District conducted stand exams in Compartments 1301 and 1317 (USFS 1988), portions of which fall within the project area (Figure 4.6-1).

Information compiled from these stand exam data and other literature, combined with information gathered through discussions with USFS foresters (Larry Besemann, pers. comm., 10 March 1988; John Nesbitt, pers. comm., 12 February 1988; and Diane Strohm, pers. comm., 10 December 1987, and 2 February and 28 March 1988), were used to prepare this summary of forest resources on the project study area.

4.6.2 Results and Discussion

4.6.2.1 Historical Use

In 1928, the Ewauna Box Company purchased the Booth-Kelly Quartz Mountain tract of timber from the Oregon Land and Livestock Company. They began building a railroad east to the tract from Bly in 1929. By the 1931 logging season, the company was shipping 20 to 24 railroad cars of logs per day from the tract to its mill in Klamath Falls. Production peaked in 1936, but the Ewauna logging camp closed at the end of that season. The company logged these lands for eight years (Tonsfeldt 1987).

Logging by Ewauna Box Co. removed the largest, best quality ponderosa pine, leaving scattered, less favored species, mostly white fir and younger ponderosa pine. This practice, known as "high grading," and the effective control of forest fire led to the present species composition and uneven-aged stand structure. The present stands commonly include incense cedar and occasionally western juniper. Sugar pine occupies the higher elevations while lodgepole pine is confined to a few stands between Angel and Drews Creeks.

By 1944, the federal government had acquired title to these lands as a part of the Fremont National Forest under the General Exchange Act (42 Stat. 465 as amended) from the Weyerhaeuser Company through its agent, the Bly Land Company (USFS 1986b). These lands were exchanged for national forest timber land elsewhere (Howard Querin, personal communication, 12 February 1988).

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4.6.2.2 Existing Stand Conditions

The 1987 stand exam (USFS 1988) on the project study area reflects the influence of the railroad logging of the 1930's. The number of trees range from 27 to 3094 trees per acre (Table 4.6-1a), though in 70 percent of the stands the number remain below 1000 trees per acre. Sawtimber size trees (≥9.0 inches dbh) range from 14 to 166 trees per acre, with 64 percent of the stands supporting less than 100 sawtimber size trees per acre (Table 4.6-1b). Ten percent of the stands have no trees 25 inches dbh and larger (Table 4.6-1c); 42 percent of the stands have at least five of this size but no more than 16 per acre. Nearly 50 percent of the stands have less than 50 percent crown closure (Table 4.6-1d).

The diameter on over 55 percent of the stands averages less than 7 inches dbh (Table 4.6-2a) though nearly 65 percent support a basal area greater than 125 square feet (Table 4.6-2b). None exceed 245 square feet basal area. The basal area per tree averages less than 0.30 square feet per tree (Table 4.6-2c).

Sixty percent of the stands are less than 120 years old at dbh with 12 percent less than 80 years old (Table 4.6-3). The youngest stand averages 61 years; the oldest, 207 years. However the oldest trees range from 116 years to 397 years with 45 percent of the oldest trees averaging more than 240 years.

Stand volumes range from 1.08 mcf (≈2.25 mbf) (thousand cubic feet and thousand board feet) to 5.63 mcf (≈27.14 mbf) per acre (Table 4.6-4). Only 23 percent of the stands average more than 3.5 mcf (≈12.8 mbf) per acre.

Periodic annual increment (PAI) ranges from 18 cubic feet (≈65 board feet) per acre per year to nearly 100 cubic feet (≈360 board feet) with 55 percent of the stands growing a less than 60 cubic feet (less than ≈220 board feet) per acre per year (Table 4.6-4d).

Eighty five percent of the forest land within the project area falls within four plant communities (Figure 4.3-1): ponderosa pine/wooly wyethia, white fir-ponderosa pine/manzanita-Oregon grape, white fir-ponderosa pine/snowberry/starwort, and white fir-ponderosa pine-incense cedar/serviceberry. Hopkins (1979) rates these mixed conifer stands as moderately to highly productive for ponderosa pine with the site index ranging from 78 to 80. The stand exam site indices for ponderosa pine range from 81 to 111 with 65 percent of the samples exceeding site index 90 (USFS 1988).

TABLE 4.6-2

SUMMARY OF 1987 STAND EXAM DATA ON TREE DIAMETER

a. Average stand diameter (inches dbh)

Average dbh	<5.0	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	>16.9
Stands (n)	15	18	15	6	3	0	0	1
Stands (%)	25.9	31.0	25.9	10.0	5.2	0.0	0.0	1.7

Maximum stand dbh 18.1
Minimum Stand dbh 3.1

b. Average stand basal area (BA) (square feet)

Average BA	<50.0	50.0-74.9	75.0-99.9	100-124.9	125-149.9	150-174.9	175-199.9	>199.9
Stands (n)	1	4	5	12	15	9	6	6
Stands (%)	1.7	6.9	8.6	20.7	25.9	15.5	10.3	10.3

Maximum stand BA 243.2
Minimum stand BA 48.0

c. Average stand basal area per tree (BA/T) (square feet)

Ave. BA/T	<.10	.10-.29	.30-.49	.50-.69	.70-.89	.90-1.09	1.10-1.29	>1.29
Stands (n)	8	29	11	6	2	0	1	1
Stands (%)	13.8	50.0	19.0	10.3	3.4	0.0	1.7	1.7

Maximum stand BA/T 1.778 Sq. Ft.
Minimum stand BA/T 0.054 Sq. Ft.

SOURCE: USFS 1988.

APPENDIX: SURVEY MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT

ARCHAEOLOGICAL SURVEY, QUARTZ MOUNTAIN GOLD PROJECT

WHEREAS, the U.S. Forest Service has responsibility for the identification, evaluation, and protection of archaeological sites occurring on its lands, as required by the National Historic Preservation Act, Section 110(a)(2), and by the regulations set forth in 36 CFR 800.4(b) (revised 10/86); and

WHEREAS, Wavecrest Resources, Inc. has proposed surface mining operations (the Quartz Mountain Gold Project) on lands administered by the Bly Ranger District of the Fremont National Forest, located in Lake County, Oregon, which may have an effect on archaeological sites within the project area; and

WHEREAS, an intensive archaeological survey of the project area has been conducted by Wavecrest Resources, Inc. to provide information required by the National Historic Preservation Act, Section 106, and by the National Environmental Policy Act, this survey having been conducted to the specifications described in the attached "Technical Proposal: Comprehensive Archaeological Survey and Testing on Nine and One-Half Sections at Quartz Mountain," dated August 20, 1987;

NOW THEREFORE, the responsible officials of the U.S. Forest Service (Fremont National Forest), and the Oregon State Historic Preservation Office agree that the procedures undertaken in this survey, as described in the attached Technical Proposal, meet or exceed the requirements of the "Fremont National Forest Cultural Resource Inventory Plan," and are in accord with accepted professional standards, and with the stipulations of Section II.A ("Archaeological Survey") and Appendix C, Section I.4 ("Guidelines for the Identification of Historic Properties") of the current Manual of Mitigation Measures of the Advisory Council on Historic Preservation.

11/12/87

Orville D. Grossarth — Date
Forest Supervisor
Fremont National Forest

OCT 1[illegible]

David G. Talbot — Date
State Historic Preservation
Officer

TABLE 4.6-4

SUMMARY OF STAND VOLUME AND GROWTH FROM THE 1987 STAND EXAM

a. Average stand live volume (thousands of board feet, mbf)

Volume, mbf	<5.0	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	>24.9
Stands (n)	2	25	19	4	3	1
Stands (%)	8.8	43.9	33.3	7.0	5.3	1.8
Maximum stand volume, mbf	27.14					
Minimum stand volume, mbf	2.25					

b. Average stand live volume (thousands of cubic feet, mcf)

Volume, mcf	<1.5	1.5-2.4	2.5-3.4	3.5-4.4	4.5-5.4	>5.4
Stands (n)	2	19	23	9	3	1
Stands (%)	3.5	33.3	40.4	15.3	5.3	1.8
Maximum stand volume, mcf	5.63					
Minimum stand volume, mcf	1.08					

c. Average stand volume, standing dead, (mcf)

Volume, mcf	<0.1	0.1-0.29	0.3-0.49	0.5-0.69	<0.69
Stands (n)	31	22	3	0	1
Stands (%)	54.4	38.6	5.3	0.0	1.8
Maximum stand volume, mcf	0.83				
Minimum stand volume, mcf	0.00 (26)				

d. Average stand PAI (cubic feet per acre per year)

Avg. PAI	<20	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	>79.9
Stands (n)	1	4	6	9	12	11	6	9
Stands (%)	1.7	6.9	10.3	15.5	20.7	19.0	10.3	15.5
Maximum stand PAI	98.8							
Minimum stand PAI	18.1							

SOURCE: USFS 1988.

10.11 LIST OF PRINCIPAL PREPARERS

10.11.1 Robert H. Winthrop

Robert Winthrop is a cultural anthropologist with expertise in cultural resource policy, Native America ethnology, religion, and culture change. He has particular experiences in ethnographic and ethnohistoric research in southern Oregon and northern California.

He received an A.B. in anthropology from the University of California, Berkeley in 1972; his graduate training in anthropology was at the University of Minnesota, Minneapolis, where he received a M.A. (in 1977), and a Ph.D. (in 1981). He has taught at the University of Minnesota and at Southern Oregon State College in Ashland, Oregon, where he is an adjunct professor of anthropology.

Mr. Winthrop has conducted or directed ethnographic studies of various Native American groups, including Shasta, Chinook, Northern Paiute, and Klamath peoples. As a principal of Winthrop Associates since 1982, he has been involved in the research and administration of some forty cultural resource projects for private and public clients. He is the editor of Culture and the Anthropological Tradition (University of Minnesota, Department of Anthropology publications, in press); and is currently completing a Dictionary of Concepts in Cultural Anthropology, under contract with Greenwood Press.

10.11.2 Kathryn R. Winthrop

Kathryn Winthrop is an archaeologist with expertise in archaeology of Oregon, California, and the Great Basin, and has nine years of research experience in performing archaeological studies in these regions.

Ms. Winthrop received an A.B. from the University of California, Berkeley in 1972, and a M.A. from the Center for Ancient Studies at the University of Minnesota, Minneapolis, in 1978. She has also done graduate study in anthropology/ archaeology at the University of Minnesota, and at the University of Oregon, Eugene, where she is completing a Ph.D.

She has been employed as an archaeologist by the Bureau of Land Management (Medford [Oregon] District), and by the U.S. Forest Service (Lassen and Modoc National Forests). As a principal of Winthrop Associates, Ms. Winthrop has directed archaeological surveys, tests, and data recovery excavations in support of numerous federal and private projects, involving mining, nuclear waste storage, timber sales, dam, bridge, and road construction.

TABLE 4.6-5

SUMMARY OF DAMAGE TO LIVE TREES

a. Damage by insects

Percent of stand affected	<20	20-39	40-59	60-79	>79
Stands (n)	22	8	15	8	4
Stands (%)	38.9	14.0	26.3	14.0	7.0
Maximum percent of stand affected	96.4				
Minimum percent of stand affected	0.0 (5)				

b. Damage by diseases

Percent of stand affected	<10	10-19	20-29	30-39	>39
Stands (n)	40	12	3	1	1
Stands (%)	70.2	21.1	5.3	1.8	1.8
Maximum percent of stand affected	40.0				
Minimum percent of stand affected	0.0 (18)				

c. Damage by physical factors (*)

Percent of stand affected	<20	20-39	40-59	60-79	>79
Stands (n)	1	9	25	18	4
Stands (%)	1.8	15.8	43.9	31.6	7.0
Maximum percent of stand affected	100.0				
Minimum percent of stand affected	8.9				

* Broken or missing top, dead top, forks, crooks, and sweep, wind, snow, ice, and lightning damage, logging and fire damage, etc.

SOURCE: USFS 1988, USFS 1985, USFS n.d.

Stewart, O.C. 1939. The Northern Paiute bands. University of California Anthropological Records 2 (3):127-49.

Tonsfeldt, W. 1987a. Mills along the lakeshore: the lumber industry on the Winema lands, 1910-1936. Prepared for the U.S. Forest Service, Winema National Forest, Klamath Falls, Oregon.

Tonsfeldt, W. 1987b. An industrial frontier: railroad logging on the Fremont National Forest. Prepared for the U.S. Forest Service, Winema National Forest, Klamath Falls, Oregon, and Fremont National Forest, Lakeview, Oregon.

Tonsfeldt, W. 1987c. Shevlin-Hixon Lumber Company Summit Line railroad logging reconnaissance project. Prepared for the U.S. Forest Service, Fremont National Forest, Lakeview, Oregon.

U.S. Advisory Council on Historic Preservation [ACHP]. 1986. Section 106, step by step. Washington, D.C.

U.S. Forest Service. 1984. Programmatic memorandum of agreement: lithic scatters. On file, Fremont National Forest, Lakeview, Oregon.

Wheat, M.M. 1967. Survival arts of the primitive Paiutes. University of Nevada Press, Reno.

Whiting, B.B. 1950. Paiute sorcery. Viking Fund Publications in Anthropology, 15.

Winthrop Associates. 1986. Cultural resource survey report: Quartz Mountain exploratory mineral drilling, Lake County, Oregon. Submitted to the Lake County Planning Department, Lakeview, Oregon. (Winthrop Associates, Ashland, Oregon).

Winthrop Associates. 1987a. Quartz Mountain data recovery excavation: site 35-LK-1970, Fremont National Forest, Lake County, Oregon. Submitted to the U.S. Forest Service, Fremont National Forest, Lakeview, Oregon. (Winthrop Associates, Ashland, Oregon).

Winthrop Associates. 1987b. Cultural resources survey: heap leach test/seventh series drilling, Quartz Mountain, Fremont National Forest (interim report letter). Submitted to the U.S. Forest Service, Fremont National Forest, Lakeview, Oregon. (Winthrop Associates, Ashland, Oregon).

4.7 RANGE RESOURCES

4.7.1 Methods

Information on the range resources of the project study area were obtained from USFS literature (USFS 1980), and from discussions with Forest Service personnel. In addition to providing information for development of a baseline description, it will also provide input for reclamation planning, and for impact assessment.

4.7.2 Results and Discussion

There is one grazing allotment, the Pothole Allotment, in the Quartz Mountain Project study area. The study area and its relationship to this allotment is shown in Figure 4.7-1. The study area comprises approximately 7,400 acres (15 percent) of the Pothole Allotment.

The Pothole Allotment covers a total of 48,700 acres. Approximately 17,000 acres (38 percent) of the total allotment is classed as unusable for grazing, leaving 31,700 acres of usable grazing land (Curtis, pers. comm., 24 Feb 1988). The following discussion is based on data and information regarding the entire allotment.

4.7.2.1 Historic Use

The present Pothole Allotment is comprised of three old allotments, the Deer Creek, Pothole, and Drews Creek Allotments, plus 15,000 acres of private land waived to the Forest Service for grazing use (USFS 1980). Grazing records indicate that some of these areas were grazed as early as 1908. Early use was dominated by sheep although there was some cattle stocking as well. Conversion to cattle throughout the allotment occurred in 1962 (USFS 1980). The history of grazing animals on the Pothole Allotment is shown in Tables 4.7-1 and 4.7-2.

The Leehmann family has been the only permittee on this allotment since the first permit was issued to Walter Leehmann Sr. in 1927. Walter Leehmann Jr. purchased his father's land and became the permittee in 1962. Leehmann and Sons, Inc., is currently the Pothole Allotment permittee (M. Morrison, pers. comm., 19 Oct 1987).

4.7.2.2 Recent Use

In the 1980 environmental assessment of the Pothole Allotment (USFS 1980), forage production and current utilization by suitable range type was given as follows:

Gatschet, A.S. 1890. The Klamath Indians of southwestern Oregon. Contributions to North American Ethnology. volume 2. U.S. Geographical and Geological Survey of the Rocky Mountain Region, Washington, D.C.

Gray, D.J. 1984. Cultural resource survey inventory report: River/Thick timber sale. Fremont National Forest, Lakeview, Oregon.

Hughes, R.E. 1986. Diachronic variability in obsidian procurement patterns in northeastern California and south-central Oregon. University of California Publications in Anthropology, 17.

Kaiser, J. 1984. Fremont National Forest Cultural Resources Inventory Plan. Fremont National Forest, Lakeview, Oregon.

Kaiser, J. 1988. Forest Archaeologist, Fremont National Forest, Lakeview, Oregon, personal communications. Telephone conversation, 6 January 1988.

Kelly, I.T. 1932. Ethnography of the Surprise Valley Paiute. University of California Publications in American Archaeology and Ethnology 31:67-210.

Kimbol, C. 1987. Chairman, Klamath Tribe, Chiloquin, Oregon, personal communications. Telephone conversation, 28 September 1987.

Kroeber, A.L. 1939. Cultural and natural areas of native North America. University of California Publications in American Archaeology and Ethnology 38:1-242.

Minor, R., S.D. Beckham, and K.A. Toepel. 1979. Cultural resource overview of the BLM Lakeview District, south-central Oregon: archaeology, ethnography, history. University of Oregon Anthropological Papers, 16.

O'Connell, J.F. 1975. The prehistory of Surprise Valley. Ballena Press, Ramona, California.

O'Connell, J.F. and D.B. Madsen. 1982. Man and environment in the Great Basin: an introduction. J. O'Connell and D. Madsen, eds., Man and environment in the Great Basin. Society for American Archaeology, SAA Papers, 2.

Pettigrew, R.M. 1986. Report on the archaeological survey of the Klamath County line-Drews Gap section, Klamath Falls-Lakeview Highway, Lake County. Oregon State Museum of Anthropology, Eugene, Oregon.

James Rock
Forest Archaeologist
Klamath National Forest
Yreka, CA

Ken Rogers
Minerals Officer
Bly Ranger District
Fremont National Forest
Bly, OR

Randy Townsend
Chairman
Fort Bidwell Indian Community Council
Fort Bidwell, CA

TABLE 4.7-1

HISTORY OF CATTLE GRAZING ON
THE PRESENT POTHOLE ALLOTMENT
FREMONT NATIONAL FOREST

Year	Season	Total AM's/season
1985-87	7/1 - 9/30	2160
1981-84	7/1 - 9/30	No record of actual use. Permitted use = 2160
1980	7/1 - 9/30	2071
1978	7/1 - 9/30	2160
1977	7/1 - 9/30	2180
1976	7/1 - 9/30	1859
1975	7/1 - 9/30	2076
1974	7/1 - 9/30	2170
1973	7/1 - 9/30	2186
1972	7/1 - 9/30	2056
1971	7/1 - 9/30	2375
1970	7/1 - 9/30	2399
1969	7/1 - 9/30	1912
1968	7/1 - 9/30	2040
1967	7/1 - 9/30	1546
1964-66	7/1 - 9/30	No record of actual use. Permitted use = 1098.
1963	7/1 - 9/30	1098
1962	6/21 - 9/30	865

AM = Animal Months

SOURCES: Curtis, pers. comm. (6 Nov. 1987); USFS (1980).

UNIFACE - A flake which has flakes removed from one surface, in the process of forming a stone tool.

Range Type	Acres/AUM	Percent Utilization
meadow	2	55
juniper/sagebrush	11	10
juniper/bunchgrass	5	15
mixed conifer/grass	14	20

Vegetation condition was classed as fair to good overall with no apparent increasing or decreasing trend. However, the assessment also noted that many stream bottoms and meadow areas showed evidence of heavy use or over use, with concomitant degradation of these areas. These riparian areas have high forage productivity, good water availability, thermal cover and shade. These characteristics cause grazing animals to concentrate in these areas. The high forage productivity in these sites has the potential for generating 10 to 15 times as much forage as forested areas of the same size (USFS 1987a). However, heavy grazing pressure over a period of years may degrade a riparian community, causing reductions in forage, water quality, stream flow, and fish and wildlife habitat.

There has been little change in vegetation condition and grazing use since the 1980 environmental assessment. There have been efforts in recent years, however, to modify range management on the Forest to improve range conditions (Curtis, pers. comm., 6 Nov 1987).

The 1987 USFS term permit for the allotment allows 411 cattle (cow-calf operation) per month plus a private land permit for 309 cattle per month for a total of 720 cattle per month. The three-month grazing season, from 1 July to 30 September, results in grazing use of 2160 animal months (AM) (M. Morrison, pers. comm., 19 Oct 1987).

4.7.2.3 Weeds

There are seven plant species that occur in the Fremont National Forest which have been designated as noxious weeds (USFS 1987a):

Canada thistle	Cirsium arvense
Water hemlock	Cicuta douglasii
Mediterranean sage	Salvia aethiopsis
Medusahead wild rye	Elymus caput-medusae
Dalmation toad flax	Linaria dalmatica
Musk thistle	Carduus nutans
Scotch thistle	Onopordum acanthium

Occasional weedy species occur in scattered sites on the project study area, but none of these species occur in large numbers.

project area; these remains must be evaluated to determine if further work is necessary. Other historic sites must be considered for evaluation depending upon each site's vulnerability to projected mining operations.

CROOK - A physical defect where a log or a tree trunk contains a sharp bend away from a straight cylinder sufficient to reduce log or tree volume.

DBH: DIAMETER AT BREAST HEIGHT - the diameter of a tree measured at 4 ft 6 in from the ground.

DENSITY - the number of individuals per unit area.

EDAPHIC - Pertaining to the soil.

ENDANGERED - a species in danger of extinction throughout all or a significant portion of its range.

FORAGE - all browse and nonwoody plants that are available to livestock or wildlife.

FORB - herbs other than graminoids.

FORK - A physical defect where the top of the tree died and two or more lateral branches below the point of death take on the character of a main stem. These new trunks may be similar or dissimilar in size and vigor. This defect reduces log or tree volume scale.

FUNGUS - organisms such as mushrooms, molds, and mildews that lack chlorophyll and reproduce by spores.

GRAMINOID - grasses and grass-like plants such as sedges and rushes.

GRAZING CAPACITY - the maximum stocking rate possible without causing loss of vegetation, soil damage, or damage to related resources.

GROUND COVER - Organic and inorganic materials which protect the soil surface. They include live vegetation, both woody and herbaceous, litter and/or debris, duff, and rock or rock fragments. The live vegetation constitutes those plants whose aerial parts lie close to or creep along the ground.

GROUND TRUTH - verification of aerial photointerpretation by observers on the ground.

HABITAT TYPE - a repeatedly occurring or potentially occurring plant community characterized by a particular combination of dominant plant species.

HABITAT - the natural environment of a plant or animal.

HERB - a vascular plant that does not develop woody tissue.

PLANT COMMUNITY - an assemblage of plants characterized or dominated by certain species.

POLES - Trees 5.0 to 8.9 inches dbh.

REGENERATION - reproduction; for example, seedling trees on the forest floor.

RIPARIAN - of, pertaining to, or situated on the banks of a river; by common usage extended to include any stream, regardless of size.

SALINE - Salty.

SEEDLINGS AND SAPLINGS - Trees less than 5.0 inches dbh.

SERAL - descriptive of a plant community which is in a developmental, transitory stage in ecologic succession.

SERPENTINE - Soils derived from parent material having high levels of iron and magnesium.

SHELTERWOOD HARVEST - The removal of the old stand in a series of treatments extending over a relatively short portion of the rotation. The partial shelter of mature trees protects the newly established even-aged reproduction.

SHRUB-STEPPE - arid or semiarid shrub-and-grassland vegetation.

SILVICULTURAL TREATMENT - One of a planned sequence of treatments for controlling the species composition and structure of the stand from its establishment through final harvest. Treatments include planting seedlings, pre-commercial and commercial thinning, and intermediate and final harvests.

SITE INDEX - An indicator of site quality based on tree growth patterns and environmental factors and refers to the height of dominant and codominant trees in even-aged stands at some index age (e.g., 50 years for ponderosa pine on the Fremont National Forest).

SMALL OR YOUNG SAWTIMBER - Trees 9.0 to 14.9 inches dbh.

SPECIES - a group of similar individuals having a common origin and a continuous breeding system.

SPECIES DIVERSITY - the number of different species occurring in some location or under some condition.

RECREATION OPPORTUNITY SPECTRUM CLASSES

Semi Primitive Non Motorized

- High probability of experiencing solitude, closeness to nature, tranquility, self reliance, challenge, and risk.
- Natural appearing environment.
- Low interaction between users.
- Some evidence of other users.
- Minimum of subtle, on-site controls.
- Access and travel is nonmotorized on trails, some primitive roads or cross country.
- Vegetative alterations: sanitation salvage to very small units in size and number, widely dispersed and not obvious.

Semi Primitive Motorized

- Moderate opportunity for solitude, tranquility, and closeness to nature. High degree of self-reliance, challenge, and risk in using motorized equipment.
- Predominantly natural appearing environment.
- Low concentration of users but often evidence of other users on trails.
- Minimum site controls and restrictions present but subtle.
- Vegetative alterations very small in size and number widely dispersed and not obvious.

Roaded Natural

- Opportunity to affiliate with other users in developed sites but with some chance for privacy. Self-reliance on outdoor skills of only moderate importance. Little challenge and risk.
- Mostly natural-appearing environment as viewed from sensitive roads and trails.
- Interaction between users at camp sites is of moderate importance.

WEED (WEEDY) - an unwanted plant, often adapted to disturbed habitats or in competition with crops or other cultivated plants.

WETLAND - an area dominated by hydrophytic vegetation and hydric soils, and having saturated soils for at least part of the growing season.

WITCHES' BROOM a dense proliferation of branches in response to fungal infection or parasites.

XERIC - refers to a habitat characterized by dry conditions rather than mesic (moderate) or hydric (wet) conditions.

Ms. Taylor holds a Master of Planning and Community Development from the University of Colorado at Denver (1987), as well as a Master of English from the University of Denver (1973). Her planning thesis was "Denver's Parks Planning Process," which analyzed past and present parks planning in Denver and proposed a model requiring that opportunities for public input to parks planning decisions be keyed to certain threshholds of project cost, size, environmental impact, and potential for controversy.

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4.11 LIST OF PRINCIPAL PREPARERS

4.11.1 M. Loverna Wilson

Ms. Wilson's expertise includes a broad background in vegetation sampling techniques and data interpretation. She is also a plant taxonomist and is familiar with the plant communities of much of the northwestern United States. Her particular area of expertise is quantitative vegetation analysis. She obtained her M.S. in Botany at Oregon State University, specializing in Plant Ecology.

Ms. Wilson's experience includes vegetation studies in Oregon, Washington, California, Idaho, Montana, Colorado, and Wyoming. She has managed qualitative and quantitative studies involving plant community analysis, habitat typing, vegetation mapping, productivity studies, and wetlands and riparian boundary determinations. Her experience includes vegetation baseline studies, monitoring programs, impact assessments, wetlands assessments, and mitigation design for hydroelectric projects; pipelines; industrial, commercial and residential developments; and surface and underground mines. She has also conducted searches for threatened and endangered plant species in Oregon, Washington, and Idaho.

Ms. Wilson was Vegetation Task Leader on this project. She was responsible for vegetation mapping, community descriptions, wetlands mapping, and sensitive species surveys. She prepared the baseline report sections on plant communities, wetlands, grazing resources, and threatened, endangered and sensitive species.

4.11.2 Richard H. Wheeler

Mr. Wheeler is a forest hydrologist with expertise in wildland water quality and in analyzing the effects of forest practices on forest water resources, wetlands, and riparian areas.

Wheeler received his BS in 1953 in forest management from the University of Maine in Orono. In 1969, he earned his Masters in forest hydrology and watershed management from Colorado State University. His research subject was the preliminary evaluation of the Anaconda (Montana) Industrial Watershed for the USDA-Forest Service, Deerlodge National Forest, and the Anaconda Company.

Wheeler's experience includes a career with the USDA-Forest Service which began in South Carolina and concluded in Oregon. He served primarily as a consultant in forest hydrology, forest water quality, and watershed management to

12.4 GLOSSARY

DEVELOPED RECREATION - recreation that requires facilities that, in turn, result in concentrated use of an area. Examples of developed recreation areas are campgrounds and ski areas; facilities in these areas might include roads, parking lots, picnic tables, toilets, drinking water, ski lifts, and buildings.

DEVELOPED RECREATION SITE - relatively small, distinctly defined areas where facilities are provided for concentrated public use; e.g., campgrounds, picnic areas, swimming areas.

DISPERSED RECREATION - a general term referring to recreation use outside the developed recreation site; this includes activities such as scenic driving, hunting, backpacking, and recreation in primitive environments.

RECREATION OPPORTUNITY SPECTRUM (ROS) - a planning and management framework for stratifying and defining classes of outdoor recreation environments, activities, and experience opportunities. The settings, activities, and opportunities for obtaining experiences have been arranged along a continuum or spectrum divided into six classes: primitive; semiprimitive nonmotorized; semiprimitive motorized; roaded natural; rural; and urban.

RECREATIONAL VISITOR DAY (RVD) - a measure of recreation use. One RVD is the equivalent of one person visiting the forest for twelve hours.

WILD AND SCENIC RIVER - a river or section of river designated as such by congressional action under the 1968 Wild and Scenic Rivers Act, as supplemented and amended, or those sections of rivers designated as wild, scenic, or recreational by an act of the legislature of the state or states through which they flow.

ZONE OF INFLUENCE - the geographic area whose social, economic and/or environmental condition is significantly affected by changes in the study area.

APPENDIX 4.A

Quartz Mountain Gold Project study area community names and corresponding USFS ecoclass codes (Hopkins 1979).

12.3.3.7 Rockhounding

Rockhounding is a major activity in Lake County. The southeastern Oregon area offers jasper, petrified wood, sunstones (the state gemstone), fire opals, obsidian, moss and white plume agates, Hart Mountain nodules, and the thunderegg, Oregon's state rock (Oregon Economic Development Department, n.d.; Lake County Chamber of Commerce, [n.d.]b). A special sunstone area has been set aside by the BLM 70 miles northeast of Lakeview, between Rabbit Basin and the Harney County line (outside area of concern). Agate and jasper are found along Kay Creek and Green Creek (Collison 1987c).

Obsidian or volcanic glass is found in Modoc National Forest, and is popular with collectors due to ease of handling. The forest also offers jasper, agate, petrified wood and Indian arrowheads (Lake County Chamber of Commerce, [n.d.]c). Gold and several types of obsidian are found in the area of Cave and Lilly Lake Campground. In the Warner Mountains area, rockhounds look for geodes and rainbow, black, rose, silver sheen and golden sheen obsidian. Agates are found in the Dorris Reservoir area, east of Alturas, while agates and petrified wood are found in the Cedar Pass area. Petrified wood is also found just north of Alturas (Modoc County Chamber of Commerce, n.d.)

Rock collecting (up to 7 pounds per person) is permitted at Hart Mountain National Antelope Refuge. Digging and blasting are not allowed. Removal of Indian artifacts is not permitted.

12.3.3.8 Off-Road Vehicle (ORV) Use

Lake County has 2,557,297 acres of BLM land and 1,851,200 acres of national forest land available for ORV use, while Klamath County has 288,549 acres of BLM land and 1,479,200 acres of national forest for ORV use (USFS 1987a).

The Fremont National Forest Off-Road Vehicle Use and Policy established in 1976 permits ORV use on more than 95 percent of the forest. In Fremont National Forest generally, high road density (3.68 road miles per square mile of land area) and gentle topography create very favorable conditions for ORV use. Current use in the forest as a whole amounts to less than one percent of total recreation use. The only areas of the forest where ORV use is prohibited are the Gearhart Mountain Wilderness and the Goodlow Mountain Research Natural Area. In the Fort Rock-Cabin Lake area, vehicles are not permitted from November to March, in order to reduce harassment of deer in their key winter range areas (USFS 1987a). On Forest Service land, off-road vehicles do not need

APPENDIX 4.B

Common and scientific names of
vascular plants observed within the
Quartz Mountain Gold Project
study area.

Table 12.3-6. Fishing license sales, Klamath and Lake counties.

	1981 License Sales per 1000 Population	% of Oregon Licenses in 1981	Est. Licenses 1981	Est. Licenses 1982	Est. Licenses 1983	Est. Licenses 1984	Est. Licenses 1985	Est. Licenses 1986
OREGON	211.81	100.0%	893,896	877,668	821,741	816,047	857,059	915,418
Combination licenses	61.89	100.0%	188,725	189,315	188,042	185,278	183,662	189,035
All anglers	149.93	100.0%	705,171	688,353	633,699	630,769	673,397	726,383
Resident angler	110.81	100.0%	324,078	288,822	283,352	285,518	293,762	303,303
Nonresident angler	0.42	100.0%	10,571	10,258	11,108	11,525	12,789	13,700
10-day angler	0.21	100.0%	34,531	13,186	14,068	13,722	13,668	14,011
KLAMATH COUNTY	324.14	3.4%	30,392	29,841	27,939	27,746	29,140	31,124
Combination licenses	129.21	NA	NA	NA	NA	NA	NA	NA
All anglers	194.93	NA	NA	NA	NA	NA	NA	NA
Resident angler	114.17	2.9%	9,398	8,376	8,217	8,280	8,519	8,796
Nonresident angler	0.85	4.6%	486	472	511	530	588	630
10-day angler	0.59	6.4%	2,210	844	900	878	875	897
LAKE COUNTY	322.34	0.4%	3,576	3,511	3,287	3,264	3,428	3,662
Combination licenses	178.84	0.8%	1,510	1,515	1,504	1,482	1,469	1,512
All anglers	143.50	NA	NA	NA	NA	NA	NA	NA
Resident angler	109.40	0.3%	972	866	850	857	881	910
Nonresident angler	2.52	1.7%	180	174	189	196	217	233
10-day angler	0.40	0.5%	173	66	70	69	68	70

Source: 1981 through 1986 Oregon fishing and combination hunting/fishing license sales and 1981 licenses per 1000 population percent of state sales for each county provided by Oregon Department of Fish and Wildlife.

Notes: Totals for Oregon and counties are the sum of combination hunting/fishing licenses and all angler licenses. Special tags are not included in angler totals. All state figures are as reported; county figures were estimated by multiplying the county share of each license type in 1981 by the actual state figures for that license type in other years.

Idaho fescue	Festuca	idahoensis	
Kentucky bluegrass	Poa	pratensis	
Long-stolon sedge	Carex	pensylvanica	
Mountain brome	Bromus	marginatus	
Nebraska sedge	Carex	nebraskensis	
Needlegrass	Stipa		
Northern meadow barley	Hordeum	brachyantherum	
Onespike oatgrass	Danthonia	unispicata	
Orchardgrass	Dactylis	glomerata	
Prairie junegrass	Koeleria	cristata	
Pullup muhly	Muhlenbergia	filiformis	
Ross' sedge	Carex	rossii	
Rush	Juncus		
Sandberg's bluegrass	Poa	sandbergii	
Sedge	Carex		
Smallwing sedge	Carex	microptera	
Spikerush	Eleocharis		
Thurber's needlegrass	Stipa	thurberiana	
Timothy	Phleum	pratense	
Tufted hairgrass	Deschampsia	caespitosa	
Water sedge	Carex	aquatilis	
Western needlegrass	Stipa	occidentalis	
Wheeler's bluegrass	Poa	nervosa	

FORBS

American bistort	Polygonum	bistortoides	
American vetch	Vicia	americana	
Arrowleaf balsamroot	Balsamorhiza	sagittata	
Ballhead sandwort	Arenaria	congesta	
Bluebells	Mertensia		
Broadleaf strawberry	Fragaria	virginiana	platypetala
Brodiaea	Brodiaea		
Buckwheat	Eriogonum		
Bull thistle	Cirsium	vulgare	
Buttercup	Ranunculus		
Calif. falsehellebore	Veratrum	californicum	
Clover	Trifolium		
Columbia monkshood	Aconitum	columbianum	
Common dandelion	Taraxacum	officinale	
Coralroot	Corallorhiza		
Cow parsnip	Heracleum	lanatum	
Dalmatian toadflax	Linaria	dalmatica	
Davidson penstemon	Penstemon	davidsonii	
Death camas	Zigadenus		
Dogbane	Apocynum		
Dwarf mistletoe	Arceuthobium	americanum	
Dwarf mistletoe	Arceuthobium	campylopodum	f. abietinum
Dwarf mistletoe	Arceuthobium	campylopodum	f. campylopodum
Elk thistle	Cirsium	foliosum	
Evening primrose	Oenothera		
Fernleaf biscuitroot	Lomatium	dissectum	
Flannel mullein	Verbascum	thapsus	
Gland cinquefoil	Potentilla	glandulosa	
Goldenrod	Solidago		

12.3.3.6 Fishing

In Lake County, 500 miles of secluded fishing streams and 7 lakes provide rainbow trout, small mouthed bass, crappie, perch and catfish (Lake County Chamber of Commerce, [n.d.]b.

The northern part of the county offers Ana Reservoir, with bass on a catch-and-release basis as well as trout; Thompson Valley Reservoir in the Fremont National Forest near Silver Lake, which is stocked with rainbow and cutthroat trout, but has problems with chubs and weeds; Christmas Valley Lake (private); Duncan Reservoir and Duncan Creek, 10 miles east of Silver Lake, with good early spring trout fishing on Duncan Creek; Silver Creek Spring, south of Silver Lake; Marsters Spring south of Paisley on the Chewaucan River (Fremont National Forest); the Ana River, open only during the general season but reportedly full of trout; Silver Creek, downstream from Thompson Reservoir; Buck Creek and Bridge Creek, which both offer good brook trout fishing; Crooked Creek, near Highly 395, with rainbow trout; The Sycan River, west of Summer Lake, with rainbow trout; and the Chewaucan River, and Dairy, Elder, and Bear Creeks, all near Paisley and all heavily stock with native type redband trout, but also heavily fished in summer. Abert Lake, though large, is not a fishery; due to high salinity, it supports only brine shrimp (Collison 1987b).

In western Lake County, Deadhorse and Campbell Lakes are stocked with large amounts of trout, but are heavily visited in summer. Blue Lake, in the Gearheart Wilderness Area, provides rainbow and brook trout. Cottonwood Meadows has developed camping, boating and picnicking facilities as well as fishing opportunities, as do Lofton Reservoir, Cinder Hill, and Dog Lake. A campsite at Drews Creek offers stream fishing plus boating on Drews Reservoir. Around the top of Quartz Mountain, Lofton Reservoir, Holbrook Reservoir, and Heart Lake allow camping, and boating is allowed on Holbrook and Lofton. Heart Lake is the only area lake stocked with Kokanee. Dog Lake is a warm water lake with a large, self-sustaining bass population, as well as crappie, bluegill, perch, and a few trout. Drews Reservoir has large channel catfish, with some bullheads, crappies, trout and chub. Boating, camping, and picnicking increase the reservoir's popularity (Collison 1987b).

Eastern Lake County lakes and reservoirs sometimes provide good fishing, but may suffer from low water levels in dry years. Fishing areas include Big Rock Reservoir, Sherlock and Mud Lake (trout), Spalding Lake (dries up in summer), Big Rock Reservoir, Hart and Crump Lakes (crappie and some trout), Jacob Reservoir (rainbow trout), Priday Reservoir (large rainbow trout), Rock Creek (in Hart Mountain National Antelope

APPENDIX 4.C

Scientific and common names of
vascular plants observed within the
Quartz Mountain Gold Project
study area.

Table 12.3-4. Hunting license sales, Klamath and Lake counties.

	1981 License Sales Per 1000 Population	% of Oregon Licenses in 1981	Licenses 1981	Est. Licenses 1982	Est. Licenses 1983	Est. Licenses 1984	Est. Licenses 1985	Est. Licenses 1986
OREGON: All hunters*	136.79	100.0%	1,390,974	1,403,531	1,345,990	1,311,268	1,296,021	1,201,971
Combination*	61.89	100.0%	188,725	191,315	188,042	185,278	183,662	189,035
Hunter licenses	74.89	100.0%	1,202,249	1,212,216	1,157,948	1,125,990	1,112,359	1,012,936
Nonresident hunter	0.05	100.0%	18,330	18,331	18,838	17,778	18,801	21,157
KLAMATH COUNTY: All hunters*	271.48	4.5%	62,594	63,159	60,570	59,007	58,321	54,089
Combination*	129.21	4.4%	8,304	8,418	8,274	8,152	8,081	8,318
Hunter licenses**	142.26	NA	NA	NA	NA	NA	NA	NA
Nonresident hunter	0.41	17.0%	3,116	3,116	3,202	3,022	3,196	3,597
LAKE COUNTY: All hunters*	382.90	0.8%	11,128	11,228	10,768	10,490	10,368	9,616
Combination*	178.84	0.8%	1,510	1,531	1,504	1,482	1,469	1,512
Hunter licenses	15.40	0.8%	9,618	9,698	9,264	9,008	8,899	8,103
Nonresident hunter	1.59	8.5%	1,558	1,558	1,601	1,511	1,598	1,798

Source: 1981 through 1986 Oregon fishing and combination hunting/fishing license sales and 1981 license per 1000 population and percent of state sales for each county provided by Oregon Department of Fish and Wildlife.

Notes: *Combination hunting/fishing licenses are not allocated to the appropriate share of hunters and fishermen in this table, since the percentage of combination licenses for each county is based on the unallocated total. Percentages Percentages are for resident combination, not including bow.

**1981 percentages not available in same format.

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Carex	nebraskensis		Nebraska sedge
Carex	pensylvanica		Long-stolon sedge
Carex	rossii		Ross's sedge
Carex	rostrata		Beaked sedge
Dactylis	glomerata		Orchardgrass
Danthonia	unispicata		Onespike oatgrass
Deschampsia	caespitosa		Tufted hairgrass
Eleocharis			Spikerush
Elymus	cinereus		Giant wildrye
Festuca	idahoensis		Idaho fescue
Hordeum	brachyantherum		Northern meadow barley
Juncus			Rush
Juncus	balticus		Baltic rush
Koeleria	cristata		Prairie junegrass
Muhlenbergia	filiformis		Pullup muhly
Phleum	pratense		Timothy
Poa	nervosa		Wheeler's bluegrass
Poa	pratensis		Kentucky bluegrass
Poa	sandbergii		Sandberg's bluegrass
Sitanion	hystrix		Bottlebrush squirreltail
Stipa			Needlegrass
Stipa	occidentalis		Western needlegrass
Stipa	thurberiana		Thurber's needlegrass

FORBS

Achillea	millefolium	lanulosa	Western yarrow
Aconitum	columbianum		Columbia monkshood
Allium			Onion
Allium	acuminatum		Tapertip onion
Anaphalis	margaritacea		Pearly everlasting
Antennaria			Pussytoes
Antennaria	geyeri		Pinewoods pussytoes
Antennaria	microphylla		Rosy pussytoes
Apocynum			Dogbane
Arabis	holboellii		Holboell rockcress
Arceuthobium	americanum		Dwarf mistletoe
Arceuthobium	campylopodum	f. abietinum	Dwarf mistletoe
Arceuthobium	campylopodum	f. campylopodum	Dwarf mistletoe
Arenaria	congesta		Ballhead sandwort
Arnica	cordifolia		Heartleaf arnica
Balsamorhiza	sagittata		Arrowleaf balsamroot
Brodiaea			Brodiaea
Calochortus	macrocarpus		Sagebrush mariposa
Castilleja			Paintbrush
Cirsium	foliosum		Elk thistle
Cirsium	vulgare		Bull thistle
Corallorhiza			Coralroot
Cynoglossum			Hound's tongue
Cypripedium	montanum		Mountain lady's slipper
Delphinium			Larkspur
Dodecatheon			Shooting star
Epilobium			Willow-herb
Equisetum			Horsetail
Eriogonum			Buckwheat

In Fremont National Forest as a whole, cross-country skiing and snowshoeing accounted for 1,700 RVDs, or 0.6 percent of all recreation on the Forest in FY 1986 (USFS 1987c).

12.3.3.2 Snowmobiling

Snowmobilers, like cross-country skiers, are not restricted to established trails, but may make use of the existing extensive network of unplowed jeep trails and logging roads.

In Fremont National Forest as a whole, snowmobiling accounted for 1,700 RVDs, or 0.6 percent of all recreation on the Forest in FY 1986 (USFS 1987c).

12.3.3.3 Camping

Camping may occur at established developed sites, or it may occur as a dispersed activity. Jeep trails and logging roads provide access for vehicle camping. In the Fremont National Forest, camping is the single largest recreation use in terms of recreation visitor days. In FY 1986, camping generated 119,800 RVDs, or 42.0 percent of the total recreational visitor days. Of these figures, 49,500 RVDs were general day camping, 8,100 auto camping, 43,100 trailer camping, and 19,100 tent camping (USFS 1987c). These figures are not broken down by developed sites and dispersed recreation.

12.3.3.4 Horseback Riding

Much of the horseback riding in Fremont National Forest occurs in the Gearhart Wilderness Area, sometimes in conjunction with elk hunting. In FY 1986, an estimated 5,600 RVDs or 2.0 percent of the Forest's total recreational visitor days were attributed to horseback riding.

12.3.3.5 Hunting

Demand for deer and elk hunting on the Fremont National Forest exceeds both the current supply and the supply that would be provided if Oregon Department of Fish & Wildlife (ODFW) herd management objectives were met. This is indicated by 1) hunter dissatisfaction with quantity of big game and quality of hunting opportunities; 2) oversubscription of limited entry deer tags for the Forest and surrounding area; and 3) historical records from the 1960s (USFS 1987a).

At Hart Mountain National Antelope Refuge, authorized refuge hunting seasons permit hunting of only those game animals for which the hunt has been established. A strip of

5.0 WILDLIFE

scenic river, and the segment from Collier State Park to Upper Klamath Lake would be classified as a recreational river segment (USFS 1987b).

12.3.2.7 Wilderness Areas

12.3.2.7.1 Gearhart Mountain Wilderness

Gearhart Mountain Wilderness, located in the Fremont National Forest, currently totals 22,823 acres. In the ROS system, the entire wilderness is classified as Wilderness-semiprimitive. This classification is based on evidence of human impacts, extensive commercial livestock grazing, and the relatively small size of the area.

Recreational use of the Wilderness tends to concentrate in a few small areas. Blue Lake, a popular fishing spot, accounts for 70 percent of the use. An inventory and evaluation conducted in 1985 found 55 campsites at the lake, of which 87 percent were located within 200 feet of the shore. Camps are prohibited within 200 feet of lakeshores, but the policy is difficult to enforce. Almost all trees on the sites have been damaged by recreation use, and campsite density, at 5 sites per acre, is comparable to or higher than that of campgrounds accessible by vehicle (USFS 1987a). Other popular areas include Gearhart Summit, the Dome-Palisades area, and the lower segment of Dairy Creek, none of which show signs of depreciative use (USFS 1987a).

Use of the Wilderness for hiking and backpacking has been increasing by 2 percent per year, but except for damage to soil resources on a heavily traveled short segment of the trail to the Notch overlook, the 17 miles of existing trails are meeting wilderness and recreation management objectives.

In 1981, the Gearhart Mountain Wilderness provided 3,100 RVDs, of which 32.3 percent were fishing, 38.7 percent were camping, 12.9 percent were hiking, and 9.7 percent were horseback riding, with swimming and nature study accounting for 3.2 percent each (USFS 1987a).

12.3.2.7.2 Other Wilderness Areas

No other wilderness areas are in the Fremont National Forest (1987a). All 3 of the wilderness areas in the Winema National Forest fall outside of the area of concern (1987b).

12.3.2.7.3 Wilderness Study Areas

Diablo Mountain Wilderness Study Area (OR-1-58) is located approximately 40 miles northeast of Bly and 45 miles north-northwest of Lakeview. It is approximately 24 miles

TECHNICAL REPORT NO. 5

WILDLIFE

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

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Revised December 1988

TABLE 12.3-3

ADDITIONAL DEVELOPED RECREATION SITES

OREGON	CALIFORNIA
Abert Rim	Baker Reservoir
Alkali Lake	Big Sage Reservoir
Booth Wayside	Cave and Lilly Lake Campground
Chandler Wayside State Park	Cedar Pass Ski Tow
Collier Memorial	Davis Creek
Cottonwood Reservoir	Dorris Reservoir
Cox Creek Wildlife Area	Fandango Pass
Crump Geyser	Howard Gulch Campground
Devils Lake	Lava Beds National Monument
Dog Lake	Plum Valley Campground
Drews Creek	Stone Reservoir
Drews Reservoir	Thomas Reservoir
Fremont National Forest	Upper Alkali Lake
Gerber Reservoir	Warner Mountains
Goose Lake	
Greaser Petroglyph	
Greaser Reservoir	
Hart Mountain National Antelope Refuge	**NEVADA**
Highway Well	Sheldon National Wildlife Refuge
Klamath Forest National Wildlife Refuge	
Lake Abert	
Lost River	
Lower Klamath National Wildlife Refuge	
Miller Creek	
Oregon Central Military Road	
Pelican Lake	
Silver Lake	
Sprague River	
Summer Lake Hot Springs	
Summer Lake	
Sunstone Collection Area	
Sycan Marsh	
Sycan River	
Thompson Valley Reservoir	
Upper Klamath Lake	
Warner Mountain	
Williamson River	
Willow Valley Reservoir	
Winema National Forest	

FOREWORD

This report was prepared by Lynn Sharp, Environmental Consultant and Steffen Robertson and Kirsten (COLORADO) Inc. (SRK) for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
P. L. Sharp	Wildlife Task Leader	SRK

12.3.2.1.2 Downhill Skiing

Downhill ski areas in the vicinity include Pelican Butte, in the Winema National Forest; Warner Valley Ski Area, 10 miles north of Lakeview; and the Cedar Pass Ski Tow, in Modoc County, 16 miles northeast of Alturas.

12.3.2.1.3 Boating Facilities

Boat ramps are available at Odell Lake, Lake Ewana, Davis Lake, Wood River, Agency Lake, Klamath Lake, Lost River, Boyle Reservoir, Klamath River, Duncan Reservoir, Squaw Lake, Ana Reservoir, Thompson Lake, Withers Lake, Deadhorse Lake, Campbell Lake, Gerber Reservoir, Heart Lake, Lofton Reservoir, Cottonwood Meadow Lake, Dog Lake, Drews Reservoir, Goose Lake, Lucky Reservoir, Mud Lake, Spaulding Reservoir, Crump Lake, Priday Reservoir, Hart Lake, Sid Luce Reservoir, Vee Lake, Big Rock Reservoir, Mule Lake, Sherlock Gulch Reservoir (Oregon State Marine Board n.d.).

12.3.2.2 Major Recreation Trails

Fremont National Forest has 77 miles of hiking and equestrian trails, with 131 additional miles identified for potential development. Trails include two National Recreation Trails: the Fremont National Recreation Trail and the Crane Mountain National Recreation Trail. Only 15 miles of these trails have been constructed. When complete, the National Recreation Trail system in the Forest will cover 115 miles, and help connect the Pacific Crest National Recreation Trail with the Desert National Recreation Trail (USFS 1987a).

Winema National Forest has 22.6 miles of the Pacific Crest Trail and 8.9 miles of National Recreation Trails. The State of Oregon has planned a Southern Intertie Trail, a national trail which would be an east/west link between the Pacific Crest Trail and the High Desert Trail, and the Winema National Forest section would link the Fremont National Forest with the Pacific Crest Trail. The forest currently has a total of 114.2 miles of hike-horse trails, 242 miles of motorized winter trails, 37.1 miles of ski trails, and 6.0 miles of canoe trails (includes Pacific Crest and National trails). No motorized summer trails are provided (USFS 1987b). Although it is not known how much of this trail system falls in the area of concern, 100 miles of these trails are in wilderness areas, none of which are in the area of concern.

12.3.2.3 Scenic Roads and Highways

The State of Oregon has a program to designate Historic and Scenic Highways. The only highway so designated in

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TABLE 12.3-2 CONTINUED

Crystal Springs
Klamath County. Picnic units. Boat launch, fishing.

CAMPING AREAS[1]

Collier Campground
Klamath County. Oregon Parks and Recreation Division. 50 trailer, 18 tent sites. Closed during FY 1985-86.

Goose Lake Campground
Lake County. Oregon Parks and Recreation Division. 48 trailer sites. Est. 5,726 camper nights in FY 1985-86.

Jackson Kimball Campground
Klamath County. 6 tent sites. Est. 980 camper nights in FY 1985-86.

Chandler Campground
Lake County. Oregon Parks and Recreation Division. Closed.

Gerber Reservoir Campground
Klamath County. BLM. 50 camp sites. Water, boating

Pot Holes Campground
Klamath County. BLM. Tent and picnic sites. Water, fishing.

Gerber Dam Campground
Klamath County. BLM. Trailer, tent and picnic sites. Boat launch, water, fishing, boating, swimming.

Cy Bingham Campground
Klamath County. Tent and picnic sites. Water, fishing.

Little Deschutes Campground
Klamath County. USFS. Trailer sites. Water, fishing, hunting, hiking.

Boundary Spring Campground
Klamath County. USFS. Tent sites. Water, hiking.

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[1]Total: 20 U.S. Forest Service campgrounds with 283 family units in county. Planning to improve facilities for camp trailers and campers.

LIST OF FIGURES

TABLE 12.3-1

RECREATION FACILITIES SUPPLY AND NEEDS
AREA OF CONCERN FOR
POTENTIAL INDIRECT RECREATION IMPACT

KLAMATH COUNTY

Facility	Unit	Supply	Gross Need	Net Need 1982	Net Need 1990
Camp Sites	Site	1,808	1,003	(805)	(606)
Picnic Tables	Table	1,358	446	(912)	(810)
Swimming Pools	Pool	8	3	(5)	(5)
Boat Ramps	Ramp	83	17	(66)	(63)
Walk/Hike Trails	Mile	148	89	(59)	(46)
Biking Trails	Mile	13	3	(10)	(10)
Bridle Trails	Mile	88	15	(73)	(70)
Ball Fields	Field	18	49	31	34
Tennis Courts	Court	10	24	14	16
All Purpose Courts	Court	6	24	18	20
Golf	Holes	45	43	(2)	1
Neighborhood Parks	Acres	54	295	241	266
Community Parks	Acres	435	590	155	205
District Parks	Acres	671	885	214	289

LAKE COUNTY

Facility	Unit	Supply	Gross Need	Net Need 1982	Net Need 1990
Camp Sites	Site	284	496	212	320
Picnic Tables	Table	295	155	(140)	(96)
Swimming Pools	Pool	2	1	(1)	(1)
Boat Ramps	Ramp	44	7	(37)	(35)
Walk/Hike Trails	Mile	15	22	7	11
Biking Trails	Mile	0	1	1	1
Bridle Trails	Mile	0	8	8	10
Ball Fields	Field	0	6	6	6
Tennis Courts	Court	2	3	1	1
All Purpose Courts	Court	0	3	3	3
Golf	Holes	18	5	(13)	(13)
Neighborhood Parks	Acres	8	40	32	27
Community Parks	Acres	0	80	80	70
District Parks	Acres	57	120	63	48

Note: Numbers in parentheses indicate a surplus.

Source: Oregon 1983.

SUMMARY

The wildlife of the Quartz Mountain Gold Study area are typical of managed forest in eastern Oregon. Wildlife species composition and distribution vary with habitat, which is a function of vegetative community, elevation, proximity to water, etc. The dominant habitat types are ponderosa pine, mixed conifer and white fir forest habitats. Wetland meadow and riparian vegetation habitats are found in valley bottoms and along streams. Shrub-steppe vegetation communities support big sage and low sage habitats, and are found between the forest and wetland habitats.

Fifty-six species of birds were observed in the study area, including the following: one game bird species, one waterfowl species, four water-associated bird species, four birds of prey species, and forty-six species of other non-game birds, including primary excavators, broad-leafed tree users, and other common bird species.

Twenty-seven mammal species or groups were observed in the study area. Big game animals observed were primarily mule deer, although black bear, mountain lion, and elk were observed or reported. Small game species such as western gray squirrel and snowshoe hare and other furbearers were observed but hunting and trapping activities for these mammals is very low. A variety of other mammals were observed as well.

Four reptiles were observed in the study area, and are common throughout the Fremont National Forest. Only two amphibian species were observed, as habitat for amphibian species is limited due to the degradation of wetland areas and ponds by overgrazing.

Field observations noted the presence of seven Fremont National Forest management indicator species or groups. Of these, two species, the mule deer and northern flicker are common residents; other indicator species are uncommon or rare residents, and include downy, black-headed, white-headed, and pileated woodpeckers, yellow-bellied and Williamson's sapsuckers, northern goshawk, and the marten. The greater sandhill crane is a USFS unique species and a USFW sensitive species and is an uncommon resident. The broad-leaved tree using bird group is classified as USFS unique group, and they are common summer residents in the area.

demand for semiprimitive nonmotorized recreation to exceed supply by 2015. All other ROS classes are projected to meet demand through at least 2030 (USFS 1987a).

12.3.1.2 Winema National Forest

Recreational opportunities in the Winema National Forest include boating, swimming, horseback riding, ORV use, hiking, camping, picnicking, downhill skiing, and other winter sports.

More than half of the Winema National Forest falls in the area of potential recreation impact. This forest includes all or part of the Mountain Lakes, Sky Lake, and Mount Thielsen Wilderness Areas (USFS 1987b), but the wilderness areas do not fall within the area of concern for indirect recreation impact (USFS 1987b). Most of the recreation users of the forest live in the Klamath Falls and Medford-Rogue Valley areas (USFS 1987b).

At present, most of the forest (82 percent) is classified as "roaded natural appearing," using the Recreation Opportunity Spectrum (ROS). Most developed recreation use is concentrated in the southwest portion of the forest (not in the area of concern) (Lilienthal 1988). Current capacity exceeds demand for dispersed recreation in all ROS classes:

ROS Class	Capacity (RVDs)	Demand (RVDs)
Primitive (only in wilderness)	50,200	38,700
Dispersed Roaded Natural	1,096,200	148,600
Dispersed Roaded Modified	1,286,900	3,800
Dispersed Semiprim. Motorized	5,000	300
Dispersed Semiprim. Nonmot.	6,000	500

Capacity also currently exceeds demand in all developed recreation opportunity spectrum classes, except for demand for downhill skiing at Pelican Butte (USFS 1987b). In 1983, utilization of developed sites was 23 percent of theoretical capacity (40 percent utilization is considered a maximum comfort level for the recreation experience being provided). At that time, the forest had 34 publicly operated sites with a total use level of 177,700 recreational visitor days (RVDs). Campgrounds accounted for 12 of the sites and 121,100 of the RVDs. Private or privately operated sites accounting for 266 additional sites and 99,500 additional RVDs (USFS 1987b).

12.3.1.3 Modoc National Forest

Of Modoc National Forest's 1.7 million acres, 81 percent are in Modoc County. The forest has 2,925 miles of forest roads and approximately 175 miles of trails, 255 miles of

5.0 WILDLIFE

5.1 INTRODUCTION

This section of the baseline report describes studies of the existing wildlife and wildlife habitat of the Quartz Mountain Gold Project study area shown in Figure 1.1-1.

5.1.1 Objectives

The objectives of the wildlife studies were to gather data sufficient to characterize existing wildlife use of the study area. The wildlife studies were designed to provide a baseline against which potential impacts of the project could be assessed, and to assist in development of possible mitigation measures. The surveys were designed to provide information on existing wildlife species composition, seasonal occurrence, and distribution in relation to habitat in the study area. The studies were also designed to determine whether any species classified as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS), or any other special-status species, such as key and management indicator species identified by the U.S. Department of Agriculture Forest Service (USFS), were present in the study area.

5.1.2 Study Area

The Quartz Mountain Gold Project study area is transitional between great basin and mountain geography and includes a diversity of forests, shrublands, grasslands, streams, springs, cliffs, and rock outcrops in mountainous, relatively dry, higher-elevation terrain in the Fremont National Forest. Edges between different forest and non-forest areas are common and enhance wildlife habitat diversity. The study area supports a moderately diverse wildlife community typical of managed forests in eastern Oregon. The study area is within the Basin and Range Physiographic Province described by Franklin and Dyrness (1973). The area has been and is being altered by activities such as logging, grazing, road-building, and mining exploration.

12.3 RECREATION RESOURCES: POTENTIAL INDIRECT IMPACT AREA

12.3.1 Major Recreation Areas

12.3.1.1 Fremont National Forest

Fremont National Forest is located in south-central Oregon, in Lake and Klamath counties. The western portion of the Forest is mostly volcanic highlands, while the eastern portion includes part of the northern half of the Warner Mountain Range.

The Forest's 1.2 million net acres include about 600 miles of intermittent streams, and many small natural lakes, wetlands, springs, reservoirs, and stockponds. The forest's streams, lakes, and reservoirs are popular with local residents for fishing, boating and camping (USFS 1987a).

Popular recreational activities include hunting, fishing, camping, skiing, and leisure driving. In FY 1986, the Forest provided 284,500 Recreational Visitor Days (RVDs), of which 121,800 or 42.8 percent were attributable to some form of day use or overnight camping, 32,000 or 11.5 percent to hunting, 30,000 or 10.6 percent to fishing, 27,700 or 9.7 percent to power boating, 24,200 or 8.5 percent to picnicking, 23,600 or 8.3 percent to gathering forest products, and the remainder divided among numerous other activities, including viewing scenery, automobile travel, hiking and walking, various winter sports, and other activities. In that year, the Bly Ranger District provided 110,400 RVDs, or 38.8 percent of total Forest RVDs, and the Lakeview Ranger District provided 44,000 RVDs, or 15.5 percent of total Forest RVDs.

In the Bly Ranger District, general underdeveloped areas provided 57,900 RVDs, or 52.4 percent of the district's total recreational use, with recreational roads providing 16,600 RVDs or 15 percent of the total. The most popular activity was camping, with 50,300 RVDs or 45.6 percent of total recreational activity. In the Lakeview Ranger District, general underdeveloped areas provided 16,100 RVDs or 36.6 percent of the district's total recreational use, with recreational roads providing 10,500 RVDs or 23.9 percent of the total. The most popular activities were gathering forest products (27.7 percent), hunting (18.4 percent), and fishing (12.8 percent) (USFS 1987c).

Although the majority of the Forest's recreational users live in Lake and Klamath counties, recreational users of the Forest come from a much wider area. During peak periods such as deer hunting season, people from throughout Oregon and northern California visit the Forest, but statistics are not

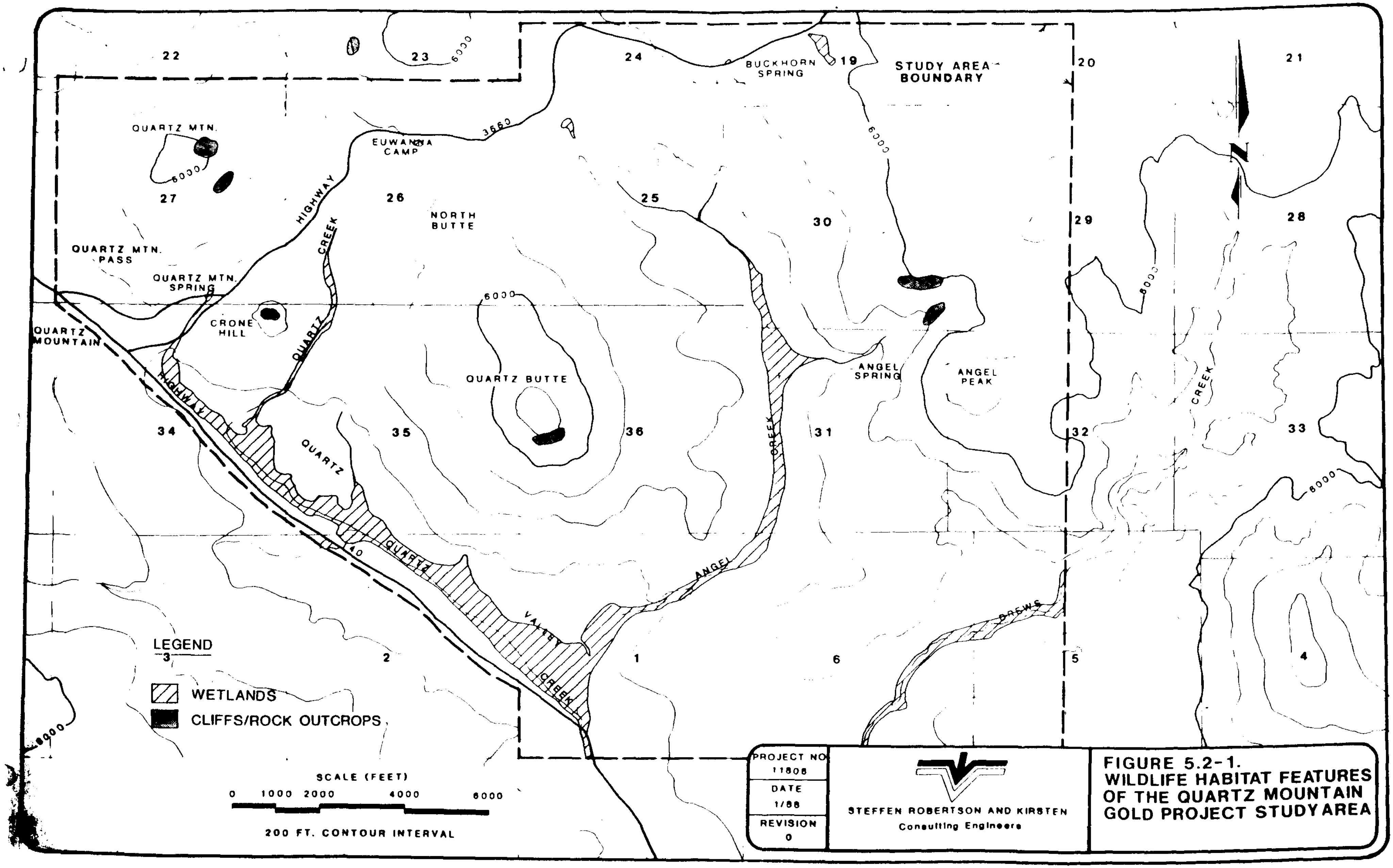


FIGURE 5.2-1.
WILDLIFE HABITAT FEATURES OF THE QUARTZ MOUNTAIN GOLD PROJECT STUDY AREA

area's southwest boundary. The DEIS for the Fremont National Forest Proposed Land and Resource Management Plan (USFS 1987a) describes fisheries habitat condition of Upper Drews Creek as fair to poor and in need of a rehabilitation survey, while Quartz Creek is not listed among the streams in the Fremont National Forest which produce 85 percent or more of all stream-related fishing. The DEIS describes Upper Drews Creek as shaded, with stable banks, while downstream, the fisheries habitat of Lower Drews Creek is poor, with siltation, low flow, and temperature problems. The banks of Lower Drews Creek are heavily grazed and lacking riparian vegetation. Lower Drews Creek flows into Drews Reservoir, which provides some warm water and trout fishing. The habitat at Drews Reservoir is rated low, since the reservoir is very muddy, with extreme water fluctuation. The reservoir is used for irrigation, recreation, and fish and wildlife (Anderson, pers. comm., 9 March 1988; USFS 1987a).

The Lakeview office of the Oregon Department of Fish and Wildlife indicates that there is virtually no fishing on Quartz Creek, and some early season trout fishing in April and May on Drews Creek. By June, the water in Drews Creek is very low. The number of people fishing Drews Creek is considered minor (Anderson, pers. comm., 9 March 1988).

Detailed statistics are not available on fishing activity or success rate in the study area. The Oregon Department of Fish and Wildlife last estimated recreation days and catch by licensed anglers in the 1977 Oregon Angler Survey (Carter, 1988). At that time, trout fishing in the Lake County area (roughly, Area 52, Region V) provided 14,777 angler days with 67,888 fish caught, while warm water game fishing in that area provided 10,598 angler days with 5,221 fish caught. In that survey, the confidence interval for statewide estimates was 10 percent, with the caution that estimates for areas with small sample size (such as this) could be less accurate (Berry, 1978; Lowry, 1978).

12.2.2.6 Rockhounding

The extent of rockhounding activity in the area is unclear. At an information meeting for the Quartz Mountain Gold Project, Frank Vaughn of Lakeview questioned what effect mine would have on recreation in the Quartz Mountain area, particularly rockhounding. He indicated that "quite a bit" of incidental rockhounding goes on in the Quartz Mountain area, and asked what restrictions would be placed on that activity (Collison 1987c). The Fremont National Forest Recreation Specialist was not aware of any rockhounding activities in the project study area itself, however (Woodward, pers. comm., 10 February 1988).

5.2.2 Forests

Coniferous forest communities in the study area vary in age and density; snag abundance, size and age; and species composition. Major habitat types or components distinguished by the Fremont National Forest and represented in the study area include Mature Mixed Conifer, which is often used by 113 wildlife (mammal, bird, amphibian, and reptile) species; and Mature Ponderosa Pine and Mature Lodgepole Pine types, each of which is often used by 108 wildlife species (USFS 1987a). The Mature Mixed Conifer type is the most common in the study area.

There are open, forest areas dominated by ponderosa pine at lower elevations. These open forests intergrade into shrubland and grassland areas at lower elevations and along meadows. Shrub and herbaceous vegetation density is highest in these open forests, but much of the shrub cover is sagebrush which is not particularly valuable to most wildlife species. Scattered large ponderosa pines and incense cedars with broken, dead, or split tops, left when the area was logged in the 1930s, can be found in these more open stands. These large trees enhance the quality of habitat in the area for snag-using wildlife species. The open forests intergrade into more closed forest at higher elevations. Firs and other pine species are also present in higher elevation areas. Understory cover by herbaceous and shrubby plants is sparse and provides little food for most wildlife species. On and around the tops of Quartz Mountain, Quartz Butte, and Angel Peak, large snags are much more common than in the lower elevation, open forests. These snags represent the Dead Trees (standing and/or down) major habitat type or component recognized by the Fremont National Forest, and are often used by 131 wildlife species (USFS 1987a).

A few small patches of the Mixed Conifer/Aspen forest habitat type, which is often used by 139 wildlife species (USFS 1987a), are found in the study area. Grazing practices appear to have greatly limited the distribution of aspen in the study area. Those areas of aspen that do exist were examined during 19-21 October 1987, just after cattle were removed from the study area. Younger trees were extensively trampled and damaged, and the herbaceous vegetation was grazed to a height of one or two inches, or even less in areas adjacent to water sources.

A few sites on the study area support Mature Wet/Moist Lodgepole Pine habitat, which is often used by 125 wildlife species (USFS 1987a). The largest of these is along a tributary of Angel Creek, just east of the Angel Camp area. This small valley formerly supported beaver, and a series of flat terraces with lodgepole pine and a wet meadow understory

12.2.1.6 Wild and Scenic Rivers

No designated or proposed Wild and Scenic Rivers pass through the study area (USFS 1987a).

12.2.1.7 Wilderness Areas

There are no Wilderness Areas, Wilderness Study Areas, or Areas Recommended Suitable for Wilderness Designation in the project study area (BLM 1987).

12.2.2 Dispersed Recreation Opportunities

Dispersed recreation refers to recreation use that occurs outside of developed recreation sites. Dispersed recreation may include activities such as scenic driving, hunting, backpacking, and recreation in primitive environments.

In planning for management of public lands, the BLM and the USDA Forest Service both make use of the Recreation Opportunity Spectrum (ROS), a planning and management framework for stratifying and defining classes of outdoor recreation environments, activities, and experience opportunities. The settings, activities, and opportunities for obtaining experiences have been arranged along a continuum or spectrum divided into six classes: primitive; semiprimitive nonmotorized; semiprimitive motorized; roaded natural; rural; and urban. Criteria for these classes are defined in Appendix 12-A. The study area would be classified as roaded-natural (Woodward, pers. comm., 14 March 1988).

Participation in dispersed recreation is measured in recreational visitor days (RVD). One RVD is the equivalent of one person visiting an area for twelve hours (for example, four persons visiting an area for 3 hours each equals one visitor day). In Fremont National Forest as a whole, dispersed recreation use averages 154,400 RVDs annually (USFS 1987a).

12.2.2.1 Cross-Country Skiing

While cross-country skiers frequently utilize developed ski trails, cross-country skiing may be considered a dispersed activity, since skiers are restricted in their choice of locations only by the terrain and snow conditions, ability, landowner restrictions, and the quality of the outdoor environment.

At present, total winter recreation use in the area (including snowmobiling, snowshoeing, snowplay, etc.) is approximately 500 recreational visitor days per year (Woodward, pers. comm., 10 February 1988).

With the exception of Drews Creek, which shows only moderate degradation due to grazing, these wetland areas are all severely degraded by overgrazing and support few shrubs and trees which would enhance wildlife habitat diversity. In all of these areas, excessive grazing by cattle has eliminated the lush, dense stands of grasses, sedges, rushes, willows, red-oisier dogwood, aspen, and other plants which would otherwise exist in the area. Such lush stands of riparian and wetland vegetation greatly increase food and cover available to wildlife. Good-quality Wet Meadows/Moist Meadows habitat is often used by 113 wildlife species, Perennial Stream/Riparian often used by 156 species, Intermittent Stream/Riparian often used by 217 species, and Seeps/Springs/Riparian often used by 132 species (USFS 1987a). Far fewer species actually use the degraded wetland habitats in the study area.

5.2.5 Streams and Ponds

Streams in the study area are all within the Quartz Creek drainage. Quartz Creek is a permanent stream below the confluence with Drews Creek, which is also permanent. The lower part of Angel Creek is also permanent. The remainder of the drainages in the study area are intermittent. They were dry during the summer and fall of 1987. Drews Creek is the least degraded by livestock use. It is a clear, cold stream with a pool-riffle regime, which provides habitat suitable for mountain stream-dwellers such as trout and the American dipper.

Several natural springs and man-made ponds exist within the study area. They include springs at the bases of Quartz Mountain, Angel Peak, and at the headwaters (Buckhorn Springs) of Angel Creek. Breeding habitat for amphibians is available in the study area in these man-made ponds, a few springs, and in a series of low rock-fill dams along Angel Spring and Quartz Creek which trap water in small pools. Man-made ponds, which probably are developed from natural springs, exist at scattered locations throughout the study area.

5.2.6 Cliffs, Rock Outcrops, and Talus

Cliffs, rock outcrops, and a few small talus slopes can be found scattered throughout the study area. These sites, which are often used by 70 wildlife species, fall within the Cliffs/Caves/Talus habitat recognized by the Fremont National Forest (USFS 1987a). The tallest cliffs are probably no higher than 60 feet, and thus are not particularly suitable for use as nesting habitat by the larger raptors, such as eagles and falcons. These cliffs, outcrops and talus slopes do provide habitat for a diversity of other wildlife species,

5.3 REPTILES AND AMPHIBIANS

5.3.1 Methods

5.3.1.1 Information Review

A meeting was held with a representative of the USFS-Bly Ranger District to discuss any special concerns regarding the reptiles and amphibians of the study area. Subsequent meetings and telephone conversations were held with USFS-Bly Ranger District and Fremont National Forest Supervisor's Office wildlife biologists to gather reports and maps pertinent to reptiles and amphibians and their habitat in the study area. The species known to occur in the Fremont National Forest were derived from Silovsky (1982), and the habitat requirements of those species were reviewed in Silovsky (1982) and Nussbaum et al. (1983) before the field studies were conducted.

5.3.1.2 Field Studies

All observations of reptiles and amphibians were recorded during field surveys and other activities in July, August, and October visits in 1987. Observations by the Fisheries Task Leader were also recorded. Areas of habitat likely to support reptiles, such as rock outcrops and areas where cover in the form of dead and downed wood, were intensively searched. Wetland areas, such as small tributaries of Drews Creek, were intensively searched for amphibians by turning over all stones in several 10-ft stretches of stream. Small springs, ponds, and impoundments along other streams were also searched for amphibians.

5.3.2 Reptiles

The common names, scientific names, relative abundance and seasonal occurrence of the four reptile species observed to date in the study area are given in Appendix 5-A, a Checklist of Wildlife. The western fence lizard, sagebrush lizard, western skink, and garter snake sp. were found in the study area. The garter snakes could not be identified to species as none were captured. These garter snakes could be either the western terrestrial garter snake (Thamnopsis elegans) or the common garter snake (Thamnopsis sirtalis), based on habitat and range information in Nussbaum et al. (1983). Both species are classed as very common in the Fremont National Forest by Silovsky (1982). The snakes, a number of juveniles, were observed by the Fisheries Task Leader in the wet meadow at the south end of Angel Creek. Western fence lizards were observed wherever downed wood was common. Sagebrush lizards were found in areas dominated by

12.2 RECREATION RESOURCES: DIRECT IMPACT AREA

12.2.1 Sites and Facilities

Sites and facilities discussed in this section include both specific naturally occurring features which lend themselves to recreational use and constructed features which facilitate recreational use.

12.2.1.1 Developed Recreation Sites

Within the study area, there are no developed recreation sites such as campgrounds, picnic areas, or boat launches (Woodward, 1988). The "Angel Camp" site is considered a cultural resource, and is discussed in that technical report. It is not a developed recreation site, although the location has been used as a hunting camp by hunting parties.

The "Ewauna Camp" site was an old railroad logging camp; nothing visible remains except the rail grades and some pieces of pipe. The site had been considered by the USFS as a location for a campground, since it is flat with scattered ponderosa pine (Woodward, pers. comm., 10 March 1988).

The nearest developed recreation facilities are at Lofton Reservoir, which is south of the study area.

12.2.1.2 Major Recreation Trails

No National Recreation Trails or other major designated hiking, bicycle or horse trails pass through the study area (Oregon, 1983, SCORP, 58; BLM, 1984, Map), although there are some jeep roads. The area does include developed cross-country and snowmobile trails, as shown in Figure 12.2-1.

A snowmobile trail follows Forest Service roads through the project area, with road 3660 connecting Highway 140 with a loop trail north and east of Quartz Valley Mountain, and road 3715 connecting the highway with another loop trail south of Quartz Mountain Pass. These trails include the 40 miles of snowmobile trails referred to as "planned" in the Fremont National Forest Draft Environmental Impact Statement (DEIS) (Woodward, pers. comm., 10 March 1988).

Cross-country ski trails in the project study area and the immediate vicinity consist of three loops: 1) south of Highway 140 from Quartz Mountain Pass, partially following the snowmobile trail on road 3715; 2) north of Highway 140 from Quartz Mountain Pass and circling Quartz Mountain; and 3) starting from road 3715 at the easternmost point of the Quartz Mountain loop, and making a large circle around North Butte

5.4 BIRDS

5.4.1 Methods

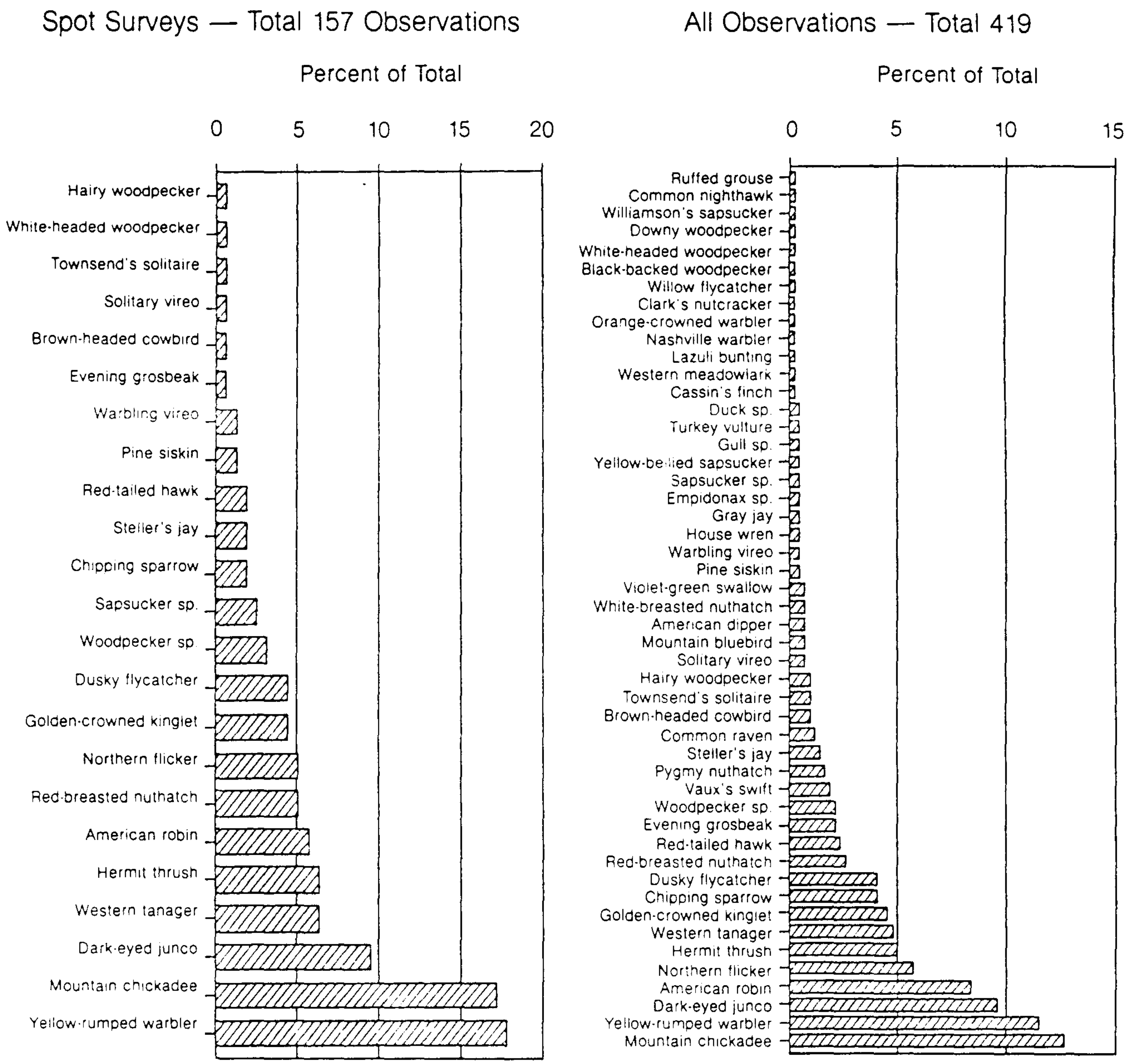
5.4.1.1 Information Review

A meeting was held with a representative of the USFS-Bly Ranger District, which included discussion of any concerns related to birds in the study area. Subsequent meetings and telephone conversations were held with USFS-Bly Ranger District and Fremont National Forest Supervisor's Office wildlife biologists to gather reports and maps pertinent to bird habitat in the study area. Information on bird habitat conditions in the study area was requested from the Oregon Department of Fish and Wildlife (ODFW)-Lakeview District wildlife biologist by telephone and in subsequent meetings. The USFWS-Klamath Basin National Wildlife Refuges was contacted by telephone and copies of their 1987-1988 Klamath basin area waterfowl survey data were requested in order to obtain general information on the phenology and numbers of waterfowl migrating through and wintering in the area. Information on status, abundance, and habitat relationships of the 228 species of birds known to occur in the Fremont National Forest is presented in Silovsky (1982).

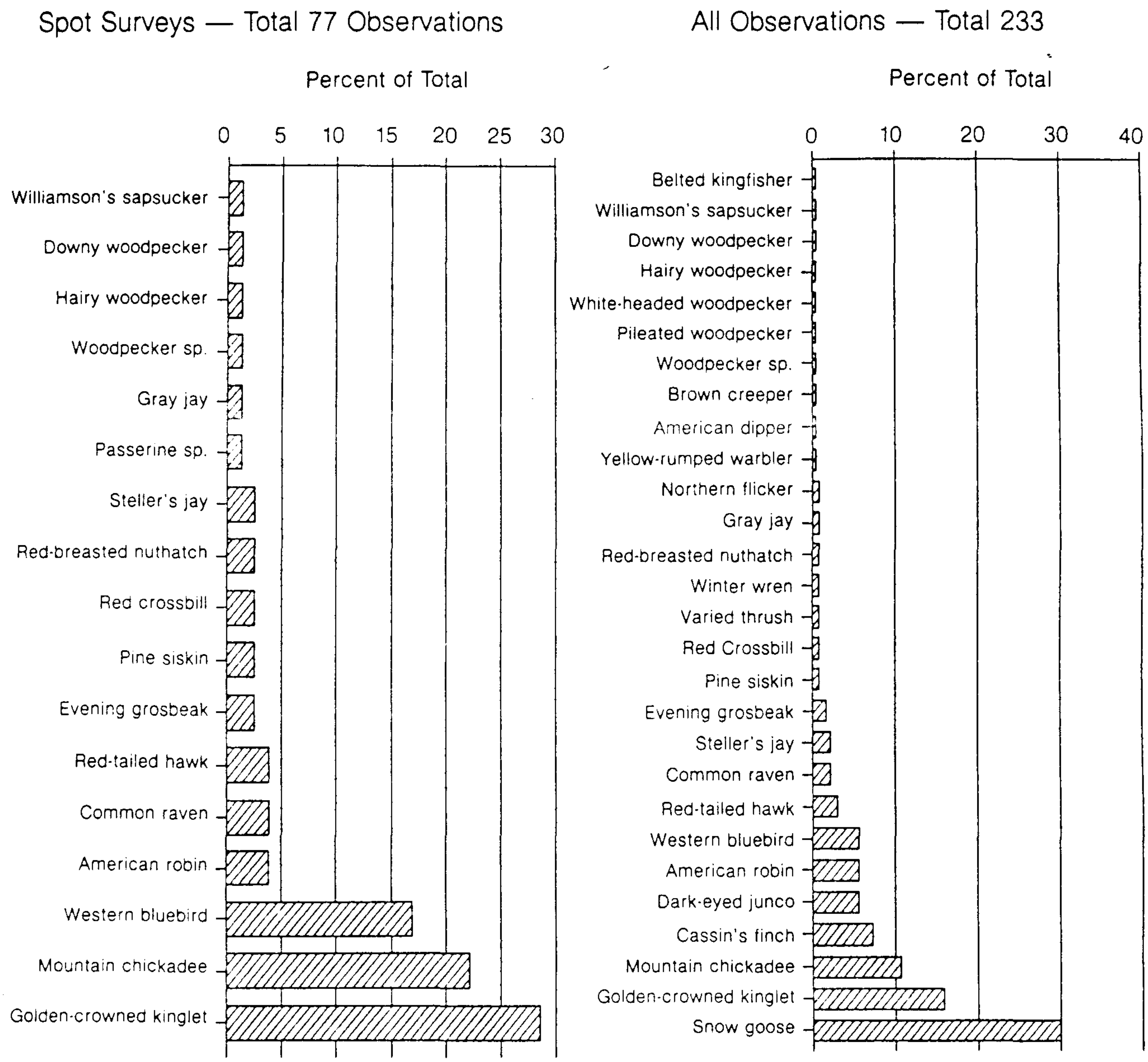
5.4.1.2 Field Studies

Field studies of birds included standardized surveys at 15 sites along roads in the study area, ground transects of areas less accessible or inaccessible by roads, and ground surveys of specific habitats or areas of concern. The standardized survey sites are shown in Figure 1.2-1. These sites were approximately one-half mile apart to avoid detecting the same bird at two sites. The sites were marked with flagging. Surveys were conducted on days with no or light wind and no precipitation, as high winds and precipitation greatly inhibit bird vocal activity. After a one-minute waiting period, all birds seen or heard for a period of 8 minutes were recorded. This survey technique contains elements of the method used by the North American Breeding Bird Survey, sponsored by the USFWS, Migratory Bird and Habitat Research Laboratory (USFWS 1979), and the variable-circular plot survey technique introduced by Reynolds et al. (1980). The technique was chosen because it can cover large areas quickly and provide fairly accurate information on relative abundance (DeSante 1986).

During the early July survey, observations were made between one-half hour before sunrise and three hours after sunrise, the time of peak activity. Only one survey was conducted during July owing to an unexpected snowfall. Two



PROJECT No.	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 5.4-1 SUMMER BIRD SPECIES COMPOSITION
DATE		
REVISION		



PROJECT No.	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 5.4-2 FALL BIRD SPECIES COMPOSITION
DATE		
REVISION		

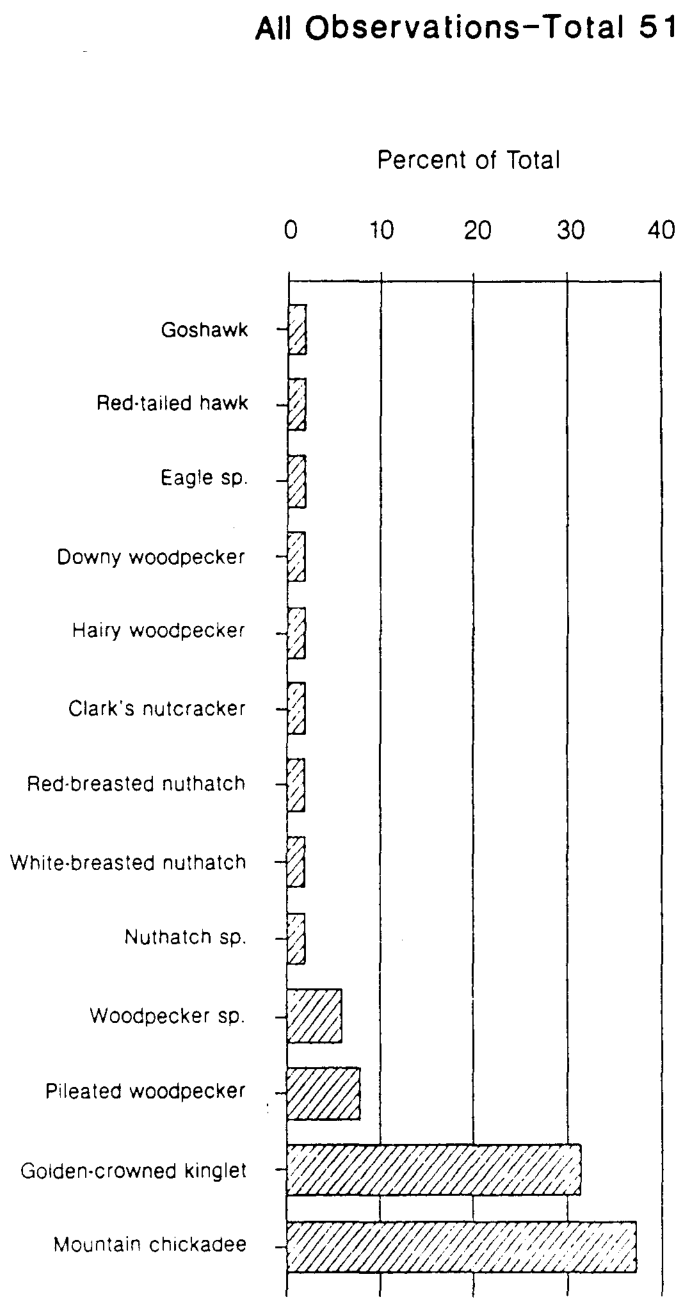
SUMMARY

Affected environment for recreation includes both the resources which might be directly affected by project components and those which might be indirectly affected by the inmigrant project population. While most of the recreation resources directly affected would be in the project study area, concerns also have been expressed for the effects on downstream recreation and winter sports trails in the neighboring areas. Since most of the inmigrant population is expected to reside in Bly and Lakeview, the area of concern for indirect impacts extends out from those population centers.

Recreation occurs both on developed sites such as campgrounds, picnic areas, and marinas, and in dispersed settings such as forests and rangelands. Examples of dispersed recreation activities include hunting, fishing, and hiking.

Recreation resources in the area of concern for direct project impacts include 1) the recently constructed cross-country skiing and snowmobile trails and the proposed winter sports parking area on U.S. 140, to be constructed in summer 1988; 2) the Ewauna Camp site which was mentioned in the Fremont National Forest Management Plan DEIS as a potential campground site; 3) Drews Creek, less for its own value as a fishing resource than as a tributary of Drews Reservoir; and 4) dispersed undeveloped roadside camping sites, which receive considerable use during hunting season.

The area of potential indirect impacts is generally not at capacity, although certain areas receive heavy use. According to the Oregon State Outdoor Recreation Plan, Klamath County's needs exceed supply for community outdoor recreation facilities such as ball fields, tennis and all purpose courts, and parks. In Lake County, needs exceed supply for these facilities, and also for trails and campsites. Demand for semiprimitive nonmotorized recreation in the Fremont National Forest is expected to exceed supply by 2015; all other Recreation Opportunity Spectrum (ROS) classes are projected to meet demand through at least 2030. About 50 percent of deer hunters visiting the Forest are not Lake or Klamath County residents. The Fremont National Forest Management Plan DEIS indicates that demand for deer and elk hunting in the Forest already exceeds supply. Certain fishing areas are heavily used. Blue Lake, in Gearheart Mountain Wilderness, has been degraded due to excessive use.



PROJECT No.	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	**FIGURE 5.4-3** WINTER BIRD SPECIES COMPOSITION
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LIST OF FIGURES

the study area are too small to support anything but very infrequent use by waterfowl.

Regional waterfowl populations are very large, however, and thousands of birds fly over the vicinity during spring and fall migration. Flocks of snow, white-fronted, and Canada geese were seen migrating southward over or near the study area during October 1987. Hundreds of thousands of coots, ducks and geese fly over or winter in the Klamath Lake vicinity. Appendix B includes the fall-winter 1987-1988 data gathered by the USFWS in the Klamath Falls-Tule Lake vicinity. Ducks and geese were frequently observed at Drews Reservoir, which is approximately 12 miles from the study area. Waterfowl nesting activity is high at Goose Lake, Summer Lake, Ebert Lake, and Clear Lake, all of which are within a radius of 40 miles of the study area.

5.4.4 Other Water-Associated Birds

Only three water-associated bird species were observed in the study area, owing to a scarcity of suitable habitat. Shorebirds are classed by the USFS (1987a) as a unique group requiring special management. A small flock of unidentified gulls were seen flying high over the study area in July 1987. A single belted kingfisher was seen at a spring developed into a stock watering pond at the headwaters of Angel Creek in October. The lack of other observations indicates that this bird may have been a migrant. American dippers were regularly observed in Drews Creek. Shorebirds were never observed in the study area. Habitat suitable for spotted sandpipers may exist along Drews Creek or lower Quartz Creek. Spotted sandpipers tend to migrate south in midsummer and may have left the study area by mid-July. Greater sandhill cranes have been observed in spring by local residents and USFS personnel in the meadows along lower Quartz Creek. Additional information on sandhill cranes is presented below in Section 5.6.3. Spring surveys will cover these areas of habitat and it is possible that additional species may be detected.

5.4.5 Birds of Prey

Red-tailed hawks and turkey vultures are common in the study area. Single observations were made of a goshawk and unidentified eagle. These are the only the only predatory bird (raptor) species observed in the study area to date. A number of other raptors, including a variety of owls and smaller hawks, probably occur. Scheduled spring surveys could detect additional species.

Several raptors are classed as Management Indicator Species or Unique Species by the USFS (1987a). The goshawk (Accipiter gentilis) is classed by the USFS as a Management

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During the fall, the most common species (disregarding the single flock of 70 snow geese that flew over the site) were the mountain chickadee and golden-crowned kinglet, each of which comprised over 10 percent of all observations; Cassin's finch, dark-eyed junco, American Robin, and western bluebird, comprising between 5 and 10 percent each. The red-tailed hawk, Stellers jay, nuthatches, and a diversity of woodpeckers were consistently seen in lower numbers during the summer and fall.

During the winter, the mountain chickadee and golden-crowned kinglet comprised over 30 percent of all 51 bird observations. Woodpeckers and nuthatches, including fairly recent pileated woodpecker signs, and observations of hairy and downy woodpeckers and red-breasted and white-breasted nuthatches, were also fairly common.

Woodpeckers and nuthatches were most common in those parts of the study area supporting mature timber where snags were commonly found. They were least common in the lower-elevation, more open stands where few snags were present. All primary excavators (birds that excavate their own nesting cavities rather than using cavities excavated by others) are classified as a Management Indicator Group by the Fremont National Forest, and represent dead trees. The members of this group that have been observed in the study area to date include all of the woodpecker, sapsucker, chickadee and nuthatch species observed plus the northern flicker (Thomas 1979).

In addition, four species of woodpecker are classed as Management Indicator Species by the Fremont National Forest. The three-toed woodpecker (Picoides tridactylus) represents overmature/mature lodgepole pine habitats and has not been observed on the study area to date, although it may occur in suitable lodgepole pine stands. The yellow-bellied sapsucker represents aspen and deciduous riparian ecosystems, and was observed in the study area during the summer surveys. The pileated woodpecker represents overmature/mature mixed conifer forest habitats (USFS 1987a), and recent signs of this woodpecker were observed in the study area.

Unique species recognized by the Fremont National Forest include Broad-leaved tree users. Species in this category which have been observed in the study area include (but are not limited to) the orange-crowned warbler, willow flycatcher, warbling vireo, ruffed grouse, common nighthawk, common flicker, violet-green swallow, house wren, Nashville warbler, lazuli bunting, pine siskin, and solitary vireo. The purple martin (Progne subis) is also classified as a Unique Species in the Fremont National Forest (USFS 1987a) but has not been

5.5 MAMMALS

5.5.1 Methods

5.5.1.1 Information Review

A meeting was held with a representative of the USFS-Bly Ranger District to discuss any mammal related concerns regarding the study area. Subsequent meetings and telephone conversations were held with USFS-Bly Ranger District and Fremont National Forest Supervisor's Office wildlife biologists to gather reports and maps pertinent to mammal occurrence in the study area. Information on mammals in the study area was requested from the Oregon Department of Fish and Wildlife (ODFW), Lakeview District wildlife biologist by telephone and in meetings. The Oregon Department of Transportation (ODOT), Lakeview office was contacted by telephone for information on road-killed deer during 1987. The ODOT Klamath Falls Regional Office was contacted by telephone and provided the same information for 1985 and 1986. Information on status, abundance, and habitat relationships of the 68 species of mammals known to occur in the Fremont National Forest is presented in Silovsky (1982).

5.5.1.2 Field Studies

All observations of mammals or their recognizable signs (e.g., tracks, droppings, marking posts, beaver dams) were recorded during all field activities, including standardized bird surveys. A few notable observations by Quartz Mountain Gold Project staff, USFS personnel, and other Task Leaders were also recorded.

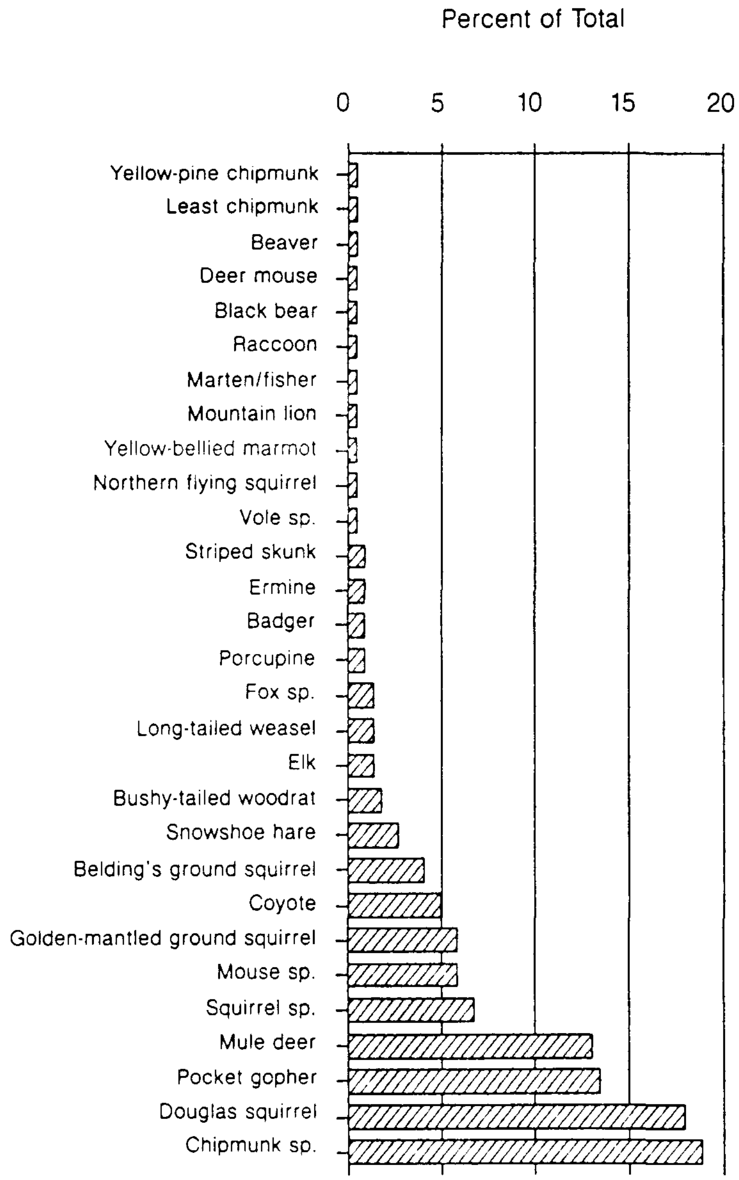
5.5.1.3 Data Analysis

The common and scientific names, relative abundance and seasonal occurrence of all mammals known to occur in the study area are included in Appendix 5.A. The field observations of mammals are presented in detail in Appendix 5.D, and summarized in Figures 5.5-1 and 5.5-2.

5.5.2 Big Game

The mule deer, elk, cougar and black bear are the big game species known to occur on the study area. There is a small herd of pronghorn (*Antelocapra americana*) which is regularly seen in the Drews Reservoir area, 12 miles to the east, which may occasionally venture as far west as the study area.

1986-1987 All Observations-Total 241



PROJECT No.	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 5.5-1. MAMMAL OBSERVATIONS IN 1986-1987
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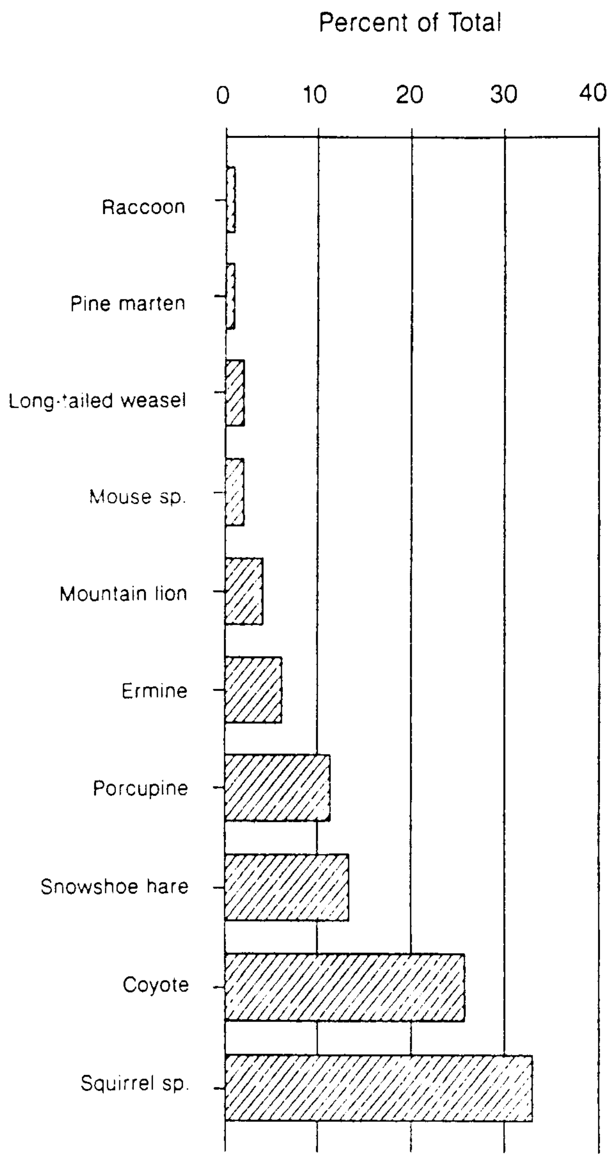
1988 Track Observations–Total 97



PROJECT No.	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 5.5-2. MAMMAL TRACK OBSERVATIONS IN WINTER 1988
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redevelopment project; as a Research Associate and Associate with Briscoe, Maphis, Murray and Lamont (1981-83), where his areas of responsibility included fiscal impact analysis, local government management systems, growth policy analysis, and development of monitoring programs; as a Senior Consulting Associate at the Denver Research Group (1983-85), working in socioeconomic impact analysis, local government impact mitigation strategies, and computer database systems development; and as a principal of Planning Information Corporation, responsible for fiscal impact analysis and mitigation strategies, implementation of computer-based data analysis systems, and local government management assistance.

11.8.3 Jennifer T. Sebesta

Ms. Sebesta is a planner with special expertise in the development of modeling applications for economic and demographic analyses.

She holds a Master of Planning and Community Development from the University of Colorado at Denver (1986) and a B.A. in Geography from the University of Colorado at Boulder (1983).

Prior to the founding of Planning Information Corporation in 1985, she worked with the firm's principals at Denver Research Group, conducting data collection, analysis and modeling for socioeconomic impact assessments. At Planning Information Corporation, she has coordinated the socioeconomic monitoring studies for the Exxon LaBarge Project in Wyoming; analyzed labor force participation and local labor market workforce availability and calibrated the export base economic and demographic projection model (PAS) used in the Yucca Mountain Socioeconomic Study; assembled data for calibrating the same model for Amoco Production Company's Bairoil Enhanced Oil Recovery Project, and prepared both the local labor force and hiring analysis and local school district fiscal and enrollment projections for that project. She is currently preparing the socioeconomic analysis for a gold mine in South Dakota.

11.8.4 Elaine A. Taylor

Ms. Taylor is a planner who has worked in environmental planning and engineering for nearly ten years. Her contributions at Planning Information Corporation (PIC) have included writing sections on Housing and land use, labor force and income, and employment and local economy for the Yucca Mountain Socioeconomic Study; preparing the recreation resource analysis and socioeconomic analysis for the five project sites in the Amoco Wyoming CO2 Projects Environmental Impact Statement; and writing or editing major sections of the Amoco Elk Basin Project Plan of Development. She is currently

5.5.2.1 Mule Deer

The mule deer is the most numerous and sought-after big game species in the study area as well as throughout the Fremont National Forest. Herd management objectives have been developed by ODFW through a supply and demand analysis of the number of deer and hunting trends. Mule deer appear to be fairly common on the study area, based on regular observations of deer and their signs during the summer and fall, but resident populations are not high. Mule deer and their signs were observed throughout the study area, but appeared to be more common during the summer at higher elevation areas and in the vicinity of Drews Creek.

The study area is not identified by the USFS or ODFW as an important mule deer fawning area. A single doe and fawn were observed several times by drilling crews during the summer of 1987 in the vicinity of Angel Peak.

Forage and cover quantity and quality varies within the study area. The wet meadows along Quartz Creek, Angel Creek, and Drews Creek provide the most abundant and probably most nutritious herbaceous forage preferred in spring and early summer. The Quartz Creek and Angel Creek meadows are heavily grazed by cattle and provide lower quality and quantity forage than the Drews Creek meadows which are less heavily grazed. Shrubby forage plants, such as bitterbrush, curlleaf mountain mahogany, cherry, and snowbrush ceanothus, which are more important to mule deer during late summer, autumn, and early spring, are patchy in distribution within the study area, tending to be more common at higher elevations and away from water sources and the influence of cattle grazing.

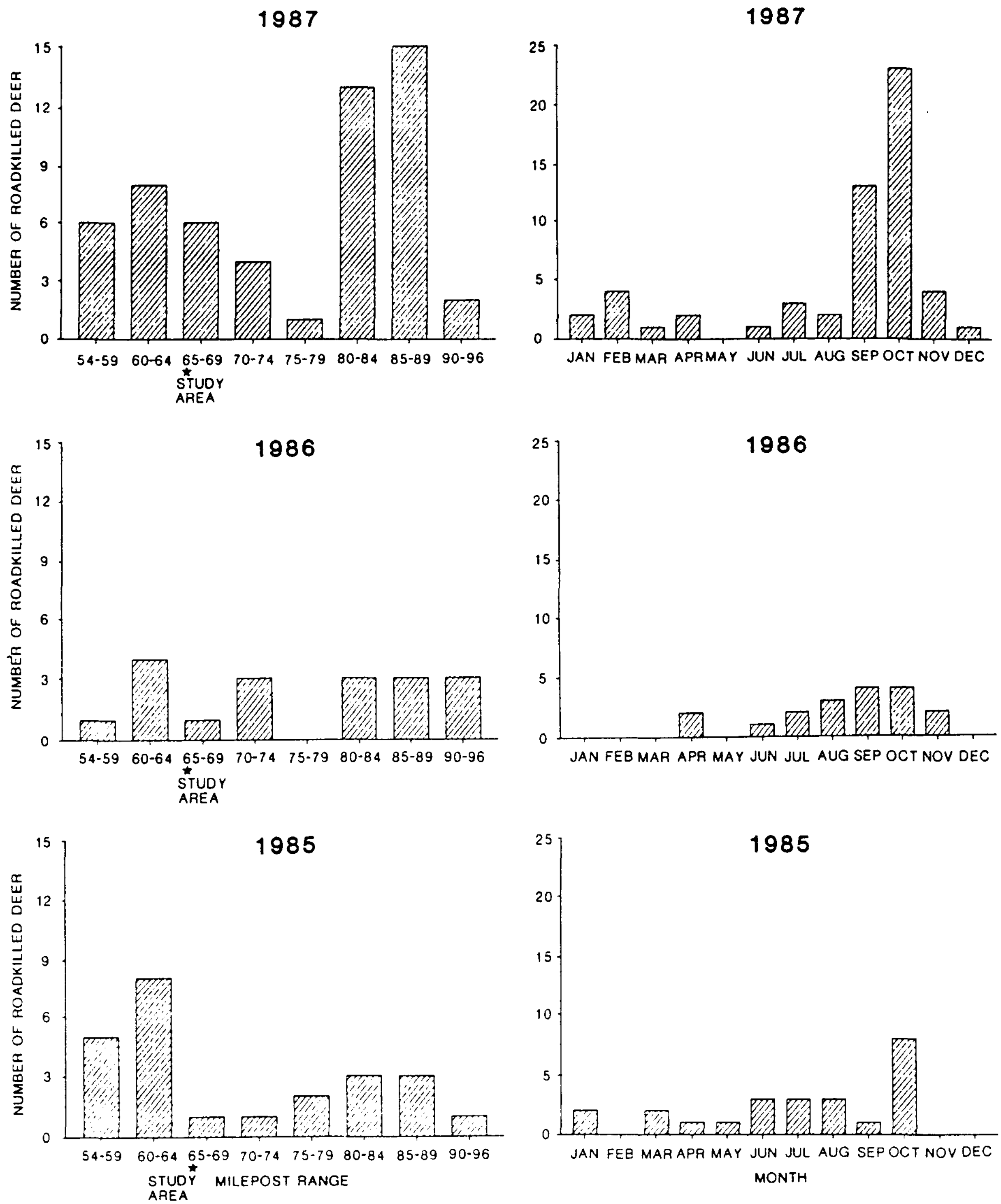
The study area is not primary mule deer winter range according to the Fremont National Forest Mule Deer Herd Range Map (USDA 1982). Mule deer are nearly absent from the study area during the winter. A small group of mule deer spent part of the winter of 1987-1988 on the southwest slope of Quartz Mountain, west of the study area (Rodgers, pers. comm., 11 February 1988). Deer tracks were not observed in the study area during the February 1988 surveys, and only one set of deer tracks had been observed during a December 1986 visit to the study area. The study area is located in the east sub-unit of the Interstate big game management unit (Unit No. 75) designated by ODFW. Many of the deer in the East Interstate Subunit migrate between winter range in northern California and summer range in southeastern Oregon. The summer range of this herd includes the study area. A historic deer migration occurs in spring and fall through the Quartz Mountain area. One migration route follows Gearhart-Coleman Rim along the west side of Drews Valley and into California; another is along the east side of Drews Valley through Drews Gap (Conn,

Terzich, D. 1988. Postmaster, Bly, Oregon, personal communication. Interview with George F. Blankenship, 12 January, 1988.

Todd, V. 1988. Manager, Research and Statistics, Adult and Family Services Division, Oregon Department of Human Resources, Salem, Oregon, personal communication. Letter to David C. M. Farr, 5 January, 1988.

West, D. 1988. Manger, Lakeview Lumber Company, Lakeview, Oregon, personal communication. Telephone conversation with Jennifer T. Sebesta, 12 January, 1988.

Whitehouse, D. 1988. Lakeview Activity Center, Lakeview, Oregon, personal communication. Telephone conversation with George F. Blankenship, 2 February, 1988.



PROJECT No.	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 5.5-3. ROADKILLED DEER ON HIGHWAY 140 BETWEEN BLY AND LAKEVIEW BY MONTH AND MILEPOST RANGE, 1985-1987
DATE		
REVISION		

Green, J. 1988. Manager, Goose Lake Lumber Company, Lakeview, Oregon, personal communication. Telephone conversation with Jennifer T. Sebesta, 14 January, 1988.

Grisel, S. 1987. City Recorder, Lakeview, Oregon, personal communication. Telephone conversation with Jed M. Goldstein, 12 December, 1987.

Harlan, R. 1987. City Councilman, Lakeview, Oregon, personal communication. Telephone conversation with Jed M. Goldstein, 12 December, 1987.

Himes, B. 1987. Manager, Bly Water and Sanitation District, Bly, Oregon, personal communication. Telephone conversation with Jed M. Goldstein, 14 December, 1987.

Himes, B. 1988. Manager, Bly Water and Sanitation District, Bly, Oregon, personal communication. Interview with George F. Blankenship, 12 January, 1988.

Knowles, D.C. 1988. Superintendent, Lake Education Service District, Lakeview, Oregon, personal communication. Interview with George F. Blankenship, 19 January, 1987.

Lake County Chamber of Commerce. 1987. An Ideal Location: Lake County, Oregon, 1987, Lakeview, Oregon.

Lawrence, D. 1988. Fire Chief, Bly, Oregon, personal communication. Interview with George F. Blankenship, 12 January, 1987.

Leach, P. 1988. Realtor, High Country Real Estate, Lakeview, Oregon, personal communication. Telephone conversation with George F. Blankenship, 7 January, 1988.

Lepley, D. 1987. Fire Chief, Lakeview Fire Department, Lakeview, Oregon, personal communication. Telephone conversation with Jed M. Goldstein, 14 December, 1987.

Mahan, M. 1988. Regional Labor Economist, Oregon Employment Division, Klamath Falls, Oregon, personal communication. Telephone conversation with Jennifer T. Sebesta, 8 February, 1988.

Nichols, R.F. 1988. Town Attorney, Lakeview, Oregon, personal communication. Letter to George F. Blankenship, 25 January, 1988.

Nicholson, G. 1988. Realtor, Century 21 Realty, Klamath Falls, Oregon, personal communication. Telephone conversation with Jennifer T. Sebesta, 2 February, 1988.

The six factors that were selected for the VAC analysis (slope, aspect, vegetation regeneration potential, vegetation screening potential, soil color contrast, and soil erosion potential) were individually mapped at 1" = 1000' to produce six 'factor' maps. These maps were then overlaid to produce the VAC map. The individual factor maps are not included in this technical report, but are described briefly below.

13.4.2.1 Slope

Slope is important in terms of visual absorption capability of the landscape because steeper slopes are difficult to revegetate and require more cut and fill areas to achieve acceptable grades for items such as roads and building pads. The Quartz Mountain site was divided into five slope categories and then assigned a VAC factor related to the slope. Slope categories included 0 - 15 percent, 15 - 30 percent, 30 - 45 percent, 45 - 60 percent, and over 60 percent. The assigned VAC ratings were 5,4,3,2, and 1, respectively. Thus, the flatter the slope (0 - 15 percent), the higher the VAC rating (5). Quartz Valley and the drainages between the buttes have relatively flat slopes, with steeper slopes found on the buttes. The largest portion of the site falls into the 0 - 15 percent slope category.

13.4.2.2 Aspect

Related to slope is the concept of aspect. This refers to the direction that a slope faces. Aspect is important in VAC because activities on slopes that face toward the greatest number or most sensitive viewers will be more visible. The Quartz Mountain project site was divided into aspect categories that included north, northeast, east, southeast, south, southwest, west, and northwest. These were then analyzed primarily in relationship to the views from SH 140 because of the sensitivity of that travel corridor. The aspect categories were assigned VAC ratings from 1 to 4 (four is the highest VAC rating for aspect) as follows: North, 3; Northeast, 4; East, 3; Southeast, 3; South, 2; Southwest,1; West, 2; Northwest, 3.

13.4.2.3 Vegetation Screening Potential

The vegetation on the Quartz Mountain site was classified into three categories of VAC: high (3), medium (2), and low (1). The open, wetland areas are considered to have low screening ability. Areas with medium screening ability include the 'shrub steppe' areas that include plants communities such as Big Sagebrush/Bunchgrass, Low Sagebrush/Bluegrass, and Juniper/Low Sagebrush/Fescue. All

Karen O'Conner
County Clerk
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Howard Ottman
Superintendent
Lakeview School District #7
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Sharon Piercy
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Crisis Intervention Center
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Maureen Plato
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Verna Price
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Iris Robinson
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Lake County Road Department
Lakeview, OR

Tom Shuft
Oregon Department of Transportation
Highway Division
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Gary Simmons
Assistant Superintendent Of Finance
Klamath County School District
Klamath Falls, OR

Linden Stuart
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Lake District Hospital
Lakeview, OR

Dennis Terzich
Postmaster
Bly, OR

Vic Todd
Manager Research and Statistics
Adult and Family Services Division
Department of Human Resources
Salem, OR

Don West
Manager
Lakeview Lumber Company
Lakeview, OR

A local resident, Beverly Stone, reported that elk did occur regularly in the study area before the exploratory drilling activity began (Stone pers. comm. 21 October 1987, 3 December 1987, and 10 February 1988). Ms. Stone also reported that small bands of elk range widely throughout the vicinity, but appear to prefer areas where roads are closed by snow conditions in winter. This is in general agreement with the published literature, particularly regarding elk use of areas in relation to distance from, and type of road, such as that reported in Perry and Overly (1977) and adapted by Thomas (1979).

The study area has not been identified by the USFS or ODFW as an important elk calving area. A single cow elk and calf were seen in the vicinity of Angel Peak by drilling crews in the summer of 1987.

Forage for elk in the study area is most abundant in the wet meadows along Quartz Creek, Angel Creek, and Drews Creek. Elk are grazers and thus compete more directly with cattle for food. As described in the previous section on mule deer, the quality and quantity of herbaceous vegetation preferred by elk is best along Drews Creek, where the grazing pressure by cattle is lowest.

Hiding cover and thermal cover are most frequently found at higher elevations in the study area, such as on Quartz Mountain, Quartz Butte, and Angel Peak. In years with little snowfall, the south-facing slopes of these mountains could provide potential winter range for elk, although the best forage would be in the wet meadows at low elevations.

5.5.2.3 Pronghorn

Pronghorn are unlikely to be found in the study area. Little suitable habitat is present. Occasionally the herd that inhabits the vicinity of the Drews Creek Reservoir 12 mi to the east may range as far west as the study area, as was once observed by Larry Conn (pers. comm., 12 February 1988) approximately 20 years ago. This herd of pronghorn is rather unique in that it does regularly utilize forested habitats, which is unusual for the species.

5.5.2.4 Mountain Lion and Black Bear

These two species of large carnivore are included in the big game category because they are considered trophies by many hunters, and licenses are required to hunt them in Oregon. Both species have been observed in the study area. A spotted mountain lion kitten was observed by USFS personnel near Angel Peak in the summer of 1987, and mountain lion tracks were observed on four occasions in the study area during the

11.5 GLOSSARY

CONSTANT DOLLARS - Dollars that have been adjusted to account for the effects of inflation.

F I R E - U. S. Bureau of Economic Analysis abbreviation for the finance, insurance and real estate sector.

INMIGRANT - A person who moves into an area (in this case, the study area).

LAKEVIEW WORKING CIRCLE - A geographic area in Lake County, Oregon, in which only mills located in the towns of Lakeview and Paisley are allowed (by the USFS) to process timber.

NOMINAL DOLLARS - Actual "as spent" dollar amounts.

OUTMIGRATION - Persons moving out of a geographic area.

SOCIOECONOMIC IMPACT - An effect of an action (in this case the proposed Quartz Mountain Gold Project) on the social structure and/or economy of a geographic area.

STUDY AREA - The geographic area that is likely to receive measurable socioeconomic impacts from the proposed action or alternatives.

TAX BASE - In Oregon, a constitutionally guaranteed dollar amount of property taxes that a school district may collect without further voter approval.

T C P U - U. S. Bureau of Economic Analysis abbreviation for the transportation communication and public utilities sector.

5.6 THREATENED, ENDANGERED, RARE OR SENSITIVE SPECIES

This section of the report deals with Federally Threatened or Endangered; State Threatened, Endangered or Sensitive; or USFS Region 6 Sensitive Species. Fremont Forest Management Indicator Species were discussed in the previous section.

5.6.1 Methods

5.6.1.1 Information Review

A letter was sent to the USFWS-Oregon Endangered Species Coordinator soliciting information on whether any threatened or endangered species were known to occur in the study area. USFS-Bly Ranger District and Fremont National Forest Supervisor's Office personnel, and the District ODFW biologist were contacted about whether threatened, endangered, rare or sensitive species were known to occur on the study area. Publications by and for the USFS were reviewed, including Isaacs and Silovsky (1981), Silovsky (1982), Bryan and Forsman (1987), Oregon Natural Heritage Data Base (1987) and USFS (1987a,b,c,d).

5.6.1.2 Field Studies

Field studies were designed to provide thorough seasonal and spatial coverage to maximize the opportunity of detecting any rare, sensitive, threatened, or endangered species that could occur on the study area. Field methods have already been described in detail in previous sections.

5.6.2 Reptiles and Amphibians

One reptile, the western pond turtle (Clemmys marmorata), is classified as a USFS Region 6 Sensitive Species. This turtle has not been observed on the study area. Spring surveys, which are the optimal time to detect this turtle, have not been conducted. The western pond turtle inhabits marshes, sloughs, moderately deep ponds, and slow-moving sections of streams and rivers with basking sites, such as logs, mats of vegetation, rocks, or accessible banks (Nussbaum et al. 1983). Suitable habitat is therefore very limited and it is unlikely that this turtle occurs on the study area. Nussbaum et al. (1983) show no records of this species in either Lake or Klamath County.

TABLE 11.4-48

LAKE COUNTY, OREGON ROAD CLASSIFICATION

Major Collector Roads

Type	Miles
Paved	127.4
Graveled	125.3
Unimproved	2.0
TOTAL	254.7

Minor Collector Roads

Type	Miles
Paved	8.1
Graveled	44.1
Unimproved	19.0
TOTAL	71.2

Local Roads

Type	Miles
Paved	16.1
Graveled	169.5
Unimproved	91.6
TOTAL	277.2

SOURCE: Steiger 1979a.

Field activities scheduled for spring 1988 will include surveys for greater sandhill crane nesting activity.

The purple martin (Progne subis) is also classified as a Unique Species in the Fremont National Forest (USFS 1987a) and a sensitive species by the USFWS (Oregon Natural Heritage Data Base 1987). The purple martin has not been observed in the study area, probably owing to a lack of suitable nesting (tree cavities or nest houses) and feeding habitat (usually lakes, marshes or ponds with abundant insect populations).

5.6.4 Mammals

One bat species, the Townsend's big-eared bat (Plecotus townsendii), is classed as a USFS Region 6 Sensitive Species, and may occur on the study area. The Townsend's big-eared bat utilizes dry meadow, moist meadow, other grassland, sagebrush-bitterbrush, western juniper, and ponderosa pine communities for feeding and breeding. This bat also feeds near cliffs, rimrocks, and talus, and breeds in caves (Thomas 1979). Some of these habitat elements are present in the study area and this species could theoretically occur although it has not been recorded to date.

2) Highway 140 connects U.S. Interstate 80 at Winnemucca, Nevada, with Crescent City, California, and is billed as the "Winnemucca to the Sea Highway." It enters Lake County in the southwest corner and proceeds westerly through Lakeview and exits the county into Klamath County at Quartz Mountain Pass. In all, 92 miles of Highway 140 lies within Lake County.

Table 11.4-47 presents 1986 Average Daily Traffic counts at selected mile posts on Highway 140.

During 1988, 7.9 miles of Highway 140, from the Klamath County line to Drews Creek is scheduled for reconstruction. The highway will be widened and repaved, and four miles of passing lanes (climbing lanes) will be added for uphill traffic near the summit of Quartz Mountain Pass. Portions of the highway will be realigned to lessen steep grades and straighten sharp curves.

Although the accident rate for this section of highway has not been particularly high, the accidents reported in the last four years have occurred in the steep grade areas.

In the year 2005 ADT's for this section of Highway 140 are projected to be 800. The 1988 ADT for this segment is projected at 620 (Oregon Department of Transportation May 1987). The design standard for two lane mountain highways is 800 to 1,000 vehicles per hour or ADT's of 3,000 to 4,000. Development that requires left turn lanes and acceleration and deceleration lanes on Oregon state highways are required to fund the construction of such lanes (Shuft, pers. comm., 9 February 1988).

11.4.6.1.3 Major Collectors

In 1979, the Lake County Transportation Plan listed 603 miles of county roads on the following types, listed in Table 11.4-48.

The Quartz Mountain Gold Project Site is not accessed by county roads, nor do county roads connect the site and any major population center.

See section 11.4.4.1.3 for a discussion of the operations of the Lake County Road Department.

Lakeview Town Streets

The town of Lakeview has approximately 14 miles of streets. All streets within the town limits (and some alleys) are paved. Almost all of the streets have curbs. About 28

TABLE 5.7-1

SUMMARY OF INFORMATION ON FREMONT NATIONAL FOREST MANAGEMENT INDICATOR SPECIES OF THE QUARTZ MOUNTAIN STUDY AREA

Common Name	Relative Abundance	Comments on Breeding Status, Distribution and Habitat Preference
Mule Deer	Common resident	Doe and fawn observed. Distributed throughout study area, appears more common at higher elevations with shrubs and wet meadows along Drews Creek where disturbance by cattle is low. Major migration routes are east and west of study area, minor migration route is along Drews Creek at east border of study area.
Bald Eagle	Not identified	Could rarely occur. One unidentified eagle observed high overhead. Wintering and breeding birds could occasionally visit study area. Good quality nesting and foraging habitat lacking in study area.
Northern three-toed woodpecker	Not observed	Could rarely occur. Mature forests at higher elevations could provide habitat.
Yellow-bellied sapsucker	Uncommon summer resident	Suspected to breed on or near study area. Observed once in a patch of large curlleaf mountain mahogany in shrub-scrub. Prefers aspens and other deciduous trees.
Williamson's sapsucker	Uncommon summer resident	Suspected to breed on or near study area. Observed once each in aspens and coniferous forest.
Downy woodpecker	Uncommon resident	Suspected to breed. Observed in ponderosa pine and mixed conifer stands. More common in more mature, higher elevation areas.

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Yellow-bellied sapsucker	Uncommon summer resident	Suspected to breed on or near study area. Observed once in a patch of large curlleaf mountain mahogany in shrub-scrub. Prefers aspens and other deciduous trees.
Williamson's sapsucker	Uncommon summer resident	Suspected to breed on or near study area. Observed once each in aspens and coniferous forest.
Downy woodpecker	Uncommon resident	Suspected to breed. Observed in ponderosa pine and mixed conifer stands. More common in more mature, higher elevation areas.

3) Rail

4) Private Bus

11.4.6.1 Highways, Roads, and Streets

In general, roadways are classified in five major types. These are:

Principal Arterial: roadways of national, interstate or state wide significance.

Minor Arterial: roadways of statewide and interregional significance.

Major Collector: roadways of intercounty and countywide significance.

Minor Collector: roadways of local and intercounty significance serving areas not already served by a higher order roadway.

Local Roads: roadways of local significance that provide access to adjacent properties.

11.4.6.1.1 Principal Arterials

There are no principal arterials within the study area. The only principal arterial in Lake County is U.S. Highway 20 which crosses the northeast corner of the county.

11.4.6.1.2 Minor Arterial

There are two minor arterials within the study area:

1) U.S. 395 which enters Lake County south of Lakeview at New Pine Creek and travels north-northeast to Burns in Harney County. In all, 91 miles of U.S. 395 are in Lake County. U.S. 395 is essentially a paved, two lane, undivided highway in good condition.

Table 11.4-46 presents selected 1986 average daily traffic (ADT) counts on Highway 395.

5.8 GLOSSARY

HIDING COVER - Hiding cover is defined as vegetation capable of hiding 90 percent of a standing adult deer or elk from the view of a human at a distance equal to or less than 200 ft (Thomas 1979). The height and density of vegetation needed to cover deer may be less than that required for elk.

MANAGEMENT INDICATOR SPECIES - A species selected because its welfare is presumed to be an indicator of the welfare of other species in the habitat. A species whose condition can be used to assess the impacts of management actions on a particular area. Managing for these species usually requires significant allocations of land or resources (USFS 1987a).

RAPTOR - Predatory birds such as hawks, eagles, falcons, vultures, and owls.

SENSITIVE SPECIES - Plant or animal species which are susceptible or vulnerable to activity impacts or habitat alterations. Those species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species, that are on an official State list, or that are recognized by the Regional Forester as needing special management to prevent placement on Federal or State lists (USFS 1987a).

SHOREBIRD - Wading or swimming birds such as gulls, terns, sandpipers, plovers, avocets, killdeer, and stilts.

THERMAL COVER - Generally, forest cover that provides a cooler microclimate in summer, a warmer microclimate or shelter from wind and exposure to cold night skies (reducing heat loss to the sky) in winter. Summer thermal cover can be coniferous or deciduous, and winter thermal cover is coniferous.

UNIQUE SPECIES - This category includes species which are rare in nature or in the Forest, scientifically unique, on special lists such as the U.S. Fish and Wildlife Service sensitive species list, protected by law or regulation, aesthetically important, and/or are particularly vulnerable to reductions in habitat quality and/or quantity. A species is selected because its welfare is presumed to be an indicator of the welfare of other species in the habitat, and/or its condition can be used to assess the impacts of management actions on a particular area. Managing for these species most often entails applying mitigating and coordinating measures or minor allocations of land (USFS 1987a).

Table 11.4-42

Lake County, Oregon Existing Land Use

Classification	Acres	Percent
Grazing	3,658,442	69.0
Timber	1,235,768	23.3
Irrigated Crops	277,269	4.3
Lakes and Reservoirs	128,084	2.42
Dry Crops	39,469	0.74
Rural Communities	2,210	0.4
Urban	1,703	
Public	506	0.01
Rural Residential	406	0.01
Individual Houses	206	0.01
Aggregate Sites	135	0.01
Marsh	5,591	0.1

SOURCE: Steiger 1979b.

Table 11.4-43

Lake County, Oregon Zoning

Classification	Acres	Square Miles	Percent
A-1, Exclusive Farm Use	191,360.0	299.0	3.59
A-2, General Rural	3,744,455.0	5,850.7	70.86
A-3, Rural Center	7,040.0	11.0	0.13
F-R, Forest Recreation	1,355,200.0	2,117.5	25.39
R-1, Rural Residential	53.3	0.1	...
C-1, Commercial Light Industrial	1,361.1	2.1	0.03
M-1, Light Industrial	54.0	0.1	...
M-2, Heavy Industrial	265.6	0.4	...

SOURCE: Steiger 1979b.

5.9 PUBLIC AND AGENCY CONTACTS

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Beverly Stone
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TABLE 11.4-41

LAKE COUNTY, OREGON LAND OWNERSHIP

Land Status	Acres	Percents
Public Ownership	4,075,538	77.0
Federal	3,696,604	69.8
State	231,540	4.4
Local	148,394	2.8
Private Ownership	1,224,251	23.1
Less than 40 Acres	100,695	1.9
40+ Acres	863,866	16.3
Timber Industry	259,690	4.9
TOTAL County	5,299,789	

SOURCE: Steiger 1979b.

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Stone, Beverly. 1988. Local resident, Quartz Mountain, Oregon. personal communications. Conversations with Lynn Sharp on 21 October 1987 and 10 February 1988; letter to Lynn Sharp dated 3 December 1987.

Thomas, J.W., tech. ed. 1979. Wildlife Habitats in Managed Forests - the Blue Mountains of Oregon and Washington. US Department of Agriculture Forest Service Agricultural Handbook No. 553. 512 pp.

U.S. Department of Agriculture Forest Service. 1982. Fremont National Forest, Mule Deer Heard Range Map.

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U.S. Department of Agriculture Forest Service. 1987b. Proposed Land and Resource Management Plan, Fremont National Forest. U.S. Department of Agriculture Forest Service, Pacific Northwest Region, Portland, OR. 212 pp.

U.S. Department of Agriculture Forest Service. 1987c. Appendices - Draft Environmental Impact Statement, Proposed Land and Resource Management Plan, Fremont National Forest. U.S. Department of Agriculture Forest Service, Pacific Northwest Region, Portland, OR.

U.S. Department of Agriculture Forest Service. 1987d. Alternative Maps, Draft Environmental Impact Statement, Proposed Land and Resource Management Plan, Fremont National Forest. U.S. Department of Agriculture Forest Service, Pacific Northwest Region. 9 maps.

The clinic is currently staffed by a part time nurse practitioner and one full time and one part time administrative staff. The clinic is funded by patient fees, insurance and federal funds (Ellen, pers. comm., 2 February 1987).

11.4.4.7.4 Bly Ambulance Service

The Bly Ambulance Service provides emergency transportation for the Bly area. The service has one ambulance that is housed at the water and sewer district garages. The service currently has seven volunteer emergency medical technicians and four drivers (Ellen, pers. comm., February 1987.)

11.4.4.7.5 Bly Area Schools

Bly is served by two schools, Gearhart Elementary School in Bly, serving grades K-8 and Bonanza School in Bonanza for Grades 9-12.

Gearhart School has a current enrollment of 110, with an optimum capacity of 140. Staffing consists of:

1	Half-time principal
1	Secretary
9	Teachers
3	Part-time Special Education teachers
1	Part-time Library Aide
1	Part-time Cook
1	Head Custodian
1	Part-time Sweeper
2	Part-time Bus Drivers

Bonanza School has a current enrollment of 196, with an optimum capacity of 210. The Bonanza School serves grades K-12; teachers in upper level courses teach grades 7-12, therefore, the staffing levels do not reflect strictly high

5.11 LIST OF PRINCIPAL PREPARERS

5.11.1 Peggy Lynn Sharp

Ms. Sharp is a wildlife ecologist and environmental planner. Her particular areas of interest include wildlife habitat classification, wildlife survey techniques, waterfowl ecology, wildlife impact assessment, and mitigation planning.

In 1968, Ms. Sharp received a B.A. in Biology from Knox College in Galesburg, Illinois. She conducted independent research on red-winged blackbird nesting habitat and cowbird parasitism, and choline metabolism in Drosophila melanogaster.

Ms. Sharp received a M.S. in Zoology from the University of Alberta, Edmonton, Alberta, Canada in 1973. She studied the social and reproductive behavior, territoriality and home range of a marked population of free-living pikas (Ochotona princeps) in the Kananaskis Valley in the Canadian Rocky Mountains.

Ms. Sharp has designed, managed, and conducted a variety of wildlife studies in northwestern Canada, and the midwest and northwest in the U.S. These include a comprehensive study of the birds of Waterton Lakes National Park in Alberta, Canada, culminating in management recommendations to enhance rare, threatened, and endangered species habitat; surveys of breeding, moulting, and migrating waterfowl in the Yukon, Northwest Territories, and Alberta; and plot census studies of breeding birds in the Northwest Territories. Ms. Sharp redesigned wildlife monitoring programs for two surface coal mines in Wyoming, trained mine personnel in their implementation, and prepared wildlife monitoring manuals. In Washington and Oregon, Ms. Sharp has designed and conducted studies of the effects of controlled underburning on nongame wildlife in Mt. Hood National Forest, small mammal populations on rangeland near Burns, Oregon; and conducted a baseline wildlife inventory, impact assessment, and wildlife and wetland mitigation plans for a proposed major destination resort on the Oregon coast. This mitigation program is the subject of a signed agreement between the Oregon Department of Fish and Wildlife and the developer.

Community Facilities and Services

The following services are available in the unincorporated community of Bly.

Service	Provider
Water	Bly Water and Sanitary District
Sewer	Bly Water and Sanitary District
Fire Department	Bly Fire Protection District
Health Clinic	Southern Oregon Rural Health Network
School (K-8)	Klamath County School District

Law enforcement services in Bly are provided by the Klamath County Sheriffs Department. The nearest deputy is located in Bly Mountain.

11.4.4.7.1 Bly Water and Sanitary District

Water System

Bly's water system was constructed in 1976, financed by an FHA bond issue. Water is obtained from a well and is stored in a 400,000 gallon reservoir, where it is chlorinated before use. No other treatment of the water is required to meet water quality standards. The well could produce between 375 and 425 gallons per minute, or between 540,000 and 612,000 gallons per day (gpd) if it were in operation 24 hours per day. On an average day it currently produces 45,000 gpd.

The system was designed to serve a maximum population of 1,400 based on an average usage of 437 gallons per person per day. Current per capita usage averages 75 to 100 gpd in winter and 225 to 300 gpd in summer. Currently the system is operating at 43 percent of capacity. No improvements or additions to the water system would be required to serve the maximum design population.

Sewer System

The district's sewer system is a three-cell lagoon located approximately one mile from the center of town. The lagoon system consists of two influent and one clarifying cell. Contents of the clarifying cell are chlorinated and used for agricultural irrigation. Outflow from the system meets all state and federal water quality standards.

APPENDIX 5.A

CHECKLIST OF WILDLIFE SPECIES OBSERVED WITHIN THE QUARTZ MOUNTAIN STUDY AREA DURING 1986-1988

11.4.4.6.7 Employment Training

Klamath-Lake Employment Training Council provides the following services:

Employee Recruiting

Employee Training

Subsidized Training

Personnel Management

Regulatory Compliance

The council has an office in Lakeview with one part time (shared) employment counselor (Plato, pers. comm., 2 February 1988).

11.4.4.6.8 Day Care

Day Care services in Lakeview are provided by the Sunshine Children's Center. The center is licensed by the state of Oregon. It is located in MacDonald Park in Lakeview, in a two story building owned by the Town of Lakeview. The town furnishes and building maintenance and repair.

The center serves approximately 30 children per day. Parents are charged an hourly rate for day care services.

11.4.4.7 Bly

Bly is classified as a rural center by the Klamath County Comprehensive Plan.

Economy

Bly has been historically dependent on the timber industry. During the 1970's Weyerhauser operated two mills in Bly. One mill was closed in 1980 and the other ran sporadically until it was shut down in 1986. Some Bly residents continue to cut Weyerhauser timber, which is shipped out of the area for milling (Himes, pers. comm., 12 January 1988).

Some Bly residents work for the USFS office in Bly. Currently there are two coffee shops, two stores, a gas station, a tavern, and a restaurant in Bly.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE	SEASONAL OCCURRENCE	STATUS
BIRDS, CONTINUED				
Clark's nutcracker	Nucifraga columbiana	rare	resident	
Common raven	Corvus corax	uncommon	resident*	
Mountain chickadee	Parus gambeli	common	resident*	
Red-breasted nuthatch	Sitta canadensis	common	resident*	
White-breasted nuthatch	Sitta carolinensis	uncommon	resident*	
Pygmy nuthatch	Sitta pygmaea	uncommon	resident	
Brown creeper	Certhia americana	rare	resident	
House wren	Troglodytes aedon	uncommon	summer**	
Winter wren	Troglodytes troglodytes	uncommon	summer	
American dipper	Cinclus mexicanus	common	resident	
Golden-crowned kinglet	Regulus satrapa	common	resident*	
Western bluebird	Sialia mexicana	rare	migrant	
Mountain bluebird	Sialia currucoides	common	summer**	
Townsend's solitaire	Myadestes townsendi	common	summer**	
Hermit thrush	Catharus guttatus	common	summer*	
American robin	Turdus migratorius	common	summer**	
Varied thrush	Ixoreus naevius	common	summer*	
Solitary vireo	Vireo solitarius	uncommon	summer*	
Warbling vireo	Vireo gilvus	uncommon	summer*	
Orange-crowned warbler	Vermivora celata	rare	summer*	
Nashville warbler	Vermivora ruficapilla	uncommon	summer*	
Yellow-rumped warbler	Dendroica coronata	common	summer*	
Western tanager	Piranga ludoviciana	common	summer*	
Lazuli bunting	Passerina amoena	uncommon	summer*	
Chipping sparrow	Spizella passerina	common	summer**	
Dark-eyed junco	Junco hyemalis	common	summer*	
Western meadowlark	Sturnella neglecta	common	summer**	
Brown-headed cowbird	Molothrus ater	common	summer*	
Cassin's finch	Carpodacus cassinii	common	summer*	
Red crossbill	Loxia curvirostra	uncommon	resident	
Pine siskin	Carduelis pinus	uncommon	summer*	
Evening grosbeak	Coccothraustes vespertinus	common	summer*	

Counseling

Health

Home Delivered Meals

Home Care

Personal Care

Chore

Case Management

Senior Service's offices are located in the Post Office in Lakeview. Meals and activities are provided at the Lakeview Community Center. The Association has a staff of 12 people.

The following Table 11.4-40 is a list of the agency's fiscal year 1988 and 1989 service objectives.

The agency's fiscal year 1988 and 1989 budget is $113,361.

11.4.4.6.6 Crises Intervention Center

The Crises Intervention Center provides the following services:

Battered Women Counseling

Child Abuse Counseling

Rape Counseling

Shelter Services

The center has offices in the basement of the Lakeview Community Center. The center provides shelter locally for victims of family violence and provides for long term shelter elsewhere.

The center has one paid director and eight volunteers. Over the last six months 77 clients used the center's various services. Funding for center activities is obtained from a combination of federal and state sources and private donations (Piercy, pers. comm., 2 February 1988).

Relative abundance

Common - Always detected during surveys (in appropriate season), can be seen on nearly all visits to preferred habitat, numbers vary.

Uncommon - Usually detected during surveys but not likely to be seen during a single visit to preferred habitat.

Rare - Not always detected during surveys and unlikely to be seen during a single visit to preferred habitat.

Seasonal occurrence

Resident - Permanent, year-round resident.

Summer - Spring-summer-fall resident, migrates south in winter.

Winter - Winter visitor

Migrant - Migrates through the area, not seen during the breeding season.

** - Breeds in the area based on observations of young and/or nests.
* - Suspected to breed in the area based on observations of agitated adults.

Status

MIS - Fremont National Forest Management Indicator Species
FS - U.S. Fish and Wildlife Service sensitive bird species

mental health programs in cooperation with local governments (Roberts 1987).

Community Health programs include the following:

Out patient Mental Health Care for Children

Community Support Service

Community Hospital Service

Non-Hospital Crisis Service

Outpatient Mental Health Care for Adults

Residential Care Facility

Pre-Commitment Service

Psychiatric Review Board

Semi-Independent Living Care

Adult Foster Care

State Hospital Service

Alcohol and Drug Counseling

The Lake County Community Mental Health Center is located in the basement of the Lake County Courthouse in Lakeview. The center has a total of three offices and five full time and two part time staff (5 1/2 FTE). There are no psychiatrists in southern Lake County. There is one hospital bed at Lake District Hospital dedicated for Lake County mentally ill patients.

The Lake County Community Mental Health Center served 135 clients from July 1986 through June of 1987. There was an average of 25 to 30 alcohol counseling patients during this period. Mental Health Care funding is derived from Federal (Title XIX), state, and county funds. The county's budget was $120,434 for that year.

The Mental Health Center also provides supported work programs at the Lakeview Activity Center. The activity Center is located in a separate building in Lakeview that contains a 600 square foot main room, a store room and an office. Center staff includes director and two part time staff. Currently the Center had nine active clients (Whitehouse, pers. comm., 2 February 1988.)

APPENDIX 5.B

WATERFOWL SURVEY DATA GATHERED BY THE U.S. FISH AND WILDLIFE SERVICE IN THE KLAMATH FALLS-TULE LAKE VICINITY

plans currently for improvements or additions to the existing hospital and nursing home.

11.4.4.6 Human Services

The following Human Services are available in Lakeview and southern Lake County:

Adult and Family Services

Children Services

Mental Health Center
including Alcohol Counseling

Public Health Department

Senior Services

Crises Intervention Center

Employment Training

Day Care

11.4.4.6.1 Adult and Family Services

Adult and Family Services in Lake County are provided by the Adult and Family Services Division (AFS) of the Oregon Department of Human Resources.

The mission of the division is to provide, develop and coordinate resources and services to meet basic needs and promote the independence and self-sufficiency of families and individuals (Webb-Petett 1987). Programs to accomplish the mission include:

Cash Payments (such as aid to families with dependent children and general assistance)

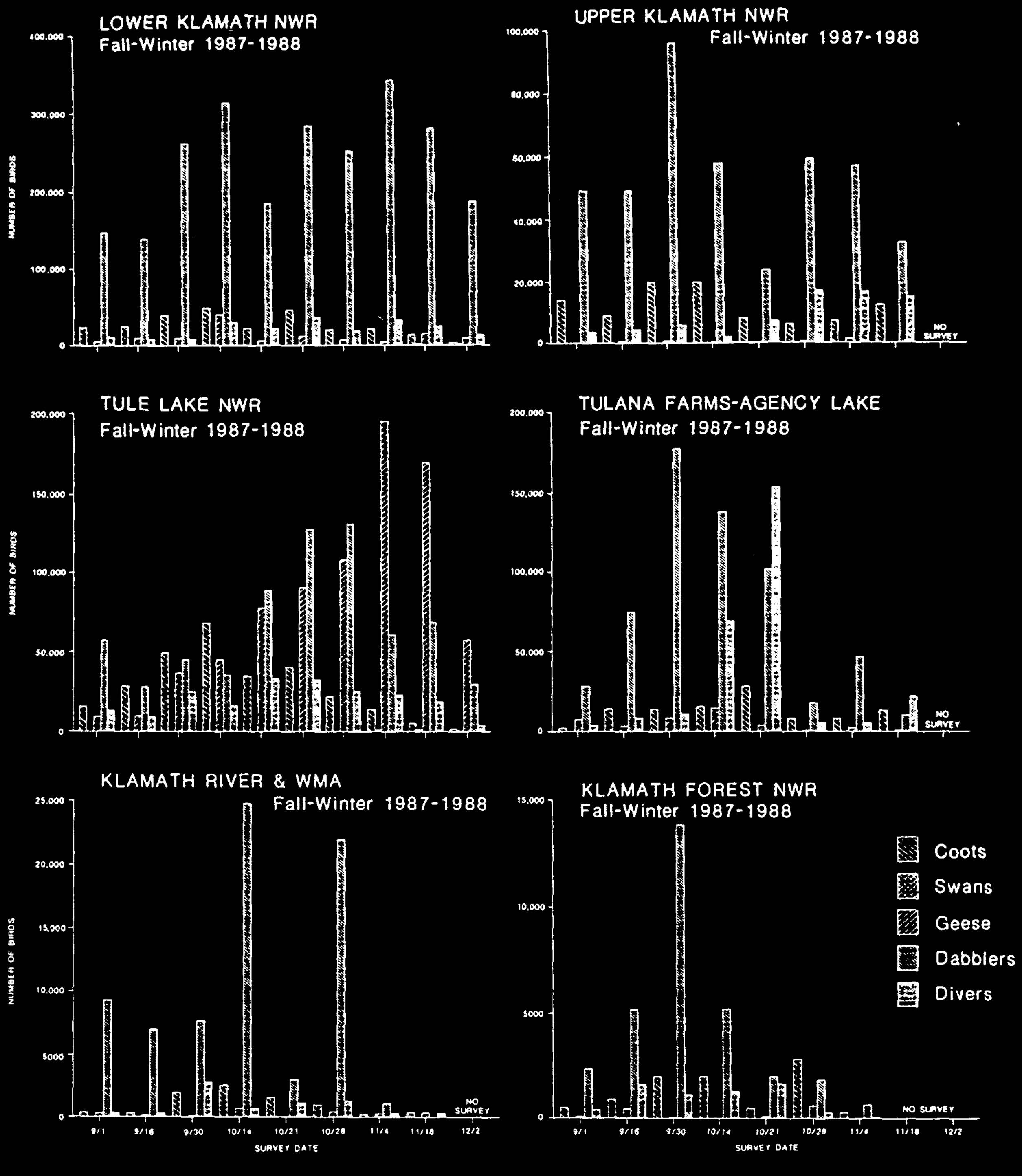
Food Stamps

Medical Coverage

Day Care

Job Finding Assistance

In Lakeview, the division is located in a building shared with the Children Services Division. AFS office space totals 862 square feet. The division has three staff members in Lakeview.



PROJECT No.
DATE
REVISION

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

FIGURE 5.B-1

KLAMATH FALLS REGION FALL AND WINTER WATER FOWL COUNT DATA FROM THE U.S. FISH AND WILD-LIFE SERVICE ward is not fixed and can be increased or decreased to meet demands for service:

3	Obstetrics/Maternity
4	Intensive Care/Cardiac Care
1	Psychiatric
1	Pediatric
1	Recovery
14	General

The following summarizes hospital occupancy rates during 1987 and early 1988:

Period	Patient Days	Occupancy/Day	% Occupancy
1/1 - 6/30/87	646	3.6	15.0
7/1 - 12/31/87	669	3.7	15.2
1/1 - 1/31/88	121	3.9	16.3

If current population/hospital usage rates were maintained, the district could accommodate a 6-fold increase in population before additional beds or facilities would be needed. The nursing home facility has maintained a fairly steady 70 percent occupancy rate during the past several years.

Services offered at the hospital include emergency room, intensive care, cardiac care, X-ray, operating room, outpatient surgery, laboratory, radiology, respiration and physical therapy. Patients requiring care not available at Lake District Hospital are stabilized and transferred by aircraft to Merle West Hospital in Klamath Falls or Rogue Valley Medical Center in Bend.

Staffing

Hospital privileges are extended to four physicians who maintain private family practices in the Lakeview area. Additionally, a radiologist, pathologist and ophthalmologist are on contract with the hospital to provide services as needed.

Hospital-employed staff consists of 93 positions which equate to 78 full time equivalent (FTE) employees in the following categories. Unless noted, numbers represent FTE employees.

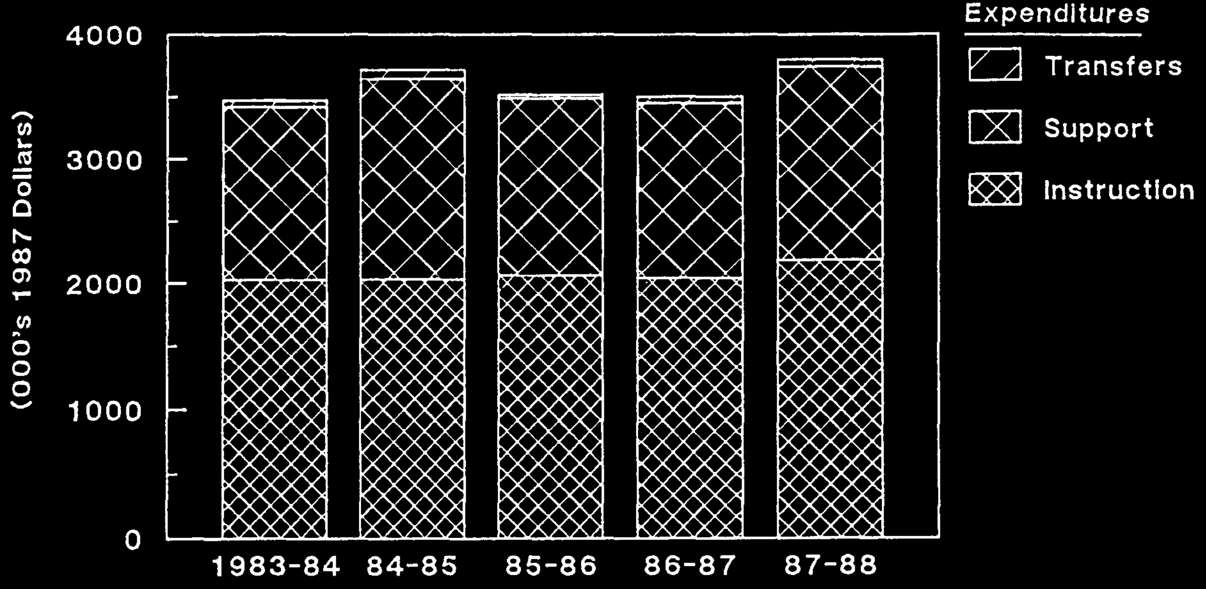
APPENDIX 5.C

SUMMARY OF 1986-1988 BIRD OBSERVATIONS
IN THE QUARTZ MOUNTAIN STUDY AREA

Figure 11.4-8

Lakeview School District #7, Oregon

General Fund Expenditures



Source: Lakeview School District #7;
Planning Information Corporation, January 1988.

Table 5C-1. Continued.

Species	10-19 NE prt stdy ar & Euwan Camp	10-20 NE Qtr Sec 25 spring leachpd	10-20 Ang Ck meadow tribut ary E	10-20 Crone H S to Qtz Ck flat	10-20 Qtz Ck at Hiwy 20	10-21 Stand ard Sur vey	10-21 Drews Crk	Total obser vati ons	Per cent of total
	Number Observed								
Snow goose						70		70	10.62
Duck sp.								2	.30
Turkey vulture								2	.30
Red-tailed hawk	1		1	1	1	3		17	2.58
Ruffed grouse								1	.15
Gull sp.								2	.30
Common nighthawk								1	.15
Vaux's swift								8	1.21
Belted kingfisher		1						1	.15
Yellow-bellied sapsucker								2	.30
Williamson's sapsucker						1		2	.30
Sapsucker sp.								2	.30
Downy woodpecker								2	.30
Hairy woodpecker						1		5	.76
White-headed woodpecker			1					2	.30
Black-backed woodpecker								1	.15
Northern flicker			2					26	3.95
Pileated woodpecker			1					2	.30
Woodpecker sp.						1		11	1.67
Dusky flycatcher								17	2.58
Willow flycatcher								1	.15
Empidonax flycatcher								2	.30
Violet-green swallow								3	.46
Gray jay	1					1		4	.61
Steller's jay	3					2		11	1.67
Clark's nutcracker								2	.30
Common raven		2				2		10	1.52
Mountain chickadee	4	1	2			11	1	79	11.99
Red-breasted nuthatch								14	2.12
White-breasted nuthatch								3	.46
Pygmy nuthatch								7	1.06
Brown creeper							1	1	.15
House wren								2	.30
Winter wren			1				1	2	.30
American dipper							1	4	.61
Golden-crowned kinglet	6		6		1	11	2	58	8.80
Western bluebird						13		13	1.97
Mountain bluebird								3	.46
Townsend's solitaire								4	.61
Hermit thrush								21	3.19
American robin	7		2	1		2		48	7.28
Varied thrush	1					1		2	.30
Solitary vireo								3	.46
Warbling vireo								2	.30
Orange-crowned warbler								1	.15
Nashville warbler								1	.15
Yellow-rumped warbler	1							49	7.44
Western tanager								20	3.03
Lazuli bunting								1	.15
Chipping sparrow								17	2.58
Dark-eyed junco	2	3	5	3				53	8.04
Western meadowlark								1	.15
Brown-headed cowbird								4	.61
Cassin's finch			17					18	2.73
Red crossbill						2		2	.30
Pine siskin						2		4	.61
Evening grosbeak			2					13	1.97
Total birds observed	26	7	40	5	2	123	6	659	100.00

Table 11.4-38
Lakeview School District #7
Revenue and Expenditure Analysis

General Fund Expenditures (1987 $000's)

	Actual 1983-84	% Tot Exp	Actual 84-85	% Tot Exp	Actual 85-86	% Tot Exp	Actual 86-87	% Tot Exp	Budget 87-88	% Tot Exp	Average 83/84-87/88	% Tot Exp
Instruction	2,025.7	58.4%	2,032.0	54.7%	2,062.6	58.6%	2,042.6	58.4%	2,188.6	57.6%	2,070.3	61.1%
Supporting Svcs	1,391.2	45.7%	1,610.4	47.4%	1,421.8	42.6%	1,408.4	41.8%	1,549.1	40.8%	1,476.2	43.6%
Interagency	52.3	1.7%	70.8	2.1%	30.9	0.9%	49.2	1.5%	59.0	1.6%	52.4	1.5%
Debt Service	0.0	0.0%	0.0	0.0%	4.2	0.1%	0.0	0.0%	2.0	0.1%	1.2	0.0%
Total Expenditures	3,469.2	113.9%	3,713.2	109.3%	3,519.5	105.6%	3,500.1	103.9%	3,798.7	100.0%	3,600.1	106.2%

Source: Lakeview School District #7 Budget;
Planning Information Corporation, January 1987

APPENDIX 5.D

SUMMARY OF 1986-1988 MAMMAL OBSERVATIONS IN THE QUARTZ MOUNTAIN STUDY AREA

When revenue figures are adjusted to constant 1987 dollars to account for inflation, a steady decrease in total revenues is seen. Revenues totalled $4.1 million in both 1983-84 and 1984-85, then decreased to $3.8 million in 1985-86 and $3.6 million in 1986-87. The trend is reversed in the current school year, with estimated revenues of $4.0 million, which includes a $200,000 contribution from the county Road Fund (Lakeview School District #7 Budgets; 1983-84 through 1987-88).

Per student revenues for District #7 have averaged $4,222 over the five year period.

Expenditures

Tables 11.4-37, 11.4-38, and 11.4-39 present Lakeview school District #7 expenditures by source and expenditures by source as a percent of total revenues for school year 1983-84 through 1987-88 as well as averages for those periods, in nominal dollars, constant 1987 dollars, and general fund per student expenditures, respectively.

School district expenditures have remained relatively stable since the 1983-84 school year. In nominal dollars (not adjusted for inflation), expenditures increased from $3.0 million in 1983-84 to a maximum of $3.4 million in the following year, then decreased to $3.3 million and $3.4 million in 1985-86 and 1986-87. The current budget estimates operating expenditures of $3.8 million, not including operating contingency or unappropriated balance funds.

Expenditures per student have shown similar trends increasing from $3,200 per student in 1983-84 to $3,700 per student beginning in 1985-85 and remaining constant through 1986-87. Based on fall enrollment figures, the 1987-88 budget represents spending of $3,900 per student.

In constant 1987 dollars, expenditures increased from about $3.5 million in 1983-84 to $3.7 million in 1984-85, then decreased to the $3.5 million level for both 1985-86 and 1986-87. Figure 11.4-8 graphs spending by operating category for the school years 1983-84 through 1987-88).

Per student expenditures increased from $3,600 in 1983-84 to $4,000 in 1984-85, then decreased to just under $4,000 in each school year through 1987-88. Per student expenditures have averaged $3,869 over the five year period, $353 less than per student revenues.

The district has the lowest per-student expenditures of any school district in Lake County. State Department of Education figures for the last completed school year, 1986-87,

Table 5D-1. Continued.

Species	10-19 NE prt stdy ar & Euwan Camp	10-20 NE Qtr Sec 25 spring leachpd	10-20 Ang Ck meadow tribut ary E	10-20 Crone H 5 to Qtz Ck flat	10-20 Qtz Ck at Hiwy 20	10-21 Stand ard Sur vey	10-21 Drews Crk	Obs's. by Others during Study	Total Obs.	% of Total Obs.
Coyote	2		1	1					11	4.56
Fox sp.	2								3	1.24
Black bear								1	1	.41
Raccoon									1	.41
Marten or Fisher									1	.41
Striped skunk			2						2	.83
Ermine									2	.83
Long-tailed weasel									3	1.24
Badger									2	.83
Mountain lion								1	1	.41
Elk								3	3	1.24
Mule deer	3	1	10			5	1	1	30	12.45
Yellow-bellied marmot									1	.41
Northern flying squirrel	1								1	.41
Golden-mantled grnd. sq.				1					13	5.39
Belding's ground squirrel			1						9	3.73
Yellow-pine chipmunk									1	.41
Least chipmunk				1					1	.41
Chipmunk sp.	6		10	3	1	4			42	17.43
Douglas' squirrel	2	1	2			12			40	16.60
Squirrel sp.	2		10						15	6.22
Pocket gopher	6	3	3	3					30	12.45
Beaver								1	1	.41
Bushy-tailed woodrat				1	1				4	1.66
Deer mouse			1						1	.41
Vole sp.	1								1	.41
Mouse sp.			10						13	5.39
Porcupine			1						2	.83
Snowshoe hare	1								6	2.49
Total mammals observed	26	5	51	10	2	21	1	7	241	100.00

APPENDIX 5.E

LETTER FROM THE U.S. FISH AND WILDLIFE SERVICE
REGARDING THREATENED AND ENDANGERED SPECIES
IN THE QUARTZ MOUNTAIN STUDY AREA

6.0 AQUATIC BIOLOGY

TECHNICAL REPORT NO. 6

AQUATIC BIOLOGY

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

FISHMAN ENVIRONMENTAL SERVICES
P.O. Box 19023
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and

STEFFEN ROBERTSON AND KIRSTEN (COLORADO) INC.
1755 East Plumb Lane Suite 230
Reno, Nevada 89502

Revised December 1988

FOREWORD

This report was prepared by Steffen Robertson and Kirsten (Colorado) Inc. for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
P. A. Fishman	Aquatic Biology Task Leader	SRK

TABLE OF CONTENTS Continued.

SUMMARY

The Quartz Mountain Gold Project Study area includes the upper portion of the Quartz Creek drainage, a portion of Drews Creek, and all of Angel Creek, a tributary to Quartz Creek. These streams are part of the Goose Lake and Summer Lake Drainage.

The upper Quartz Creek drainage occupies the western part of the study area. Flow is intermittent in the upper and middle sections, and in the lower section is regulated outflow from Butcher Flats reservoir. The upper section is wet meadow with occasional sections of stream channel, and the middle section is shallow and overgrown. Habitat for fish species is poor in these sections, but is present in the deeper, steeper lower section of the creek where pools are more common and vegetation canopy is present.

The upper section of Angel Creek, a tributary to Quartz Creek, has a severely eroded, shallow channel and is intermittent. The middle portion has a steeper gradient and is slightly deeper. The lower section flows through an open meadow and is severely eroded due to livestock activity.

Drews Creek, a spring-fed perennial stream, flows through the eastern portion of the study area and drains a large area east of the study area. The upper section, outside the study area, has a low to moderate gradient and is made up of riffles interspersed with runs and shallow pools. Downstream the creek flows through a wet meadow that extends into the study area, and is composed of multiple channels and pools formed by numerous beaver dams. Drews Creek then flows through a steep-walled canyon where it forms steep cascades, deep pools with large boulders, and an eight-foot high waterfall. Downstream from the canyon it is primarily moderately steep cascades and pools with good riparian cover. The creek along Highway 140 is a series of medium height cascades interspersed with pools and runs, with little stream cover.

Aquatic plants found in these streams, primarily in Drews Creek, are typical of Pacific Northwest streams. Sixty-one algal taxa were found, of which 46 were yellow-green algae. Blue-green algae is most common in Drews Creek, and green algae were not common.

Benthic invertebrates were confined to Drews Creek because of insufficient flow in the other streams. This community is, for the most part, typical of western mountain streams with a coniferous canopy, although several taxa are more indicative of extreme environmental conditions such as

6.0 AQUATIC BIOLOGY

6.1 INTRODUCTION

The aquatic biology section of the Quartz Mountain Gold Project baseline report describes studies of the existing aquatic conditions within the study area (Figure 1.1-1). Investigations of Drews Creek, the only permanent stream within the study area, were extended beyond the area perimeters to document conditions outside of potential project influence.

6.1.1 Objectives

The objectives of the aquatic biology studies were to gather data in sufficient detail to provide background information for assessment of environmental impacts resulting from proposed project alternatives. Three streams; Quartz, Angel, and Drews Creeks, comprise the drainage of the study area, and are described in this section. Studies were conducted to describe the physical and biological characteristics of each of those streams. Stream surveys, periphyton, benthic invertebrates, and fish were the main areas of study.

Objectives of the stream surveys were to: (1) describe the stream habitat types and determine riffle/run/pool ratios; (2) determine stream gradient; (3) determine substrate characteristics; (4) determine cover types and riparian vegetation; and (5) determine channel characteristics such as depth and width.

Objectives of periphyton studies were to provide a baseline description of the aquatic plant community and to determine the species diversity and species composition within each sub-drainage.

Objectives of the benthic invertebrate studies were to determine diversity and numerical abundance within each drainage and assess the trophic or feeding type diversity of benthic communities within each drainage.

Objectives of the fish studies were to characterize the fish fauna by species present, relative abundance, distribution within drainages, and recreational use of study area fishery resources.

6.2 LITERATURE REVIEW

No existing data were found for the aquatic biology of the study area. One stream survey data form was found in U.S. Forest Service (USFS) files (USFS 1979) for a section of Quartz Creek downstream from the study area. Some data are in the Oregon Department of Fish and Wildlife (ODFW) files for fish populations in Drews Reservoir (Anderson, pers. comm., 1987). Some information on aquatic habitats and species is available in the Fremont National Forest Proposed Land and Resource Management Plan (USFS 1987).

6.3.2 Aquatic Plants

Periphyton (attached algae) sampling during 1987 was limited to the Drews Creek drainage due to extreme low water levels in Quartz and Angel Creeks. One station in Quartz Creek (QC-4) was added during spring 1988. Three locations in Drews Creek were sampled on 26 August 1987 near station DR-2.4. In addition, three replicate samples were collected from stations DR-1 and DR-3 in October 1987. Two replicate samples were collected from QC-4 during April 1988.

Periphyton samples were obtained by scraping a measured surface area (1.17 square inches) from a smooth rock using a knife and brush, and preserving the removed material in a 10% formalin solution.

Algal units were identified and counted under magnification from randomly selected transects in a measured chamber.

6.3.3 Benthic Invertebrates

Insufficient stream depth and lack of flow prevented quantitative invertebrate sampling in Angel Creek, therefore a reference collection of representative taxa was compiled by removing organisms from streambed substrates using forceps. Quantitative samples were collected from Quartz Creek (QC-4) during April 1988 due to extreme low water in 1987.

Invertebrate sampling was conducted at three stations in Drews Creek during August and October 1987. Three separate sites in the vicinity of station DR-2.4 were sampled during the August field visit while two replicate samples were collected at stations DR-1 and DR-3 in October. Two replicate samples were also taken at stations DR-2.4 and DR-3 in April 1988. Samples were collected from riffle areas using a Surber sampler with a sampling area of one square foot. Collection procedure consisted of placing the sampler over the stream substrate and removing all attached organisms from the enclosed rocks to a depth of approximately six inches. Organisms were washed by stream flow from the rocks into the collection net. Contents of the net were then transferred to labeled plastic bags and preserved with 10 percent formalin solution.

Benthic samples from each stream were sorted, identified, and enumerated where applicable. Most aquatic insects were identified to species level except for the early instars of certain nymphal mayflies, caddisflies, stoneflies, and dipterans. Data were analyzed to reflect species composition and relative abundance in the benthic community.

6.4 EXISTING AQUATIC ENVIRONMENT

6.4.1 Quartz Creek

6.4.1.1 Stream Surveys

Quartz Creek can be divided into three distinct sections for purposes of this discussion; most of the lower section is outside the Quartz Mountain Gold Project study area boundary. The upper section, basically draining the area between forest highway 3660 and Oregon State Highway 140 (elevations 5504-5400 ft), was dry throughout the summer and autumn (through at least early November). Snowmelt and spring inflow to Quartz Creek was observed in this section during April 1988. The upper end of this section can be characterized as meadow, with shallow swales and very shallow sections of channel (1-2 ft wide and 1-6 inches deep). Streamside vegetation alternates between grasses, open pine woods and some aspen groves.

The middle section of Quartz Creek is a low gradient, braided-channel stream in a wet meadow (elevation 5350 - 5300 ft). Channels in this section are severely eroded. Rock retention dams have been placed across the channel in various locations, presumably to enhance groundwater recharge; pools as deep as 2-3 ft exist behind these structures. Surface flow in this section was a trickle during August and November; water temperatures were 55.4°F (13°C) in August and 44.6°F (7°C) during November.

The lower section of Quartz Creek, from the meadow to it's confluence with Drews Creek, is a small stream in a relatively narrow floodplain canyon. The portion of the stream above it's confluence with Butcher Creek is generally open, with sparse riparian vegetation and severely eroded banks. Pools are generally shallow and lack fish cover, such as undercut banks and overhead vegetation. Stream gravels generally contain large quantities of fine sediments, and many shallow riffles were overgrown with range grasses in November. The section of stream just above Butcher Creek had virtually no surface flow during the November, 1987 visit, and a large section of the streambed was dry.

From the confluence of Butcher Creek, Quartz Creek is markedly different from it's upper sections. The inflow of water from Butcher Creek and the steeper gradient in this section are important factors in this difference. Dense willow and aspen riparian vegetation forms a canopy over most of this stream section. Stream habitat types consist of a series of cascades, riffles and pools, which appeared to provide good fish habitat. A large cascading waterfall on Quartz Creek is

TABLE 6.4-1

SUMMARY OF STREAM BENTHIC INVERTEBRATE ABUNDANCE AND DIVERSITY DATA FOR DREWS AND QUARTZ CREEKS LAKE COUNTY, OREGON, 1987 AND 1988

	DR-2.4 Aug. 26 1987	DR-2.4 Apr. 6 1988	DR-1 Oct. 2 1987	DR-3 Oct. 3 1987	DR-3 Apr. 8 1988	QC-4 Apr. 8 1988
Total # of indiv.	1041	317	143	435	234	292
Total # of taxa	48	46	40	45	39	20
Shannon Index (log2)	3.810	4.425	4.363	3.624	3.977	2.182
Evenness Index	0.682	0.801	0.820	0.660	0.753	0.505
	mean values					
NUMBER OF TAXA						
Misc. taxa	5	6	4	6	5	3
Ephemeroptera	5	7	5	6	6	0
Plecoptera	5	5	7	6	2	2
Trichoptera	9	9	9	8	8	2
Coleoptera	6	4	6	5	4	3
Diptera-Other	7	6	3	7	6	3
Diptera-Chironomidae	11	9	6	7	8	7
Total, all taxa	48	46	40	45	39	20
NUMBER OF INDIVIDUALS						
Misc. taxa	15	25	6	17	40	77
Ephemoptera	48	25	11	25	14	0
Plecoptera	18	12	12	7	5	10
Trichoptera	113	32	15	45	24	4
Coleoptera	232	53	41	232	39	3
Diptera-Other	18	15	11	23	11	160
Diptera-Chironomida	597	155	47	96	101	38
Total, all taxa	1041	317	143	435	234	292

Number of Surber sample replicates:
DR-2.4 = 3 Aug. 26, 1987
DR-2.4 = 2 Apr. 6, 1988
DR-1 = 2
DR-3 = 2
DR-4 = 2

TABLE 6.4-2 Continued.

	STATIONS						
	DR1	DR2.4	DR3	AC5	AC6	AS	QC4
Zapada Oregonensis Group	x						
Leuctridae			x				
Perlidae		x					
Calineuria californica		x	x				
Doroneuria sp.	x						
Hesperoperla pacifica				x			
Perlodidae			x				
Cultus sp.	x						
Isoperla sp.		x	x				
Skwala sp.	x	x	x		x		
Chloroperlidae							
Sweltsa-*Alloperla* sp.	x	x	x				x
Trichoptera							
Rhyacophilidae							
Rhyacophila Angelita Gr.							x
Rhyacophila arnaudi	x	x					
R. Betteni Group	x		x				
R. Brunnea Group	x	x	x				
Glossosomatidae		x					
Agapetus taho	x	x			x		
Glossosoma sp.	x		x				
Hydroptilidae							
Hydroptila sp.	x	x				x	
Philopotamidae							
Wormaldia sp.		x				x	
Polycentropodidae							
Polycentropus sp.			x				
Hydropsychidae							
Hydropsyche sp.	x	x	x		x		
Parapsyche almota						x	
Limnephilidae							
Dicosmoecus atripes							x
Dicosmoecus gilvipes							
Neophylax splendens		x				x	
Neophylax sp.		x	x				
Brachcentridae							
Brachycentrus sp.		x	x				
Micrasema sp.	x	x	x	x			
Lepidostomatidae							
Lepidostoma sp.	x	x	x				
Helicopsychidae							
Helicopsyche borealis			x				
Sercostomatidae							
Gumaga sp.		x	x				
Coleoptera							
Dytiscidae (adult)	x						

[1] See Figure 1.2-2 for station locations. DR = Drews Cr., AC = Angel Cr., AS = Angel Spring, QC = Quartz Cr.

[2] Presence is denoted at each station by an x.

TABLE 6.4-3

SPECIES AND SIZE RANGES OF FISH COLLECTED
BY ELECTROFISHING IN QUARTZ CREEK
DURING 1987 AND 1988

DATE	STATION	SPECIES	NUMBER OF FISH	LENGTH RANGE INCHES(mm)	WATER TEMP. °F(°C)
10 NOV 87	Meadow	trout	3	7.2-10.0 (183-255)	44.6 (7.0)
		dace	15	1.3-3.4 (34-85)	
07 APR 88	QC-5	trout	2	3.2-3.7 (81-95)	41.9 (5.5)
		dace	1	2.5 (63)	
07 APR 88	BA-3 QM-1	trout	1	4.9 (124)	46.4 (8.0)
		dace	6	1.6-4.1 (40-104)	
08 APR 88	QC-4	dace	20 measured 100s collected	.87-3.7 (22-95)	42.8 (6.0)

A small tributary to Angel Creek flows through a canyon that empties into the Angel Camp meadow at an aspen grove above Angel Springs (AS). The lower end of this creek (elevation 5500 ft) flows through a wet meadow; the upper end (elevation 5800 ft) is contained in a very narrow ravine. The headwaters of the creek issue from the base of the ravine headwall, composed of rock and gravel. Streamside vegetation consists of grass and pines. The creek has a diversity of aquatic plants and invertebrates. Water temperature on 1 October, 1987 was 52.7°F (11.5°C).

Angel Creek below the Angel Camp meadow (the middle section) is in a moderately steep gradient zone (elevation 5400 - 5300 ft) that drops to the floor of the Quartz Creek canyon. Numerous seeps and springs were found beginning part way down this gradient (station AC5); these provided flowing water in Angel Creek to the confluence with Quartz Creek.

The creek bed in the upper part of this section, above the springs, is primarily boulders and bedrock, with some sand and gravel. This section was dry during the August and October, 1987 visits, but would be primarily cascade habitat if flow existed. Some small pools were found in the area of the springs and seeps, the largest measured 5 by 6 ft, and was 1½ ft deep.

Stream survey data recorded for the middle section of Angel Creek are listed below (October 1, 1987):

Channel width: 3 ft Thalweg depth: <1 - 1½ ft.
Percent of unit in pools: <10
Percent of unit shaded: 60
Turbidity: 5-10 ft visibility (estimate)
Water temperature: 56.3°F (13.5°C)
Flow: 0.2 cfs (estimate)
Gradient: moderate, 4%
Streamside cover type: grass, second growth pine and aspen
Comments: 3-5 ft high waterfall and log jam, passability for fish uncertain; benthic plants and animals typical for area; livestock damage moderate to severe.

The lowest of the three Angel Creek sections is in a moderate to flat gradient area that starts at the base of the hillside and flows into the meadow along state highway 140. A diversion and small irrigation ditch contained most of the flow from Angel Creek during the August, October, and November 1987 field visits. This ditch runs along the west side of Angel Creek canyon and into the large meadow below. The natural channel of Angel Creek runs along the east side of the

6.4.3 Drews Creek

6.4.3.1 Stream Surveys

Drews Creek drains much of the eastern and southern perimeters of the Quartz Mountain Project study area. Surface flows were considerably greater than the other streams surveyed during the 1987 field season. Stream surveys began at the upstream biological sampling station (DR-1, elevation 5500 ft) and included representative stream sections downstream to the Highway 140 crossing (elevation 5040 ft). Station DR-2.4 is within the Quartz Mountain Gold Project study area; other stations are upstream and downstream of the study area. The upstream station (DR-1) can be characterized as a series of riffles with fairly low to medium gradient (1.5-3.5 percent) interspersed with sections of run and an occasional pool (Table 6.4-4). Substrate in this reach was primarily boulder or bedrock with pockets of gravel in the low gradient riffles. Most pools contained deposits of sand and/or mud. Stream width varied from three to ten feet while depth was generally less than one foot except in the pools. Below the DR-1 study reach, an additional stream section approximately three-fourths of a mile in length was surveyed to determine the riffle/run/pool ratio, percent shade, and gradient. This section (Section B) was somewhat steeper and contained less pool habitat. Several large log jams affect the flow patterns, but most likely would not create impassable barriers to fish movement. The data are also presented in Table 6.4-4.

Forest Service Road 017 fords Drews Creek at station DR-2. Below this crossing, the stream becomes mostly low gradient riffles and runs with open streamside vegetation including grasses and open pine woods. Cattle damage in the form of bank erosion and siltation is moderate in this reach. A fairly wide, wet meadow opens up below this point and the stream becomes a series of multiple channels formed by numerous beaver dams. Several locations are marked by impassable dams and their corresponding pools. The main channel, where recognizable, can be characterized as a meandering series of pool-riffle combinations with steep cut banks. The creek is generally four to eight feet wide and the depth generally less than one foot deep (pools behind beaver dams are wider and deeper). Little overhead cover is present in the meadow; however, several six inch redband trout were observed in the pools. Stream survey data for Drews Creek in the vicinity of station DR-2.4 (Table 6.4-5) shows the riffle/pool ratio and the overall low gradient conditions.

Below station DR-2.4, as Drews Creek flows out of the meadow area, the valley becomes narrower and stream habitat is again dominated by riffle-run combinations. Beavers also use this reach but to a lesser extent. Streamside vegetation

TABLE 6.4-5

STREAM SURVEY DATA FROM DREWS CREEK, STATION DR-2.4
AUGUST 26, 1987

Habitat Type	Length (ft)	Average Depth (ft)	Average Width (ft)	Gradient (%)
pool	63.0		6.0	0.5
riffle	24.9		6.0	
pool	17.1	0.8	6.0	
riffle	24.9		6.0	
pool	17.1		8.0	
riffle	22.0		5.0	
pool	40.0	1.0	4.0	
riffle	18.0			
pool	34.1			
riffle	38.1		5.0	1.0
pool	49.9	1.3	5.0	
Total length:	349.1			

riffle:pool ratio = 1.0 : 1.7

The April 1988 data reflect cold-water, winter conditions illustrated by the abundance of diatoms (yellow-green algae) and the relative scarcity of blue-green and green algae as illustrated below:

STATION	Blue-green	Yellow-green	Green
DR-2.4	5	26	1
DR-3	3	38	2

Algal abundance in samples was not based on plant cell counts or biomass, but on frequency of intercepts within a sample counting cell. The large, colonial blue-green alga, Nostoc verrucosum, was the most abundant blue-green in samples from six of the nine stations sampled. Oscillatoria spp. and Rivularis sp. were also very abundant blue-greens. The most abundant yellow-green algae were the species Nitzschia sp. #1, Cocconeis placentula, Navicula spp., Fragilaria vaucheriae, and Synedra ulna v. oxyrhynchus. Green algal species were not relatively abundant in the samples.

6.4.3.3 Benthic Invertebrates

A total of 40 taxa as collected in October samples from station DR-1 (Table 6.4-1). October samples from station DR-3 had a similar number of taxa (45); however, the number of individuals was greater at DR-3 than at DR-1 primarily due to large numbers of larval aquatic beetles at DR-3. Total numbers of individuals were much higher during August at station DR-2.4 than in October at either station DR-1 or DR-3. A greater number of Chironomid and caddisfly (primarily Hydropsyche sp. and Agapetus taho) larvae in August were largely responsible for this difference in total numbers.

April 1988 samples at DR-2.4 were similar in diversity to August 1987 samples at the same location. The Shannon diversity and Pielou evenness indices were both somewhat higher than in August.

The invertebrate communities at station DR-3 during October 1987 and April 1988 were similar in composition and diversity with the exception of the Plecoptera (stoneflies). Abundance was also similar except for the presence of large numbers of coleoptera larvae.

Concentrations of the clam, Margaritifera falcata, were observed in several locations along Drews Creek. Concentrations of clams were found primarily in areas of sand and mud deposition along the edges of the main flow. Two quantitative samples in the area of Station DR-2.4 found clam densities of 20 and 48 individuals per square foot of substrate. The clams ranged in length from 0.9 inches (22 mm) to 3.2 inches (81 mm). Further discussion of these clams as

TABLE 6.4-6

SPECIES AND SIZE RANGES OF FISH COLLECTED BY ELECTROFISHING IN DREWS CREEK ON NOVEMBER 10, 1987 AND APRIL 7, 1988

DATE	STATION	SPECIES	NUMBER OF FISH	LENGTH RANGE inches(mm)	WATER TEMP.°F(°C)
10 Nov 87	below DR-2.4	trout	3	3.0 - 3.5 (75.5 - 90.0)	46.4 (8.0)
10 Nov 87	DR-2.4	trout	4	3.0 - 10.3 (77 - 262)	46.4 (8.0)
		lamprey	1	3.5 (89.0)	
10 Nov 87	above DR-2.4	trout	2	5.4 - 5.6 (137 - 142)	46.4 (8.0)
10 Nov 87	DR-3	trout	2	2.8 - 4.8 (70 - 123)	46.4 (8.0)
06 Apr 88	DR-2.4	trout	1	3.2 (81)	49.6 (9.8)
07 Apr 88	DR-2.4	trout	2	3.9 - 5.5 (99 - 140)	40.6 (4.8)

trout = redband trout
lamprey = Pacific lamprey (ammocoetes)
dace = speckled dace

- fish habitat: no spawning gravel, good rearing gravel, instream shelter, poor undercut banks, good overhanging vegetation, fair shade.

The Angel Creek drainage also does not generally appear to provide good quality habitat for fish and other aquatic species. Low water during 1987 certainly showed an extreme condition, but severe degradation by livestock and the absence of structure or cover in the large meadow sections of the stream result in poor habitat. The middle section of the stream, in the steeper gradient area between the meadows, offers the best habitat for trout, and contained a relatively high diversity of aquatic plants and animals for the drainage. The small tributary above Angel Spring also has a diversity of plant and animal life, but is too small to provide adequate fish habitat.

Drews Creek provides a sharp contrast to Quartz and Angel Creeks. Drews Creek drains a relatively large watershed east of the study area. The drainage is fed by numerous springs, which maintain streamflow throughout the year. The extensive beaver marshes in the eastern, low gradient part of the study area provide pond and wetland habitat that is not found in the smaller drainages of Quartz and Angel Creeks. The steep gradient section below the beaver meadow, extending to Highway 140 and below, provides variable habitat including cascade and pool, and ample cover from boulders, logs, and riparian shrubs and trees. Livestock damage is moderate to severe in the meadow area and above; some livestock damage is also evident in the steeper part of the stream.

6.5.2 Aquatic Plants

Periphyton samples from Quartz Creek were dominated by diatoms and diatom spores. These results are not unusual considering the prevailing cold weather conditions during April 1988; diatoms are generally adaptive to cold water, low nutrient conditions. The dominance of Chrysophyte spores may indicate that many diatoms are still in an overwintering state until warmer conditions occur.

The diversity of algae in samples from Drews Creek is typical of Northwest streams (Geiger, pers. comm. 1987). A few species in the samples, particularly the abundant Nostoc verrucosum, are known to fix atmospheric nitrogen. It is not clear whether or not the abundance of this species in Drews Creek is an indication of nitrogen limitation. Algal biomass provides an important food source for a large variety of aquatic insects, clams and other invertebrates, thus forming an important base for many aquatic food webs.

(ODFW undated). Studies of redband trout have shown that few fish survive past three years, the age of first spawning.

The ODFW has no particular management strategy for redband trout, primarily because it is not heavily fished. Some hatchery work was conducted in an attempt to develop a brood stock of this species; this work was not successful, and has been discontinued (Griggs, pers. comm. 1987).

Redband trout were observed in moderate numbers in the lower section of Quartz Creek, and a few were collected in the meadow section along highway 140. The typical distribution of redband trout in this stream is not evident from observations made during the low water conditions of 1987. The lower section of the stream definitely provides good habitat for redband trout. The presence of large, mature fish in the meadow along the highway indicates that fish are possibly distributed into the middle and perhaps upper parts of the drainage, if water is available. The carrying capacity of Quartz Creek for redband trout, particularly in the study area, appears to be marginal.

Redband trout were observed or collected in most sections of Drews Creek. Collected fish were in at least 2 or 3 age groups, judging from size distribution. Comparison with length at age data for other southeastern Oregon drainages (Kunkel 1976) suggests that most fish collected in Drews Creek were age I to III, with one fish perhaps age V.

In summary, redband trout are present in all three drainages within the study area. Redband trout are widely distributed in Drews Creek, where they appear to be successfully reproducing. Redband trout were fairly abundant in lower Quartz Creek. The presence of mature individuals in the Quartz Creek meadow (along Highway 140) suggests that the species could be more widely distributed in the upper sections of that stream during more normal water conditions than experienced during 1987. Whether or not this species spawns in the upper part of Quartz Creek cannot be answered with the present data base.

The observation of redband trout in a small pool in the middle section of Angel Creek indicates that this species could be more widely distributed in that stream during a more normal water year. In a sense, the pool in Angel Creek, like the pools in the Quartz Creek meadow, might serve as refuges for trout and other fish during periods of extreme low water; these fish can then re-populate other sections of the streams when water levels return to normal.

Fish survey records for Drews Reservoir were examined from the files of ODFW in Lakeview, OR (Anderson, pers. comm.,

6.6 GLOSSARY

BEDROCK - stream substrate consisting of solid rock.

BENTHIC - pertaining to organisms that live on the bottom of lakes or streams.

BIOACCUMULATION - pertains to the accumulation of organic or inorganic chemicals and compounds in living tissue.

BOULDER - stream substrate of rock fragments greater than nine inches and less than 24 inches in diameter.

COBBLE - stream substrate of rock fragments from two to nine inches in diameter.

CASCADE - a short,steep drop in stream bed elevation often marked by boulders and agitated white water.

CONFLUENCE - the point where two streams or rivers join

DIATOM - a type of single celled algae which may be free-floating in water or attached to substrates in lakes and streams.

DIVERSITY - a measure of the number of different taxa

EVENNESS - a diversity measure

GRAVEL - stream substrate of rock fragments from 0.2 inches to two inches in diameter.

INSTAR - stage in the development of aquatic insects.

INTERMITTENT STREAM - stream that flows only in response to precipitation or snow melt, little or not continued supply from spring.

LARGE BOULDERS - stream substrate 24 inches or more in diameter.

PERIPHYTON - attached algae on natural substrates

POOL - a small and relatively deep body of quiet water in a stream or river

RIFFLE - a shallow rapids in an open stream where the surface is broken into waves by submerged obstructions.

RIPARIAN - pertaining to vegetation along banks of a stream.

6.7 PUBLIC AND AGENCY CONTACTS

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6.9 LIST OF PRINCIPAL PREPARERS

6.9.1 Paul A. Fishman

Paul Fishman, owner of Fishman Environmental Services (FES), has conducted numerous freshwater ecology studies over the past 20+ years. Recent and on-going studies include surveys of Columbia Basin anadromous fish hatcheries, stream flow studies, wetland assessments and impact mitigation. As a senior ecologist on the Quartz Hill Molybdenum Project in SE Alaska, Mr. Fishman was responsible for marine and estuarine fish studies for the baseline and monitoring phases of the project for U.S. Borax and Chemical Corp.

6.9.2 Steven R. Johnson

Steve Johnson has 12 years experience as a fisheries biologist conducting impact assessment and mitigative planning for water related projects. His experience with mining industries projects includes conducting aquatic biology studies for the Mt. Tolman Copper and Molybdenum Mine in Washington and an oil shale development project in western Colorado.

6.9.3 N. Stan Geiger

Stan Geiger, director of Scientific Resources Inc. (SRI), is an aquatic plant ecologist with 15 years experience in aquatic resource analysis, aquatic macrophyte ecology and algal taxonomy and ecology. Mr. Geiger's experience with algal taxonomy and ecology include published and presented papers on the planktonic algae of Crater Lake, Oregon and the post-eruption phytoplankton in Spirit Lake, Washington.

6.9.4 Robert Wisseman

Bob Wisseman, an aquatic ecologist, provided invertebrate taxonomic identification and data analysis for the Quartz Mountain Gold Project. Mr. Wisseman has over 10 years experience in design and implementation of aquatic research projects throughout the United States. His experience with mining projects includes an invertebrate baseline study for Sunbeam mines in Stanley, Idaho and seasonal monitoring of streams in the vicinity of Asarco mines in western Montana.

5.8 GLOSSARY

HIDING COVER - Hiding cover is defined as vegetation capable of hiding 90 percent of a standing adult deer or elk from the view of a human at a distance equal to or less than 200 ft (Thomas 1979). The height and density of vegetation needed to cover deer may be less than that required for elk.

MANAGEMENT INDICATOR SPECIES - A species selected because its welfare is presumed to be an indicator of the welfare of other species in the habitat. A species whose condition can be used to assess the impacts of management actions on a particular area. Managing for these species usually requires significant allocations of land or resources (USFS 1987a).

RAPTOR - Predatory birds such as hawks, eagles, falcons, vultures, and owls.

SENSITIVE SPECIES - Plant or animal species which are susceptible or vulnerable to activity impacts or habitat alterations. Those species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species, that are on an official State list, or that are recognized by the Regional Forester as needing special management to prevent placement on Federal or State lists (USFS 1987a).

SHOREBIRD - Wading or swimming birds such as gulls, terns, sandpipers, plovers, avocets, killdeer, and stilts.

THERMAL COVER - Generally, forest cover that provides a cooler microclimate in summer, a warmer microclimate or shelter from wind and exposure to cold night skies (reducing heat loss to the sky) in winter. Summer thermal cover can be coniferous or deciduous, and winter thermal cover is coniferous.

UNIQUE SPECIES - This category includes species which are rare in nature or in the Forest, scientifically unique, on special lists such as the U.S. Fish and Wildlife Service sensitive species list, protected by law or regulation, aesthetically important, and/or are particularly vulnerable to reductions in habitat quality and/or quantity. A species is selected because its welfare is presumed to be an indicator of the welfare of other species in the habitat, and/or its condition can be used to assess the impacts of management actions on a particular area. Managing for these species most often entails applying mitigating and coordinating measures or minor allocations of land (USFS 1987a).

5.9 PUBLIC AND AGENCY CONTACTS

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5.11 LIST OF PRINCIPAL PREPARERS

5.11.1 Peggy Lynn Sharp

Ms. Sharp is a wildlife ecologist and environmental planner. Her particular areas of interest include wildlife habitat classification, wildlife survey techniques, waterfowl ecology, wildlife impact assessment, and mitigation planning.

In 1968, Ms. Sharp received a B.A. in Biology from Knox College in Galesburg, Illinois. She conducted independent research on red-winged blackbird nesting habitat and cowbird parasitism, and choline metabolism in Drosophila melanogaster.

Ms. Sharp received a M.S. in Zoology from the University of Alberta, Edmonton, Alberta, Canada in 1973. She studied the social and reproductive behavior, territoriality and home range of a marked population of free-living pikas (Ochotona princeps) in the Kananaskis Valley in the Canadian Rocky Mountains.

Ms. Sharp has designed, managed, and conducted a variety of wildlife studies in northwestern Canada, and the midwest and northwest in the U.S. These include a comprehensive study of the birds of Waterton Lakes National Park in Alberta, Canada, culminating in management recommendations to enhance rare, threatened, and endangered species habitat; surveys of breeding, moulting, and migrating waterfowl in the Yukon, Northwest Territories, and Alberta; and plot census studies of breeding birds in the Northwest Territories. Ms. Sharp redesigned wildlife monitoring programs for two surface coal mines in Wyoming, trained mine personnel in their implementation, and prepared wildlife monitoring manuals. In Washington and Oregon, Ms. Sharp has designed and conducted studies of the effects of controlled underburning on nongame wildlife in Mt. Hood National Forest, small mammal populations on rangeland near Burns, Oregon; and conducted a baseline wildlife inventory, impact assessment, and wildlife and wetland mitigation plans for a proposed major destination resort on the Oregon coast. This mitigation program is the subject of a signed agreement between the Oregon Department of Fish and Wildlife and the developer.

APPENDIX 5.A

CHECKLIST OF WILDLIFE SPECIES OBSERVED WITHIN THE QUARTZ MOUNTAIN STUDY AREA DURING 1986-1988

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE	SEASONAL OCCURRENCE	STATUS
BIRDS, CONTINUED				
Clark's nutcracker	Nucifraga columbiana	rare	resident	
Common raven	Corvus corax	uncommon	resident*	
Mountain chickadee	Parus gambeli	common	resident*	
Red-breasted nuthatch	Sitta canadensis	common	resident*	
White-breasted nuthatch	Sitta carolinensis	uncommon	resident*	
Pygmy nuthatch	Sitta pygmaea	uncommon	resident	
Brown creeper	Certhia americana	rare	resident	
House wren	Troglodytes aedon	uncommon	summer**	
Winter wren	Troglodytes troglodytes	uncommon	summer	
American dipper	Cinclus mexicanus	common	resident	
Golden-crowned kinglet	Regulus satrapa	common	resident*	
Western bluebird	Sialia mexicana	rare	migrant	
Mountain bluebird	Sialia currucoides	common	summer**	
Townsend's solitaire	Myadestes townsendi	common	summer**	
Hermit thrush	Catharus guttatus	common	summer*	
American robin	Turdus migratorius	common	summer**	
Varied thrush	Ixoreus naevius	common	summer*	
Solitary vireo	Vireo solitarius	uncommon	summer*	
Warbling vireo	Vireo gilvus	uncommon	summer*	
Orange-crowned warbler	Vermivora celata	rare	summer*	
Nashville warbler	Vermivora ruficapilla	uncommon	summer*	
Yellow-rumped warbler	Dendroica coronata	common	summer*	
Western tanager	Piranga ludoviciana	common	summer*	
Lazuli bunting	Passerina amoena	uncommon	summer*	
Chipping sparrow	Spizella passerina	common	summer**	
Dark-eyed junco	Junco hyemalis	common	summer*	
Western meadowlark	Sturnella neglecta	common	summer**	
Brown-headed cowbird	Molothrus ater	common	summer*	
Cassin's finch	Carpodacus cassinii	common	summer*	
Red crossbill	Loxia curvirostra	uncommon	resident	
Pine siskin	Carduelis pinus	uncommon	summer*	
Evening grosbeak	Coccothraustes vespertinus	common	summer*	

Relative abundance

Common - Always detected during surveys (in appropriate season), can be seen on nearly all visits to preferred habitat, numbers vary.

Uncommon - Usually detected during surveys but not likely to be seen during a single visit to preferred habitat.

Rare - Not always detected during surveys and unlikely to be seen during a single visit to preferred habitat.

Seasonal occurrence

Resident - Permanent, year-round resident.

Summer - Spring-summer-fall resident, migrates south in winter.

Winter - Winter visitor

Migrant - Migrates through the area, not seen during the breeding season.

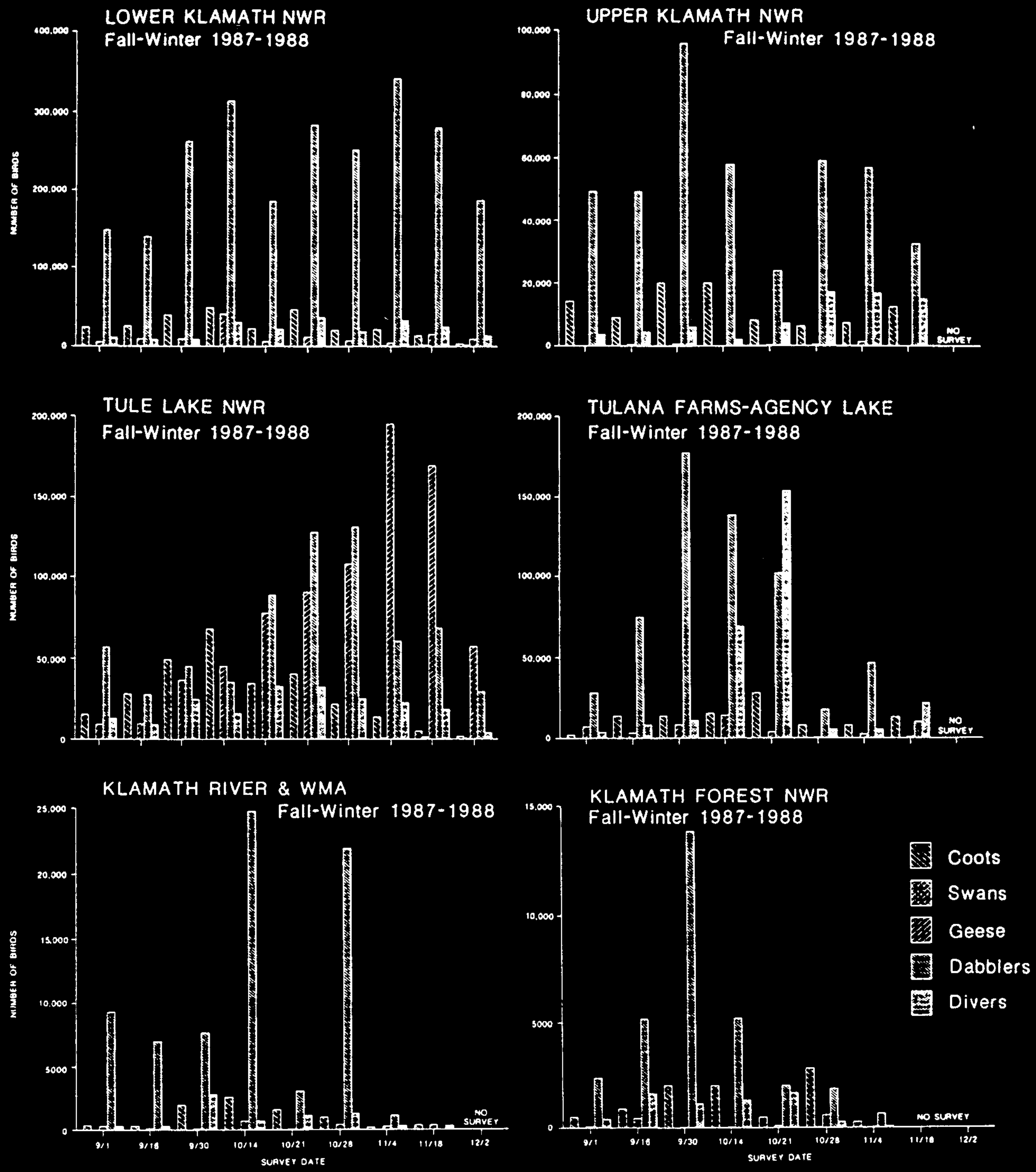
** - Breeds in the area based on observations of young and/or nests.
* - Suspected to breed in the area based on observations of agitated adults.

Status

MIS - Fremont National Forest Management Indicator Species
FS - U.S. Fish and Wildlife Service sensitive bird species

APPENDIX 5.B

WATERFOWL SURVEY DATA GATHERED BY THE U.S. FISH AND WILDLIFE SERVICE IN THE KLAMATH FALLS-TULE LAKE VICINITY



PROJECT No.	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 5.B-1 KLAMATH FALLS REGION FALL AND WINTER WATER FOWL COUNT DATA FROM THE U.S. FISH AND WILD-LIFE SERVICE
DATE		
REVISION		

APPENDIX 5.C

SUMMARY OF 1986-1988 BIRD OBSERVATIONS
IN THE QUARTZ MOUNTAIN STUDY AREA

Table 5C-1. Continued.

Species	10-19 NE prt stdy ar & Euwan Camp	10-20 NE Qtr Sec 25 spring leachpd	10-20 Ang Ck meadow tribut ary E	10-20 Crone H S to Qtz Ck flat	10-20 Qtz Ck at Hiwy 20	10-21 Stand ard Sur vey	10-21 Drews Crk	Total obser vati ons	Per cent of total
	Number Observed								
Snow goose						70		70	10.62
Duck sp.								2	.30
Turkey vulture								2	.30
Red-tailed hawk	1		1	1	1	3		17	2.58
Ruffed grouse								1	.15
Gull sp.								2	.30
Common nighthawk								1	.15
Vaux's swift								8	1.21
Belted kingfisher		1						1	.15
Yellow-bellied sapsucker								2	.30
Williamson's sapsucker						1		2	.30
Sapsucker sp.								2	.30
Downy woodpecker								2	.30
Hairy woodpecker						1		5	.76
White-headed woodpecker			1					2	.30
Black-backed woodpecker								1	.15
Northern flicker			2					26	3.95
Pileated woodpecker			1					2	.30
Woodpecker sp.						1		11	1.67
Dusky flycatcher								17	2.58
Willow flycatcher								1	.15
Empidonax flycatcher								2	.30
Violet-green swallow								3	.46
Gray jay	1					1		4	.61
Steller's jay	3					2		11	1.67
Clark's nutcracker								2	.30
Common raven		2				2		10	1.52
Mountain chickadee	4	1	2			11	1	79	11.99
Red-breasted nuthatch								14	2.12
White-breasted nuthatch								3	.46
Pygmy nuthatch								7	1.06
Brown creeper							1	1	.15
House wren								2	.30
Winter wren			1				1	2	.30
American dipper							1	4	.61
Golden-crowned kinglet	6		6		1	11	2	58	8.80
Western bluebird						13		13	1.97
Mountain bluebird								3	.46
Townsend's solitaire								4	.61
Hermit thrush								21	3.19
American robin	7		2	1		2		48	7.28
Varied thrush	1					1		2	.30
Solitary vireo								3	.46
Warbling vireo								2	.30
Orange-crowned warbler								1	.15
Nashville warbler								1	.15
Yellow-rumped warbler	1							49	7.44
Western tanager								20	3.03
Lazuli bunting								1	.15
Chipping sparrow								17	2.58
Dark-eyed junco	2	3	5	3				53	8.04
Western meadowlark								1	.15
Brown-headed cowbird								4	.61
Cassin's finch			17			2		18	2.73
Red crossbill						2		2	.30
Pine siskin						2		4	.61
Evening grosbeak			2					13	1.97
Total birds observed	26	7	40	5	2	123	6	659	100.00

APPENDIX 5.D

SUMMARY OF 1986-1988 MAMMAL OBSERVATIONS IN THE QUARTZ MOUNTAIN STUDY AREA

Table 50-1. Continued.

Species	10-19 NE prt stdy ar & Euwan Camp	10-20 NE Qtr Sec 25 spring leachpd	10-20 Ang Ck meadow tribut ary E	10-20 Crone H S to Qtz Ck flat	10-20 Qtz Ck at Hiwy 20	10-21 Stand ard Sur vey	10-21 Drews Crk	Obs's. by Others during Study	Total Obs.	% of Total Obs.
Coyote	2		1	1					11	4.56
Fox sp.	2								3	1.24
Black bear								1	1	.41
Raccoon									1	.41
Marten or Fisher									1	.41
Striped skunk			2						2	.83
Ermine									2	.83
Long-tailed weasel									3	1.24
Badger									2	.83
Mountain lion								1	1	.41
Elk								3	3	1.24
Mule deer	3	1	10			5	1	1	30	12.45
Yellow-bellied marmot									1	.41
Northern flying squirrel	1								1	.41
Golden-mantled grnd. sq.				1					13	5.39
Belding's ground squirrel			1						9	3.73
Yellow-pine chipmunk									1	.41
Least chipmunk				1					1	.41
Chipmunk sp.	6		10	3	1	4			42	17.43
Douglas' squirrel	2	1	2			12			40	16.60
Squirrel sp.	2		10						15	6.22
Pocket gopher	6	3	3	3					30	12.45
Beaver								1	1	.41
Bushy-tailed woodrat				1	1				4	1.66
Deer mouse			1						1	.41
Vole sp.	1								1	.41
Mouse sp.			10						13	5.39
Porcupine			1						2	.83
Snowshoe hare	1								6	2.49
Total mammals observed	26	5	51	10	2	21	1	7	241	100.00

APPENDIX 5.E

LETTER FROM THE U.S. FISH AND WILDLIFE SERVICE REGARDING THREATENED AND ENDANGERED SPECIES IN THE QUARTZ MOUNTAIN STUDY AREA

6.0 AQUATIC BIOLOGY

TECHNICAL REPORT NO. 6

AQUATIC BIOLOGY

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

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Revised December 1988

FOREWORD

This report was prepared by Steffen Robertson and Kirsten (Colorado) Inc. for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
P. A. Fishman	Aquatic Biology Task Leader	SRK

TABLE OF CONTENTS Continued.

SUMMARY

The Quartz Mountain Gold Project Study area includes the upper portion of the Quartz Creek drainage, a portion of Drews Creek, and all of Angel Creek, a tributary to Quartz Creek. These streams are part of the Goose Lake and Summer Lake Drainage.

The upper Quartz Creek drainage occupies the western part of the study area. Flow is intermittent in the upper and middle sections, and in the lower section is regulated outflow from Butcher Flats reservoir. The upper section is wet meadow with occasional sections of stream channel, and the middle section is shallow and overgrown. Habitat for fish species is poor in these sections, but is present in the deeper, steeper lower section of the creek where pools are more common and vegetation canopy is present.

The upper section of Angel Creek, a tributary to Quartz Creek, has a severely eroded, shallow channel and is intermittent. The middle portion has a steeper gradient and is slightly deeper. The lower section flows through an open meadow and is severely eroded due to livestock activity.

Drews Creek, a spring-fed perennial stream, flows through the eastern portion of the study area and drains a large area east of the study area. The upper section, outside the study area, has a low to moderate gradient and is made up of riffles interspersed with runs and shallow pools. Downstream the creek flows through a wet meadow that extends into the study area, and is composed of multiple channels and pools formed by numerous beaver dams. Drews Creek then flows through a steep-walled canyon where it forms steep cascades, deep pools with large boulders, and an eight-foot high waterfall. Downstream from the canyon it is primarily moderately steep cascades and pools with good riparian cover. The creek along Highway 140 is a series of medium height cascades interspersed with pools and runs, with little stream cover.

Aquatic plants found in these streams, primarily in Drews Creek, are typical of Pacific Northwest streams. Sixty-one algal taxa were found, of which 46 were yellow-green algae. Blue-green algae is most common in Drews Creek, and green algae were not common.

Benthic invertebrates were confined to Drews Creek because of insufficient flow in the other streams. This community is, for the most part, typical of western mountain streams with a coniferous canopy, although several taxa are more indicative of extreme environmental conditions such as

6.0 AQUATIC BIOLOGY

6.1 INTRODUCTION

The aquatic biology section of the Quartz Mountain Gold Project baseline report describes studies of the existing aquatic conditions within the study area (Figure 1.1-1). Investigations of Drews Creek, the only permanent stream within the study area, were extended beyond the area perimeters to document conditions outside of potential project influence.

6.1.1 Objectives

The objectives of the aquatic biology studies were to gather data in sufficient detail to provide background information for assessment of environmental impacts resulting from proposed project alternatives. Three streams; Quartz, Angel, and Drews Creeks, comprise the drainage of the study area, and are described in this section. Studies were conducted to describe the physical and biological characteristics of each of those streams. Stream surveys, periphyton, benthic invertebrates, and fish were the main areas of study.

Objectives of the stream surveys were to: (1) describe the stream habitat types and determine riffle/run/pool ratios; (2) determine stream gradient; (3) determine substrate characteristics; (4) determine cover types and riparian vegetation; and (5) determine channel characteristics such as depth and width.

Objectives of periphyton studies were to provide a baseline description of the aquatic plant community and to determine the species diversity and species composition within each sub-drainage.

Objectives of the benthic invertebrate studies were to determine diversity and numerical abundance within each drainage and assess the trophic or feeding type diversity of benthic communities within each drainage.

Objectives of the fish studies were to characterize the fish fauna by species present, relative abundance, distribution within drainages, and recreational use of study area fishery resources.

6.2 LITERATURE REVIEW

No existing data were found for the aquatic biology of the study area. One stream survey data form was found in U.S. Forest Service (USFS) files (USFS 1979) for a section of Quartz Creek downstream from the study area. Some data are in the Oregon Department of Fish and Wildlife (ODFW) files for fish populations in Drews Reservoir (Anderson, pers. comm., 1987). Some information on aquatic habitats and species is available in the Fremont National Forest Proposed Land and Resource Management Plan (USFS 1987).

6.3.2 Aquatic Plants

Periphyton (attached algae) sampling during 1987 was limited to the Drews Creek drainage due to extreme low water levels in Quartz and Angel Creeks. One station in Quartz Creek (QC-4) was added during spring 1988. Three locations in Drews Creek were sampled on 26 August 1987 near station DR-2.4. In addition, three replicate samples were collected from stations DR-1 and DR-3 in October 1987. Two replicate samples were collected from QC-4 during April 1988.

Periphyton samples were obtained by scraping a measured surface area (1.17 square inches) from a smooth rock using a knife and brush, and preserving the removed material in a 10% formalin solution.

Algal units were identified and counted under magnification from randomly selected transects in a measured chamber.

6.3.3 Benthic Invertebrates

Insufficient stream depth and lack of flow prevented quantitative invertebrate sampling in Angel Creek, therefore a reference collection of representative taxa was compiled by removing organisms from streambed substrates using forceps. Quantitative samples were collected from Quartz Creek (QC-4) during April 1988 due to extreme low water in 1987.

Invertebrate sampling was conducted at three stations in Drews Creek during August and October 1987. Three separate sites in the vicinity of station DR-2.4 were sampled during the August field visit while two replicate samples were collected at stations DR-1 and DR-3 in October. Two replicate samples were also taken at stations DR-2.4 and DR-3 in April 1988. Samples were collected from riffle areas using a Surber sampler with a sampling area of one square foot. Collection procedure consisted of placing the sampler over the stream substrate and removing all attached organisms from the enclosed rocks to a depth of approximately six inches. Organisms were washed by stream flow from the rocks into the collection net. Contents of the net were then transferred to labeled plastic bags and preserved with 10 percent formalin solution.

Benthic samples from each stream were sorted, identified, and enumerated where applicable. Most aquatic insects were identified to species level except for the early instars of certain nymphal mayflies, caddisflies, stoneflies, and dipterans. Data were analyzed to reflect species composition and relative abundance in the benthic community.

6.4 EXISTING AQUATIC ENVIRONMENT

6.4.1 Quartz Creek

6.4.1.1 Stream Surveys

Quartz Creek can be divided into three distinct sections for purposes of this discussion; most of the lower section is outside the Quartz Mountain Gold Project study area boundary. The upper section, basically draining the area between forest highway 3660 and Oregon State Highway 140 (elevations 5504-5400 ft), was dry throughout the summer and autumn (through at least early November). Snowmelt and spring inflow to Quartz Creek was observed in this section during April 1988. The upper end of this section can be characterized as meadow, with shallow swales and very shallow sections of channel (1-2 ft wide and 1-6 inches deep). Streamside vegetation alternates between grasses, open pine woods and some aspen groves.

The middle section of Quartz Creek is a low gradient, braided-channel stream in a wet meadow (elevation 5350 - 5300 ft). Channels in this section are severely eroded. Rock retention dams have been placed across the channel in various locations, presumably to enhance groundwater recharge; pools as deep as 2-3 ft exist behind these structures. Surface flow in this section was a trickle during August and November; water temperatures were 55.4°F (13°C) in August and 44.6°F (7°C) during November.

The lower section of Quartz Creek, from the meadow to it's confluence with Drews Creek, is a small stream in a relatively narrow floodplain canyon. The portion of the stream above it's confluence with Butcher Creek is generally open, with sparse riparian vegetation and severely eroded banks. Pools are generally shallow and lack fish cover, such as undercut banks and overhead vegetation. Stream gravels generally contain large quantities of fine sediments, and many shallow riffles were overgrown with range grasses in November. The section of stream just above Butcher Creek had virtually no surface flow during the November, 1987 visit, and a large section of the streambed was dry.

From the confluence of Butcher Creek, Quartz Creek is markedly different from it's upper sections. The inflow of water from Butcher Creek and the steeper gradient in this section are important factors in this difference. Dense willow and aspen riparian vegetation forms a canopy over most of this stream section. Stream habitat types consist of a series of cascades, riffles and pools, which appeared to provide good fish habitat. A large cascading waterfall on Quartz Creek is

TABLE 6.4-1

SUMMARY OF STREAM BENTHIC INVERTEBRATE ABUNDANCE AND DIVERSITY DATA FOR DREWS AND QUARTZ CREEKS LAKE COUNTY, OREGON, 1987 AND 1988

	DR-2.4 Aug. 26 1987	DR-2.4 Apr. 6 1988	DR-1 Oct. 2 1987	DR-3 Oct. 3 1987	DR-3 Apr. 8 1988	QC-4 Apr. 8 1988
Total # of indiv.	1041	317	143	435	234	292
Total # of taxa	48	46	40	45	39	20
Shannon Index (log2)	3.810	4.425	4.363	3.624	3.977	2.182
Evenness Index	0.682	0.801	0.820	0.660	0.753	0.505

	mean values					
NUMBER OF TAXA						
Misc. taxa	5	6	4	6	5	3
Ephemeroptera	5	7	5	6	6	0
Plecoptera	5	5	7	6	2	2
Trichoptera	9	9	9	8	8	2
Coleoptera	6	4	6	5	4	3
iptera-Other	7	6	3	7	6	3
iptera-Chironomidae	11	9	6	7	8	7
Total, all taxa	48	46	40	45	39	20
NUMBER OF INDIVIDUALS						
Misc. taxa	15	25	6	17	40	77
Ephemoptera	48	25	11	25	14	0
Plecoptera	18	12	12	7	5	10
Trichoptera	113	32	15	45	24	4
Coleoptera	232	53	41	232	39	3
Diptera-Other	18	15	11	23	11	160
Diptera-Chironomida	597	155	47	96	101	38
Total, all taxa	1041	317	143	435	234	292

Number of Surber sample replicates:
DR-2.4 = 3 Aug. 26, 1987
DR-2.4 = 2 Apr. 6, 1988
DR-1 = 2
DR-3 = 2
DR-4 = 2

TABLE 6.4-2 Continued.

	STATIONS						
	DR1	DR2.4	DR3	AC5	AC6	AS	QC4
Zapada Oregonensis Group	x						
Leuctridae			x				
Perlidae		x					
Calineuria californica		x	x				
Doroneuria sp.	x						
Hesperoperla pacifica				x			
Perlodidae			x				
Cultus sp.	x						
Isoperla sp.		x	x				
Skwala sp.	x	x	x		x		
Chloroperlidae							
Sweltsa-*Alloperla* sp.	x	x	x				x
Trichoptera							
Rhyacophilidae							
Rhyacophila Angelita Gr.							x
Rhyacophila arnaudi	x	x					
R. Betteni Group	x		x				
R. Brunnea Group	x	x	x				
Glossosomatidae		x					
Agapetus taho	x	x			x		
Glossosoma sp.	x		x				
Hydroptilidae							
Hydroptila sp.	x	x				x	
Philopotamidae							
Wormaldia sp.		x				x	
Polycentropodidae							
Polycentropus sp.			x				
Hydropsychidae							
Hydropsyche sp.	x	x	x		x		
Parapsyche almota						x	
Limnephilidae							
Dicosmoecus atripes							x
Dicosmoecus gilvipes							
Neophylax splendens		x				x	
Neophylax sp.		x	x				
Brachcentridae							
Brachycentrus sp.		x	x				
Micrasema sp.	x	x	x	x			
Lepidostomatidae							
Lepidostoma sp.	x	x	x				
Helicopsychidae							
Helicopsyche borealis			x				
Sercostomatidae							
Gumaga sp.		x	x				
Coleoptera							
Dytiscidae (adult)	x						

1 See Figure 1.2-2 for station locations. DR = Drews Cr., AC = Angel Cr., AS = Angel Spring, QC = Quartz Cr.

2 Presence is denoted at each station by an x.

TABLE 6.4-3

SPECIES AND SIZE RANGES OF FISH COLLECTED
BY ELECTROFISHING IN QUARTZ CREEK
DURING 1987 AND 1988

DATE	STATION	SPECIES	NUMBER OF FISH	LENGTH RANGE INCHES(mm)	WATER TEMP. °F(°C)
10 NOV 87	Meadow	trout	3	7.2-10.0 (183-255)	44.6 (7.0)
		dace	15	1.3-3.4 (34-85)	
07 APR 88	QC-5	trout	2	3.2-3.7 (81-95)	41.9 (5.5)
		dace	1	2.5 (63)	
07 APR 88	BA-3 QM-1	trout	1	4.9 (124)	46.4 (8.0)
		dace	6	1.6-4.1 (40-104)	
08 APR 88	QC-4	dace	20 measured 100s collected	.87-3.7 (22-95)	42.8 (6.0)

A small tributary to Angel Creek flows through a canyon that empties into the Angel Camp meadow at an aspen grove above Angel Springs (AS). The lower end of this creek (elevation 5500 ft) flows through a wet meadow; the upper end (elevation 5800 ft) is contained in a very narrow ravine. The headwaters of the creek issue from the base of the ravine headwall, composed of rock and gravel. Streamside vegetation consists of grass and pines. The creek has a diversity of aquatic plants and invertebrates. Water temperature on 1 October, 1987 was 52.7°F (11.5°C).

Angel Creek below the Angel Camp meadow (the middle section) is in a moderately steep gradient zone (elevation 5400 - 5300 ft) that drops to the floor of the Quartz Creek canyon. Numerous seeps and springs were found beginning part way down this gradient (station AC5); these provided flowing water in Angel Creek to the confluence with Quartz Creek.

The creek bed in the upper part of this section, above the springs, is primarily boulders and bedrock, with some sand and gravel. This section was dry during the August and October, 1987 visits, but would be primarily cascade habitat if flow existed. Some small pools were found in the area of the springs and seeps, the largest measured 5 by 6 ft, and was 1½ ft deep.

Stream survey data recorded for the middle section of Angel Creek are listed below (October 1, 1987):

Channel width: 3 ft   Thalweg depth: <1 - 1½ ft.
Percent of unit in pools: <10
Percent of unit shaded: 60
Turbidity: 5-10 ft visibility (estimate)
Water temperature: 56.3°F (13.5°C)
Flow: 0.2 cfs (estimate)
Gradient: moderate, 4%
Streamside cover type: grass, second growth pine and aspen
Comments: 3-5 ft high waterfall and log jam, passability for fish uncertain; benthic plants and animals typical for area; livestock damage moderate to severe.

The lowest of the three Angel Creek sections is in a moderate to flat gradient area that starts at the base of the hillside and flows into the meadow along state highway 140. A diversion and small irrigation ditch contained most of the flow from Angel Creek during the August, October, and November 1987 field visits. This ditch runs along the west side of Angel Creek canyon and into the large meadow below. The natural channel of Angel Creek runs along the east side of the

6.4.3 Drews Creek

6.4.3.1 Stream Surveys

Drews Creek drains much of the eastern and southern perimeters of the Quartz Mountain Project study area. Surface flows were considerably greater than the other streams surveyed during the 1987 field season. Stream surveys began at the upstream biological sampling station (DR-1, elevation 5500 ft) and included representative stream sections downstream to the Highway 140 crossing (elevation 5040 ft). Station DR-2.4 is within the Quartz Mountain Gold Project study area; other stations are upstream and downstream of the study area. The upstream station (DR-1) can be characterized as a series of riffles with fairly low to medium gradient (1.5-3.5 percent) interspersed with sections of run and an occasional pool (Table 6.4-4). Substrate in this reach was primarily boulder or bedrock with pockets of gravel in the low gradient riffles. Most pools contained deposits of sand and/or mud. Stream width varied from three to ten feet while depth was generally less than one foot except in the pools. Below the DR-1 study reach, an additional stream section approximately three-fourths of a mile in length was surveyed to determine the riffle/run/pool ratio, percent shade, and gradient. This section (Section B) was somewhat steeper and contained less pool habitat. Several large log jams affect the flow patterns, but most likely would not create impassable barriers to fish movement. The data are also presented in Table 6.4-4.

Forest Service Road 017 fords Drews Creek at station DR-2. Below this crossing, the stream becomes mostly low gradient riffles and runs with open streamside vegetation including grasses and open pine woods. Cattle damage in the form of bank erosion and siltation is moderate in this reach. A fairly wide, wet meadow opens up below this point and the stream becomes a series of multiple channels formed by numerous beaver dams. Several locations are marked by impassable dams and their corresponding pools. The main channel, where recognizable, can be characterized as a meandering series of pool-riffle combinations with steep cut banks. The creek is generally four to eight feet wide and the depth generally less than one foot deep (pools behind beaver dams are wider and deeper). Little overhead cover is present in the meadow; however, several six inch redband trout were observed in the pools. Stream survey data for Drews Creek in the vicinity of station DR-2.4 (Table 6.4-5) shows the riffle/pool ratio and the overall low gradient conditions.

Below station DR-2.4, as Drews Creek flows out of the meadow area, the valley becomes narrower and stream habitat is again dominated by riffle-run combinations. Beavers also use this reach but to a lesser extent. Streamside vegetation

TABLE 6.4-5

STREAM SURVEY DATA FROM DREWS CREEK, STATION DR-2.4
AUGUST 26, 1987

Habitat Type	Length (ft)	Average Depth (ft)	Average Width (ft)	Gradient (%)
pool	63.0		6.0	0.5
riffle	24.9		6.0	
pool	17.1	0.8	6.0	
riffle	24.9		6.0	
pool	17.1		8.0	
riffle	22.0		5.0	
pool	40.0	1.0	4.0	
riffle	18.0			
pool	34.1			
riffle	38.1		5.0	1.0
pool	49.9	1.3	5.0	
Total length:	349.1			

riffle:pool ratio = 1.0 : 1.7

The April 1988 data reflect cold-water, winter conditions illustrated by the abundance of diatoms (yellow-green algae) and the relative scarcity of blue-green and green algae as illustrated below:

STATION	Blue-green	Yellow-green	Green
DR-2.4	5	26	1
DR-3	3	38	2

Algal abundance in samples was not based on plant cell counts or biomass, but on frequency of intercepts within a sample counting cell. The large, colonial blue-green alga, Nostoc verrucosum, was the most abundant blue-green in samples from six of the nine stations sampled. Oscillatoria spp. and Rivularis sp. were also very abundant blue-greens. The most abundant yellow-green algae were the species Nitzschia sp. #1, Cocconeis placentula, Navicula spp., Fragilaria vaucheriae, and Synedra ulna v. oxyrhynchus. Green algal species were not relatively abundant in the samples.

6.4.3.3 Benthic Invertebrates

A total of 40 taxa as collected in October samples from station DR-1 (Table 6.4-1). October samples from station DR-3 had a similar number of taxa (45); however, the number of individuals was greater at DR-3 than at DR-1 primarily due to large numbers of larval aquatic beetles at DR-3. Total numbers of individuals were much higher during August at station DR-2.4 than in October at either station DR-1 or DR-3. A greater number of Chironomid and caddisfly (primarily Hydropsyche sp. and Agapetus taho) larvae in August were largely responsible for this difference in total numbers.

April 1988 samples at DR-2.4 were similar in diversity to August 1987 samples at the same location. The Shannon diversity and Pielou evenness indices were both somewhat higher than in August.

The invertebrate communities at station DR-3 during October 1987 and April 1988 were similar in composition and diversity with the exception of the Plecoptera (stoneflies). Abundance was also similar except for the presence of large numbers of coleoptera larvae.

Concentrations of the clam, Margaritifera falcata, were observed in several locations along Drews Creek. Concentrations of clams were found primarily in areas of sand and mud deposition along the edges of the main flow. Two quantitative samples in the area of Station DR-2.4 found clam densities of 20 and 48 individuals per square foot of substrate. The clams ranged in length from 0.9 inches (22 mm) to 3.2 inches (81 mm). Further discussion of these clams as

TABLE 6.4-6

SPECIES AND SIZE RANGES OF FISH COLLECTED BY ELECTROFISHING IN DREWS CREEK ON NOVEMBER 10, 1987 AND APRIL 7, 1988

DATE	STATION	SPECIES	NUMBER OF FISH	LENGTH RANGE inches(mm)	WATER TEMP.°F(°C)
10 Nov 87	below DR-2.4	trout	3	3.0 - 3.5 (75.5 - 90.0)	46.4 (8.0)
10 Nov 87	DR-2.4	trout	4	3.0 - 10.3 (77 - 262)	46.4 (8.0)
		lamprey	1	3.5 (89.0)	
10 Nov 87	above DR-2.4	trout	2	5.4 - 5.6 (137 - 142)	46.4 (8.0)
10 Nov 87	DR-3	trout	2	2.8 - 4.8 (70 - 123)	46.4 (8.0)
06 Apr 88	DR-2.4	trout	1	3.2 (81)	49.6 (9.8)
07 Apr 88	DR-2.4	trout	2	3.9 - 5.5 (99 - 140)	40.6 (4.8)

trout = redband trout
lamprey = Pacific lamprey (ammocoetes)
dace = speckled dace

- fish habitat: no spawning gravel, good rearing gravel, instream shelter, poor undercut banks, good overhanging vegetation, fair shade.

The Angel Creek drainage also does not generally appear to provide good quality habitat for fish and other aquatic species. Low water during 1987 certainly showed an extreme condition, but severe degradation by livestock and the absence of structure or cover in the large meadow sections of the stream result in poor habitat. The middle section of the stream, in the steeper gradient area between the meadows, offers the best habitat for trout, and contained a relatively high diversity of aquatic plants and animals for the drainage. The small tributary above Angel Spring also has a diversity of plant and animal life, but is too small to provide adequate fish habitat.

Drews Creek provides a sharp contrast to Quartz and Angel Creeks. Drews Creek drains a relatively large watershed east of the study area. The drainage is fed by numerous springs, which maintain streamflow throughout the year. The extensive beaver marshes in the eastern, low gradient part of the study area provide pond and wetland habitat that is not found in the smaller drainages of Quartz and Angel Creeks. The steep gradient section below the beaver meadow, extending to Highway 140 and below, provides variable habitat including cascade and pool, and ample cover from boulders, logs, and riparian shrubs and trees. Livestock damage is moderate to severe in the meadow area and above; some livestock damage is also evident in the steeper part of the stream.

6.5.2 Aquatic Plants

Periphyton samples from Quartz Creek were dominated by diatoms and diatom spores. These results are not unusual considering the prevailing cold weather conditions during April 1988; diatoms are generally adaptive to cold water, low nutrient conditions. The dominance of Chrysophyte spores may indicate that many diatoms are still in an overwintering state until warmer conditions occur.

The diversity of algae in samples from Drews Creek is typical of Northwest streams (Geiger, pers. comm. 1987). A few species in the samples, particularly the abundant Nostoc verrucosum, are known to fix atmospheric nitrogen. It is not clear whether or not the abundance of this species in Drews Creek is an indication of nitrogen limitation. Algal biomass provides an important food source for a large variety of aquatic insects, clams and other invertebrates, thus forming an important base for many aquatic food webs.

(ODFW undated). Studies of redband trout have shown that few fish survive past three years, the age of first spawning.

The ODFW has no particular management strategy for redband trout, primarily because it is not heavily fished. Some hatchery work was conducted in an attempt to develop a brood stock of this species; this work was not successful, and has been discontinued (Griggs, pers. comm. 1987).

Redband trout were observed in moderate numbers in the lower section of Quartz Creek, and a few were collected in the meadow section along highway 140. The typical distribution of redband trout in this stream is not evident from observations made during the low water conditions of 1987. The lower section of the stream definitely provides good habitat for redband trout. The presence of large, mature fish in the meadow along the highway indicates that fish are possibly distributed into the middle and perhaps upper parts of the drainage, if water is available. The carrying capacity of Quartz Creek for redband trout, particularly in the study area, appears to be marginal.

Redband trout were observed or collected in most sections of Drews Creek. Collected fish were in at least 2 or 3 age groups, judging from size distribution. Comparison with length at age data for other southeastern Oregon drainages (Kunkel 1976) suggests that most fish collected in Drews Creek were age I to III, with one fish perhaps age V.

In summary, redband trout are present in all three drainages within the study area. Redband trout are widely distributed in Drews Creek, where they appear to be successfully reproducing. Redband trout were fairly abundant in lower Quartz Creek. The presence of mature individuals in the Quartz Creek meadow (along Highway 140) suggests that the species could be more widely distributed in the upper sections of that stream during more normal water conditions than experienced during 1987. Whether or not this species spawns in the upper part of Quartz Creek cannot be answered with the present data base.

The observation of redband trout in a small pool in the middle section of Angel Creek indicates that this species could be more widely distributed in that stream during a more normal water year. In a sense, the pool in Angel Creek, like the pools in the Quartz Creek meadow, might serve as refuges for trout and other fish during periods of extreme low water; these fish can then re-populate other sections of the streams when water levels return to normal.

Fish survey records for Drews Reservoir were examined from the files of ODFW in Lakeview, OR (Anderson, pers. comm.,

6.6 GLOSSARY

BEDROCK - stream substrate consisting of solid rock.

BENTHIC - pertaining to organisms that live on the bottom of lakes or streams.

BIOACCUMULATION - pertains to the accumulation of organic or inorganic chemicals and compounds in living tissue.

BOULDER - stream substrate of rock fragments greater than nine inches and less than 24 inches in diameter.

COBBLE - stream substrate of rock fragments from two to nine inches in diameter.

CASCADE - a short,steep drop in stream bed elevation often marked by boulders and agitated white water.

CONFLUENCE - the point where two streams or rivers join

DIATOM - a type of single celled algae which may be free-floating in water or attached to substrates in lakes and streams.

DIVERSITY - a measure of the number of different taxa

EVENNESS - a diversity measure

GRAVEL - stream substrate of rock fragments from 0.2 inches to two inches in diameter.

INSTAR - stage in the development of aquatic insects.

INTERMITTENT STREAM - stream that flows only in response to precipitation or snow melt, little or not continued supply from spring.

LARGE BOULDERS - stream substrate 24 inches or more in diameter.

PERIPHYTON - attached algae on natural substrates

POOL - a small and relatively deep body of quiet water in a stream or river

RIFFLE - a shallow rapids in an open stream where the surface is broken into waves by submerged obstructions.

RIPARIAN - pertaining to vegetation along banks of a stream.

6.7 PUBLIC AND AGENCY CONTACTS

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Ken Rogers
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Bly, OR

6.9 LIST OF PRINCIPAL PREPARERS

6.9.1 Paul A. Fishman

Paul Fishman, owner of Fishman Environmental Services (FES), has conducted numerous freshwater ecology studies over the past 20+ years. Recent and on-going studies include surveys of Columbia Basin anadromous fish hatcheries, stream flow studies, wetland assessments and impact mitigation. As a senior ecologist on the Quartz Hill Molybdenum Project in SE Alaska, Mr. Fishman was responsible for marine and estuarine fish studies for the baseline and monitoring phases of the project for U.S. Borax and Chemical Corp.

6.9.2 Steven R. Johnson

Steve Johnson has 12 years experience as a fisheries biologist conducting impact assessment and mitigative planning for water related projects. His experience with mining industries projects includes conducting aquatic biology studies for the Mt. Tolman Copper and Molybdenum Mine in Washington and an oil shale development project in western Colorado.

6.9.3 N. Stan Geiger

Stan Geiger, director of Scientific Resources Inc. (SRI), is an aquatic plant ecologist with 15 years experience in aquatic resource analysis, aquatic macrophyte ecology and algal taxonomy and ecology. Mr. Geiger's experience with algal taxonomy and ecology include published and presented papers on the planktonic algae of Crater Lake, Oregon and the post-eruption phytoplankton in Spirit Lake, Washington.

6.9.4 Robert Wisseman

Bob Wisseman, an aquatic ecologist, provided invertebrate taxonomic identification and data analysis for the Quartz Mountain Gold Project. Mr. Wisseman has over 10 years experience in design and implementation of aquatic research projects throughout the United States. His experience with mining projects includes an invertebrate baseline study for Sunbeam mines in Stanley, Idaho and seasonal monitoring of streams in the vicinity of Asarco mines in western Montana.

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RUN - a section of relatively smooth flowing water.

SAND - coarse-grained mineral sediments with diameters less than two mm and greater than 0.062mm.

THALWEG - The middle or chief navigable channel of a waterway.

WETLANDS - lands transitional to terrestrial and aquatic systems where the water table is at or near the surface.

26 August 1987). Species recorded as present in the reservoir include: trout, bridgelip sucker, roach, brown bullhead, white crappie, black crappie, yellow perch, bluegill, largemouth bass, pumpkinseed, lamprey and dace. Channel catfish were planted in the reservoir during 1979. Most of these species would not be expected to migrate into Drews Creek.

Redband trout is listed, in the Fremont National Forest Draft Management Plan, as a native species that would suffer population reductions as a result of changes in habitat related to timber and/or range management and human disturbance (USFS 1987). Drews Creek is identified in the Forest Plan as 1 of 25 streams on the Fremont National Forest that produce 85 percent or more of all stream-based fishing. Lower Drews Creek is described as having POOR fish habitat condition due to low flow, siltation and temperature problems. The potential for improvement is listed as VERY LOW due to the Drews Reservoir situation. Survey priority is VERY LOW. Upper Drews Creek is described as having FAIR/POOR fish habitat conditions, due to shade and bank stability factors. The potential for improvement is listed as MODERATE at local sites. Survey priority has been assigned "R" for rehabilitation survey (USFS 1987).

6.5.3 Benthic Invertebrates

Diversity and evenness values for the Quartz Creek benthic invertebrate community were relatively low compared to other montane streams. The low values reflect the non-perennial nature of the stream habitat. Intermittent seasonal stream-flows, siltation from snow melt and degradation from cattle use limit invertebrate species colonization in Quartz Creek. Oligochaete worms and several taxa of Diptera (primarily Chironomidae) were the most successful colonizers.

The benthic fauna collected from Drews Creek are generally typical of western montane streams with a coniferous canopy. Several taxa in this assemblage are more typical of low gradient streams with high summer temperatures and limited riparian vegetation. These taxa include the snails Physella sp. and Stagnicola sp., the clam Margaritifera falcata, the dragonflies Argia sp. and Cordulegaster dorsalis, the caddisflies Hydroptila sp. and Helicopsyche borealis, and the beetles Dytisicidae and Hydrophilidae. The taxa collected from Drews Creek are fairly typical and widely distributed throughout the western states. In general, they can also be classified as tolerant to extreme conditions such as high summer temperatures and high algal production.

Diversity and evenness values for Drews Creek were generally on the high end compared to values for other small western streams.

6.5.4 Fish Populations

Three species of fish were observed or collected in the study area streams during 1987. Speckled dace were found in Quartz, Angel and Drews Creeks. This species is found in the United States and Canada west of the Continental Divide, generally in shallow water less than 3 ft deep (Wydoski and Whitney 1979). Adult dace feed on aquatic insects and algae, and are forage for trout. One Pacific lamprey larva (ammocoetes) was collected from Drews Creek; this species, usually found in coastal streams, is landlocked in Goose Lake (Bond 1973). Lamprey ammocoetes filter plant and animal plankton from the water.

Redband trout were observed and collected in all three drainages in the study area. The redband was first described from streams on the high desert plateaus of southeastern Oregon, and later from tributaries of some northern California rivers (ODFW undated). This species has characteristics of rainbow, cutthroat and California golden trout, but is distinguished by coloration, spotting and meristic counts. Redband trout are well adapted to their environment, and do well in harsh environments, including elevated temperatures

6.5 DISCUSSION

6.5.1 Quality of Aquatic Habitat

The major factor determining the quality and usability of the aquatic environment for aquatic species in the Quartz Mountain Gold Project area is the amount of surface water. This was particularly true during the summer and fall of 1987, which was a record (10 year) low water year. Most of the streams within the project area were dry through the summer and fall, providing little or no aquatic habitat.

Quartz Creek within the study area had water primarily in the lower portion of the large meadow along highway 140. Available habitat was restricted to the pools behind rock check dams and some deeper parts of the stream channel. Livestock damage to the stream is severe; extensive erosion and breakdown of stream banks, and lack of shade-producing riparian vegetation result in poor habitat quality. Low flows and lack of shade also resulted in extensive algal growth during the summer. Water temperatures were only moderately high during summer months, this indicates some influence from groundwater discharge.

Quartz Creek below the study area, to the confluence with Butcher Creek, has poor quality habitat for trout and other aquatic species. This reach is generally shallow, has few pools, poor shade-producing riparian cover, and is moderately to severely degraded by livestock activity. Parts of the stream were dry during the 1987 field visits; flows were low in sections with water.

The combination of water from Butcher Creek, and possibly the increased gradient and reduced accessibility for livestock in the lower section of Quartz Creek results in good quality aquatic habitat. A well developed willow/aspen shrub riparian border provides ample shade in this section. Cascade and pool habitat is abundant due to the gradient and boulder substrates. A habitat survey conducted on this section by the US Forest Service during August, 1979 (USFS 1979) described the section as follows:

- forested - shade = 40% - water = 54°F
- flow = 5.7 cfs - pool area = 40% - riffle area = 60%
- percent canopy cover = 70%
- percent ground cover = 75%
- bank condition: 90% or more of bank free of damage
- riparian features/activity: roads, cow path, moderate beaver activity

indicators for the presence of organic chemicals and metals in water appears in Section 6.6.

6.4.3.4 Fish

Small redband trout (*Salmo* sp.), three to five inches in length, were observed throughout Drews Creek during August, October, and November 1987 field visits. Table 6.4-6 summarizes electrofishing data from Drews Creek in November 1987 and April 1988. Several larger redband trout up to 10 inches in length were collected in the study reach (DR-2.4) as well as in the beaver ponds upstream of DR-2.4. A juvenile Pacific lamprey (*Lampetra tridentata*), three and one-half inches in length, was also collected in this section of the creek.

increases, mostly in the form of pine trees and willows. The riffle-run ratio is roughly 50:50 with only a few small pools. Several hundred feet downstream from this point, the surrounding meadow and woods give rise to steep rock walls. The stream habitat becomes steep cascades and pools with large boulders at this point. A seemingly impassable falls approximately eight feet high blocks upstream fish movement through this reach; however, numerous trout in the 8-10 inch range were observed both upstream and downstream of this obstacle.

Drews Creek in the vicinity of station DR-3 remains fairly steep with cascades and pools the dominant stream habitat types. The gradient is moderately steep (2 - 2.5%), good riparian cover such as willow, aspen, and thick shrubs line both banks, and there is little evidence of cattle in the area. Good instream fish cover from large boulders and good access from Forest Service road 017 make this a commonly used fishing area.

Drews Creek along Highway 140 can best be characterized as a series of medium height cascades with intermittent pools and runs. The riffle:run:pool ratio is approximately 1.3 : 1.5 : 1.0. The stream gradient varies from one percent up to four percent in cascade areas. The creek substrate consists primarily of cobble and mud. There is limited shade from the riparian zone along the banks since vegetation consists mostly of grasses. Average depths were approximately 0.5 feet in the riffles and runs while pools averaged one foot in depth.

6.4.3.2 Aquatic Plants

Periphyton sampling during 1987 at three stations in Drews Creek resulted in the identification of 61 algae taxa; 10 blue-green algae (Cyanophyta), 46 yellow-green algae (Chrysophyta), mostly diatoms, and 5 green algae (Chlorophyta). A list of alga species, and percent relative abundance is presented in Appendix 6-A. The number of taxa per algal type for each station in 1987 is summarized below:

STATION	Blue-green	Yellow-green	Green
DR-1	7	25	1
DR-2.4	7	31	2
DR-3	9	26	2

This diversity is comparable between stations.

An additional 22 taxa were collected during April 1988. Of these, 1 was blue-green, 19 yellow-green, and 2 green algae.

TABLE 6.4-4

STREAM SURVEY DATA FROM DREWS CREEK STATIONS DR1
OCTOBER 2, 1987

Unit	Habitat Type	Length (ft)	Average Depth (ft)	Average Width (ft)	Gradient (%)
STATION DR-1, SECTION A[1]					
1	riffle	70.5	0.5	4.0	2.0
	pool	15.7	1.0	3.0	1.5
	run, w/boulder	25.9	0.7	5.0	2.5
	riffle	33.8	0.4	4.0	2.5
2	run	26.2	0.5	4.0	1.5
	riffle	6.6	0.4	4.0	nd
	run, w/boulders	13.8	0.4	4.0	nd
	riffle, log jam	13.5	0.3	3.0	nd
	run	22.0	0.5	5.0	nd
3	riffle	18.2	0.4	5.0	3.5
	run	11.5	0.6	4.0	nd
	riffle	19.0	0.3	5.0	nd
	run	9.8	0.5	5.0	nd
	pools/cascades	41.0	0.7	8.5	nd
Total length	=	328.1			

Section A riffle:run:pool ratio = 2.9:2.0:1.0

UNIT	LENGTH (ft)	RIFFLE:RUN:POOL RATIO (%)	PERCENT SHADE	GRADIENT (%)
STATION DR-1 SECTION B[1]				
1	127.1	63.3:30.2:6.5	25 - 30	2.5 - 3.5
2	45.7	55.8:32.8:2.7 log jam 9.5	15 - 25	"
3	113.4	60.5:26.6:12.9	70 - 90	"
4	180.1	59.4:34.5:6.1	30 - 50	
5	275.2	57.8:35.6:6.6	50	
6	346.6	47.5:48.8:3.7	50	
Total length =	1088.1			

Section B riffle:run:pool ratio = 9.0:5.4:1.0; log jam = 1.6

[1] Section A is a 100 m (328.1 ft) section from station DR-1 downstream; Section B is from the downstream end of Section A to station DR-2.

nd = no data

canyon. This channel was dry during autumn, 1987, except for several areas of isolated, shallow pools.

Stream survey data recorded for lower Angel Creek (AC6) are presented below (1 October, 1987):

Channel width: 6 ft — Thalweg depth: 3 ft
Percent of unit in pools: <1
Percent of unit shaded: 0
Turbidity: 1-2 ft visibility (estimate)
Water temperature: 54.5°F (12.5°C) (isolated pools)
Flow: none
Gradient: flat
Streamside cover type: grass
Comments: stream channel severely eroded and damaged by livestock

6.4.2.2. Aquatic Plants

Periphyton samples were not obtained from the Angel Creek drainage.

6.4.2.3. Benthic Invertebrates

Random qualitative sampling in the headwaters of Angel Spring Creek (AS) resulted in the identification of 11 taxa, including: mayflies, caddisflies, beetles, crane flies, and midge flies (Table 6.4-2).

Qualitative sampling at station AC-5 identified 13 invertebrate taxa, including ostracods, snails, damselflies, dragonflies, mayflies, caddisflies, stoneflies, beetles, black flies, and midge flies (Table 6.4-2).

A qualitative sampling of invertebrates was taken from the lower Angel Creek irrigation ditch (station AC-6) during late August, 1987. This sample contained 11 taxa of invertebrates, including snails, mayflies, caddisflies, stoneflies, beetles, and midge flies (Table 6.4-2).

6.4.2.4 Fish

Speckled dace were found in the pool at the lower end of the upper meadow on Angel Creek (AC-4), and in isolated pools in the lower meadow just above the confluence with Quartz Creek. Two small redband trout, about 5-6 inches in length, were observed in the small pool at AC-5, in the middle section of Angel Creek.

particularly in the flatter stream sections such as QC-4 and BA-3.

6.4.2 Angel Creek

6.4.2.1 Stream Surveys

The Angel Creek drainage was surveyed during late August and early October, 1987. The drainage consists of 3 major sections: 1) headwaters and Angel Camp Meadow, 2) a steeper gradient middle section, and, 3) the lower meadow along Highway 140. The upper section originates above a long, narrow high meadow containing Angel Camp (5400 - 5500 feet elevation). The portion above Angel Camp meadow is a small channel with occasionally exposed rock, cobble or boulder bed material. The creek had no flowing water either above or in the meadow during the August and October field visits. Small pools were found in places where the creek channel was deeper than in surrounding areas. Surface water, with a very slight flow, was found at the lower end of the meadow. A pool, measuring about 10 ft across and 2½ ft deep, drained into a shallow vegetated channel (emergent wetland plants), which flowed into a second, smaller pool. The creek bed was dry above the first pool and below the second pool.

The stream survey data recorded for the Angel Camp meadow are summarized below:

Angel Camp Meadow, except lower end (Stations AC-2, AC-3):

Channel width: 2 - 10 ft Thalweg depth: <1 - 6 ft
Percent of unit in pools: <10
Percent of unit shaded: <1
Gradient: flat
Streamside cover type: grass
Comments: no flowing water, creek mostly dry with occasional small pools; very severe damage from livestock.

Angel Camp Meadow: lower end (AC-4):

Channel width: 10 ft Thalweg depth: <1 - 2.5 ft
Percent of unit in pools: <10
Percent of unit shaded: 30
Turbidity: 1 - 2 ft visibility
Water temperature: 58.1°F (14.5°C) (25 Aug., 1 Oct. 1987)
Flow: <0.1 cfs
Gradient: flat, approx. 1%
Streamside cover type: grass, scattered pines
Comments: creek bed dry above and below this section (length of section = 300 - 500 ft).

TABLE 6.4-2 Continued.

	STATIONS						
	DR1	DR2.4	DR3	AC5	AC6	AS	QC4
Dytiscidae (larvae)							x
Hydrophilidae (adult)						x	
Psephenidae							
Eubrianax edwardsi	x	x	x	x	x		x
Elmidae							
Heterlimnius corpulentus		x					x
Optioservus quadrimaculatus	x	x	x				
Zaitzevia sp.	x	x	x				
Diptera-Other							
Tipulidae							
Antocha sp.	x	x	x				x
Dicranota sp.		x	x				
Hexatoma sp.		x	x				
Tipula sp.						x	
Simuliidae		x	x				x
Simulium sp.			x	x	x		
Psychodidae							
Pericoma sp.	x	x	x				
Ceratopogonidae	x	x	x				x
Dixidae		x					
Empididae							
Chelifera sp.			x				
Tabanidae			x				
Diptera-Chironomidae							
Chironomidae	x	x	x				
Corynoneura sp.						x	
Cricotopus sp.	x	x	x		x		
Cricotopus (*Nostococladius*) sp.	x	x	x	x			
Micropsectra sp.	x	x	x				x
Orthocladius sp.	x	x				x	x
Orthocladius (*Euorthocladius*) sp.		x	x				x
Pagastia sp.		x					
Parametriocnemus sp.		x	x				x
Paratrichocladius sp.	x	x	x	x			
Polypedilum sp.		x					
Pseudodiamesa sp.			x				x
Rheocricotopus sp.		x					x
Thienemannimyia sp.		x	x				x
Tvetenia Bavarica Group		x	x	x	x		

1 See Figure 1.2-2 for station locations. DR = Drews Cr., AC = Angel Cr., AS = Angel Spring, QC = Quartz Cr.

2 Presence is denoted at each station by an x.

TABLE 6.4-2

BENTHIC INVERTEBRATE TAXA LIST FOR
DREWS, ANGEL AND QUARTZ CREEKS, LAKE COUNTY, OREGON
AUGUST AND OCTOBER 1987, AND APRIL,1988

	STATIONS						
	DR1	DR2.4	DR3	AC5	AC6	AS	QC4
Turbellaria	x						x
Nematoda		x	x		x		x
Oligochaeta	x	x	x				x
Ostracoda		x		x			
Acari			x				
Gastropoda							
Physidae							
Physella sp.		x	x		x		
Lymnaeidae							
Stagnicola sp.				x			
Sphaeriidae		x	x				
Pelecypoda							
Unionacea: Margaritiferidae							
Margaritifera falcata		x					
Odonata							
Zygoptera: Coenagrionidae							
Argia sp.	x	x		x			
Anisoptera: Cordulegastridae							
Cordulegaster dorsalis	x		x	x			
Ephemeroptera							
Siphlonuridae							
Ameletus sp.		x				x	
Baetidae							
Baetis tricaudatus	x	x	x	x	x		
Leptophlebiidae							
Paraleptophlebia sp.	x	x	x	x		x	
Heptageniidae							
Cinygma sp.	x	x				x	
Cinygmula sp.			x				
Drunella sp.		x	x				
Epeorus (*Iron*) sp.	x	x	x				
Rhithrogena sp.		x	x				
Tricorythodes minutes			x				
Ephemerellidae							
Ephemerella inermis	x	x	x				
Serratella tibialis		x					
Plecoptera							
Peltoperlidae							
Yoraperla brevis	x	x					
Nemouridae							
Prostoia besametsa		x	x				x
Zapada cinctipes	x	x	x		x		

Plecoptera (continued)

1 See Figure 1.2-2 for station locations. DR = Drews Cr., AC = Angel Cr., AS = Angel Spring, QC = Quartz Cr.

2 Presence is denoted at each station by an x.

immediately upstream of the confluence with Drews Creek. This waterfall could present a barrier to fish migrating upstream.

6.4.1.2 Aquatic Plants

Periphyton samples were not collected from Quartz Creek during summer or fall 1987 due to lack of surface flow within the study area. The pool areas behind the meadow check dams were choked with filamentous green algae during the summer.

April 1988 periphyton sampling in Quartz Creek resulted in identification of 19 algal taxa (Appendix 6-A). The breakdown by phyla showed no blue-green algae (Cyanophyta) present, 18 yellow-green (Chrysophyta) taxa, and 1 green algae (Chlorophyta). The most abundant algal taxa were diatoms such as Gonphonema angustatum, Nitzschia paleacea, Synedra ulna and unidentified diatom spores.

6.4.1.3 Benthic Invertebrates

Benthic invertebrates were not collected from Quartz Creek during summer or fall 1987 due to lack of surface flow; however, replicate samples were collected at station QC-4 in April 1988.

A total of 20 taxa were collected from April sampling at QC-4 (Table 6.4-1). Half of these taxa were aquatic Diptera (fly) comprised mostly of larvae of the family Chironomidae. The Diptera family Simuliidae was the most numerically abundant taxon. Oligochaete worms were also numerically abundant in Quartz Creek.

A complete taxa list for Drews, Angel and Quartz Creeks is presented in Table 6.4-2.

6.4.1.4 Fish

During the August visit, the only fish observed were Speckled dace (Rhinichthys osculus). These were observed in Quartz Creek just below the meadow during the August visit.

During November, small trout were observed in several locations below the confluence with Butcher Creek. Speckled dace were abundant in the meadow pools during November sampling; lengths ranged from 1.4 to 3.3 inches (36 to 85 mm) (Table 6.4-1). Three redband trout (Salmo sp.) were also collected from these shallow pools; fish lengths were 7.1, 7.2 and 9.9 inches (183, 185 and 255 mm). These trout appeared to be in good physical condition.

Several redband trout (all < five inches) were collected during April 1988 (Table 6.4-3). Speckled dace were numerous,

6.3.4 Fish

Visual observation, dipnetting, and electrofishing were used to determine the presence or absence, species composition, and abundance of fish in study area streams. Extreme low water conditions precluded use of electrofishing gear during August and October 1987 visits to Quartz and Angel Creeks, dipnets were therefore used for fish capture wherever individuals were observed. A Smith-Root backpack electrofisher was used during the November 1987 and April 1988 field visits to sample all three drainages. Electrofishing effort was limited to usable fish habitat e.g., pools, obstructions, and other likely fish holding areas in the meadow area of Quartz Creek. Electrofishing was also conducted at stations DR-2.4, DR-3 and DR-4 in Drews Creek. Extreme low water conditions continued into fall 1987 making thorough sampling of Angel and Quartz Creeks difficult.

6.3 METHODS

6.3.1 Stream Surveys

Quartz, Angel, and Drews Creeks are the major tributaries draining the Quartz Mountain Gold Project study area. Stream surveys were conducted to characterize the physical properties of each of these drainages. Techniques used to characterize these stream reaches varied due to the unusually low flow levels resulting from low rainfall conditions during summer and fall 1987. Quartz Creek was surveyed on 28 August 1987 near the Oregon State Highway 140 crossing. The survey was limited to visual assessment of physical parameters augmented by occasional streambed measurements. The dry stream channel above the Highway 140 meadow was also walked to assess the gradient and channel configuration. An additional segment of Quartz Creek extending from Highway 140 downstream to its confluence with Drews Creek was assessed visually during a 9 November 1987 survey. Upper Quartz Creek from the headwaters down to the meteorology station at the western end of Quartz meadow was visually assessed during April 1988. Continued low water conditions precluded more intensive stream evaluation of this area.

Angel Creek was dry through most of the upper meadow area (stations AC-1 through AC-4, Figure 1.2-1) during surveys. This section was assessed visually and data recorded on Oregon Department of Fish and Wildlife (ODFW) physical and biological stream survey forms. Physical parameters assessed on this survey included stream width, depth, temperature, gravel and pool data, shade, and cover. Presence of fish species was recorded in addition to any factors limiting their use of the stream. Similar survey data were collected in the hillside spring reach of Angel Creek (AC-5) as well as the lower meadow station (AC-6) near Quartz Creek. Angel Springs (AS), at the lower end of a tributary to Angel Creek entering the upper meadow from the east, was assessed visually from its source to its confluence with Angel Creek during the October field visit.

Four stream segments of Drews Creek were surveyed using the ODFW survey criteria described for Angel Creek (stations DR-1 through DR-3; Figure 1.2-1) during surveys. In addition, several 328.1 ft (100 m) segments along two of the Drews Creek biological sampling stations (DR-1 and DR-2.4) were surveyed to characterize the stream gradient and the riffle/run/pool ratio.

6.1.2 Study Area

6.1.2.1 General

The Quartz Mountain Gold Project study area is located 25 miles west of Lakeview, Oregon on the north side of Oregon State Highway 140 in Lake County, Oregon. Quartz Mountain Pass (Elevation 5504 ft) marks the main entry point from the west to the study area. Quartz Mountain divides two major drainage basins as identified by the Oregon Water Resources Department (OWRD). The Sprague River Drainage Basin flows to the west of Quartz Mountain while the Goose and Summer Lakes Drainage Basin drains the study area to the east. The Quartz Mountain study area is shown in Figure 1.1-1.

6.1.2.2 Aquatic

The aquatic biology study area includes the Quartz, Angel, and Drews Creek drainages (Figure 1.2-1). Angel Creek, the largest drainage contained in the study area, is a tributary of Quartz Creek which, in turn, drains into Drews Creek. The Quartz Creek drainage consists of a small intermittent stream near it's headwaters which flows into a wetland meadow along Oregon State Highway 140. The meadow is fed by several springs. Angel Creek is also an intermittent spring-fed stream which flows into the lower end of the Quartz Creek meadow. Drews Creek flows through the eastern portion of the study area where it is joined by Quartz Creek.

high summer temperatures, high algal production, and limited cover.

The redband trout inhabits all three streams in the study area, although in periods of low flow in Angel and Quartz Creeks, it is confined to pools in the deeper reaches. Successful reproduction of redband trout is probably limited to Drews Creek due to higher flows, the presence of riparian and instream cover, and the presence of spawning gravel. Other fish species were also observed in all three drainages.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Portland Field Office
727 NE 24th Avenue
Portland, OR 97232

January 28, 1987

Refer to: 1-7-87-TA-36

Lynn Sharp
10906 S. E. 54th Place
Milwaukie, OR 97222

Dear Ms. Sharp:

This is in response to your letter, dated December 1, 1986 requesting information on listed and proposed endangered and threatened species which may be present within the area of the proposed gold mine at T37S, R16E, Sec 21-23 and 26-28 near Lakeview, Oregon.

To the best of our present knowledge there are no listed or proposed species occurring within the area of the subject project. Should a species become officially listed or proposed before completion of the project, Fremont National Forest will be required to reevaluate its responsibilities under the Act.

We appreciate your concern for endangered species.

Sincerely yours,

Russell D. Peterson

Russell D. Peterson
Field Supervisor

cc:
RO (AFA/SE)
PFO (ES)
ODFW (Nongame)
ONHP

1SHARP.DH.BO.GBWPES:01/30/87

mammal88

Table 5D-2. Summary of 1988 Mammal Track Observations in the Quartz Mountain Study Area.

Species	2-10 Corral to Ang Ck, N. Butte	2-10 Crone Hill South Side	2-11 Crone to top QzBtte N. to Corral EuwanaC	2-11 Corral to Buck Horn Spring	2-12 East Side Qtz Mtn	Total Obs.	% of Total Obs.
	Number of Observations						
Coyote	14	5	3	1	2	25	25.77
Fox sp.						0	.00
Black bear						0	.00
Raccoon		1				1	1.03
Pine marten					1	1	1.03
Striped skunk						0	.00
Ermine	4		2			6	6.19
Long-tailed weasel	1		1			2	2.06
Badger						0	.00
Mountain lion	1		2	1		4	4.12
Elk						0	.00
Mule deer						0	.00
Yellow-bellied marmot						0	.00
Northern flying squirrel						0	.00
Golden-mantled grnd. sq.						0	.00
Belding's ground squirrel						0	.00
Yellow-pine chipmunk						0	.00
Least chipmunk						0	.00
Chipmunk sp.						0	.00
Douglas' squirrel						0	.00
Squirrel sp.	8	6	12	5	1	32	32.99
Pocket gopher						0	.00
Beaver						0	.00
Bushy-tailed woodrat						0	.00
Deer mouse						0	.00
Vole sp.						0	.00
Mouse sp.			1	1		2	2.06
Porcupine	6		2	2	1	11	11.34
Snowshoe hare	1	1	10		1	13	13.40
Total mammals observed	35	13	33	10	6	97	100.00

Table 5D-1. Summary of 1986-1987 Mammal Observations in the Quartz Mountain Study Area.

Number of Observations

Species	12-8 Crone & N no nmbrs	12-9 same plus W side Ang Pk	7-15 Qtz Mtn to top	7-15 Crone mea dow N	7-15 Drews Crk	7-16 Stand ard Sur vey	7-16 Ang Pk plateau meadow camp	7-17 snowed trans line to Ang Ck	8-26 to 8-28 no nmbrs	10-19 Stand ard Sur vey
Coyote	1						2	1	1	2
Fox sp.		1								
Black bear										
Raccoon										1
Marten or Fisher			1							
Striped skunk										
Ermine	1	1								
Long-tailed weasel		1	1							1
Badger							1	1		
Mountain lion										
Elk										
Mule deer		1	1		1		1	2		3
Yellow-bellied marmot					1					
Northern flying squirrel										
Golden-mantled grnd. sq.			4	2		1	4		1	
Belding's ground squirrel							8			
Yellow-pine chipmunk							1			
Least chipmunk										
Chipmunk sp.			6	1		1	4		1	5
Douglas' squirrel	1		3			12	1			6
Squirrel sp.	1	2								
Pocket gopher		1	1	1	3		3	3		3
Beaver					oldsign					
Bushy-tailed woodrat					2					
Deer mouse										
Vole sp.										
Mouse sp.		1								2
Porcupine	1									
Snowshoe hare	1	2					1	1		
Total mammals observed	6	10	17	4	7	14	26	8	3	23

birds88

Table 5C-2. Summary of 1988 Bird Observations in the Quartz Mountain Study Area.

Species	2-10 Corral to Ang C, N. Butte	2-10 Crone Hill South Side	2-11 Crone to top QzButt N. to Corral EuwanC	2-11 Corral to Buck Horn Spring	2-12 East Side Qtz Mtn	Total obser vati ons	Per cent of total
Snow goose						0	.00
Duck sp.						0	.00
Turkey vulture						0	.00
Goshawk	1					1	1.96
Red-tailed hawk			1			1	1.96
Eagle sp.				1		1	1.96
Ruffed grouse						0	.00
Gull sp.						0	.00
Common nighthawk						0	.00
Vaux's swift						0	.00
Belted kingfisher						0	.00
Yellow-bellied sapsucker						0	.00
Williamson's sapsucker						0	.00
Sapsucker sp.						0	.00
Downy woodpecker				1		1	1.96
Hairy woodpecker				1		1	1.96
White-headed woodpecker						0	.00
Black-backed woodpecker						0	.00
Northern flicker						0	.00
Pileated woodpecker	1	1	2			4	7.84
Woodpecker sp.			3			3	5.88
Dusky flycatcher						0	.00
Willow flycatcher						0	.00
Empidonax flycatcher						0	.00
Violet-green swallow						0	.00
Gray jay						0	.00
Steller's jay						0	.00
Clark's nutcracker	1					1	1.96
Common raven						0	.00
Mountain chickadee	2	5	8	4		19	37.25
Red-breasted nuthatch	1					1	1.96
White-breasted nuthatch	1					1	1.96
Pygmy nuthatch						0	.00
Nuthatch sp.			1			1	1.96
Brown creeper						0	.00
House wren						0	.00
Winter wren						0	.00
American dipper						0	.00
Golden-crowned kinglet	2	4	8	2		16	31.37
Western bluebird						0	.00
Mountain bluebird						0	.00
Townsend's solitaire						0	.00
Hermit thrush						0	.00
American robin						0	.00
Varied thrush						0	.00
Solitary vireo						0	.00
Warbling vireo						0	.00
Orange-crowned warbler						0	.00
Nashville warbler						0	.00
Yellow-rumped warbler						0	.00
Western tanager						0	.00
Lazuli bunting						0	.00
Chipping sparrow						0	.00
Dark-eyed junco						0	.00
Western meadowlark						0	.00
Brown-headed cowbird						0	.00
Cassin's finch						0	.00
Red crossbill						0	.00
Pine siskin						0	.00
Evening grosbeak						0	.00
Total birds observed	9	10	23	9		51	100.00

Table 5C-1. Summary of 1986-1987 Bird Observations in the Quartz Mountain Study Area.

Species	1986 12-8 Crone & N no nmbrs	1986 12-9 same plus W side Ang Pk	1987 7-15 Qtz Mtn to top	7-15 Crone mea dow N	7-15 Drews Crk	7-16 Stand ard Sur vey	7-16 Ang Pk plateau meadow camp	7-17 snowed trans line to Ang Ck	8-26 to 8-28 no nmbrs
					Number Observed				
Snow goose									
Duck sp.					2				
Turkey vulture									2
Red-tailed hawk			1			3	3	2	1
Ruffed grouse					1				
Gull sp.							2		
Common nighthawk			1						
Vaux's swift					8				
Belted kingfisher									
Yellow-bellied sapsucker							2		
Williamson's sapsucker							1		
Sapsucker sp.				1		1			
Downy woodpecker			1						
Hairy woodpecker			2	1		1			
White-headed woodpecker						1			
Black-backed woodpecker			1						
Northern flicker			1	1	2	8	6	5	1
Pileated woodpecker	1								
Woodpecker sp.	1		2			5	2		
Dusky flycatcher			7			7	3		
Willow flycatcher									1
Empidonax flycatcher					1			1	
Violet-green swallow					3				
Gray jay							1		1
Steller's jay					1	3		1	1
Clark's nutcracker		1					1		
Common raven								5	
Mountain chickadee	1		8	6		27	8	3	1
Red-breasted nuthatch	1			1		8	1	1	
White-breasted nuthatch			2				1		
Pygmy nuthatch			4				3		
Brown creeper									
House wren							2		
Winter wren									
American dipper					2			1	
Golden-crowned kinglet	2		7			7	3	2	
Western bluebird									
Mountain bluebird							3		
Townsend's solitaire						1	1	2	
Hermit thrush			7			10	3	1	
American robin			4	5	2	9	2	13	
Varied thrush									
Solitary vireo						1	2		
Warbling vireo						2			
Orange-crowned warbler			1						
Nashville warbler							1		
Yellow-rumped warbler			10		1	28	7	1	1
Western tanager			7	1		10	2		
Lazuli bunting					1				
Chipping sparrow			2	4		3	7	1	
Dark-eyed junco			7	4	6	15	5	2	1
Western meadowlark								1	
Brown-headed cowbird						1	3		
Cassin's finch				1					
Red crossbill									
Pine siskin						2			
Evening grosbeak			3		4	1	1		
Total birds observed	6	1	78	25	34	154	76	42	10

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE	SEASONAL OCCURRENCE	STATUS
MAMMALS				
Coyote	Canis latrans	common	resident*	
Fox sp.	Vulpes or Urocyon	rare	resident	
Black bear	Ursus americanus	rare	resident	
Raccoon	Procyon lotor	uncommon	resident	
Marten	Martes americana	uncommon	resident	
Striped skunk	Mephitis mephitis	uncommon	resident	
Ermine	Mustela erminea	uncommon	resident	
Long-tailed weasel	Mustela frenata	uncommon	resident	
Badger	Taxidea taxus	uncommon	resident	
Mountain lion	Felis concolor	rare	resident**	
Elk	Cervus elaphus	uncommon	resident*	
Mule deer	Odocoileus hemoinus	common	resident**	MIS
Yellow-bellied marmot	Marmota flaviventris	uncommon	resident**	
Northern flying squirrel	Glaucomys sabrinus	rare	resident	
Western gray squirrel	Sciurus carolinensis	uncommon	resident	
Golden-mantled ground squirrel	Spermophilus lateralis	common	resident**	
Belding's ground squirrel	Spermophilus beldingi	common	resident**	
Yellow pine chipmunk	Tamias amoenus	common	resident**	
Least chipmunk	Tamias minimus	common	resident**	
Douglas' squirrel	Tamiasciurus douglasii	common	resident*	
Pocket gopher	Thomomys sp. or spp.	common	resident	
Beaver	Castor canadensis	common	resident	
Bushy-tailed woodrat	Neotoma cinerea	common	resident	
Deer mouse	Peromyscus maniculatus	common	resident	
Vole	Microtus sp. or spp.	common	resident	
Porcupine	Erethizon dorsatum	uncommon	resident	
Snowshoe hare	Lepus americanus	common	resident	

TABLE 5.A-1

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE	SEASONAL OCCURRENCE	STATUS
AMPHIBIANS				
Western toad	Bufo boreas	common	resident**	
Frog	Rana or Hyla sp.	common	resident*	
REPTILES				
Western fence lizard	Sceloporus occidentalis	common	resident*	
Sagebrush lizard	Sceloporus graciosus	common	resident*	
Western skink	Eumeces skiltonianus	common	resident**	
Garter snake	Thamnopsis sp. or spp.	common	resident**	
BIRDS				
Snow goose	Chen caerulescens	rare	migrant	
Turkey vulture	Cathartes aura	uncommon	summer	
Red-tailed hawk	Buteo jamaicensis	common	summer*	
Goshawk	Accipiter gentilis	rare	resident	MIS
Ruffed grouse	Bonasa umbellus	uncommon	resident*	
Greater sandhill crane	Grus americana tabida	uncommon	resident	FS
Gull	Larus sp.	rare	summer	
Common nighthawk	Chordeiles minor	rare	summer*	
Vaux's swift	Chaetura vauxi	uncommon	summer	
Belted kingfisher	Ceryle alcyon	rare	migrant?	
Yellow-bellied sapsucker	Sphyrapicus varius	uncommon	summer*	MIS
Williamson's sapsucker	Sphyrapicus thyroideus	uncommon	summer*	MIS
Downy woodpecker	Dendrocopos pubescens	uncommon	resident*	MIS
Hairy woodpecker	Dendrocopos villosus	uncommon	resident**	MIS
White-headed woodpecker	Dendrocopos albolarvatus	uncommon	resident*	MIS
Black-backed woodpecker	Picoides arcticus	uncommon	resident*	MIS
Northern flicker	Colaptes auratus	common	summer**	MIS
Pileated woodpecker	Dryocopus pileatus	rare	resident	MIS
Dusky flycatcher	Empidonax oberholseri	common	summer*	
Willow flycatcher	Empidonax traillii	rare	migrant?	
Empidonax flycatcher	Empidonax sp.	uncommon	summer*	
Violet-green swallow	Tachycineta thalassina	common	summer*	
Gray jay	Perisoreus canadensis	uncommon	resident	
Steller's jay	Cyanocitta stelleri	common	resident*	

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WATERBIRD OR WATER-ASSOCIATED BIRD - Includes shorebirds and other water-dependent birds such as kingfishers, dippers, pelicans, cormorants, coots, grebes, loons, and cranes.

WATERFOWL - Ducks, geese, and swans.

APPENDIX A

RELATIVE PERCENT ABUNDANCE OF ATTACHED ALGAE IN SAMPLES FROM DREWS CREEK

RELATIVE PERCENT ABUNDANCE OF ATTACHED ALGAE ON NATURAL SUBSTRATES, DREW, QUARTZ AND ANGEL CREEKS, LAKE COUNTY, OREGON 1987-1988

DIVISION*	SPECIES	AUTHORITY	DR. CK. DR2.4 A 26/8/87	DR. CK. DR2.4 B 26/8/87	DR. CK. DR2.4 C 26/8/87	DR. CK. DR2.4 A 6/4/88	DR. CK. DR2.4 B 6/4/88	DR. CK. DR3 A 3/10/87	DR. CK. DR3 B 3/10/87	DR. CK. DR3 C 3/10/87	DR. CK. DR3 A 8/4/88	DR. CK. DR3 B 8/4/88	ANGEL CK. 10/10/87	DR. CK. DR1 A 2/10/87	DR. CK. DR1 B 2/10/87	DR. CK. DR1 C 2/10/87	QTZ. CK. A 8/4/88	QTZ. CK. A 8/4/88
C	MELOSIRA VARIANS	C. A. AG.	0.952	0.000	0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	MERIDION CIRCULARE	AGARDH.	0.000	0.000	0.000	0.000	0.980	0.000	0.000	0.000	0.926	1.980	0.000	0.000	0.000	0.000	0.000	0.000
C	NAVICULA ARVENSIS	HUST.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.971	0.000
C	NAVICULA CRYPTOCEPHALA	KUETZ.	0.000	4.854	2.105	0.000	1.961	3.922	5.000	11.765	12.963	0.000	0.000	0.000	0.000	0.980	0.000	0.000
C	NAVICULA CRYPTOCEPHALA V. VEN.	(K.) RABH.	17.143	1.942	5.263	1.980	0.000	11.765	4.000	9.804	11.111	7.921	0.000	1.923	3.774	3.922	0.000	0.000
C	NAVICULA MINIMA	GRUN.	0.000	0.971	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	NAVICULA RADIOSA	KUETZ.	1.905	0.971	3.158	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	NAVICULA SP. #1		2.857	0.000	0.000	0.000	11.765	0.000	1.000	0.000	1.852	2.970	0.000	0.000	0.000	0.000	0.000	0.000
C	NAVICULA SP. #2		1.905	0.000	0.000	0.000	0.000	0.000	1.000	0.000	2.778	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	NAVICULA SP. #3	BORY	0.952	0.000	0.000	0.000	0.000	0.000	0.000	5.882	0.926	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	NAVICULA SP. #4		0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000	0.000	0.000	0.000	0.000	0.943	0.000	0.000	0.000
C	NITZSCHIA ACICULARIS	W. SMITH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000
C	NITZSCHIA ACUTA	HANTZSCH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.926	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	NITZSCHIA DISSIPATA	(KUETZ.) GRUN.	0.000	0.000	0.000	0.990	0.980	0.000	0.000	0.000	5.556	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	NITZSCHIA FLEXA	SCHUMANN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000
C	NITZSCHIA FRUSTULUM	KUETZ.	0.000	0.000	0.000	0.000	7.843	0.000	0.000	0.000	11.111	4.950	0.000	0.000	0.000	0.000	0.000	0.000
C	NITZSCHIA GRACILIS		0.000	0.000	0.000	0.000	42.157	0.000	0.000	0.000	2.778	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	NITZSCHIA LINEARIS	W. SMITH	0.000	0.000	0.000	0.000	1.961	0.000	0.000	1.961	0.926	0.990	0.000	0.000	0.000	0.000	0.000	0.000
C	NITZSCHIA PALEACEA	GRUN.	0.000	0.000	0.000	0.000	2.941	0.000	0.000	0.000	0.926	2.970	0.000	0.000	0.000	0.000	8.738	0.962
C	NITZSCHIA RECTA		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000
C	NITZSCHIA SP. #1	HASSALL	9.524	13.592	6.316	4.950	1.961	11.765	4.000	10.784	0.000	0.000	0.000	14.423	16.981	10.784	0.971	0.000
C	NITZSCHIA SP. #2	HASSALL	1.905	0.000	1.053	1.980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.962	0.000	0.000	0.000	0.000
C	NITZSCHIA SP. #3	HANTZSCH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000	0.000	0.962	0.000	0.000	0.000	0.000
C	PINNULARIA BOREALIS	EHR.	0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	RHOICOSPHENIA CURVATA	(KUETZ.) GR. EX.RAB.	2.857	0.000	0.000	5.941	0.980	0.000	2.000	0.980	0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000
C	RHOPALODIA GIBBA	(EHR.) O. MUELL.	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000
C	STAURONEIS ANCEPS	EHR.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000
C	SURIRELLA OVATA	KUETZ.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.852	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	SYNEDRA RUMPENS	KUETZ.	0.000	0.971	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	SYNEDRA ULNA	(NITZSCH) EHR.	0.000	0.000	0.000	0.000	1.961	0.000	0.000	0.000	2.778	4.950	0.000	0.000	0.000	0.000	3.883	3.846
C	SYNEDRA ULNA V. OXYRHYNCHUS	(FOR.) HUS.	2.857	6.796	1.053	0.000	0.000	5.882	3.000	1.961	0.000	0.000	0.000	1.923	8.491	3.922	0.000	0.000
C	SYNEDRA ULNA V. RAMESI	(HERIB.) HUST.	1.905	2.913	0.000	0.000	0.000	2.941	0.000	1.961	0.000	4.950	0.000	0.000	0.943	0.980	0.000	0.000
C	TRIBONEMA SP.		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.971	0.000
C	UNIDENT. DIATOM		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.887	1.961	2.913	0.962
G	ANKISTRODESMUS SP.		0.000	0.000	0.000	0.000	0.000	0.000	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000
G	BRANCHED CHLOROPHYTE		0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G	OEDOGONIUM SP.	LINK	0.952	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.926	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G	SCENEDESMUS ARMATUS	(CHOD.) G. M. SMITH	0.000	0.971	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G	STIGEOCLONIUM-LIKE SP.		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.923
G	TETRAEDRON SP.		0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G	ZYGNEMA SP.	AGARDH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	100.000	0.000	0.000	0.000	0.000	0.000
	RELATIVE PERCENT ABUNDANCE		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	TOTAL TAXA OBSERVED IN COUNTS		28	17	20	21	19	17	19	22	28	29	1	18	20	18	15	11

DR. CK. = Drews Creek
QTZ. CK. = Quartz Creek

1, 2.4, 3; A, B, C = replicates
26/8 = 26 August

* C = Chrysophytes (includes diatoms); BG = Blue-green Algae; G = Green Algae; DATES: 26/8/87 = 26 August 1987; SAMPLES COLLECTED 1987-88

7.0 SURFACE WATER

TECHNICAL REPORT NO. 7

SURFACE HYDROLOGY AND WATER QUALITY

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

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Revised December 1988

FOREWORD

This report was prepared by Steffen Robertson and Kirsten (COLORADO) Inc. (SRK) for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
R. H. Wheeler	Surface Water, Forestry Task Leader	SRK

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are likely; the most severe in recent history, during late December 1964.

The quality of the project area waters is good, generally meeting or exceeding drinking water standards. These waters are largely unfit for human consumption, however, due to microbiological organisms that are present as a result of unrestricted grazing by domestic livestock and use by wildlife.

Dissolved inorganic chemical and sediment (organic and inorganic) concentrations reflect those consistent with the area's history. The springs appear to yield waters with a pH below 6.6 while all stream waters exceeded 7.5. Spring waters are poorly buffered; stream waters moderately so. The turbidity of Quartz Creek consistently exceeded that of Drews Creek or the springs principally due to exposure and accessibility of the fine soil materials in the gullies of Quartz Valley to transport downstream. Water temperature of the springs hovered around 50 degrees F, while that of the streams fluctuated with the season from summer highs approaching 65 degrees to late fall and early winter lows of 40 degrees F. The concentration of many inorganic chemical species remains below the detection limits in laboratory analysis.

7.0 SURFACE WATER HYDROLOGY AND WATER QUALITY

7.1 INTRODUCTION

7.1.1 Objectives

The objective of the surface water study was to characterize surface waters in the Quartz Mountain Gold Project study area. The study involved examining the characteristics of surface waters as well as those elements which directly influence surface waters. The parameters studied are listed below.

- Regional surface water overview;
- General drainage patterns and the physiographic features which affect these patterns;
- Climatic influences on surface water drainage in the study area; and
- Stream water quality in the study area.

The study will provide baseline information for determining project impacts and for developing and evaluating mitigative measures.

7.1.2 Study Area

Most of the Quartz Mountain Gold Project and associated study area lie in the 20 square mile Quartz Creek watershed. Quartz Creek flows into Drews Creek approximately 2 miles downstream of the study area. A segment of Drews Creek, upstream of the Quartz Creek confluence, flows through the eastern portion of the study area.

The surface water study area is shown on Figure 1.2-1. Due to lack of available historic information on the Quartz Creek Watershed, a larger regional area was studied for the purpose of establishing reasonable baseline information. The regional study area includes the Quartz Creek Watershed and the Drews Creek Watershed to Drews Reservoir, approximately 5 miles downstream of the Drews Creek - Quartz Creek confluence, as well as some areas of adjacent watersheds for which more data is available.

A more complete description of the study area is contained in Section 7.3. Table 7.1-1 shows the size of the drainage areas of the principal watersheds in the study area.

7.2 LITERATURE REVIEW

7.2.1 Hydrologic Data

Hydrologic information from the project area and from the Drews Creek Watershed is extremely limited. The literature review showed that there is no historic hydrologic data for either the Quartz Creek Watershed or the Drews Creek Watershed above Drews Reservoir.

The U.S. Geological Survey (USGS) currently maintains three stream gages in the region; one on the Sycan River below Snake Creek near Beatty, one on the Sprague River near Beatty, and one on the Chewaucan River near Paisley. The station on Sycan River below Snake Creek near Beatty was established in 1917 and monitored through 1925. The station was re-established in 1979 and is currently active. The station on the Sprague River near Beatty Station has been in operation since 1954 and the one on the Chewaucan River near Paisley since 1925. Records of the daily mean discharges for the period of record for all these stations were obtained from the USGS.

The USGS had a station 2.7 miles downstream of Drews Reservoir on Drews Creek but operation of this station was discontinued in the early 1980's. The Drews Creek near Lakeview station, as this station was named, monitored flows regulated by Drews Reservoir and is therefore not representative of unregulated flows above the reservoir in either Drews Creek or Quartz Creek.

The data from the gaging stations are discussed further in Sections 7.4.2 and 7.5.2.

7.2.2 Climatic Data

Three weather stations in the region provide long-term climatic data (U.S. Department of Commerce 1986). Operated in cooperation with the National Weather Service (NWS), the stations are located in Klamath Falls, Lakeview, and Round Grove, a ranch located three miles west of Quartz Mountain Pass on State Highway 140. The Round Grove weather station was active from 1921 through 1986. The Lakeview weather station has been active since 1910. The Klamath Falls weather station was activated in 1894 but complete data is available only since 1915. This station is also presently active.

The Soil Conservation Service (SCS) maintains a snow course at the project area. Snow depths and snow water equivalent are measured monthly during the winter. The snow

7.3 DRAINAGE BASIN CHARACTERISTICS

7.3.1 Regional Drainage Characteristics

The region lies in the transitional zone between the Basin and Range physiographic province and the Columbia River Plateau physiographic province. The general topography of the region is round to oval-shaped buttes of moderate relief separated by drainages. These drainages exhibit a weakly dendritic pattern and on the west side of Coleman Rim, in the study area vicinity, trend south-southwest.

Drews Creek Watershed is the regional watershed encompassing 32.5 square miles. Water in Quartz Creek in the study area is tributary to Drews Creek. Drews Creek flows into Drews Reservoir, a large reservoir used primarily for water storage for irrigation. From Drews Reservoir a controlled discharge allows water to flow in Drews Creek to Goose Lake. Goose Lake is a large, closed basin lake with a surface area of 194 square miles which straddles the Oregon-California border.

7.3.2 Study Area Drainage Characteristics

Most of the study area lies within the 20 square mile Quartz Creek Watershed. A small area in the northwestern portion of the study area drains to the west-northwest to a tributary to Ish Tish Creek, a tributary to the Sprague Creek Watershed. While this area is part of the study area it is not currently part of the Quartz Mountain Gold Project area. Another small area in the southeast portion of the study area drains directly into Drews Creek although the actual confluence of Quartz Creek with Drews Creek is two miles downstream of the study area. The primary focus of this study will be on the Quartz Creek watershed.

The highest point in the Quartz Creek Watershed is Quartz Butte, 6279 feet above mean sea level (msl). This butte lies in the center of the Quartz Creek Watershed. Quartz Butte is a large intrusive rhyolite exogenous dome. The topography of Quartz Butte causes the study area drainage pattern to shift from dendritic to annular. This pattern is characterized by a circular network of tributary streams around Quartz Butte linked by a perimeter stream, Quartz Creek.

Broad wet meadows characterize the drainages of the area. The meadows flood annually during snowmelt, serving to moderate peak snowmelt flows and to regulate streamflow during drier months by slowly releasing stored water. The meadows were probably formed with no defined drainage channel.

7.4 SURFACE HYDROLOGY

7.4.1 Methods

The USGS, National Weather Service, and SCS provided hydrological and climatological data. The SCS data from the snow course and SNOTEL sites are specific to the study area. The remaining data were taken from hydrologic and climatic monitoring stations in the general region of the study area and were adjusted to be more representative of the study area.

Climatic and hydrologic monitoring stations were established by SRK in the summer of 1987 and will provide verification of predicted study area conditions.

7.4.1.1 Precipitation and Water Yield

The SCS SNOTEL, located on the southwest margin of the project area, began operation in 1982. Because the SNOTEL has been in operation for only four years, the SNOTEL precipitation data was compared to long term precipitation data from the Klamath Falls, Lakeview and Round Grove climatic stations, and a long term average was calculated that is believed to be representative of the SNOTEL site and the study area.

Table 7.4-1 shows how the precipitation averages were determined. The average for the three regional stations for 1982 - 1986 (17.99 inches) was compared to the long term average for the stations (15.04 inches). The long term average was found to be 84% of the four year average. The percentage coefficient was then applied to the four year average for the SNOTEL site (26.78) to reach a long term average precipitation of 22.5 inches for the study area.

Minimum and maximum precipitation for the study area were computed in the same manner. The maximum and minimum averages for the three regional stations were compared to the four year average to derive percentage coefficients. The coefficients were then applied to the four year SNOTEL average to calculate expected maximum and minimum yearly precipitation.

SRK established a climatic station in the Quartz Valley Meadow in late 1987. This station, in conjunction with the Quartz Mountain SNOTEL, will provide daily, monthly, and yearly precipitation data which can be used to verify projections made based on existing data.

There is no long-term streamflow data available for streams in the study area. Of the three stream gaging stations in the study area described in Section 7.2.1, the Chewaucan River near Paisley Station, which lies near the study area and has a long period of record, will be used to develop streamflow patterns in Quartz Creek. The Chewaucan unit-area yields are expected to exceed those of Quartz Creek since Quartz Creek lies in a rain shadow. However, yields in the Chewaucan River have been adjusted to predict yields in Quartz Creek, as discussed below.

The ratios of average monthly mean discharge to the average annual discharge for the Chewaucan Station are included in Tables 7.4-2, Part A and 7.4-2, Part B, and provide the basis for predicting the flow pattern for Quartz Creek at SH 140 near Quartz Mountain. This point was chosen to be representative of flows for the project area since Quartz Creek at SH 140 is the mouth of the 12 square mile watershed which is likely to be affected by mining activities. The adjustments to these ratios shown in Table 7.4-2, Part C, take into account the smaller size and the rain shadow influence on Quartz Creek resulting in a more limited, less persistent snowpack, a more rapid meltout, and a quicker transit time through the drainage system.

Adjusted precipitation data from the Quartz Mountain SNOTEL (Table 7.4-1) and a runoff factor can be used to estimate streamflow for annual maximum, minimum and average values. The runoff factor has been derived from two summary reviews of national and international research on water yields from forest lands (Anderson et al. 1976; Bosch and Hewlett 1982). The runoff factor reflects the depleting influence of transpiration, evaporation, soil and ground water storage and recharge on the contribution of basin precipitation to streamflow and water yield (Table 7.4-3). A factor of 0.15 was determined to represent the runoff factor for near average years for Quartz Creek (Table 7.4-2, Part D and 7.4-2, Part E).

The runoff factor changes for higher or lower precipitation years. In a low year, the factor declines as depletions sharply increase. The opposite occurs in a high year. Runoff factors for high and low precipitation years have been chosen as 0.25 and 0.10 respectively (Table 7.4-3).

In this study, streamflow was measured with a flow meter at monthly intervals on the main Drews Creek and Quartz Creek sites (DR3 and QU1). These measurements should help to verify the predicted basin yield and streamflow. Measurements are taken semi-annually at seven other sites (ANT, NF, DRI, DR4, BU, QU3, and DR4) to represent high and low flow

TABLE 7.4-3

RUNOFF FACTORS TO DERIVE QUARTZ CREEK HYDROGRAPHY
AT QUARTZ CR. AT SH 140 NR. QUARTZ MOUNTAIN
(7700 AC., 12.03 SQ. MI.)

Year	Runoff Factor (in/in)	Basin Annual Precip. (in.)	Per Acre (in.)	Per Acre (ft.)	Annual Yield af/yr	Annual Yield cfs/yr	Annual Yield csm
Ave.	0.15	20	3.0	.25	1900	2.6	0.22
High	0.25	35	8.8	0.73	5600	7.8	0.65
Low	0.10	12	1.2	0.10	800	1.1	0.09

TABLE 7.4-4

SURFACE HYDROLOGY AND WATER QUALITY SITES AND SCHEDULE OF SAMPLING

Site Name	Site ID	Sampling Frequency	Remarks
Quartz Creek at SH 140	QU1	Monthly	Field Parameters Monthly Full Suite May & Aug/Sept
Drews Creek above SH 140	DR3	Monthly	Field Parameters Monthly Full Suite May & Aug/Sept
Angel Creek at Powerline	AN	May & Aug/Sept	Full Suite
Drews Creek Near Angel Peak	DRZ	May & Aug/Sept	Full Suite
North Fork Quartz Creek at Angel Camp	NF	May & Aug/Sept	Full Suite Tributary to Angel Creek
	ANT	May & Aug/Sept	Full Suite
Butcher Creek at Mouth	BU	Continual sampling not planned	Sample May & Aug/Sept 1988 to establish baseline
Drews Creek below Quartz Creek at SH 140	DR4	Continual sampling not planned	Sample May & Aug/Sept 1988 to establish baseline
Quartz Creek above Butcher Creek	QU3	Continual sampling not planned	Sample May & Aug/Sept 1988 to establish baseline
Quartz Creek above Drews Creek at SH 140	QU4	Continual sampling not planned	Sample May & Aug/Sept 1988 to establish baseline
Drews Creek above Hunter's Cabin	DR1	Eliminated	DRZ replaced this site
Quartz Creek below Butcher Creek	QUZ	Eliminated	QU1 will supply data
Quartz Mountain Spring	QM	Monthly	Field Parameters Monthly Full Suite May & Aug/Sept

For the period of record at the three index stations, Klamath Falls, Lakeview, and Round Grove, the average annual precipitation was 15.04 inches. The minimum annual precipitation average for the three stations was 57 percent of the average, while the maximum of 23.81 inches was 159 percent of the average (Table 7.4-1).

Using the method outlined in Section 7.4.1.1 to calculate an expected long term average for the study area based on the Quartz Mountain SNOTEL, the average annual precipitation is 22.5 inches. Using the same method, the predicted minimum precipitation is 12.9 inches, while the predicted maximum precipitation is 35.3 inches (Table 7.4-1).

The Quartz Mountain SNOTEL recorded annual precipitation below average for 1987. While the annual precipitation for 1987 (20.8 Inches) is greater than the lowest annual precipitation of record of the SNOTEL (17.3 inches in 1985), the volume in inches per day for 1987 is 12 percent less than 1985 (Table 7.4-5). The volume of 0.27 inches per day for 1987 is also 12 percent less than the average of 0.31 inches per day for the period of record. This information supports field data for 1987 which showed low to zero flow for many creeks and springs.

Sixty percent of the annual precipitation falls during the snow season, November through March. Snowpack accumulation usually begins in the third week in November and reaches its peak in mid-March. Once snowmelt begins, complete meltout occurs within 30 days. Meltout is usually completed by mid-April. Table 7.4-6 shows snow accumulation and meltout data from the Quartz Mountain SNOTEL.

Warm periods during the snow season may deplete the snowpack, especially when accompanied by rain. Steeper slopes will retain less snow than level areas or meadows. Over a period of nearly 50 years the snowpack at the Quartz Mountain snow course has rarely exceeded 36 inches at its peak (Appendix 7.B, Table 7.B-1). In 1963, the maximum depth of snow was only six inches.

Figure 7.4-1 shows the average annual hydrography for Quartz Creek based on the predicted average annual precipitation (Table 7.4-1). The annual daily peak flow can occur in any month from December through May, according to data from the Chewaucan, Sprague, and Sycan Rivers. Quartz Creek will usually reach its peak flow before the much larger streams due to its smaller size, headwater location, and more limited snowpack. Derived flows for Quartz Creek for the annual average, maximum, and minimum year are 2.6 cfs, 7.8 cfs, and 1.1 cfs, respectively (Table 7.4-3).

TABLE 7.4-6

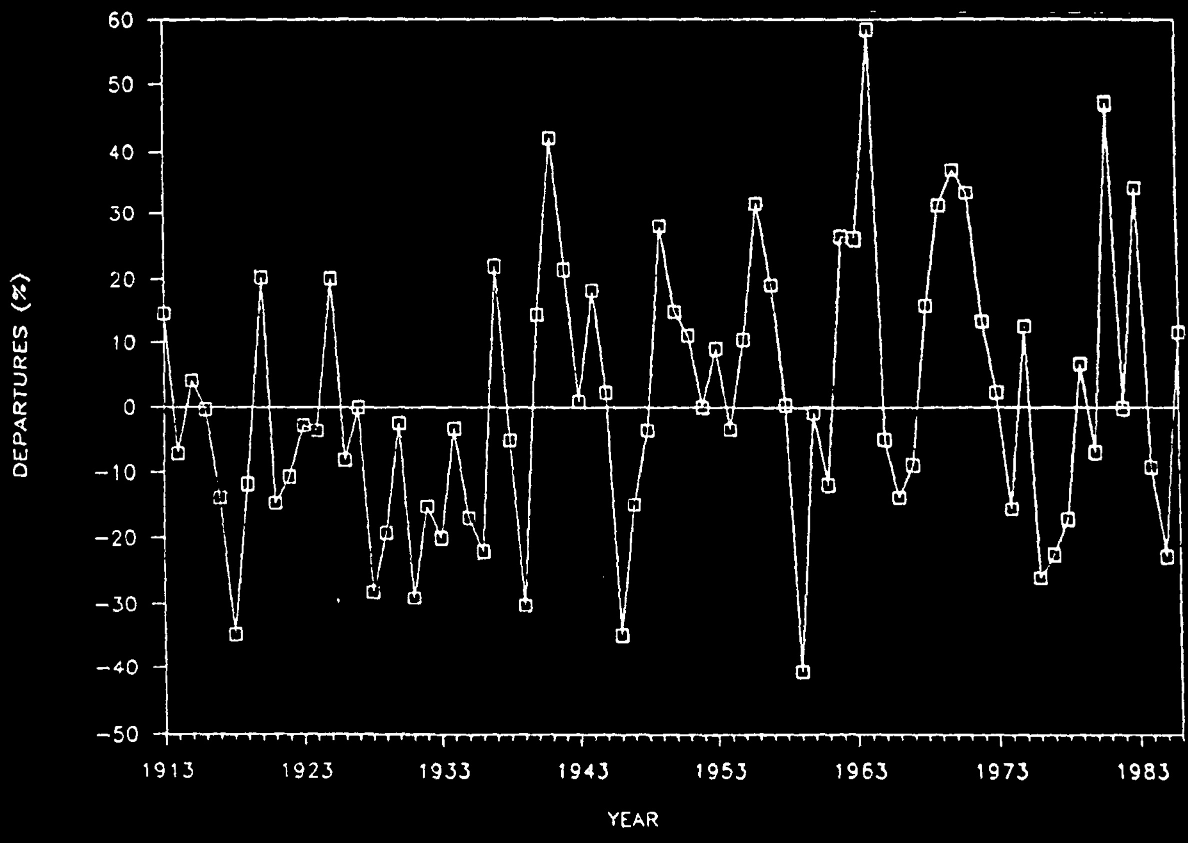
SNOW ACCUMULATION AND DEPLETION
QUARTZ MOUNTAIN, SNOTEL

	Snow Pack					
Water Year	Start Date	Max. SWE[a]	Max. Date	Meltout Date	Persistence (days)	Snowmelt Rate (in./dy.)
1982	11/11	13.5	44/8	4/25	165	1.93
1983	11/17	17.1	3/23[b]	5/12	176	0.66
1984	11/15	11.5	3/19	4/20	158	0.31
1985	11/2	10.1	3/15	4/16	163	0.32
1986	11/10	6.0	1/17	3/26	136	0.09
1987	12/30	6.5	3/22	4/5	96	0.46
1988	12/8					
Av.	11/21	10.8	3/14	4/16	149	0.63
Median	11/15	10.8	3/21	4/19	161	0.39

[a] SWE = snow water equivalent, inches
[b] 17.1 in. remained unchanged for 24 days. Snowmelt commenced on 4/15.

FIGURE 7.4-1

DEPARTURES (%) OF ANNUAL PRECIPITATION
FROM THE HISTORICAL AVERAGES FOR LAKEVIEW



For the last four months of 1987, the discharge in Quartz Creek did not exceed 0.1 cfs (Appendix 7.A, Table 7.A-2). In October the creek was dry. These measurements support the derived hydrography for a minimum yield year (Table 7.4-1).

As mentioned above, nine springs were located in the study area (Table 7.4-4 and Figure 7.4-1), six of which exhibited year round flow during 1987 (AG, AP, BH, QM, RR1, RR2). Angel Creek Spring (AG) probably yields the greatest flow as it surfaces in a narrow, rocky, steep canyon. Angel Creek Spring sustains the flow of Angel Creek. The canyon, a geologic nick point, forces subsurface water flowing down the Angel Creek Valley to the surface. At least three springs (AC, AP, BH) lie upstream of Angel Creek Spring.

Quartz Mountain Spring (QM) flow ranges from 2 gpm to 10 gpm (Appendix 7.A, Table 7.A-1 and 7.A-3), sufficient to meet the needs of the few residents of Quartz Mountain. Flows are stored in one of two cisterns. Reconstruction of the spring box and the addition of a water meter in the fall of 1987 should improve yield into the two branches of the system to Quartz Mountain as well as allow for continuous measurement of the yield.

The USFS improved Buckhorn (BH) and Ewauna (EW) Springs principally for livestock (cattle) watering. Buckhorn Spring flows into a stock tank, and Ewauna Spring flows intermittently into a stock pond.

The two Railroad Springs (RR1 and RR2), one upstream of the railroad grade, the other below, are likely connected and can be considered one spring. RR1 issues from the edge of the timber on the hillside above Quartz Valley; RR2 issues from colluvium at the margin of the Quartz Valley meadow. During the Summer 1987, RR1 produced at least 4.5 gpm (Appendix 7.A, Table 7.A-3). A small drainage channel collects the flow at the meadow edge and transports it across the meadow into Quartz Creek.

7.4.2.2 <u>Flood Flows</u>

The time of the year most susceptible to flood-producing conditions is early to mid-winter, but flooding can occur throughout early spring. Floods normally occur as the snowpack builds to its peak snow water content and warming periods bring snowmelt and periods of rain instead of snow. If soils are saturated with moisture and if the snowmelt rate exceeds the soil drainage rate, overland flow and flooding can occur.

The greatest flood recorded in the period of record for the Chewaucan gaging station occurred in December 1964 under

TABLE 7.4-7

MAXIMUM RECORDED 24-HOUR PRECIPITATION
AT QUARTZ MOUNTAIN SNOTEL, 1981-1987

MONTH / YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	(INCHES)											
1981										0.7	2.9*	1.8
1982	1.0	0.7	2.0	0.6	0.4	0.3	0.6	0.2	0.4	0.7	0.4	1.0
1983	0.4	1.0	1.7	0.3	0.5	0.7	0.6	0.7	0.2	0.2	1.2	0.9
1984	0.3	0.4	0.7	0.7	0.5	0.6	0.1	1.3	0.1	0.8	0.9	0.5
1985	0.2	1.0	0.7	0.3	0.4	0.3	0.5	0.0	1.1	0.6	0.9	0.7
1986	0.8	1.5	1.6	0.3	0.8	0.5	0.2	0.0	0.6	0.4	0.4	0.3(2)
1987	0.6	0.6	0.4(2)	0.2	0.7	0.5	0.9	0.3	0.1	0.1	0.4(2)	1.0

* 11/16, part of an 8-day storm period producing 5.1 inches precipitation

TABLE 7.4-9

ESTIMATED PEAK DISCHARGE
FOR THREE SMALL WATERSHEDS
USING ADAMS et al. (1986)

Return period (years)	Peak Discharge (cubic feet per second)		
	Quartz Cr. at SH 140	Angel Cr.	North Fork
25	300	170	55
50	370	215	70
100	450	275	90

TABLE 7.5-1

WATER QUALITY MONITORING PARAMETERS

Field Parameters

- Discharge (gpm or cfs)
- Air Temperature (°C)
- Water Temperature (°C)
- Field pH (pH units)
- Field Conductivity (mhos/cm)

Laboratory Parameters (in mg/l Unless Otherwise Noted)

Alkalinity	Antimony
Arsenic	Barium
Cadmium	Chloride
Chromium	Conductivity (Laboratory)(mhos/cm)
Copper	Total Cyanide
Fluoride	Hardness
Iron	Lead
Manganese	Mercury
Nitrate-Nitrogen	Non-Filterable residue
pH (Laboratory)(pH Units)	Selenium
Settleable Solids	Silver
Sodium	Total Solids
Sulfate	Turbidity (NTU)
Zinc	Gross Alpha (pCi/l)
Gross Beta (pCi/l)	

NOTES: Field parameters will accompany all sampling.
Laboratory parameters will be evaluated twice yearly in May and August/September.

TABLE 7.5-2

QUARTZ MOUNTAIN PROJECT AREA WATER QUALITY DATA
FROM BUTZ et al., 1980
(RANGE OF CONCENTRATION)

SAMPLING PARAMETER	DREWS CREEK IMMEDIATELY DOWNSTREAM OF QUARTZ CREEK	BUTCHER CREEK
pH	8.0 - 8.2	6.9 - 8.2
Conductivity (mhso/cm)	150 - 190	150 - 240
Alkalinity (ppm)	78 - 91	78 - 110
Sodium (ppm)	4.1 - 5.3	4.1 - 9.3
Calcium (ppm)	11.7 - 15.4	11.7 - 18.3
Magnesium (ppm)	4.1 - 6.1	4.1 - 7.9
Arsenic (ppb)	0.6	0.9 - 4.9
Boron (ppb)	0 - 8	0 - 8
Mercury (ppb)	ND - 0.34	0.06
Uranium (ppb)	0.02 - 0.20	0.20 - 0.80

basins are found in OAR 340-41-922 and 925 and are summarized in Appendix 7.F. While the standards reflect general water quality data within the Goose and Summer Lakes basins, they may differ substantially from water quality found in specific streams.

Water quality data collected to date for the study area indicate a departure from the basin-wide standards. For instance, the iron standard calls for iron concentrations not to exceed 0.3 mg/l. Stream waters in the Quartz Creek watershed consistently exceed 0.3 mg/l. Establishment of existing water quality in the study area through continued monitoring under the present monitoring program will provide a more accurate basis for evaluating potential future degradation than the use of basin-wide standards.

(11) Drews Creek Above SH 140 (DR3)
(12) Drews Creek below Quartz Creek at SH 140 (DR4)

Site QUI is important in characterizing flows in Quartz Creek immediately below the project area. Site DR3 will monitor flows in Drews Creek upstream of the confluence with Quartz Creek. Both will be equipped with a continuous water level recorder with a heated stilling well for winter operations.

Sites NF, AN, QU2 and DR1 will have a staff gage and a crest gage. Site ANT will have both if a suitable location for placement can be found. If a suitable location can not be found, only a staff gage will be installed. The remaining sites (BU, QU3, QU4, DR4) will have staff gages only.

A staff gage measures the water level at the instant it is being read. A crest gage measures the highest water level between visits.

It should be noted that no further measurements are planned for DR2 at this time. DR1 is more accessible and defines the upstream boundary of the project area, therefore DR2 has been eliminated.

7.6.2.2 Springs

Springs located and sampled during 1987 include:
(1) Quartz Mountain Spring (QM)
(2) Ewauna Spring (EW)
(3) Quartz Valley Spring (QV)
(4) Railroad Spring 1 (RR1)
(5) Railroad Spring 2 (RR2)
(6) Buckhorn Spring (BH)
(7) Angel Peak Spring (AP)
(8) Angel Camp Spring (AC)
(9) Angel Creek Spring (AG)

All these springs surface in the Quartz Creek drainage. No effort has been made to locate springs within the Drews Creek drainage. If the project expands eastward into the Drews Creek drainage, an effort will be undertaken to locate and sample any springs present.

Flow from the springs, except Quartz Mountain Spring, is difficult to measure. Measurements to date have been made using a calibrated bucket and stop watch. At some of the springs weirs or flumes may be installed to allow more accurate and consistent flow measurements.

The springs currently planned for monitoring are BK, QM, and RR1. RR2 has been eliminated since this spring is a

The species selected for analysis on this project may be found in OAR 340-41-922 and 925. Those species selected but not included in the OAR represent additional species essential to characterizing the quality of the surface waters and interpreting many of the standards. Many of the species included in the standards but not selected for analysis are organic chemical compounds not applicable to heap leaching.

Microbiological indicator species and their concentrations also comprise a portion of the standards; however, they apply specifically to drinking water. The presence of domestic cattle over the entire project area renders all surface water unfit for human consumption without treatment. As the mining operations will not alter this condition, there will be no need to monitor microbiological indicators.

The dissolved oxygen content of the flowing water only occasionally falls below saturation. When it does, the turbulent flow of the stream quickly restores dissolved oxygen levels.

7.6.3 Field Determinations

Measurements taken and physical species analyzed in the field at the time laboratory samples are collected are described in Appendix 7.G and include:

(1) Streamflow or spring discharge,

(2) Water and air temperature,
(3) Current water stage and peak stage, if appropriate,
(4) Field conductivity and pH.

Other environmental descriptors which facilitate interpretation of the laboratory date include:
(1) Weather conditions,
(2) Site conditions,
(3) Problems encountered and their resolution.

7.6.4 Laboratory Determinations

Each site collection requires four sample containers:
1-500ml Cubitainer
1-1L glass bottle (acidified with HNO3)
1-1L glass bottle (buffered with NaOH)
1-2L glass bottle

A gummed label on each sample bottle identifies the collector's name, the site name, the sample number, the date and time of the sample, and any other pertinent information.

7.7 GLOSSARY

ALKALINE - Waters containing more than average amounts of carbonates of sodium, potassium, magnesium and/or calcium.

ALKALINITY - Capacity of water to accept positively charged ions.

ANNULAR - A ringlike pattern associated with maturely dissected dome or basin structures.

BACTERIOLOGICAL SPECIES - Any of numerous, sometimes parasitic, unicellular organisms having various forms and often causing bacteria.

BASIN YIELDS - The amount of water which will flow from a drainage or catchment area in a given storm.

CLOSED-BASIN LAKE - A lake which has no outlet, from which water escapes only by evaporation.

CONFLUENCE - The point where two streams meet.

CONTINUOUS RECORDER - A device which measures stream flow levels on a continual basis.

CREST GAGE - Measures the highest point a stream water level reaches.

DENDRITIC - A drainage pattern characterized by irregular branching in all directions with the tributaries joining the main stream at all angles.

DISCHARGE - Rate of flow at a given instant in terms of volume per unit of time.

DRAINAGE AREA - All areas which could contribute run off to a given point.

DRINKING WATER STANDARDS - Maximum allowable concentrations of various elements in water to be used for human consumption. Established by the U.S. Environmental Protection Agency as primary and secondary standards.

EVAPORATION - The act of converting water to a vapor.

FLOOD - A relatively high streamflow which overtops the banks in any reach of a stream.

FLUME - An artificial channel or chute for a stream of water, usually used to allow determination of flow.

SPECIFIC CONDUCTIVITY - A measure of the conductivity of liquids.

SPRING - A place where water flows from a rock or soil.

STAFF GAGE - A measuring device manually used to record water levels at the time of reading.

STILLING WELL - A device used to allow monitoring of water levels in turbulent flow.

TRANSPIRATION - Ability of plants to uptake water and release water as a vapor through plant pores.

TRIBUTARY - Any stream which contributes water to another stream.

TURBIDITY - Measure of the amount of suspended sediment.

UNIT-AREA YIELDS - The amount of water which will flow from a given area in a given storm.

WATERSHED - Area contained within a drainage divide above a specified point on a stream.

WEIR - A dam across a stream to regular flow to allow measurement.

7.9 REFERENCES

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7.10 PRINCIPAL PREPARER

7.10.11 Richard Wheeler

Mr. Wheeler is a forest hydrologist with expertise in wild land water quality and in analyzing the effects of forest practices on forest water resources, wet lands, and riparian areas.

Wheeler received his BS in 1953 in forest management from the University of Maine in Orono. In 1969, he won his masters in forest hydrology and watershed management from Colorado State University. His research subject was the preliminary evaluation of the Anaconda (Montana) Industrial Watershed for the USDA Forest Service, Deerlodge National Forest, and the Anaconda Company.

Wheeler's experience includes a career with the USDA-Forest Service which began in South Carolina and concluded in Oregon. He served mostly as a consultant in forest hydrology, forest water quality, and watershed management to forest supervisors and their staffs and to district rangers on 21 national forests. He managed the forest hydrology/water quality program for the national forests in the four state Northern Region as well as assisted the state water quality agencies in Idaho and Montana in their efforts to develop their state programs on water quality and forest practices. His last assignment was as staff hydrologist on the Mt. Hood National Forest, Oregon.

International experience with the Food and Agriculture Organization of the United Nations took him to the mountains of northern Thailand. As a member of an international team, he served as the project hydrologist educating and training Thai counterparts from the Royal Forest Department as well as peasant farmers in applied hydrology in forest and agricultural practices. He also advised on forestry and agricultural projects sponsored by His Majesty, The King, and served as a consultant to the United Nations Environment Programme, Bangkok.

APPENDIX 7.A

STREAM AND SPRING DISCHARGE
AND FLOW DATA FROM THE QUARTZ MOUNTAIN PROJECT

TABLE 7.A-2

STREAM DISCHARGE SUMMARY
FROM THREE SITES ON
THE QUARTZ MOUNTAIN GOLD PROJECT

Station Name	ID	Date YYMMDD	Time HHMM	Vel. (fps)	Disch. (cfs)
Butcher Cr.	BU	870903	1240	0.894	0.652
Drews Cr. ab. SH 140	DR3	870902	1305	0.295	0.652
		871005	1000	0.327	0.702
		871112	1200	0.353	1.78
		871210	1040	1.89	11.6
Quartz Cr. at SH 140	QU1	870903	1120	0.450	0.054
		871005	1055	0.000	0.000
		871112	1430	0.317	0.076
		871209	1105	0.548	0.092

APPENDIX 7.B

PRECIPITATION, SNOW DEPTH, AND DISCHARGE DATA
FROM THE PROJECT AREA AND VICINITY

TABLE 7.B-2

SUMMARY OF MONTHLY PRECIPITATION FROM FOUR STATIONS

YEAR	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
A. Klamath Falls														
1926	AVERAGE (NEAR)	0.51	1.52	0.11	0.92	0.13	T	0.1	T	0.06	0.65	7.49	1.29	13.23
1948	MAXIMUM	2.7	1.35	1.98	1.23	1.28	1.59	1.6	1.79	1.28	0.98	1.82	3.31	20.91
1905	MINIMUM	1.6	0.85	0.75	0.65	1.56	0.28	T	0.20	0.50	0.40	0.35	1.18	7.14
	AVERAGE YEAR	1.94	2.54	1.21	0.76	0.9	0.56	0.28	0.41	0.59	1.10	1.85	2.12	13.32
	MAXIMUM MONTH	5.9	4.66	3.62	2.5	4.75	3.09	1.63	2.93	3.06	4.55	7.94	8.93	(1964)
	MINIMUM MONTH	T	T	0.02	T		T(80)	T(23)	0(4)	0	0	0.09	0.22	
	YRS OF RECORD	86	88	89	86	85	89	87	86	85	85	86	89	78
B. Lakeview														
1982	AVERAGE (NEAR)	0.78	1.47	1.78	0.52	1.01	1.22	0.94	0.22	0.80	1.71	2.24	2.27	14.96
1964	MAXIMUM	3.97	0.11	0.82	0.76	1.35	4.23	0.24	0.41	0.39	0.45	2.06	8.96	23.75
1959	MINIMUM	1.42	0.99	0.81	0.22	1.52	0.26	0.05	0.65	1.63	0.69	T	0.65	8.89
	AVERAGE YEAR	1.76	1.52	1.34	1.11	1.37	1.11	0.33	0.34	0.61	1.13	1.66	1.85	14.98
	MAXIMUM MONTH	5.81	4.71	3.84	3.36	4.12	5.47	2.69	3.04	2.73	6.62	4.59	8.96	
	MINIMUM MONTH	0.13	0.11	0.01	0.17	T(2)	T(4)	0	0	0	T(2)	T(2)	T	
	YRS OF RECORD	73	73	74	74	74	73	74	74	73	73	73	73	72
C. Quartz Mountain SNOTEL														
	AVERAGE YEAR*	2.9	2.4	2.4	1.7	1.7	1.7	0.5	0.7	0.9	1.9	3.3	3.8	23.9

*Data computed 1961-1985 average correlated from several other regional stations (USDA-SCS 1986)

YEAR	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
D. Round Grove														
1961	AVERAGE (NEAR)	1.10	3.05	1.77	0.7	2.04	0.9	T	1.59	0.57	2.19	1.35	[illegible]	17.16
1973	AVERAGE (NEAR)	1.45	0.95	1.29	0.68	1.87	0.05	T	0.18	1.19	1.78	5.61	2.11	17.16
1983	MAXIMUM	1.68	3.71	4.00	1.41	0.55	1.46	0.93	2.09	0.50	1.33	3.97	5.18	26.80
1930	MINIMUM	1.73	1.34	1.22	1.25	0.59	0.72	0.35	0.43	0.39	0.44	0.56	0.47	10.09
	AVERAGE YEAR	1.92	3.75	1.79	1.35	1.55	1.33	0.48	0.60	0.84	1.59	1.97	2.35	17.24
	MAXIMUM MONTH	6.09	4.03	4.33	4.43	4.40	4.91	2.00	3.95	2.97	7.27	5.61	10.03	(1986)
	MINIMUM MONTH	0.27	0.17	0.04	0	0.04	T	0	0(3)	0	0	T(3)	0.30	
	YRS OF RECORD	62	61	63	63	64	64	61	60	61	61	63	63	53

TABLE 7.B-4

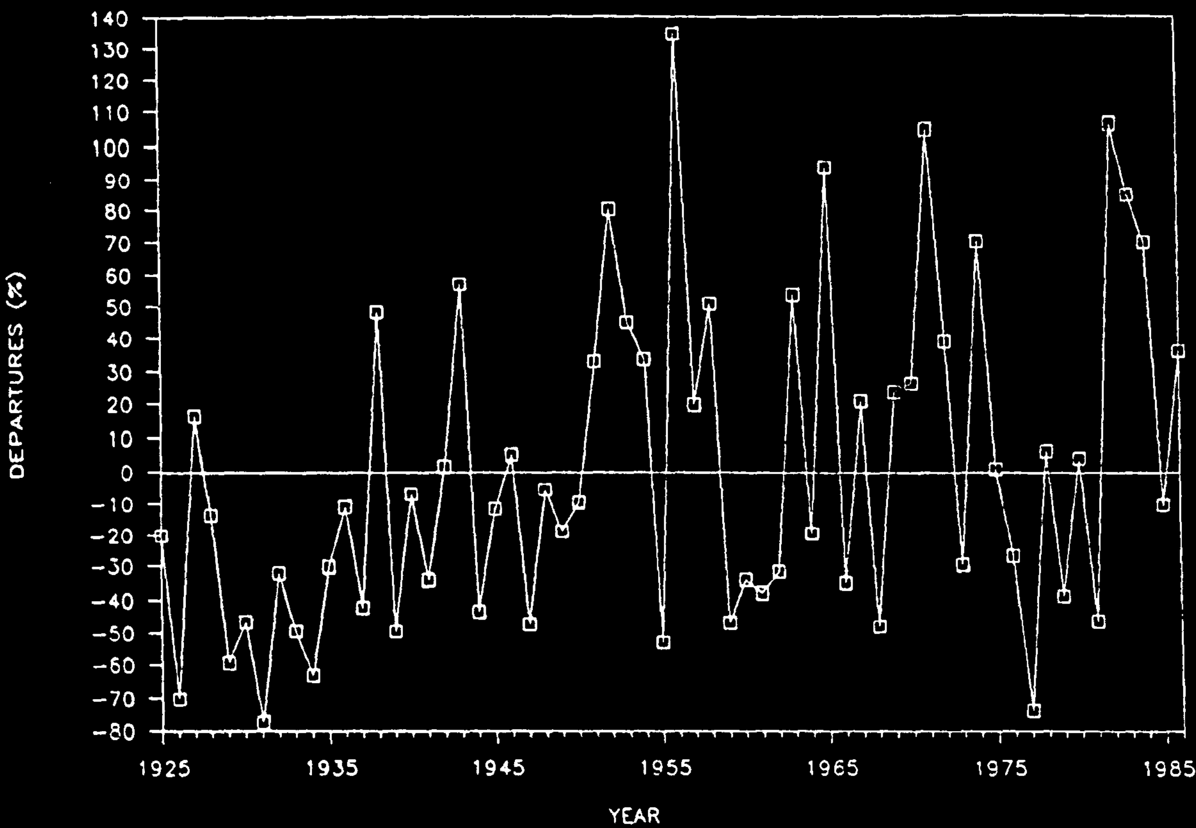
YEARLY PRECIPITATION AND LONG-TERM DEPARTURES FROM THE AVERAGE FOR LAKEVIEW, 1913-1986

YEAR	PRECIP (IN.)	DEPARTURE (IN.)	DEPARTURE (%)	YEAR	PRECIP (IN.)	DEPARTURE (IN.)	DEPARTURE (%)
1913	17.15	2.17	14.5	1950	17.19	2.21	14.8
1914	13.92	-1.06	-7.1	1951	16.66	1.68	11.2
1915	15.60	0.62	4.1	1952	M	M	M
1916	14.93	-0.05	-0.3	1953	16.34	1.36	9.1
1917	12.92	-2.06	-13.8	1954	14.47	-0.51	-3.4
1918	9.77	-5.21	-34.8	1955	16.56	1.58	10.5
1919	13.22	-1.76	-11.7	1956	19.70	4.72	31.5
1920	18.00	3.02	20.2	1957	17.84	2.86	19.1
1921	12.79	-2.19	-14.6	1958	15.48	0.50	0.3
1922	13.41	-1.57	-10.5	1959	8.89	-6.09	-40.7
1923	14.58	-0.40	-2.7	1960	14.86	-0.12	-0.8
1924	9.69	-5.29	-3.5	1961	13.21	-1.77	-11.8
1925	17.98	3.00	20.0	1962	18.90	3.92	26.2
1926	13.77	-1.21	-8.1	1963	18.85	3.87	25.9
1927	M	M	M	1964	23.75	8.77	58.5
1928	10.77	-4.21	-28.1	1965	14.23	-0.75	-5.0
1929	12.10	-2.88	-19.2	1966	12.91	-2.07	-13.8
1930	11.34	-3.64	-2.4	1967	13.66	-1.32	-8.8
1931	10.62	-4.36	-29.1	1968	17.34	2.36	15.9
1932	12.71	-2.27	-15.2	1969	19.66	4.68	31.2
1933	11.99	-2.99	-20.0	1970	20.53	5.55	37.0
1934	14.49	-0.49	-3.3	1971	19.77	4.79	33.3
1935	12.43	-2.55	-17.0	1972	16.98	2.00	13.4
1936	11.69	-3.29	-22.0	1973	15.32	0.34	2.3
1937	18.26	3.28	21.9	1974	12.65	-2.33	-15.6
1938	14.21	-0.77	-5.1	1975	16.87	1.89	12.6
1939	10.44	-4.54	-30.3	1976	11.12	-3.86	-25.8
1940	17.13	2.15	14.4	1977	11.64	-3.34	-22.3
1941	21.30	6.32	42.2	1978	12.40	-2.58	-17.2
1942	18.18	3.20	21.4	1979	15.99	1.01	6.7
1943	15.10	0.12	0.8	1980	13.94	-1.04	-6.9
1944	17.71	2.73	18.2	1981	22.08	7.10	47.4
1945	15.32	0.34	2.3	1982	14.96	-0.02	-0.1
1946	9.75	-5.23	-34.9	1983	20.11	5.13	34.2
1947	12.86	-2.12	-14.9	1984	13.62	-1.36	-9.1
1948	14.46	-0.52	-3.5	1985	11.61	-3.37	-22.5
1949	10.82	-4.16	27.8	1986	16.73	1.75	11.7
				Average	14.98		

*Yearly precipitation from 1913-1933 adjusted by double-mass analysis after Linsley, et al (1949).

FIGURE 7.B-1

DEPARTURES (%) OF ANNUAL DISCHARGE
FROM THE HISTORICAL AVERAGES, CHEWAUCAN
RIVER NEAR PAISLEY



APPENDIX 7.C

DRINKING WATER STANDARDS AT THE QUARTZ MOUNTAIN PROJECT

APPENDIX 7.D

WATER QUALITY DATA FROM SELECTED SITES IN THE PROJECT AREA COLLECTED PRIOR TO 1987

APPENDIX 7.E

WATER QUALITY DATA FROM STREAMS AND SPRINGS IN THE QUARTZ MOUNTAIN PROJECT COLLECTED SINCE SEPTEMBER 1987

TABLE 7.E-2

WATER QUALITY DATA FOR QUARTZ MOUNTAIN SPRING (QM)
QUARTZ MOUNTAIN PROJECT

Species \Date \Time	870902 1030	871005 1200	871112 1520	871209 1010	880111 1050	880210 1120	880310 1020	880408 1100	880510 0830	880615 0830	880712 1050	880812 0620
Alkalinity, Total	39.6	38.1	37.3	39.4	37.8	38.4	36.2	39.4	36.1	37.7	39.8	40.8
Bicarbonate	39.6	38.1	37.3	39.4	37.8	38.4	36.2	39.4	36.1	37.7	39.8	40.8
Carbonate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006
Barium	<0.1	<0.1	0.06	0.06	0.05	0.06	0.05	0.08	<0.05	<0.05	<0.05	0.05
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloride	2.70	2.00	2.10	2.00	2.04	2.00	1.74	1.76	2.29	2.16	2.87	3.59
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Conductivity (umhos/cm)	64.0	60.0	62.0	64.0	72.0	65.0	68.3	66.8	64.9	65.8	65.5	65.8
Copper	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10
Cyanide, Total	<0.004	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride	0.30	0.07	<0.05	0.18	<0.05	0.06	<0.05	0.06	<0.05	0.05	0.05	0.05
Hardness, Total	23.4	22.7	26.8	21.0	24.5	24.1	24.0	28.8	30.0	24.6	26.4	21.9
Iron	0.25	0.17	0.12	0.11	<0.1	0.50	0.30	<0.10	0.40	0.22	0.16	0.10
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.044	0.001	<0.001	<0.001	0.085
Nitrate (mg NO3-N/L)	0.16	<0.1	0.23	0.16	0.16	0.15	0.15	0.14	0.15	0.14	0.18	0.06
Non-Filterable Residue	0.6	0.5	0.3	<0.1	1.0	0.5	0.2	0.2	0.2	1.8	<0.2	0.2
pH (Units)	6.5	6.6	6.5	6.6	6.6	6.6	6.6	6.9	6.6	6.8	6.8	6.9
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Settleable Solids (ml/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium	3.6	3.3	13.8	1.8	5.5	7.2	10.2	12.8	12.4	8.0	5.8	5.8
Solids, Total	104.0	104.0	110.0	104.0	91.0	96.0	103.0	106.0	103.0	110.0	104.0	104.0
Sulfate	0.21	<0.1	1.00	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10
Temperature (C)	11.0	10.5	11.0	11.0	6.9	10.5	8.7	8.8	11.0	11.0	11.5	
Turbidity (FTU)	3.20	2.60	3.10	3.40	3.00	2.80	3.50	3.25	6.90	4.80	4.60	3.80
Zinc	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10
Gross Alpha (pCi/L)		<1	<1	<1	<5	0.33	0.20	0.00	0.00	0.00	0.00	0.00
Gross Beta (pCi/L)		<1	1.80	<1	<5	4.82	0.77	0.00	6.58	0.00	2.80	8.77

All data in mg/L unless otherwise noted

TABLE 7.E-4

WATER QUALITY DATA FOR SECONDARY STREAM STATIONS

Species	AN		ANT		BU		DR1		DR2	DR4	NF	QU2	QU4
Sta. ID\ Date\	870903	880510	870902	880510	870902	880510	870902	880509	870902	870902	880510	880510	870902
Time\	1445	1000	1440	0855	1635	1520	1330	0935	1420	1000	1210	1545	1010
Alkalinity, Total	92.1	44.9	75.1	36.1	65.3	54.2	61.7	54.2	63.8	66.9	28.4	39.2	74.6
Bicarbonate	82.9	44.9	75.1	36.1	65.3	54.2	53.5	54.2	33.0	66.9	28.4	39.2	74.6
Carbonate	9.2	0.0	0.0	0.0	0.0	0.0	8.2	0.0	30.8	0.0	0.0	0.0	0.0
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	0.006	<0.005	0.040	0.008	<0.005	<0.005	0.006	<0.005	0.007	<0.005	<0.005	<0.005	<0.005
Barium	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.10	<0.10	0.06	<0.05	<0.10
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloride	1.90	1.03	2.10	1.55	2.70	1.23	1.50	1.28	1.90	2.10	1.61	1.29	2.30
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Conductivity (umhos/cm)	137.0	71.4	101.0	66.1	97.0	88.3	84.0	89.0	86.0	96.0	49.8	66.9	101.0
Copper	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cyanide, Total	<0.004	<0.005	<0.004	<0.005	<0.004	<0.005	<0.004	<0.005	<0.004	<0.004	<0.005	<0.005	<0.004
Fluoride	0.16	<0.05	<0.05	<0.05	0.08	<0.05	0.13	0.05	<0.05	0.08	<0.05	<0.05	<0.05
Hardness, Total	76.5	41.2	55.3	34.0	57.4	48.4	54.0	49.2	56.5	57.0	26.8	36.0	56.1
Iron	0.15	0.65	0.54	3.14	4.17	0.82	0.74	0.44	0.63	1.83	0.94	1.00	2.07
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	<0.01	<0.01	0.03	<0.01	0.22	0.02	0.02	<0.01	0.02	0.17	<0.01	<0.01	0.20
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate (mg NO3-N/L)	<0.10	<0.10	<0.10	0.15	0.73	<0.10	<0.10	<0.10	<0.10	0.42	0.10	<0.10	0.52
Non-Filterable Residue	1.5	3.0	2.3	6.7	20.0	8.0	1.4	2.4	1.7	17.0	6.5	5.0	22.2
pH (Units)	8.4	7.7	7.8	7.5	8.1	8.0	8.4	7.8	9.0	7.9	7.6	7.6	8.0
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Settleable Solids (ml/L)	<0.1	0.10	<0.10	0.10	0.20	0.10	<0.10	0.10	<0.10	<0.10	0.10	<0.10	<0.10
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium	4.5	10.1	3.7	10.7	4.4	11.8	2.3	9.6	2.3	3.8	8.2	10.1	4.6
Solids, Total	144.0	99.0	162.0	163.0	148.0	95.0	111.0	86.0	110.0	124.0	120.0	102.0	141.0
Sulfate	0.34	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	1.03
Temperature (C)	17.5	11.0	15.5	9.0	20.5	20.0	18.0	6.5	18.5	12.5	12.0	15.0	13.5
Turbidity (FTU)	0.72	9.0	3.4	35.5	20.0	6.9	1.6	2.4	1.4	16.5	19.0	10.0	21.0
Zinc	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Gross Alpha (pCi/L)		0.00		1.08		0.00		0.00			0.35	0.00	
Gross Beta (pCi/L)		2.96		12.31		0.00		0.00			1.89	5.54	

AN: Angel Creek near Powerline
ANT: Tributary to Angel Creek
BU: Butcher Flat Creek at Quartz Creek
DR1: Drews Creek near Angel Peak
DR2: Drews Creek near Hunter's Cabin
DR4: Drews Creek above Quartz Creek
NF: North Fork Quartz Creek
QU2: Quartz Creek above Butcher Creek
QU4: Quartz Creek above Drews Creek

All data in mg/l unless otherwise noted

TABLE 7.E-6

DISCHARGE AND VELOCITY DATA FOR THREE SITES SAMPLED MONTHLY
DREWS CREEK NEAR SH 140 (DR3)
QUARTZ CREEK AT SH 140 NEAR QUARTZ MOUNTAIN (QU1)
AND QUARTZ MOUNTAIN SPRING (QM)

Date		Discharge			Velocity			
Sampled	ID\	DR3	QU1	QM	DR3		QU1	
		(cfs)	(cfs)	(gpm)	(fps)	(mph)[a]	(fps)	(mph)[a]
870902		0.652		1.03	0.295	0.20		
870903			0.054				0.450	0.31
871005		0.702	DRY	0.68	0.327	0.22		
871112		1.78	0.076	4.51	0.353	0.24	0.317	0.22
871209			0.092	9.93			0.548	0.37
871210		11.62[b]			1.89	1.3		
880111		2.34	0.064		0.340	0.23	0.064	0.044
880210		3.55	0.000	9.73	0.810	0.55		
880310		7.69	3.96	9.38	1.39	0.95	1.36	0.93
880408		11.50	1.29	8.65	2.04	1.4	0.245	0.17
880509				11.21				
880511		8.72	1.87		1.37	0.93	0.851	0.58
880615		4.42	0.01	9.44	1.10	0.75	0.022	0.015
880712		1.64	<0.01	9.49	0.459	0.31	0.006	0.004
880812			Dry	6.2				

[a] MPH = FPS x 0.6818
[b] Storm peak following storm on night of 12/09

TABLE 7.E-8

MAXIMUM RECORDED 24-HOUR PRECIPITATION AT QUARTZ MOUNTAIN SNOTEL, 1981-1987

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR	(INCHES)											
1981										0.7	2.9[a]	1.8
1982	1.0	0.7	2.0	0.6	0.4	0.3	0.6	0.2	0.4	0.7	0.4	1.0
1983	0.4	1.0	1.7	0.3	0.5	0.7	0.6	0.7	0.2	0.2	1.2	0.9
1984	0.3	0.4	0.7	0.7	0.5	0.6	0.1	1.3	0.1	0.8	0.9	0.5
1985	0.2	1.0	0.7	0.3	0.4	0.3	0.5	0.0	1.1	0.6	0.9	0.7
1986	0.8	1.5	1.6	0.3	0.8	0.5	0.2	0.0	0.6	0.4	0.4	0.3(2)
1987	0.6	0.6	0.4(2)	0.2	0.7	0.5	0.9	0.3	0.1	0.1	0.4(2)	1.0
1988	1.0	0.1	0.4	1.0	0.7	0.5	0.0	0.1	0.3			

[a] 11/16, part of an 8-day storm period producing 5.1 inches precipitation

TABLE 7.E-10

PRECIPITATION PER DAY OF PRECIPITATION
FOR QUARTZ MOUNTAIN SNOTEL
1982-1988[a]

Year	Total Precip. (in.)	Total Days	Precip./Day (in.)
1982	30.8	96	0.32
1983	35.8	115	0.31
1984	29.6	100	0.31
1985	17.3	57	0.30
1986	23.6	77	0.31
1987	20.8	78	0.27
1988[a]	13.7	52	0.26
Average	26.3	87	0.30

[a] Through 9/30, end of WY 1988; data not included in average.

TABLE 7.E-12

DETECTION LIMITS OF LABORATORY EQUIPMENT
AT KLAMATH ENVIRONMENTAL SERVICES

SPECIES	LIMIT	SPECIES	LIMIT
Alkalinity[a,b]	20.	Manganese	0.01
Antimony	0.005	Mercury	0.01
Arsenic	0.005	Nitrate (mg NO_3-N/L)	0.1
Barium	0.1	NFR	0.1
Cadmium	0.005	pH (Units)	[d]
Chloride	0.1	Selenium	0.005
Chromium	0.005	Settleable Solids (ml/L)	0.1
Conductivity (umhos/cm)	[c]	Silver	0.005
Copper	0.1	Sodium	0.1
Cyanide, Total	0.004	Solids, Total	0.1
Fluoride	0.05	Turbidity (FTU)	[e]
Hardness	0.1	Zinc	0.1
Iron	0.05	Radionucleides (pCi/L)	1.0
Lead	0.005		

[a] All limits in milligrams per liter (mg/L) unless otherwise noted.

[b] As mg/L $CaCO_3$

[c] No detection limit. No decimal values.

[d] No detection limit. Data recorded to nearest tenth of a unit.

[e] No detection limit. Data recorded to nearest tenth of a FTU or to two significant figures.

APPENDIX 7.F

OREGON ADMINISTRATIVE RULES
CHAPTER 20, SECTION 41
DEPARTMENT OF ENVIRONMENTAL QUALITY (OAR-340-41)

of water and related resources. Such programs may include, but not be limited to, the following:

(a) Development of projects for storage and release of suitable quality waters to augment low stream flow;

(b) Urban runoff control to reduce erosion;

(c) Possible modification of irrigation practices to reduce or minimize adverse impacts from irrigation return flows;

(d) Stream bank erosion reduction projects.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 1-1980, f. & ef. 1-9-80

General Groundwater Quality Protection Policy

340-41-029 The following statements of policy are intended to guide federal agencies and state agencies, cities, counties, industries, citizens, and the Department of Environmental Quality staff in their efforts to protect the quality of groundwater:

(1) General Policies:

(a) It is the responsibility of the EQC to regulate and control waste sources so that impairment of the natural quality of groundwater is minimized to assure beneficial uses of these resources by future generations.

(b) In order to assure maximum reasonable protection of public health, the public should be informed that groundwater – and most particularly local flow systems or water table aquifers – should not be assumed to be safe for domestic use unless quality testing demonstrates a safe supply. Domestic water drawn from water table aquifers should be tested frequently to assure its continued safety for use.

(c) For the purpose of making the best use of limited staff resources, the Department will concentrate its control strategy development and implementation efforts in areas where waste disposal practices and activities regulated by the Department have the greatest potential for degrading groundwater quality. These areas will be delineated from a statewide map outlining the boundaries of major water table aquifers prepared in 1980 by Sweet, Edwards & Associates, Inc. This map may be revised periodically by the Water Resources Department.

(d) The Department will seek the assistance and cooperation of the Water Resources Department to design an ambient monitoring program adequate to determine long-term quality trends for significant groundwater flow systems. The Department will assist and cooperate with the Water Resources Department in their groundwater studies. The Department will also seek the advice, assistance, and cooperation of local, state, and federal agencies to identify and resolve groundwater quality problems.

(e) The EQC recognizes and supports the authority and responsibilities of the Water Resources Department and Water Policy Review Board in the management of groundwater and protection of groundwater quality. In particular, existing programs to regulate well construction and to control the withdrawal of groundwater provide important quality protective opportunities. These policies are intended to complement and not duplicate the programs of the Water Resources Department.

(2) Source Control Policies:

(a) Consistent with general policies for protection of surface water, highest and best practicable treatment and control of sewage, industrial wastes, and landfill leachates, shall be required so as to minimize potential pollutant loading to groundwater. Among other factors, energy, economics, public health protection, potential value of the groundwater resource to present and future generations, and time required for recovery of quality after elimination of pollutant loadings may be considered in arriving at a case-by-case determination of highest and best practicable treatment and control. For areas where urban density development is planned or is occurring and where rapidly draining soils overlay local groundwater flow systems and their associated water table aquifers, the collection, treatment and disposal of sewage, industrial wastes and leachates from landfills will be deemed highest and best practicable treatment and control unless otherwise approved by the EQC pursuant to subsections (b) or (c) of this section.

(b) Establishment of controls more stringent than those identified in subsection (a) of this section may be required by the EQC in situations where:

(A) DEQ demonstrates such controls are needed to assure protection of beneficial uses;

(B) The Water Resources Director declares a critical groundwater area for reasons of quality; or

(C) EPA designates a sole source aquifer pursuant to the Federal Safe Drinking Water Act.

(c) Less stringent controls than those identified in subsection (a) of this section may be approved by the EQC for a specific area if a request, including technical studies showing that lesser controls will adequately protect beneficial uses is made by representatives of the area and if the request is consistent with other state laws and regulations.

(d) Disposal of wastes onto or into the ground in a manner which allows potential movement to groundwater shall be authorized and regulated by the existing rules of the Department's Water Pollution Control Facility (WPCF) Permit, Solid Waste Disposal Facility Permit, or On-Site (Subsurface) Sewage Disposal System Construction Permit, whichever is appropriate:

(A) WPCF permits shall specify appropriate groundwater quality protection requirements and monitoring and reporting requirements. Such permits shall be used in all cases other than for those covered by Solid Waste Disposal Facility Permit or On-site (subsurface) disposal permits.

(B) Solid Waste Disposal Facility Permits shall be used for landfills and sludge disposal not covered by NPDES or WPCF permits. Such permits shall specify appropriate groundwater quality protection requirements and monitoring and reporting requirements.

(C) On-site Sewage Disposal System Construction permits shall be issued in accordance with adopted rules. It is recognized that existing rules may not be adequate in all cases to protect groundwater quality. Therefore, as deficiencies are documented, the Department shall propose rule amendments to correct the deficiencies.

(e) In order to minimize groundwater quality degradation potentially resulting from nonpoint sources, it is the policy of the EQC that activities associated with land and animal management, chemical application and handling, and spill prevention be conducted using the appropriate state of the art management practices ("Best Management Practices").

(3) Problem Abatement Policies:

day period with no more than 10 percent of the samples in the 30-day period exceeding 400 per 100 ml.

(f) Bacterial pollution or other conditions deleterious to waters used for domestic purposes, livestock watering, irrigation, bathing, or otherwise injurious to public health shall not be allowed.

(g) The liberation of dissolved gases, such as carbon dioxide, hydrogen sulfide, or other gases, in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, recreation or other reasonable uses made of such waters shall not be allowed.

(h) The development of fungi or other growths having a deleterious effect on stream bottoms, fish or other aquatic life, or which are injurious to health, recreation, or industry shall not be allowed.

(i) The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish shall not be allowed.

(j) The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry shall not be allowed.

(k) Objectionable discoloration, scum, oily sleek or floating solids, or coating of aquatic life with oil films shall not be allowed.

(l) Aesthetic conditions offensive to the human senses of sight, taste, smell, or touch shall not be allowed.

(m) Radioisotope concentrations shall not exceed maximum permissible concentrations (MPC's) in drinking water, edible fishes, wildlife, irrigated crops, livestock and dairy products, or pose an external radiation hazard.

(n) The concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection shall not exceed one hundred and ten percent (110%) of saturation, except when stream flow exceeds the 10-year, 7-day average flood. However, for Hatchery receiving waters and waters of less than 2 feet in depth, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection shall not exceed one hundred and five percent (105%) of saturation.

(o) Dissolved chemical substances: Guide concentrations listed below shall not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in rule 340-41-922: (mg/l)

(A) Arsenic (As)	0.01
(B) Barium (Ba)	1.0
(C) Boron (Bo)	0.5
(D) Cadmium (Cd)	0.003
(E) Chromium (Cr)	0.02
(F) Copper (Cu)	0.005
(G) Cyanide (Cn)	0.005
(H) Fluoride (F)	1.0
(I) Iron (Fe)	0.1
(J) Lead (Pb)	0.05
(K) Manganese (Mn)	0.05
(L) Phenols (totals)	0.001
(M) Zinc (Zn)	0.01

(p) Pesticides and other Organic Toxic Substances shall not exceed those criteria contained in the 1976 edition of the EPA publication "Quality Criteria for Water". These criteria shall apply unless supporting data show conclusively that beneficial uses will not be adversely affected by exceeding a criterion by a specific amount or that a more stringent criterion is warranted to protect beneficial uses.

(3) Where the natural quality parameters of waters of the Goose and Summer Lakes Basin are outside the numerical limits of the above assigned water quality standards, the natural water quality shall be the standard.

(4) Mixing zones.

(a) The Department may suspend the applicability of all or part of the water quality standards set forth in this rule, except those standards relating to aesthetic conditions, within a defined immediate mixing zone of specified and appropriately limited size adjacent to or surrounding the point of waste water discharge.

(b) The sole method of establishing such mixing zone shall be by the Department defining same in a waste discharge permit.

(c) In establishing a mixing zone in a waste discharge permit the Department:

(A) May define the limits of the mixing zone in terms of distance from the point of the waste water discharge or the area or volume of the receiving water or any combination thereof;

(B) May set other less restrictive water quality standards to be applicable in the mixing zone in lieu of the suspended standards; and

(C) Shall limit the mixing zone to that which in all probability, will:

(i) Not interfere with any biological community or population of any important species to a degree which is damaging to the ecosystem; and

(ii) Not adversely affect any other beneficial use disproportionately.

(5) Testing methods: The analytical testing methods for determining compliance with the water quality standards contained in this rule shall be in accordance with the most recent edition of Standard Methods for the Examination of Water and Waste Water published jointly by the American Public Health Association, American Water Works Association, and Water Pollution Control Federation, unless the Department has published an applicable superseding method in which case testing shall be in accordance with the superseding method; provided, however, that testing in accordance with an alternative method shall comply with this rule if the Department has published the method or has approved the method in writing.

[Publications: The publication(s) referred to or incorporated by reference in this rule are available from the office of the Department of Environmental Quality.]

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77, DEQ 1-1980, f. & ef. 1-9-80

Minimum Design Criteria for Treatment and Control of Wastes

340-41-935 Subject to the implementation program set forth in rule 340-41-120, prior to discharge of any wastes from any new or modified facility to any waters of the Goose and Summer Lakes Basin, such wastes shall be treated and controlled in facilities designed in accordance with the following minimum criteria (In designing treatment facilities, combinations which may be harmful, may chemically change to harmful forms in the environment, or may bioaccumulate to levels that adversely affect public health, safety, or welfare; aquatic life; or other designated beneficial uses.

(B) Levels of toxic substances shall not exceed the most recent criteria values for organic and inorganic pollutants established by EPA and published in Quality Criteria for Water (1986). A list of the criteria is presented in Table 20.

(C) The criteria in (B) shall apply unless data from scientifically valid studies demonstrate that the most sensitive designated beneficial uses will not be adversely affected by exceeding a criterion or that a more restrictive criterion is warranted to protect beneficial uses, as accepted by the Department on a site specific basis. Where no published EPA criteria exist for a toxic substance, public health advisories and other published scientific literature may be considered and used, if appropriate, to set guidance values.

(D) Bio-assessment studies such as laboratory bioassays or instream measurements of indigenous biological communities, shall be conducted, as the Department deems necessary, to monitor the toxicity of complex effluents, other suspected discharges or chemical substances without numeric criteria, to aquatic life. These studies, properly conducted in accordance with standard

TABLE 20

WATER QUALITY CRITERIA SUMMARY

(Applicable to all basins)[1]

The concentration for each compound listed in this chart is a criteria or guidance value*not to be exceeded in waters of the state for the protection of aquatic life and human health. Specific descriptions of each compound and an explanation of values are included in Quality Criteria for Water (19[illegible]). Selecting values for regulatory purposes will depend on the most sensitive beneficial use to be protected, and what level of protection is necessary for aquatic life and human health.

			Concentration in Micrograms Per Liter For Protection of Aquatic Life				Concentration in Units Per Liter For Protection of Human Health		
COMPOUND NAME (OR CLASS)	PRIORITY POLLUTANT	CARCINOGEN	FRESH ACUTE CRITERIA	FRESH CHRONIC CRITERIA	MARINE ACUTE CRITERIA	MARINE CHRONIC CRITERIA	WATER AND FISH INGESTION	FISH CONSUMPTION ONLY	DRINKING WATER M.C.L.
ACENAPTHENE	Y	N	*1,700.	*520.	*970.	*710.			
ACROLEIN	Y	N	*68.	*21.	*55.		320.ug	780.ug	
ACRYLONITRILE	Y	Y	*7,550.	*2,600.			0.058ug**	0.65ug**	
ALDRIN	Y	Y	3.0		1.3		0.074ng**	0.079ng**	
ALKALINITY	N	N		20,000.					
AMMONIA	N	N	CRITERIA ARE pH AND TEMPERATURE DEPENDENT—SEE DOCUMENT						
ANTIMONY	Y	N	*9,000.	*1,600.			146.ug	45,000.ug	
ARSENIC	Y	Y					2.2ng**	17.5ng**	0.05mg
ARSENIC (PENT)	Y	Y	*850.	*48.	*2,319.	*13.			
ARSENIC (TRI)	Y	Y	360.	190.	69.	36.			
ASBESTOS	Y	Y					30Kf/L**		
BARIUM	N	N					1.mg		1.0mg
BENZENE	Y	Y	*5,300.		*5,100.	*700.	0.66ug**	40.ug**	
BENZIDINE	Y	Y	*2,500.				0.12ng**	0.53ng**	
BERYLLIUM	Y	Y	*130.	*5.3			0.8ng**	117.ng**	
BHC	Y	N	*100.		*0.34				
CADMIUM	Y	N	3.9+	1.1+	43.	9.3	10.ug		0.010mg
CARBON TETRACHLORIDE	Y	Y	*35,200.		*50,000.		0.4ug**	6.94ug**	
CHLORDANE	Y	Y	2.4	0.0043	0.09	0.004	0.46ng**	0.48ng**	
CHLORINATED BENZENES	Y	Y	*250.	*50.	*160.	*129.	488.ug		
CHLORINATED NAPHTHALENES	Y	N	*1,600.		*7.5				
CHLORINE	N	N	19.	11.	13.	7.5			
CHLOROALKYL ETHERS	Y	N	*238,000.						
CHLOROETHYL ETHER (BIS-2)	Y	Y					0.03ug**	1.36ug**	
CHLOROFORM	Y	Y	*28,900.	*1,240.			0.19ug**	15.7ug**	
CHLOROISOPROPYL ETHER (BIS-2)	Y	N					34.7ug	4.36mg	
CHLOROMETHYL ETHER (BIS)	Y	N					0.00000376ng**	0.00184ug**	
CHLOROPHENOL 2	Y	N	*4,380.	*2,000.					
CHLOROPHENOL 4	N	N			*29,700.				
CHLOROPHENOXY HERBICIDES (2,4,5,-TP)	N	N					10.ug		
CHLOROPHENOXY HERBICIDES (2,4-D)	N	N					100.ug		
CHLORPYRIFOS	N	N	0.083	0.041	0.011	0.0056			
CHLORO-4 METHYL-3 PHENOL	N	N	*30.						
CHROMIUM (HEX)	Y	N	16.	11.	1.100	50.	50.ug		0.05mg
CHROMIUM (TRI)	N	N	1,700.+	210.+	*10,300.		179.mg	3,433.mg	0.05mg
COPPER	Y	N	18.+	12.+	2.9	2.9			
CYANIDE	Y	N	22.	5.2	1.	1.	200.ug		

TABLE 20
WATER QUALITY CRITERIA SUMMARY (continued)

COMPOUND NAME (OR CLASS)	PRIORITY POLLUTANT	CARCINOGEN	Concentration in Micrograms Per Liter For Protection of Aquatic Life				Concentration in Units Per Liter For Protection of Human Health		
			FRESH ACUTE CRITERIA	FRESH CHRONIC CRITERIA	MARINE ACUTE CRITERIA	MARINE CHRONIC CRITERIA	WATER AND FISH INGESTION	FISH CONSUMPTION ONLY	DRINKING WATER M.C.L.
DDT	Y	Y	1.1	0.001	0.13	0.001	0.024ng**	0.024ng**	
DDT METABOLITE (DDE)	Y	Y	*1,050.		*14.				
DDT METABOLITE (TDE)	Y	Y	*0.06		*3.6				
DEMETON	Y	N		0.1		0.1			
DIBUTYLPHTHALATE	Y	N					35.mg	154.mg	
DICHLOROBENZENES	Y	N	*1,120.	*763.	*1,970.		400.ug	2.6mg	
DICHLOROBENZIDINE	Y	Y					0.01ug**	0.020ug**	
DICHLOROETHANE 1,2	Y	Y	*118,000.	*20,000.	*113,000.		0.94ug**	243.ug**	
DICHLOROETHYLENES	Y	Y	*11,600.		*224,000.		0.033ug**	1.85ug**	
DICHLOROPHENOL 2,4	N	N	*2,020.	*365.			3.09mg		
DICHLOROPROPANE	Y	N	*23,000.	*5,700.	*10,300.	*3,040.			
DICHLOROPROPENE	Y	N	*6,060.	*244.	*790.		87.ug	14.1mg	
DIELDRIN	Y	Y	2.5	0.0019	0.71	.0019	0.071ng**	0.076ng**	
DIETHYLPHTHALATE	Y	N					350.mg	1.8g	
DIMETHYLPHENOL 2,4	Y	N	*2,120.						
DIMETHYLPHTHALATE	Y	N					313.mg	2.9g	
DINITROTOLUENE 2,4	N	Y					0.11ug**	9.1ug**	
DINITROTOLUENE	Y	N					70.ug	14.3mg	
DINITROTOLUENE	N	Y	*330.	*230.	*590.	*370.			
DINITRO-O-CRESOL 2,4	Y	N					13.4g	765.ug	
DIOXIN (2,3,7,8-TCDD)	Y	Y	*0.01	*0.00001			0.000013ng**	0.000014ng**	
DIPHENYLHYDRAZINE	Y	N					42.ng**	0.56ug**	
DIPHENYLHYDRAZINE 1,2	Y	N	*270.						
DI-2-ETHYLHEXYLPHTHALATE	Y	N					15.mg	50.mg	
ENDOSULFAN	Y	N	0.22	0.056	0.034	0.0087	74.ug	159.ug	
ENDRIN	Y	N	0.18	0.0023	0.037	0.0023	1.ug		0.0002mg
ETHYLBENZENE	Y	N	*32,000.		*430.		1.4mg	3.28mg	
FLUORANTHENE	Y	N	*3,980.		*40.	*16.	42.ug	54.ug	
GUTHION	N	N		0.01		0.01			
HALOETHERS	Y	N	*360.	*122.					
HALOMETHANES	Y	Y	*11,000.		*12,000.	*6,400.	0.19ug**	15.7ug**	
HEPTACHLOR	Y	Y	0.52	0.0038	0.053	0.0036	0.28ng**	0.29ng**	
HEXACHLOROETHANE	N	Y	*980.	*540.	*940.		1.9ug	8.74ug	
HEXACHLOROBENZENE	Y	N					0.72ng**	0.74ng**	
HEXACHLOROBUTADIENE	Y	Y	*90.	*9.3	*32.		0.45ug**	50.ug**	
HEXACHLOROCYCLOHEXANE (LINDANE)	Y	Y	2.0	0.08	0.16				0.004mg
HEXACHLOROCYCLOHEXANE-ALPHA	Y	Y					9.2ng**	31.ng**	
HEXACHLOROCYCLOHEXANE-BETA	Y	Y					16.[illegible]ng**	54.7ng**	
HEXACHLOROCYCLOHEXANE-GAMA	Y	Y					18.6ng**	62.5ng**	
HEXACHLOROCYCLOHEXANE-TECHNICAL	Y	Y					12.3ng**	41.4ng**	
HEXACHLOROCYCLOPENTADIENE	Y	N	*7.	*5.2	*7.		206.ug		
IRON	N	N		1,000.			0.3mg		
ISOPHORONE	Y	N	*117,000.		*12,900.		5.2mg	520.mg	
LEAD	Y	N	82.+	3.2+	140.	5.6	50.ug		0.05mg
MALATHION	N	N		0.1		0.1			

testing procedures, may be considered as scientifically valid data for the purposes of (C). If toxicity occurs, the Department shall evaluate and implement measures necessary to reduce toxicity on a case-by-case basis.

* Rule References by Basin:

Basin	Toxic Substances
North Coast	340-41-205(p)
Mid Coast	340-41-245(p)
Umpqua	340-41-285(p)
South Coast	340-41-325(p)
Rogue	340-41-365(p)
Willamette	340-41-445(p)
Sandy	340-41-485(p)
Hood	340-41-525(p)
Deschutes	340-41-565(p)
John Day	340-41-605(p)
Umatilla	340-41-645(p)
Walla Walla	340-41-685(p)
Grande Ronde	340-41-725(p)
Powder	340-41-765(p)
Malheur River	340-41-805(p)
Owyhee	340-41-845(p)
Malheur Lake	340-41-885(p)
Goose and Summer Lakes	340-41-925(p)
Klamath	340-41-965(p)

KUW:h
WH2111.1

Note: Bracketed [ ] material is deleted.
Underlined ____ material is new.

FINAL RULE LANGUAGE FOR TOXIC SUBSTANCES STANDARDS

The Current Pesticides and Other Organic Toxic Substances rule to be deleted. Rule references for each basin appear as a footnote (*) at the end of the final rule.

OAR 340-41-*__(2)(p)

["Pesticides and other organic toxic substances shall not exceed those criteria contained in the 1976 edition of the EPA publication "Quality Criteria for Water". These criteria shall apply unless supporting data shows conclusively that beneficial uses will not be adversely affected by exceeding a criterion by a specific amount or that a more stringent criterion is warranted to protect beneficial uses."]

Final toxic substances standards to be adopted as rule OAR 340-41-*__(2)(p). Specific rule reference for each basin are included as a footnote (*) at the end of the final rule.

OAR 340-41-__*(2)(p) Toxic Substances

(A) Toxic substances shall not be introduced above natural background levels in the waters of the state in amounts, concentrations, or

(e) More stringent waste treatment and control requirements may be imposed where special conditions may require.

(2) Industrial wastes:

(a) After maximum practicable inplant control, a minimum of secondary treatment or equivalent control (reduction of suspended solids and organic material where present in significant quantities, effective disinfection where bacterial organisms of public health significance are present, and control of toxic or other deleterious substances).

(b) Specific industrial waste treatment requirements shall be determined on an individual basis in accordance with the provisions of this plan, applicable federal requirements, and the following:

(A) The uses which are or may likely be made of the receiving stream;

(B) The size and nature of flow of the receiving stream;

(C) The quantity and quality of wastes to be treated; and

(D) The presence or absence of other sources of pollution on the same watershed.

(c) Where industrial, commercial, or agricultural effluents contain significant quantities of potentially toxic elements, treatment requirements shall be determined utilizing appropriate bioassays.

(d) Industrial cooling waters containing significant heat loads shall be subjected to offstream cooling or heat recovery prior to discharge to public waters.

(e) Positive protection shall be provided to prevent bypassing of raw or inadequately treated industrial wastes to any public waters.

(f) Facilities shall be provided to prevent and contain spills of potentially toxic or hazardous materials and a positive program for containment and cleanup of such spills should they occur shall be developed and maintained.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77

Goose and Summer Lakes Basin

Beneficial Water Uses to be Protected

340-41-922 Water quality in the Goose and Summer Lakes Basin (See Figures 1 and 19) shall be managed to protect the recognized beneficial uses as indicated in Table 18.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77

Water Quality Standards Not to be Exceeded (To be Adopted Pursuant to ORS 468.735 and Enforceable Pursuant to ORS 468.720, 468.990, and 468.992)

340-41-925 (1) Notwithstanding the water quality standards contained below, the highest and best practicable treatment and/or control of wastes, activities, and flows shall in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and water temperatures, coliform bacterial concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor, and other deleterious factors at the lowest possible levels.

(2) No wastes shall be discharged and no activities shall be conducted which either alone or in combination with other wastes or activities will cause violation of the following standards in the waters of the Goose and Summer Lakes Basin:

(a) Dissolved oxygen (DO):

(A) All basin waters except Goose Lake: DO concentrations shall not be less than 75 percent of saturation at the seasonal low, or less than 95 percent of saturation in spawning areas during spawning, incubation, hatching, and fry stages of salmonid fishes.

(B) Goose Lake: DO concentrations shall not be less than 7 milligrams per liter.

(b) Temperature:

(A) Goose Lake: Daily average temperatures shall not exceed 70° F. or the daily mean ambient air temperature, whichever is greater.

(B) All other waters: No measurable increases shall be allowed outside of the assigned mixing zone, as measured relative to a control point immediately upstream from a discharge when stream temperatures are 68° F. or greater; or more than 0.5° F. increase due to a single-source discharge when receiving water temperatures are 67.5° F. or less; or more than 2° F. increase due to all sources combined when stream temperatures are 66° F. or less, except for specifically limited duration activities which may be authorized by DEQ under such conditions as DEQ and the Department of Fish and Wildlife may prescribe and which are necessary to accommodate legitimate uses or activities where temperatures in excess of this standard are unavoidable and all practical preventive techniques have been applied to minimize temperature rises. The Director shall hold a public hearing when a request for an exception to the temperature standard for a planned activity or discharge will in all probability adversely affect the beneficial uses.

(c) Turbidity (Jackson Turbidity Units, JTU): No more than a 10 percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. However, limited duration activities necessary to address an emergency or to accommodate essential dredging, construction or other legitimate activities and which cause the standard to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and one of the following has been granted:

(A) Emergency activities: Approval coordinated by DEQ with the Department of Fish and Wildlife under conditions they may prescribe to accommodate response to emergencies or to protect public health and welfare.

(B) Dredging, Construction or other Legitimate Activities: Permit or certification authorized under terms of Section 401 or 404 (Permits and Licenses, Federal Water Pollution Control Act) or OAR 141-85-100 et seq. (Removal and Fill Permits, Division of State Lands), with limitations and conditions governing the activity set forth in the permit or certificate.

(d) pH (Hydrogen Ion Concentration):

(A) Goose Lake: pH values shall not fall outside the range of 7.5 to 9.5.

(B) All other basin waters: pH values shall not fall outside the range of 7.0 to 9.0.

(e) Organisms of the coliform group where associated with fecal sources (MPN or equivalent MF using a representative number of samples): A log mean of 200 fecal coliform per 100 milliliters based on a minimum of 5 samples in a 30-

months. Where applicable in a waste discharge permit, the low flow period may be further defined.

(16) "Secondary treatment" as the following context may require for:

(a) "Sewage wastes" means the minimum level of treatment mandated by EPA regulations pursuant to Public Law 92-500.

(b) "Industrial and other waste sources" imply control equivalent to best practicable treatment (BPT).

(17) "Nonpoint Sources" refers to diffuse or unconfined sources of pollution where wastes can either enter into – or be conveyed by the movement of water to – public waters.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 24-1981, f. & ef. 9-8-81

Highest and Best Practicable Treatment and Control Required

340-41-010 [SA 26, f. 6-1-67; Repealed by DEQ 128, f. & ef. 1-21-77]

Restriction on the Discharge of Sewage and Industrial Wastes and Human Activities Which Affect Water Quality in the Waters of the State

340-41-015 [SA 26, f. 6-1-67; Repealed by DEQ 128, f. & ef. 1-21-77]

Maintenance of Standards of Quality

340-41-020 [SA 26, f. 6-1-67; DEQ 28, f. 5-24-71, ef. 6-25-71; Repealed by DEQ 128, f. & ef. 1-21-77]

Implementation of Treatment Requirements and Water Quality Standards

340-41-022 [DEQ 28, f. 5-24-71, ef. 6-25-71; DEQ 46, f. 6-15-72, ef. 7-1-72; Repealed by DEQ 128, f. & ef. 1-21-77]

Mixing Zones

340-41-023 [DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

Testing Methods

340-41-024 [DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

General Water Quality Standards

340-41-025 [SA 26, f. 6-1-67; DEQ 39, f. 4-5-72, ef. 4-15-72; DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

Policies and Guidelines Generally Applicable to All Basins

340-41-026 (1)(a) Existing high quality waters which exceed those levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water shall be maintained and protected unless the Environmental Quality Commission chooses, after full satisfaction of the intergovernmental coordination and public participation provisions of the continuing planning process, to lower water quality for necessary and justifiable economic or social development. The Director or his designee may allow lower water quality on a short-term basis in order to respond to emergencies or to otherwise protect public health and welfare. In no event, however, may degradation of water quality interfere with or become injurious to the beneficial uses of water within surface waters of the following areas:

(A) National Parks;

(B) National Wild and Scenic Rivers;

(C) National Wildlife Refuges;

(D) State Parks.

(b) Point source discharges shall follow policies and guidelines (2), (3), and (4), and nonpoint source activities shall follow guidelines (5), (6), (7), (8), and (9).

(2) In order to maintain the quality of waters in the State of Oregon, it is the policy of the EQC to require that growth and development be accommodated by increased efficiency and effectiveness of waste treatment and control such that measurable future discharged waste loads from existing sources do not exceed presently allowed discharged loads unless otherwise specifically approved by the EQC.

(3) For any new waste sources, alternatives which utilize reuse or disposal with no discharge to public waters shall be given highest priority for use wherever practicable. New source discharges may be approved by the Department if no measurable adverse impact on water quality or beneficial uses will occur. Significant or large new sources must be approved by the Environmental Quality Commission.

(4) No discharges of wastes to lakes or reservoirs shall be allowed without specific approval of the EQC.

(5) Log handling in public waters shall conform to current EQC policies and guidelines.

(6) Sand and gravel removal operations shall be conducted pursuant to a permit from the Division of State Lands and separated from the active flowing stream by a water-tight berm wherever physically practicable. Recirculation and reuse of process water shall be required wherever practicable. Discharges, when allowed, or seepage or leakage losses to public waters shall not cause a violation of water quality standards or adversely affect legitimate beneficial uses.

(7) Logging and forest management activities shall be conducted in accordance with the Oregon Forest Practices Act so as to minimize adverse effects on water quality.

(8) Road building and maintenance activities shall be conducted in a manner so as to keep waste materials out of public waters and minimize erosion of cut banks, fills, and road surfaces.

(9) In order to improve controls over nonpoint sources of pollution, federal, state, and local resource management agencies will be encouraged and assisted to coordinate planning and implementation of programs to regulate or control runoff, erosion, turbidity, stream temperature, stream flow, and the withdrawal and use of irrigation water on a basin-wide approach so as to protect the quality and beneficial uses

TABLE 7.E-11

SNOW ACCUMULATION AND DEPLETION, QUARTZ MOUNTAIN SNOTEL

	Snow Pack						
Water Year	Start Date	Max. SWE[a]	Max. Date	Start Melt Date	End Melt Date	Persistence (days)	Snowmelt Rate (in/dy)
1982	11/11	13.5	4/8	4/11	4/25	165	0.90
1983	11/17	17.1	3/23	4/15	5/12	176	0.66
1984	11/15	11.5	3/19	3/20	4/20	158	0.31
1985	11/2	10.1	3/15	3/16	4/16	163	0.32
1986	11/10	6.0	1/17	1/18	3/26	136	0.09
1987	12/30	6.5	3/22	3/26	4/5	96	0.46
1988	12/16	6.7	2/4	2/16	3/24	99	0.18
Av.	11/23	10.8	3/14	3/14	4/14	142	0.56
Median	11/16	10.1	3/19	3/20	4/16	158	0.32

[a] SWE: snow water equivalent, inches

TABLE 7.E-9

MONTHLY PRECIPITATION SINCE 1982 AT LAKEVIEW 2NNW AND QUARTZ MOUNTAIN SNOTEL

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Lakeview 2NNW													
1982	0.78	1.47	1.78	0.52	1.01	1.22	0.94	0.22	0.80	1.71	2.24	2.27	14.96
1983	1.00	2.12	2.76	1.88	1.82	0.49	0.34	1.19	0.56	0.93	2.94	4.08	20.11
1984	0.20	1.31	1.19	1.16	0.82	1.42	0.77	1.05	0.45	1.98	2.65	0.62	13.62
1985	0.37	1.22	1.90	0.36	0.91	0.13	0.28	0.00	1.99	0.23	4.12	0.10	11.61
1986	1.07	4.71	2.08	0.51	2.80	0.43	0.08	T	2.73	0.61	0.81	0.90	16.73
1987	2.04	1.28	2.30	1.54	1.69	2.37	1.18	0.10	0.00	0.00	0.83	2.51	15.84
1988	1.74	0.24	0.37	3.38	0.93	0.54	0.08	0.18	T				
AVG	0.91	2.02	1.77	1.34	1.43	0.94	0.52	0.43	1.09	0.91	2.26	1.59	15.41
MAX	2.04	4.71	2.76	3.38	2.80	1.42	0.94	1.19	2.73	1.98	4.12	4.08	20.11
MIN	0.20	1.22	0.37	0.36	0.82	0.13	0.08	0.00	0.00	0.00	0.81	0.10	11.63
AVG(73)	1.76	1.52	1.34	1.11	1.37	1.11	0.33	0.34	0.61	1.13	1.66	1.85	14.98[a]
AVG(25)	2.09	1.65	1.46	1.16	1.38	1.24	0.33	0.61	0.59	1.36	2.21	2.22	16.30[b]

a 1913-1986
b 1961-1985

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Quartz Mountain SNOTEL													
1982	4.7	2.3	3.8	3.6	0.6	2.0	1.4	0.5	0.5	2.9	2.9	5.6	30.8
1983	2.5	5.7	5.7	1.8	1.3	1.5	1.2	1.4	0.3	0.4	5.1	8.9	35.8
1984	0.5	2.7	3.5	2.7	2.2	2.6	0.1	1.3	0.1	3.2	5.5	2.0	26.4
1985	0.4	2.2	3.5	1.0	0.8	0.7	0.5	0.0	3.0	1.1	3.0	1.1	17.3
1986	2.6	6.2	3.3	1.5	2.3	1.5	0.2	0.0	3.2	0.6	1.1	1.1	23.6
1987	3.5	2.1	2.7	0.3	1.3	2.2	2.7	0.6	0.2	0.1	1.3	3.8	20.8
1988	4.7	0.1	1.6	4.0	1.5	1.0	0.0	0.1	0.7				
AVG(7)	2.7	3.0	3.4	1.8	1.4	1.6	0.9	0.6	1.1	1.4	3.2	3.8	25.8
MAX	4.7	6.2	5.7	4.0	2.3	2.6	1.4	1.4	3.2	3.2	5.5	8.9	35.8
MIN	0.4	0.1	1.6	0.3	0.6	0.7	0.0	0.0(2)	0.1	0.1	1.1	1.1(2)	17.3
AVG(25)	2.9	2.4	2.4	1.7	1.7	1.7	0.5	0.7	0.9	1.9	3.3	3.8	23.9[c]

c 1961-1985

TABLE 7.E-7

DISCHARGE AND VELOCITY DATA FROM ONE RANDOM AND EIGHT SECONDARY SURFACE WATER SAMPLING STATIONS

Sta. ID	Sample Date	Discharge cfs	Discharge gpm	Velocity fps	Velocity mph
AN	880510	1.18		1.74	1.2[a]
ANT	871005	0.007		[b]	
	880510	0.043		[b]	
BU	870903	2.87		0.89	0.61
	880510	0.744		0.38	0.26
	880616			0.32[c]	0.22
DR1	880508	8.51		2.01	1.4
NF	880510	0.313		0.36	0.25
QU2	880510	1.82		0.66	0.45
	880616			0.065[c]	0.044
BH	871005		0.806		
	871111		0.685		
	880509		1.08		
RR1	870903		4.50		
	880509		13.23		
DR5[d]	880616	1.84		0.24	0.16

[a] MPH = FPS x 0.6818

[b] Unable to measure velocity due to small channel cross-section. Flow measurement at a small falls.

[c] Velocity measurement only.

[d] Drews Creek in Drews Valley at FR 3945, a random station.

TABLE 7.E-5

WATER QUALITY DATA FOR SECONDARY SPRING STATIONS

Species	Sta. ID\	BH		EW	RR1		RR2
	Date\	871112	880509	880509	870903	880510	870903
	Time\	1600	1145	1215	1345	1405	1410
Alkalinity, Total		89.5	57.3	37.2	31.4	28.4	34.5
Bicarbonate		89.5	57.3	37.2	31.4	28.4	34.5
Carbonate		0.0	0.0	0.0	0.0	0.0	0.0
Antimony		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium		<0.05	<0.05	0.07	<0.10	0.05	<0.10
Cadmium		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloride		1.20	1.31	1.73	1.90	1.55	1.90
Chromium		<0.005	0.005	<0.005	<0.005	<0.005	<0.005
Conductivity (umhos/cm)		128.0	96.5	66.8	50.0	50.2	51.0
Copper		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cyanide, Total		<0.001	<0.005	<0.005	<0.004	<0.005	<0.004
Fluoride		<0.05	<0.05	<0.05	0.08	<0.05	0.08
Hardness, Total		87.7	58.0	40.8	25.5	26.0	23.0
Iron		0.16	1.49	6.61	0.13	0.22	0.25
Lead		<0.005	<0.005	0.006	<0.005	<0.005	<0.005
Manganese		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate (mg NO3-N/L)		0.12	0.11	0.24	<0.10	<0.10	0.68
Non-Filterable Residue		0.3	0.4	11.0	10.0	1.0	12.0
pH (Units)		6.6	6.6	6.3	6.5	6.7	7.9
Selenium		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Settleable Solids (ml/L)		<0.10	<0.10	0.10	0.10	<0.10	0.10
Silver		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium		11.3	8.1	12.3	2.7	9.4	2.6
Solids, Total		126.0	121.0	166.0	90.0	84.0	91.0
Sulfate		3.50	<0.10	<0.10	0.48	<0.10	0.34
Temperature (C)		10.0	9.0	7.5		12.0	13.5
Turbidity (FTU)		0.80	15.50	38.50	2.00	5.90	2.90
Zinc		<0.10	<0.10	<0.01	<0.10	<0.10	<0.10
Gross Alpha (pCi/L)			0.00	0.00		0.00	
Gross Beta (pCi/L)			0.00	0.00		3.30	

BH: Buckhorn Spring
EW: Ewauna Spring
RR1: Railroad Spring 1
RR2: Railroad Spring 2

TABLE 7.E-3

WATER QUALITY DATA FOR QUARTZ CREEK AT SH 140 NEAR QUARTZ MOUNTAIN (QU1)

Species \Date \Time	870902 1535	871005 1115	871112 1330	871209 1115	880111 1215	880210 1210	880310 1045	880408 1125	880511 0810	880615 0950	880712 1140	880812 DRY
Alkalinity, Total	108.0	114.0	81.1	68.3	89.3	72.6	35.2	44.7	49.0	62.8	99.8	
Bicarbonate	8.2	85.4	81.1	68.3	89.3	72.6	35.2	44.7	49.0	62.8	99.8	
Carbonate	99.8	29.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Antimony	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Barium	0.10	<0.05	0.11	0.08	0.07	<0.05	0.07	0.05	<0.05	0.07	<0.05	
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chloride	2.70	2.40	2.10	1.70	1.91	1.47	2.05	1.49	1.45	1.32	2.36	
Chromium	<0.005	<0.005	<0.005	0.100	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Conductivity (umhos/cm)	151.0	156.0	120.0	101.0	147.0	115.0	65.6	71.1	79.4	96.0	146.0	
Copper	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	
Cyanide, Total	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Fluoride	0.13	0.13	0.11	0.17	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	
Hardness, Total	87.1	75.8	69.4	49.2	69.4	59.5	32.1	43.7	43.6	49.5	78.0	
Iron	0.99	0.65	0.53	2.46	0.46	1.80	2.80	1.40	0.24	0.56	0.34	
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Manganese	0.04	0.04	0.01	<0.01	0.02	0.06	0.03	0.01	<0.01	0.01	0.01	
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Nitrate (mg NO3-N/L)	<0.1	0.14	<0.1	0.21	<0.1	0.16	0.03	0.12	0.11	<0.10	<0.10	
Non-Filterable Residue	5.5	18.6	3.0	4.3	4.3	15.6	10.0	3.7	7.0	4.0	6.0	
pH (Units)	8.4	9.6	7.7	7.4	7.4	7.3	7.0	7.4	7.3	7.3	8.1	
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Settleable Solids (ml/L)	<0.1	<0.1	<0.1	<0.1	<0.1	0.10	0.10	<0.10	0.10	<0.10	<0.10	
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Sodium	5.8	9.0	17.5	4.0	7.0	7.7	6.1	10.5	9.8	8.0	10.7	
Solids, Total	174.0	184.0	145.0	181.0	177.0	160.0	171.0	124.0	113.0	124.0	161.0	
Sulfate	<0.1	<0.1	2.70	<0.1	<0.1	<0.1	<0.1	<0.10	0.30	<0.10	<0.10	
Temperature (C)	20.5	10.0	10.5	4.5	0.0	2.0	0.0	4.0	10.0	18.0	20.0	
Turbidity (FTU)	6.60	14.00	7.00	36.00	16.00	17.50	35.50	18.00	8.10	6.30	4.60	
Zinc	<0.1	<0.1	0.10	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	
Gross Alpha (pCi/L)		<1	<1	<1	<5	0.16	0.08	0.36	1.43	2.72	0.40	
Gross Beta (pCi/L)		<1	<1	<1	<5	3.15	1.62	0.00	4.50	16.88	0.00	

All data in mg/L unless otherwise noted

TABLE 7.E-1

WATER QUALITY DATA FOR DREWS CREEK ABOVE SH 140 (DR3)
QUARTZ MOUNTAIN GOLD PROJECT

Species \Date \Time	870902 1515	871005 1015	871112 1050	871209 1210	880111 1315	880210 1300	880310 1130	880408 1210	880511 0850	880615 1050	880712 1225	880812 0645
Alkalinity, Total	63.3	64.6	54.2	51.5	52.6	49.3	50.1	50.5	47.5	59.6	65.1	68.8
Bicarbonate	29.6	64.6	54.2	51.5	52.6	49.3	50.1	50.5	47.5	59.6	65.1	68.8
Carbonate	33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antimony	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.007	0.015
Barium	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloride	2.00	1.10	1.50	1.40	1.08	1.14	1.48	1.29	1.26	1.35	2.07	2.87
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Conductivity (umhos/cm)	85.0	86.0	82.0	77.0	88.0	77.0	86.0	78.6	81.8	92.2	96.6	99.1
Copper	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10
Cyanide, Total	<0.004	<0.004	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride	0.13	0.20	0.09	0.15	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05
Hardness, Total	57.0	56.8	51.1	45.4	46.9	45.8	50.9	47.3	48.8	50.3	61.2	57.7
Iron	0.42	0.13	0.29	0.51	0.20	0.90	1.80	1.40	0.44	0.68	0.72	0.52
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	0.02	0.02	<0.1	<0.1	<0.1	0.02	0.06	0.03	0.02	0.02	0.07	0.04
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate (mg NO3-N/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10
Non-Filterable Residue	1.2	0.6	1.0	3.8	2.0	4.2	12.0	10.3	6.3	5.5	3.6	5.5
pH (Units)	9.0	8.0	7.8	7.7	7.7	7.6	7.8	7.9	7.8	7.8	8.2	7.8
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Settleable Solids (ml/L)	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	0.2	0.1	<0.10	<0.10	0.1
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium	2.5	3.4	11.6	2.7	3.2	4.0	5.8	8.6	8.2	5.3	6.3	6.8
Solids, Total	103.0	105.0	85.0	98.0	90.0	89.0	117.0	100.0	88.0	97.0	106.0	111.0
Sulfate	<0.1	<0.1	0.80	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10
Temperature (C)		9.0	8.0	4.0	0.0	2.5	0.0	2.1	7.5	17.0	19.5	
Turbidity (FTU)	1.40	0.95	1.40	4.40	3.80	4.30	9.80	6.65	5.30	3.70	1.50	2.00
Zinc	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10
Gross Alpha (pCi/L)		<1	<1	<1	<5	5.68	0.14	0.00	1.25	0.55	1.13	0.00
Gross Beta (pCi/L)		<1	<1	<1	<5	7.40	3.61	0.00	0.00	0.00	0.00	0.00

All data in mg/L unless otherwise noted

TABLE 7.D-1

WATER QUALITY DATA FROM SEVERAL SITES WITHIN THE QUARTZ MOUNTAIN PROJECT AREA PRIOR TO 1987

SAMPLE COLLECTION DATE	QUARTZ CREEK 05/21/86	QUARTZ CREEK 05/13/85	QUARTZ CREEK 08/27/85	DREWS CREEK 05/21/86	QUARTZ MOUNTAIN SPRING 06/21/86	QUARTZ MOUNTAIN SPRING 06/23/86	QUARTZ MOUNTAIN SPRING 08/27/85	B. STOKES'S FAUCET* 10/09/85	G. FULLERTON'S FAUCET 05/21/86	[illegible] WELL 05/13/85	[illegible] WELL 08/27/85
pH	7.2	7.1	9.1	8.1	6.9	6.8	7.0	6.7	6.8	7.06	6.89
Conductivity (umhos/cm)	60	75	225	90	73	70	78	72	72	80	85
Alkalinity (mg/l)($CaCO_3$)	28	28	112	41	31	32	33	34	31	35	31
Sulfate (mg/l)	5	1.0	0	8	8	0.5	4	1.2	5	6.0	6
Total Coliform (100 ml)	2	N/A	N/A	5	0	N/A	N/A	N/A	2	N/A	N/A
Iron (mg/l)	0.07	0.41	0.04	0.11	4.0	0.08	0.04	0.25	0.02	0.3	0.22
Manganese (mg/l)	0.02	B.D.	N/A	0.02	0.61	B.D.	N/A	0.05	0.02	B.D.	N/A
Mercury (mg/l)	0.0006	N/A	0.0002	0.0008	0.002	N/A	0.0002	0.005	0.0005	N/A	0.0004
Antimony (mg/l)	0.01	N/A	N/A	0.01	0.03	N/A	N/A	N/A	0.01	N/A	N/A
Arsenic (mg/l)	0.003	N/A	0.022	0.003	0.003	0.006	0.006	0.006	0.003	0.005	0.006
Fluoride (mg/l)	0.1	N/A	N/A	0.1	0.2	N/A	N/A	N/A	0.1	N/A	N/A
Chloride (mg/l)	2	N/A	N/A	2	2	N/A	N/A	N/A	2	N/A	N/A
Nitrate (mg/l)	0.9	N/A	N/A	0.9	0.8	N/A	N/A	N/A	0.9	N/A	N/A
Cyanide, Total (mg/l)	0.006	N/A	N/A	0.006	0.006	N/A	N/A	N/A	0.005	N/A	N/A
Cadmium (mg/l)	N/A	N/A	0.0016	N/A	N/A	N/A	0.0001	0.001	N/A	N/A	0.0035
Zinc (mg/l)	N/A	N/A	0.25	N/A	N/A	0.015	0.15	0.07	N/A	0.17	0.36
Hardness (mg/l)	N/A	N/A	N/A	N/A	N/A	10	N/A	15	N/A	20	N/A
Lead (mg/l)	N/A	N/A	N/A	N/A	N/A	0.5	N/A	0.01	N/A	0.5	N/A
Magnesium (mg/l)	1.6	N/A	N/A	2.6	1.1	N/A	N/A	1.2	0.9	N/A	N/A
Calcium (mg/l)	4.2	N/A	N/A	7.0	3.6	N/A	N/A	4.0	3.3	N/A	N/A
Potassium (mg/l)	2.0	N/A	N/A	1.0	5.0	N/A	N/A	N/A	4.5	N/A	N/A
Sodium (mg/l)	5	N/A	N/A	4	7	N/A	N/A	N/A	7	N/A	N/A
Color (C.U.)	5	N/A	N/A	10	5	N/A	N/A	N/A	5	N/A	N/A
Total Dissolved Solids (mg/l)	119	N/A	N/A	90	120	N/A	N/A	N/A	134	N/A	N/A

*Sampled by T.D. Hall of Bend office of DEQ
N/A = Not analyzed
B.D. = Below detection limit

TABLE 7.C-1

HIGHLIGHTS OF THE DRINKING WATER STANDARDS
(OAR 333-61-030) AS OF JULY 1986
AND THEIR MAXIMUM CONTAMINANT LEVELS (MCL)
QUARTZ MOUNTAIN GOLD PROJECT

Contaminant		MCL (mg/L)
Primary Contaminants		
Arsenic		0.05
Barium		1.00
Cadmium		0.01
Chromium		0.05
Lead		0.05
Mercury		0.002
Nitrate (as N)		10
Selenium		0.01
Silver		0.05
Secondary Contaminants		
pH		6.0-9.0
Hardness		250
Total Solids		500
Chloride		250
Copper		1.0
Iron		0.3
Manganese		0.05
Sulfate		250
Zinc		5.0
Radio active substances:	Gross A	15 pCi/L
	Gross B	50 pCi/L
Turbidity (NTU)		1.0 as monthly average or 5.0 based on average of two consecutive days
Coliform Bacteria (Membrane Filter)		No more than: 1/100 ml as the monthly arithmetic mean 4/100 ml in more than one sample when <20 samples/mo. 4/100 ml in more than 5% of samples when >20 samples/mo.

TABLE 7.B-5

DEPARTURES OF ANNUAL DISCHARGE FROM THE HISTORICAL AVERAGE, CHEWAUCAN RIVER NEAR PAISLEY, OREGON

YEAR	AVERAGE CFS	DEPARTURE CFS	DEPARTURE %	YEAR	AVERAGE CFS	DEPARTURE CFS	DEPARTURE %
1925	120.0	-30.4	-20.2	1956	353.0	202.6	134.7
1926	44.8	-10[illegible].6	-70.2	1957	180.0	29.6	19.7
1927	175.0	24.6	16.4	1958	227.0	76.6	50.9
1928	130.0	-20.4	-13.6	1959	80.2	-70.2	-46.9
1929	61.1	-89.3	-59.4	1960	99.4	-51.0	-33.9
1930	80.4	70.0	-46.5	1961	93.4	-57.0	-37.9
1931	34.1	-116.3	-77.3	1962	103.0	-47.4	-31.5
1932	102.0	-48.4	-32.2	1963	231.0	80.6	53.6
1933	76.1	-74.3	-49.4	1964	121.0	-29.4	-19.5
1934	55.5	-94.9	-63.1	1965	291.0	140.6	93.5
1935	105.0	-45.4	-30.2	1966	98.0	-52.4	-34.8
1936	134.0	-16.4	-10.9	1967	182.0	31.6	21.0
1937	86.8	-63.6	-42.3	1968	78.4	-72.0	-47.9
1938	223.0	72.6	48.3	1969	186.0	35.6	23.7
1939	75.8	-74.6	-49.6	1970	190.0	39.6	26.3
1940	140.0	-10.4	-6.9	1971	308.0	157.6	104.8
1941	99.0	-51.4	-34.2	1972	209.0	58.6	39.0
1942	153.0	2.6	1.7	1973	106.0	44.4	-29.5
1943	236.0	85.6	56.9	1974	256.0	105.6	70.2
1944	85.0	-65.4	-43.5	1975	152.0	1.6	1.1
1945	133.0	-17.4	-11.6	1976	110.0	-40.4	-26.7
1946	158.0	7.6	5.1	1977	39.3	-111.1	-73.9
1947	79.2	-71.2	-47.3	1978	160.0	9.6	6.4
1948	142.0	-8.4	-5.5	1979	92.4	-58.0	-38.6
1949	122.0	-28.4	-18.9	1980	157.0	605.0	4.4
1950	136.0	-14.4	-9.6	1981	80.6	-69.8	-46.4
1951	200.0	49.6	33.0	1982	311.0	160.6	106.8
1952	271.0	120.6	80.2	1983	278.0	127.6	84.8
1953	218.0	67.6	44.9	1984	256.0	105.6	70.2
1954	201.0	50.6	33.6	1985	135.0	-15.4	-10.2
1955	70.6	-79.8	-53.1	1986	205.0	54.6	36.3

TABLE 7.B-3

MONTHLY PRECIPITATION SINCE 1982 AT FOUR STATIONS

MONTH / YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YR.
A. Klamath Falls													
1982	0.98	2.35	1.84	0.65	0.25	1.54	0.65	0.63	0.40	1.34	1.71	3.15	15.49
1983	1.07	2.50	2.78	1.44	0.56	0.36	0.51	0.73	0.52	0.78	3.66	5.81	20.72
1984	0.23	1.51	1.25	1.10	0.51	0.74	0.40	1.56	0.50	1.94	3.69	1.30	14.73
1985	0.14	1.20	0.95	0.29	0.39	0.68	0.95	0.08	2.36	0.87	1.61	0.74	10.26
1986	1.87	4.66	1.48	0.18	0.89	0.69	0.11	0.00	2.45	0.50	0.94	0.62	14.39
AVG	0.86	2.44	1.66	0.73	0.52	0.80	0.52	0.60	1.25	1.09	2.32	2.32	15.12
MAX	1.87	4.66	2.78	1.44	0.89	1.54	0.95	1.56	2.45	1.94	3.69	5.81	20.72
MIN	0.14	1.20	0.95	0.18	0.25	0.36	0.11	0.00	0.40	0.50	0.94	0.62	10.25
B. Lakeview													
1982	0.78	1.47	1.78	0.52	1.01	1.22	0.94	0.22	0.80	1.71	2.24	2.27	14.96
1983	1.00	2.12	2.76	1.88	1.82	0.49	0.34	1.19	0.56	0.93	2.94	4.08	20.11
1984	0.20	1.31	1.19	1.16	0.82	1.42	0.77	1.05	0.45	1.98	2.65	0.62	13.62
1985	0.37	1.22	1.90	0.36	0.91	0.13	0.28	0.00	1.99	0.23	4.12	0.10	11.61
1986	1.07	4.71	2.08	0.51	2.80	0.43	0.08	T	2.73	0.61	0.81	0.90	16.73
AVG	0.68	2.17	1.94	0.89	1.47	0.74	0.48	0.49	1.31	1.09	2.55	1.59	15.41
MAX	1.07	4.71	2.76	1.88	2.80	1.42	0.94	1.19	2.73	1.98	4.12	4.08	20.11
MIN	0.20	1.22	1.19	0.36	0.82	0.13	0.08	0.00	0.45	0.23	0.81	0.10	11.63
C. Quartz Mountain SNOTEL													
1982	4.7	2.3	3.8	3.6	0.6	2.0	1.4	0.5	0.5	2.9	2.9	5.6	30.8
1983	2.5	5.7	5.7	1.8	1.3	1.5	1.2	1.4	0.3	0.4	5.1	8.9	35.8
1984	0.5	2.7	3.5	2.7	2.2	2.6	0.1	1.3	0.1	3.2	5.5	2.0	26.4
1985	0.4	2.2	3.5	1.0	0.8	0.7	0.5	0.0	3.0	1.1	3.0	1.1	17.3
1986	2.6	6.2	3.3	1.5	2.3	1.5	0.2	0.0	3.2	0.6	1.1	1.1	23.6
1987	3.5	2.1	2.7	0.3	1.3	2.2	2.7	0.6	0.2	0.1	1.3	3.8	20.8
AVG	2.4	3.5	3.8	1.8	1.4	1.8	1.0	0.6	0.7	1.4	3.2	3.8	26.8
MAX	4.7	6.2	5.7	3.6	2.3	2.6	1.4	1.4	3.2	3.2	5.5	8.9	35.8
MIN	0.4	2.2	3.3	1.0	0.6	0.7	0.1	0.0(2)	0.1	0.1	1.1	1.1	17.3
D. Round Grove													
1982	2.27	3.93	2.68	1.83	0.51	1.95	1.14	0.23	0.89	2.49	2.99	3.24	24.21
1983	1.68	3.71	4.00	1.41	0.55	1.46	0.93	2.08	0.50	1.33	3.97	5.18	26.80
1984	0.27	1.12	2.34	2.5[illegible]	1.16	1.82	0.32	2.10	0.20	2.42	3.83	1.20	19.33
1985	0.40	0.90	1.92	0.80	0.95	0.70	0.14	M	2.36	0.09	1.17	0.70	
1986	2.14	4.30	2.31	0.87	1.76	0.50	M	M	2.40	0.74	1.09	0.66	
AVG	1.35	2.80	2.65	1.49	0.99	1.29	0.63	1.47	1.27	1.58	2.61	2.20	20.33
MAX	2.27	3.99	4.00	2.55	1.76	1.95	1.14	2.10	2.40	2.49	3.97	5.18	26.80
MIN	0.27	0.90	1.92	0.80	0.51	0.50	0.14	0.23	0.20	0.74	1.09	0.66	19.33

TABLE 7.B-1

MAXIMUM SNOW DEPTH, QUARTZ MOUNTAIN SNOW COURSE, 1939-1986, SNOW COURSE LOCATED IN QUARTZ VALLEY MEADOW

YEAR	SNOW DEPTH DATE	SNOW DEPTH IN.	YEAR	SNOW DEPTH DATE	SNOW DEPTH IN.
1939	2/28	18	1963	3/18	6 min.
1940	2/29	8	1964	3/27	29
1941	2/26	23	1965	1/29	17
1942	3/4	22	1966	2/28	26
1943	1/31	39	1967	3/30	24
1944	2/29	24	1968	1/30	25
1945	3/26	18	1969	1/30	41
1946	2/28	32	1970	3/2	10
1947	1/31	9	1971	4/1	22
1948	3/28	12	1972	1/27	32
1949	3/1	26	1973	2/28	12
1950	3/3	14	1974	2/26	10
1951	3/4	17	1975	3/27	39
1952	3/3	42 max.	1976	2/26	19
1953	1/2	30	1977	1/28	8
1954	2/2	25	1978	12/28	13
1955	2/1	22	1979	2/27	15
1956	3/1	38	1980	12/27	19
1957	2/1	13	1981	1/27	8
1958	1/29	25	1982	1/29	23
1959	2/27	13	1983	12/29	29
1960	2/26	21	1984	2/27	28
1961	1/27	7	1985	2/25	20
1962	2/27	27	1986	12/27	14
AVERAGE	2/17	21.1			
MEDIAN	2/27	22.5			

TABLE 7.A-3

SPRING DISCHARGE SUMMARY
FOR THREE SPRINGS
QUARTZ MOUNTAIN GOLD PROJECT

Station Name	ID	Date YYMMDD	Time HHMM	Q[a] (gpm)
Buckhorn Spring	BH	871005	1500	0.81[b]
		871111	1600	0.69[b]
Quartz Mountain Spring	QM	870902	1030	1.79[c]
		871005	1200	1.19[c]
		871112	1520	7.85[c]
		871210	1135	9.93[d]
Railroad Spring 1	RR1	870903	1345	4.50[e]

a Q = Discharge, gallons per minute (gpm)

b Q greater than measured due to seepage at spring box

c Q measured at spring overflow only. Tabular Q computed from spring and Quartz Mountain overflows on 12/10/87

d Q measured at both spring and Quartz Mountain overflows

e Q greater than measured due to seepage around and under measurement site in loose rock and soil. Actual Q about 20% greater than measured.

TABLE 7.A-1

QUARTZ MOUNTAIN SPRING WATER SYSTEM FLOW DATA

DATE	TIME (24 HR)	METER READING	GPM[1]	FLOW RATE (SEC/10G)	GPM[2]	UPPER CISTERN (SEC/5.7G)	GPM[3]	LOWER CISTERN (SEC/5.7G)	GPM[4]	TOTAL GPM	
10/23/87	1638	4050	-	24	25.0	-	-	142	2.4	-	
10/24/87	0916	29160	25.9	24	25.0	-	-	-	-	-	
10/24/87	1612	39660	25.2	24	25.0	-	-	-	-	-	
10/25/87	1004	68775	27.3	23	26.1	-	-	-	-	-	
10/26/87	0752	102490	25.8	23	26.1	29	11.7	-	-	-	
10/26/87	1705	116420	28.3	24	25.0	60	5.7	70	4.9	10.6	1/
10/27/87	1116	144430	25.7	24	25.0	60	5.7	75	4.6	10.3	
10/28/87	1508	187345	25.6	22	27.3	49	7.0	115	3.0	10.0	
10/29/87	1551	225570	25.8	23	26.1	50	6.8	95	3.6	10.4	
11/02/87	1636	378270	26.3	24	25.0	39	8.8	235	1.5	10.3	
11/03/87	1027	406400	26.3	22	27.3	-	-	-	-	-	
11/03/87	1138	407280	14.1	56	10.7	57	6.0	75	4.6	10.6	2/
11/05/87	1420	439100	10.5	60	10.0	72	4.7	65	5.3	10.0	
11/06/87	1245	453200	10.5	-	-	72	4.7	70	4.9	9.6	
11/09/87	1445	499870	10.5	58	10.3	72	4.7	64	5.3	10.0	
11/18/87	1450	637425	10.6	58	10.3	76	4.5	80	4.3	8.8	
11/18/87	1638	638580	10.7	58	10.3	-	-	-	-	-	
11/19/87	1430	652590	10.7	56	10.7	60	5.7	86	4.0	9.7	
11/20/87	1430	667980	10.7	56	10.7	57	6.0	85	4.0	10.0	
11/21/87	0734	678910	10.7	57	10.5	105	3.3	82	4.2	7.5	3/
11/22/87	1725	700170	10.5	-	-	-	-	-	-	-	
11/23/87	1441	714390	11.1	55	10.9	57	6.0	85	4.0	10.0	
11/24/87	1628	731020	10.7	57	10.5	60	5.7	80	4.3	10.0	
11/30/87	1425	822790	10.8	55	10.9	-	-	-	-	-	
12/01/87	1620	839600	10.8	55	10.9	55	6.2	81	4.2	10.4	
12/02/87	1355	853930	11.1	52	11.5	57	6.0	80	4.3	10.3	
12/03/87	1151	868320	10.9	55	10.9	59	5.8	82	4.2	10.0	
12/07/87	1628	934475	10.6	56	10.7	55	6.2	80	4.3	10.5	
12/09/87	1414	964700	11.0	55	10.9	57	6.0	82	4.2	10.2	
12/10/87	1612	982100	11.2	53	11.3	57	6.0	80	4.3	10.3	
12/11/87	1137	995000	11.1	54	11.1	57	6.0	83	4.1	10.1	
12/14/87	1122	1042565	11.0	54	11.1	59	5.8	81	4.2	10.0	
12/15/87	1642	1061970	11.0	57	10.5	57	6.0	82	4.2	10.2	
12/17/87	1127	1090200	11.0	55	10.9	59	5.8	82	4.2	10.0	
12/18/87	1536	1108810	11.0	54	11.1	59	5.8	82	4.2	10.0	
12/21/87	1636	1157300	11.1	53	11.3	58	5.9	87	3.9	9.8	

GPM[1] = Gallons Per Minute based on differences in meter readings
GPM[2] = Gallons Per Minute based on meter dial
GPM[3] = Gallons Per Minute based on measurement of upper cistern overflow
GPM[4] = Gallons Per Minute based on measurement of lower cistern overflow
TOTAL GPM =Gallons Per Minute based on sum of overflow from both cisterns

1/ Valve adjustment to balance flow to system

2/ Meter box releveled, valve adjustment to balance flow to system and to create slight backpressure on meter to reduce water meter cavitation and erroneous readings

3/ Demand on upper cistern in system during measurement

U.S. Department of Commerce. 1986. Monthly surface data, Bly R.S., Gerber Dam, Klamath Falls, Lakeview, Round Grove. USDC-NOAA (Nat'l. Clim. Data Ctr., Asheville) TD-3220 (floppy disk).

USDA Soil Conservation Service. 1986. Annual data summary, Oregon, water year 1986. USDA-SCS (Snow Survey). 28p.

USDA Soil Conservation Service. 1987. Oregon water supply outlook, 1/1/88. USDA-SCS (Snow Survey). 31p.

Water Resources Department. 1986. Oregon water laws. OWRD (Salem). 207p.

7.8 PUBLIC AND AGENCY CONTACTS

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FLOW METER - A device which allows for measurement of stream flow by measuring velocity in a given cross-sectional area.

HARDNESS - Measure of the calcium and magnesium salts in water.

INORGANIC - Not containing organic material.

INTERMITTENT - Stream which flows only at certain times of the year, as when it receives water from springs of from some surface source.

INTRUSIVE - While fluid having penetrated into or between other rocks, but solidifying before reaching the surface.

MEANDERS - Series of looplike bends in the course of a stream.

MOUTH - The exit or point of discharge of a stream into another stream or a lake or sea.

NEUTRAL - Having a pH near 7 and being neither acidic nor alkaline.

ORGANIC - Containing carbon compounds.

PERENNIAL - Stream which flows throughout the year.

PHYSIOGRAPHIC PROVINCE: A region of similar structure and climate that has had a unified geomorphic history.

RADIOACTIVE - A series of elements which are capable of changing spontaneously into another element by the emission of charged particles.

RAIN SHADOW - A very dry region on the lee side of a topographic obstacle where rainfall is noticeably less than on the windward side.

RUNOFF - Discharge of water through surface streams.

SEEP - A spot where water oozes from the earth.

SETTLEABLE SOLIDS - The solids in a solution which will settle out if allowed to sit undisturbed.

SNOW COURSE - A measuring line established by the Soil Conservation Service to periodically determine snow depths and snow water equivalent.

Laboratory analysis will conform to the standards found in the most recent edition of "Standard Methods for the Examination of Water and Waste Water," published jointly by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation unless the laboratory conducting the analyses, QMG, and DEQ jointly concur that another analytical procedure provides more reliable data.

Klamath Environmental Services (KES), 200 East Main, Klamath Falls, Oregon, Oregon approved laboratory #75, California approved, and EPA certified, provides laboratory services. KES will contract out those species analyses it is unable to do.

downslope extension of RR1. Perennial flow in Angel Creek begins with flow from Angel Creek Spring. The stream sampling point for Angel creek is directly downstream of AG, therefore no sampling will occur at Site AG.

Several springs, QV, EW and AC could not be sampled in 1987 since the springs did not flow during the dry season. An attempt will be made to sample these springs in the spring of 1988, but continual sampling of these springs is not planned.

7.6.2.3 Monitoring Schedule

QM, QU1, and DR3 are sampled monthly for both water quality and flow. QU1 and DR3 will be equipped with a continuous reading water level recorder. A water meter provides a cumulative total of flow from QM. These sites represented the key water monitoring locations.

Stream sites QU2, QU3, QU4, AN, ANT, NF, DR1, DR4, and BU, and springs BK and RR1 will be sampled twice each year in May and again in August or September. May and August/September represent the highest and the lowest yield months, respectively, based on U. S. Geological Survey streamflow data from the two stations closest to the project, Sprague River near Beatty and Chewaucan River near Paisley. The highest annual discharge occurs anywhere from December through May, however accessibility is often severely restricted until early spring. Both the lowest discharge of the year and the lowest monthly yield are most likely to occur in August/September.

Sites QU2, QU3, BU and DR4 will be sampled twice yearly to characterize flow and water quality for one to two years. It is expected that after these sites have been characterized the sites can be eliminated. Future sampling of these sites would be only in response to an unexpected hydrologic occurrence, such as an accidental discharge.

Several springs, QV, EW and AC could not be sampled in th fall of 1987 due to lack of flow. These sites will be sample in May but will not be part of the regular monitoring program

The preceding schedule does not accommodate the sampling of unusual or extreme random events, whether natural or man-caused. The schedule is flexible, and additional monitoring sites or times can be added as needed.

Each time a flow measurement is taken a water quality sample will be collected. For sites read on a monthly basis, QU1, QM, DR3, a full analysis will be performed in May and August/September. However, field parameters will be recorded at these sites on a monthly basis. Table 7.5-1 shows parameters for field and laboratory analysis.

7.6 SRK MONITORING PROGRAM

7.6.1 Introduction

Surface water monitoring of the study area is important to characterize existing flow and water quality conditions. For any one set of data to be useful, it must be compared to other data sets. The method of data collection and the location of the collection point must be consistent to allow accurate comparison.

SRK has developed a surface water monitoring program for the study area. The program includes both monitoring sites and monitoring methods. The program is intended to establish monitoring consistency for data comparisons and can be used to monitor existing conditions and the effect of additional disturbance on the surface water systems of the study area. The program developed should be considered flexible. Ongoing monitoring may indicate conditions which would necessitate additional sampling or analyses or conditions which would allow the elimination of some sampling or analyses.

Following collection and laboratory analysis, the data should be evaluated by a qualified individual. Any unexpected data changes may require additional sampling.

This section outlines sample locations, schedule for sampling, general sample methods and parameters to be analyzed. Appendix G contains Detailed sampling procedures.

7.6.2 Monitoring Site Selection

The careful selection of monitoring sites allows characterization of existing conditions, and documentation and evaluation of changes which occur. The changes could result from natural or human influenced events

7.6.2.1 Stream Sites

The selection of stream sites followed a field reconnaissance of each stream draining the area. The names of the stream sampling sites are:

(1) North Fork Quartz Creek (NF)
(2) Tributary to Angel Creek at Angel Camp (ANT)
(3) Angel Creek (AN)
(4) Quartz Creek at SH 140 near Quartz Mountain (QU1)
(5) Quartz Creek above Butcher Creek (QU2)
(6) Butcher Creek (BU)
(7) Quartz Creek below Butcher Creek (QU3)
(8) Quartz Creek above Drews Creek at SH 140 (QU4)
(9) Drews Creek near Angel Peak (DR1)
(10) Drews Creek above Hunter's Cabin (DR2)

None of the laboratory data show unexpectedly high concentrations of any species. Many of the parameters are consistently at or below detection levels. The May 1987 samples provide data on a high flow period, but no flow measurement was taken in conjunction with the May sampling. The higher flow conditions show decreased levels of dissolved ions and increased levels of velocity-dependent species such as settleable solids, NFR and turbidity.

The fall 1987 sampling reflects low flow conditions with flows significantly increasing in December 1987. Low flow conditions will tend to be the opposite of high flow conditions, exhibiting increased levels of dissolved ions and decreased levels of velocity-dependent species. It is apparent from the data collected to date that stream water quality varies greatly and is dependent on flow velocities and dilution effects.

Data collected to date shows that water quality in the springs is generally the same as stream water quality. The streams exhibit slightly higher levels of some metals and salts and slightly higher pH levels. Water from both the springs and streams is considered of good quality and is acceptable for most beneficial uses. Intense livestock usage causes unacceptable levels of bacteriological species which would not allow surface waters to be used for drinking water.

Water pH varies from nearly neutral to slightly alkaline. All waters within the study area are soft, with total hardness consistently falling below 100 mg/l. Hard waters are those whose hardness exceeds 140 mg/l.

The turbidity of Quartz Creek consistently exceeds turbidity in all other samples. The higher turbidity is due to erosion of the discontinuous gullies which form the Quartz Creek stream channel. The gullies, a result of intense livestock usage, have changed the hydraulics of the Quartz Creek watershed and caused some degradation to water quality. The meadows now drain more quickly, allowing for less attenuation of metals and salts. In addition, the more rapidly draining meadows accelerate erosion, with a resultant increase in primarily suspended sediment.

Water temperature of the springs remained around 50`F during the 1987 sampling effort. Stream temperature fluctuated with the season, from highs of approximately 65`F to lows of 40`F.

The DEQ has developed specific water quality standards for 20 basins in the state. The standards apply to natural waters and contain a non-degradation clause (OAR 340-41-026 (1)(a)). Standards specific to the Goose and Summer Lake

All laboratory analyses for SRK sampling will be performed in a laboratory certified by both EPA and the State of Oregon.

Sampling for full laboratory analysis will occur twice yearly, May and August/September, at most sites in the study area.

Table 7.4-4 lists the sample sites, their identification, and the sampling frequency. Section 7.6 provides detailed information on SRK's monitoring program.

7.5.2 Results and Discussion

Sampling done by Butz et al. (1980) and USFS personnel provide some background data, but were not collected over a long enough period of time to be used for complete characterization of study area waters. Both sets of samples show water quality of the study area waters to be good, with parameters falling generally within drinking water standards.

Samples collected by Butz et al. (1980) were collected during the driest part of the year and reflect the worst water quality expected for Butcher Creek and Drews Creek downgradient of Quartz Creek. The data is summarized in Table 7.5-2. The data show slightly higher levels for alkalinity, calcium, magnesium and specific conductance than the USFS sample collected for Drews Creek. However, the USFS sample was taken in May, presumably during a period of higher flows and dilution. No flow data are available for either set of samples.

The USFS data show several water quality parameters which exceed drinking water standards at the Quartz Mountain Spring. These parameters do not, however, consistently exceed the standards. The USFS samples seem to indicate that spring water quality may be slightly poorer than stream water quality. USFS data is summarized in Appendix 7.D, Table 7.D-1.

Both the USFS data and the study by Butz et al. (1980) reflect limited, inconsistent sampling and should not be used to draw anything but very general conclusions about water quality in the study area.

Baseline water quality sampling for the study described here began in May of 1987, but a routine sampling program was not in place until the fall of 1987. Sample data for May 1987 is presented in Appendix 7.D, Table 7.D-1 and sample data for sampling beginning in September 1987 is presented in Appendix 7.E, Tables 7.E-1 through 7.E-11.

7.5 SURFACE WATER QUALITY

7.5.1 Methods

The first recorded water quality data for the Drews Creek watershed comes from a study sponsored by the U.S. Department of Energy. The study, conducted by Butz et al. (1980), evaluated the impacts of uranium mining on the water quality in the Lakeview area. A total of 303 stream samples were collected. While no samples were collected in the Quartz Creek watershed, approximately 8 samples were taken on Butcher Creek and Drews Creek immediately downstream of the confluence with Quartz Creek. The samples were collected from July 1979, through September 1979, and should represent low flow conditions. Only one sample was taken per site, and sampling was not accompanied by a flow measurement. However, the sample data is useful in beginning to characterize the water quality of the Drews Creek watershed. Parameters monitored were primarily rare earth and radioactive elements, but also included some of the major salts, specific conductivity and pH.

USFS Fremont National Forest personnel began a sampling program in May of 1985, in an attempt to establish baseline water quality in response to renewed interest in mining claims in the Quartz Mountain area. Sampling occurred from May 1985, to May 1986. Six sites were sampled; some only once, others as many as three times. Although the data is limited, some general conclusions can be drawn, and the data base can be used for comparison with on-going water quality monitoring.

SRK initiated a sampling program in September 1987 to develop a data base to broadly characterize the project area waters. The array of sampling parameters initially included the inorganic species of both the primary and the secondary inorganics as defined by the drinking water standards, Oregon Administrative Rules (OAR) 333-61-030 (1) and (6) (Appendix 7.C). To this array SRK added alkalinity, antimony, total cyanide, specific conductivity, sodium, settleable solids, total suspended solids or non-filterable residue (NFR), and turbidity. This array provided the most meaningful data to characterize the area's surface waters. In October 1987, SRK added radionucleides to this array because of the presence of uranium ores in close proximity to the project area. The complete lists of monitoring parameters is shown in Table 7.5-1.

Measurements for discharge, ambient air and water temperature and field pH and conductivity accompany all water sample collections.

TABLE 7.4-8

PRECIPITATION DATA FOR STORMS OF SELECTED RETURN PERIODS AFTER MILLER et al. (1973)

Return Period (years)	Storm Yield (inches)		
	1-hour	6-hours	24-hours
2	0.36	0.8	1.6
5		1.0	2.0
10		1.1	2.2
25		1.3	2.6
50		1.5	2.8
100	1.04	1.7	3.0

these conditions. The storm which caused the flood was one of low intensity, long duration, and high volume. The storm occurred as the snow pack was building and soils were saturated.

In November 1981, one day in an eight day storm period produced 2.9 inches of moisture, as measured by the Quartz Mountain SNOTEL. This storm fell between the 50- and 100-year return period (Table 7.4-7) and is the most recent large storm of record.

High intensity rainfall, reaching or exceeding one inch per hour, typically accompanies short duration convectional storms during periods of hot weather and unstable air masses. Though such storms are fairly common in the study area, they rarely create problems such as floods.

Table 7.4-8 shows precipitation intensity data based on the Precipitation-Frequency Atlas (Miller et.al, 1973) for return periods of 2 to 100 years and term durations from 1 to 24 hours. The atlas does not distinguish between rain and snow precipitation, nor does it take into account existing moisture conditions.

Table 7.4-9 shows the peak discharge for three return periods, 25 years, 50 years, and 100 years. Peak discharges were calculated based on 24 hours storm precipitation data from the Precipitation-Frequency Atlas (Miller et al. 1973) and equations from Adams et al. (1986). The equations presented in Adams et al. (1986) have been formulated, based upon intensive field studies, for small forested watersheds in Oregon such as the Quartz Creek Watershed.

TABLE 7.4-5

PRECIPITATION PER DAY OF PRECIPITATION
FOR THE QUARTZ MOUNTAIN SNOTEL
1982 - 1987

YEAR	TOTAL PRECIP. (in)	TOTAL # OF DAYS (days)	PRECIP./ DAY (in)
1982	30.8	96	0.32
1983	35.8	115	0.31
1984	29.6	100	0.31
1985	17.3	57	0.30
1986	23.6	77	0.31
1987	20.8	78	0.27
AVG.	26.3	87	0.30

TABLE 7.4-4 (Continued)

Site Name	Site ID	Sampling Frequency	Remarks
Railroad Spring 1	RR1	May & Aug/Sept	
Buckhorn Spring	BK	May & Aug/Sept	
Ewauna Spring	EW	Continual sampling not planned	Sample May & Aug/Sept 1988 to establish baseline
Angel Camp Spring	AC	Continual sampling not planned	Sample May & Aug/Sept 1988 to establish baseline
Quartz Valley Spring	QV	Continual sampling not planned	Sample May & Aug/Sept 1988 to establish baseline
Angel Creek Spring	AG	None Planned	Measured at Site AN
Angel Peak Spring	AP	None Planned	Measured at Site ANT
Railroad Spring Z	RRZ	None Planned	Measured as RR1

conditions. Table 7.4-4 shows the sampling frequency at each sample site.

Nine springs have been located in the study area (Figure 1.2-1). The largest spring is the Quartz Mountain Spring, which supplies the residents of Quartz Mountain with domestic water. The spring facilities were reconstructed in the fall of 1987 and a water meter was added to continuously measure flow. Two overflow pipes, one at the spring and one in the town of Quartz Mountain, allow cross-checking of the water meter (Appendix 7.A, Table 7.A-1).

Three of the remaining eight springs are intermittent. The intermittent springs, Angel Camp Spring, Ewauna Spring and Quartz Valley Spring, may permit a yield measurement in the spring of 1988; however, continued sampling of these springs is not currently planned.

The remaining five springs, Railroad Spring 1, Railroad Spring 2, Angel Creek Spring, Angel Peak Spring, and Buckhorn Spring are believed to be continuously flowing but have limited yield data available. Several of these springs were measured in the spring and late summer with a flow meter, if flow permitted, or with a calibrated bucket and stop watch. A complete discussion of the planned monitoring program is provided in Section 7.6.

The yield data will help establish baseline information prior to mining operations. Table 7.4-4 gives site names, map key names and sampling frequency for the springs to be sampled in the study area and serves as a key for Figure 1.2-1.

7.4.1.2 Flood Flows

A search of available information indicates that flood flows have not been previously estimated for the Quartz Creek Watershed. Using precipitation data for storm volumes of varying return periods (two to 100 years) and durations (five minutes to 24 hours) presented in the Precipitation-Frequency Atlas (Miller et al. 1973) and regionalized equations to compute peak discharges from small forested watersheds for return periods from 25 to 100 years presented in Adams et al. (1986), flood flows for the study area can be derived. Flood flows are discussed in Section 7.4.2.2.

7.4.2 Results and Discussion

7.4.2.1 Precipitation and Water Yield

Methods for obtaining precipitation and water yield data were discussed previously in Section 7.4.1.1.

TABLE 7.4-2

DETERMINATION OF THE QUARTZ CREEK HYDOGRAPH

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
A. Monthly Average and Annual Average Discharge (csm) Chevaucan River near Paisley (275 mi²)													
AVG	0.146	0.200	0.319	0.325	0.426	0.624	1.26	1.84	0.954	0.236	0.122	0.115	0.547
B. Ratio of Monthly to Annual Discharge - Chevaucan River near Paisley													
AVG	0.27	0.37	0.58	0.59	0.78	1.1	2.3	3.4	1.7	0.43	0.22	0.21	1.0
C. Ratio of Monthly to Annual Discharge - Quartz Creek at SH140													
AVG	0.20	0.30	0.40	0.40	0.50	1.50	3.00	4.00	1.20	0.30	0.10	0.10	1.00
MAX	0.05	0.15	0.20	0.30	0.40	1.80	3.50	4.00	1.20	0.30	0.05	0.05	1.00
MIN	0.10	0.20	0.30	0.40	0.50	1.50	3.50	2.50	1.20	0.30	0.10	0.10	1.00
D. Monthly and Annual Discharge - Quartz Creek at SH140 (csm)													
AVG	0.04	0.07	0.09	0.09	0.11	0.33	0.66	0.88	0.26	0.07	0.02	0.02	0.22
MAX	0.04	0.11	0.14	0.22	0.29	1.30	2.50	2.90	0.86	0.22	0.04	0.04	0.72
MIN	0.01	0.02	0.03	0.04	0.04	0.14	0.32	0.22	0.11	0.03	0.01	0.01	0.09
E. Monthly Annual Discharge - Quartz Creet at SH140 (cfs)													
AVG	0.5	0.8	1.1	1.1	1.3	4.0	7.9	10.6	3.2	0.8	0.3	0.3	2.5
MAX	0.5	1.3	1.7	2.6	3.5	15.6	30.1	34.9	10.3	2.6	0.5	0.5	8.7
MIN	0.1	0.2	0.4	0.5	0.5	1.7	3.8	2.6	1.3	0.3	0.1	0.1	1.1
F. Monthly and Annual Discharge - Quartz Creek at SH140 (acre feet)													
AVG	31	48	68	68	72	246	469	651	190	49	18	18	1928
MAX	31	77	104	160	194	958	1789	2143	612	160	31	30	6289
MIN	6	12	25	31	28	104	226	160	77	18	6	6	693

TABLE 7.4-1

DETERMINATION OF QUARTZ MOUNTAIN SNOTEL PRECIPITATION FOR THE LONG-TERM AVERAGE AND FOR A MINIMUM AND A MAXIMUM YEAR

Station	1982 - 1986 Average Annual Precip.	Average Annual Period of Record	Percent Change (15.04/ 17.99)	Minimum Precip. Period of Record	Percent Change (8.59/ 15.04)	Maximum Precip. Period of Record	Percent Change (23.81/ 15.04)
Klamath Falls	15.12	12.98		6.80		20.87	
Lakeview	15.41	14.98		8.89		23.75	
Round Grove	23.45	17.16		10.09		26.80	
3-Station Average	17.99	15.04	0.84	8.59	0.57	23.81	1.58
SNOTEL	26.78	22.5[a]		12.9[b]		35.3[c]	

[a] 26.78 x 0.84 = 22.5 predicted

[b] 22.50 x 0.57 = 12.8 predicted

[c] 22.50 x 1.58 = 35.6 predicted

However, continued livestock use has caused numerous erosion gullies to form which now act as channels through the meadows.

Quartz Creek, the principal drainage in the study area, originates at Quartz Mountain Spring, west of Crone Hill. The spring supplies the residents of the community of Quartz Mountain with domestic water. Quartz Creek is perennial for approximately a quarter of a mile downstream from Quartz Mountain Spring. From this point to its confluence with Butcher Creek, south of the study area, Quartz Creek is intermittent.

Butcher Creek lies outside of the study area to the south but is an important tributary to Quartz Creek. Flow from Butcher Flat Reservoir on Butcher Creek is regulated and provides continuous flow in Butcher Creek and Quartz Creek below its confluence with Butcher Creek. From this point to its confluence with Drews Creek, Quartz Creek is perennial.

Within the study area two streams contribute to the flow of Quartz Creek. The North Fork Quartz Creek originates from Ewauna Spring on the west side of Quartz Butte. The creek meanders south across a wet meadow and then flows between Quartz Butte and Crone Hill. When the North Fork reaches the Quartz Valley meadow, no channel is defined and the stream disappears but probably contributes to the flow in Quartz Valley meadow through seepage. One such seep was noted in the middle of the meadow.

The second stream tributary to Quartz Creek is Angel Creek. Like the North Fork of Quartz Creek, Angel Creek is alternately perennial and intermittent. Stream flow in the channel ceases, only to reappear downstream as spring or seep flow.

Two small tributaries enter Angel Creek from the east. Both originate from springs on the hillside above Angel Creek. One tributary enters Angel Creek approximately one half mile upstream of Angel Camp while the other tributary enters the creek at Angel Camp. The upstream tributary flows intermittently while the downstream tributary is perennial.

Nine springs have been defined within the project area (Figure 1.2-1). During the limited observation time of this study, six springs exhibited year-round flow while three ceased flowing during the drier summer and fall season. As previously mentioned, many of these springs provide continuous flow in portions of the Quartz Creek Watershed and serve as an important source of water for livestock watering and domestic use.

course has been active since 1929, however only bi-monthly readings are available from 1960 through 1974.

The SCS also began operation of the Quartz Mountain SNOTEL in the 1982 water year (actual operations began October 1981 with water years running from October to September). The SNOTEL records data on precipitation, air temperature and snow water equivalent which is then telemetered to the SCS-Snow Survey Office in Portland. The data is available as daily measurements or summarized in monthly reports. The precipitation and temperature data is collected year-round and provides the only historic record, albeit short term, of temperature and precipitation in the study area.

7.2.3 Water Quality Data

Very little historic water quality data is available for the flows in Quartz Creek or Drews Creek. The U.S. Department of Energy conducted a study in the late 1970's to address water quality as affected by uranium mining in the Drews Creek drainage basin (Butz et al. 1980). This study examined a limited number of parameters, primarily rare earth elements, but does provide the first recorded water quality data for the Quartz Creek area.

Fremont National Forest personnel began a sampling program in May of 1985 in an attempt to establish baseline water quality in response to renewed interest in mining claims in the Quartz Mountain area. Sampling took place over the course of a year. A total of 6 separate sites were sampled for water quality, some only once, others as many as three times.

Results of both programs are discussed in Section 7.5.2.

TABLE 7.1-1

DRAINAGE AREAS OF THE PRINCIPAL WATERSHED
OF THE QUARTZ MOUNTAIN GOLD PROJECT

Watershed/Catchment	Area Acres	Area Sq. Mi.
Drews Cr. bl. Quartz Cr.	20740	32.41
Drews Cr. ab. Quartz Cr.	8020	12.53
Quartz Cr. ab. Drews Cr.	12720	19.88
Butcher Cr.	3530	5.52
Quartz Cr. at SH 140 nr. Quartz Mtn.	7700	12.03
Angel Cr.	3780	5.91
Tributary to Angel Cr.	380	0.59
Buckhorn Spr. Cr.	590	0.92
North Fork Quartz Cr.	900	1.41

ab. = above
bl. = below
nr. = near

SUMMARY

The Quartz Mountain Gold Project lies in the 20 square mile forested Quartz Creek Watershed in the headwaters of the Drews Creek Watershed about 30 miles west of Lakeview on State Highway 140. The project area lies in a transitional area between the Cascade Range and the Basin and Range Provinces.

Little data on the water resources of the Quartz Mountain area existed before the initiation of the project in the summer of 1987. The Quartz Mountain SNOTEL and Snow Course was operating at this time, the SNOTEL since 1981. Other climatic and the hydrologic stations are far from the area, but nevertheless provide useful information relative to the project area. In order to fully evaluate the project area's water resources, a measuring and sampling network consisting of eighteen stream and spring locations is now operating.

The project area lies primarily within the Quartz Creek watershed, the primary focus of this study. It is drained by three streams. Quartz Creek, the principal drainage in the study area, originates at Quartz Mountain Spring. This creek is perennial for the portion of its length near the source but intermittent in the downstream portions. Butcher Creek lies primarily outside the southwestern portion of the study area but is an important tributary to Quartz Creek. Angel Creek, a tributary to Quartz Creek, drains the central portion of the study area and is alternately perennial and intermittent. Nine springs have also been identified within the project area.

The average annual precipitation for the study area is 22.5 inches based on existing data from the SNOTEL monitoring station. About sixty percent of this precipitation falls in the form of snow from November through March. The snowpack accumulation begins in mid- to late November and reaches its peak in mid-March. Snowmelt begins shortly after this and is usually completed by mid-April. The remainder of the annual precipitation falls during summer storms. The project area experiences low to no precipitation during one or more of the summer months causing many streams, including Quartz Creek, to go dry. Summer thunderstorms do not produce rains of sufficient intensity to present much threat to the project area.

The greatest threats to the water resources occur during the winter months. With the passage of warm air masses accompanied by rains of low intensity and long duration on a snowpack overlying soils that are nearly saturated, the snowpack depletes quickly. Floods causing substantial damage

LIST OF FIGURES

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RELATIVE PERCENT ABUNDANCE OF ATTACHED ALGAE ON NATURAL SUBSTRATES, DREW, QUARTZ AND ANGEL CREEKS, LAKE COUNTY, OREGON 1987-1988

DIVISION*	SPECIES	AUTHORITY	DR. CK. DR2.4 A 26/8/87	DR. CK. DR2.4 B 26/8/87	DR. CK. DR2.4 C 26/8/87	DR. CK. DR2.4 A 6/4/88	DR. CK. DR2.4 B 6/4/88	DR. CK. DR3 A 3/10/87	DR. CK. DR3 B 3/10/87	DR. CK. DR3 C 3/10/87	DR. CK. DR3 A 8/4/88	DR. CK. DR3 B 8/4/88	ANGEL CK. 10/10/87	DR. CK. DR1 A 2/10/87	DR. CK. DR1 B 2/10/87	DR. CK. DR1 C 2/10/87	QTZ. CK. A 8/4/88	QTZ. CK. A 8/4/88
BG	AGMENELLUM QUADRUPLICATUM	BREB.	0.000	0.000	1.053	0.000	0.000	0.000	3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BG	ANACYSTIS CYANEA	DROUET AND DAILY	0.000	0.000	0.000	0.000	0.000	7.843	0.000	1.961	0.000	0.000	0.000	0.000	2.830	0.980	0.000	0.000
BG	ANACYSTIS SP.	MENEGHINI	0.000	0.000	0.000	18.812	0.000	0.000	1.000	0.000	1.852	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BG	APHANIZOMENON FILAMENT	MORREN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BG	CYANOPHYTE FILAMENT CELLS		0.000	0.000	0.000	0.000	1.961	0.000	0.000	0.000	2.778	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BG	NOSTOC VERRUCOSUM	VAUCHER	11.429	1.942	21.053	1.980	0.000	25.490	13.000	16.667	0.000	0.000	0.000	20.192	24.528	44.118	0.000	0.000
BG	OSCILLATORIA ANGUINA	(BORY) GOMONT	0.000	46.602	0.000	0.000	0.000	7.843	0.000	4.902	0.000	0.000	0.000	28.846	4.717	3.922	0.000	0.000
BG	OSCILLATORIA SP. #1	VAUCHER	2.857	5.825	0.000	2.970	0.000	2.941	0.000	6.863	0.000	0.000	0.000	3.846	1.887	7.843	0.000	0.000
BG	OSCILLATORIA SP. #2	VAUCHER	1.905	0.000	1.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.717	0.000	0.000	0.000
BG	RIVULARIS SP.	(ROTH) AGARDH	0.000	0.000	25.263	29.703	0.000	5.882	40.000	2.941	0.000	0.000	0.000	5.769	1.887	0.000	0.000	0.000
BG	SCYTONEMA SP.	AGARDH	0.952	0.000	3.158	0.000	0.000	0.000	3.000	0.000	0.000	0.000	0.000	0.962	0.000	0.000	0.000	0.000
BG	STIGONEMA SP.	C.A. AGARDH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.863	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	ACHNANTHES EXIGUA	GRUN.	0.952	0.000	1.053	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	ACHNANTHES LANCEOLATA	(BREB.) GRUN.	1.905	0.000	1.053	0.000	0.980	0.000	0.000	0.000	4.630	1.980	0.000	1.923	0.943	0.000	0.971	0.000
C	ACHNANTHES LINEARIS V. CURTA	H. L. SMITH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.980	0.000	0.000	0.000	0.000	0.000	0.000
C	ACHNANTHES MINUTISSIMA	KUETZ.	1.905	0.000	1.053	0.000	0.980	0.000	0.000	0.000	0.000	2.970	0.000	0.000	0.000	0.000	1.942	0.000
C	ACHNANTHES SP.	BORY	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.962	0.000	0.000	0.000	0.000
C	AMPHIPLEURA PELLUCIDA	KUETZ.	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	AMPHORA SP.	EHR. ex KUETZ	0.952	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.926	0.990	0.000	0.962	0.000	0.000	0.000	0.000
C	CALONEIS BACILLUM	(GRUN.) CL.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.630	1.980	0.000	0.000	0.000	0.000	0.000	0.000
C	CHLOROPHYTE CELLS		0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	2.970	0.000	0.000	0.000	0.000	0.000	1.923
C	CHRYSOPHYTE SPORE		0.952	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	51.456	24.038
C	COCCONEIS PLACENTULA	EHR.	0.000	4.854	0.000	0.000	0.000	6.863	13.000	0.000	0.000	0.000	0.000	2.885	0.000	9.804	0.000	0.000
C	COCCONEIS PLACENTULA V. EUG.	(EHR.) CL.	22.857	0.000	15.789	1.980	1.961	0.000	0.000	7.843	6.481	18.812	0.000	0.000	0.943	0.000	0.000	0.000
C	CYCLOTELLA MENEGHINIANA	KUETZ.	1.905	0.971	1.053	0.000	0.000	0.980	0.000	0.980	0.926	0.990	0.000	3.846	0.000	0.000	0.971	1.923
C	CYMBELLA AFFINIS	KUETZ.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000
C	CYMBELLA MINUTA	HILS EX RABH.	0.000	0.000	2.105	2.970	2.941	1.961	1.000	0.000	8.333	0.000	0.000	0.000	2.830	0.000	0.971	2.885
C	CYMBELLA SINUATA	GREG.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000
C	CYMBELLA SP.	AGARDH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	CYMBELLA TUMIDA	(BREB. I KUETZ.)V.H.	0.952	0.000	0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	DIATOMA HIEMALE V. MESODON	(EHR.) GRUN.	0.000	0.000	1.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	EPITHEMIA SOREX	KUETZ.	0.952	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.923	0.000	0.000	0.971	0.000
C	EUNOTIA SP.	EHR.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.971	0.000
C	FRAGILARIA CONSTRUENS V. VEN.	(EHR.) GRUN.	0.952	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	FRAGILARIA VAUCHERIAE	(KUETZ.) PETERS	0.000	1.942	0.000	10.891	8.824	0.000	0.000	0.980	4.630	11.881	0.000	1.923	14.151	1.961	0.000	0.962
C	GOMPHONEIS HERCULEANA	(EHR.) CL.	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	1.961	0.000	0.000
C	GOMPHONEIS SP.	CL.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.943	0.000	0.000	0.000
C	GOMPHONEMA ACUMINATUM	EHR.	0.000	0.000	1.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	GOMPHONEMA ANGUSTATUM	(KUETZ.) RABH.	2.857	2.913	5.263	3.960	1.961	0.000	0.000	0.000	0.000	6.931	0.000	0.000	0.943	0.980	22.330	59.615
C	GOMPHONEMA PARVULUM	KUETZ.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.962
C	GOMPHONEMA SP. #1		0.000	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.000
C	GOMPHONEMA SP. #2		0.000	0.000	0.000	0.000	0.000	0.980	0.000	0.980	0.000	0.000	0.000	5.769	2.830	0.000	0.000	0.000
C	GOMPHONEMA TRUNCATUM	EHR.	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	GOMPHONEMA VENTRICOSUM	GREG.	0.000	0.000	0.000	2.970	0.000	0.000	0.000	0.000	1.852	0.000	0.000	0.000	0.000	2.941	0.000	0.000
C	GYROSIGMA SP.		0.000	0.971	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	HANNAEA ARCUS	(EHR.) PATR.	0.000	0.000	0.000	1.980	4.902	0.000	0.000	0.000	2.778	5.941	0.000	0.000	2.830	0.000	0.000	0.000
C	MELOSIRA ITALICA	(EHR.) KUETZ.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.980	0.000	0.000	0.000	0.000	0.000	0.000
C	MELOSIRA SP.		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.926	0.000	0.000	0.000	0.000	0.000	0.971	0.000

* C = Chrysophytes (includes diatoms); BG = Blue-green Algae; G = Green Algae; DATES: 26/8/87 = 26 August 1987; SAMPLES COLLECTED 1987-88

DR. CK. = Drews Creek
QTZ. CK. = Quartz Creek

1, 2.4, 3; A, B, C = replicates
26/8 = 26 August

STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	CLIENT GALATIC RESOURCES INC. PROJECT QUARTZ MOUNTAIN PROJECT No. 11808 DATE DRILLED 11/4/87 DRILLER ROGER CHANCELLOR	BOREHOLE No. MW-2 SHEET 1 OF 2 INSPECTOR D.G.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
	TOPSOIL, SILTY, FRACTURED BASALT (10)	
25 50 75	HARD, DARK GREY TO BLACK, VESICULAR, FRACTURED BASALT (80)	(80) <1
100 125 150 175	HARD, RED & BLACK, HIGHLY FRACTURED, INTERFLOW BASALT (180)	(100) 1.5 (160) 1
200		

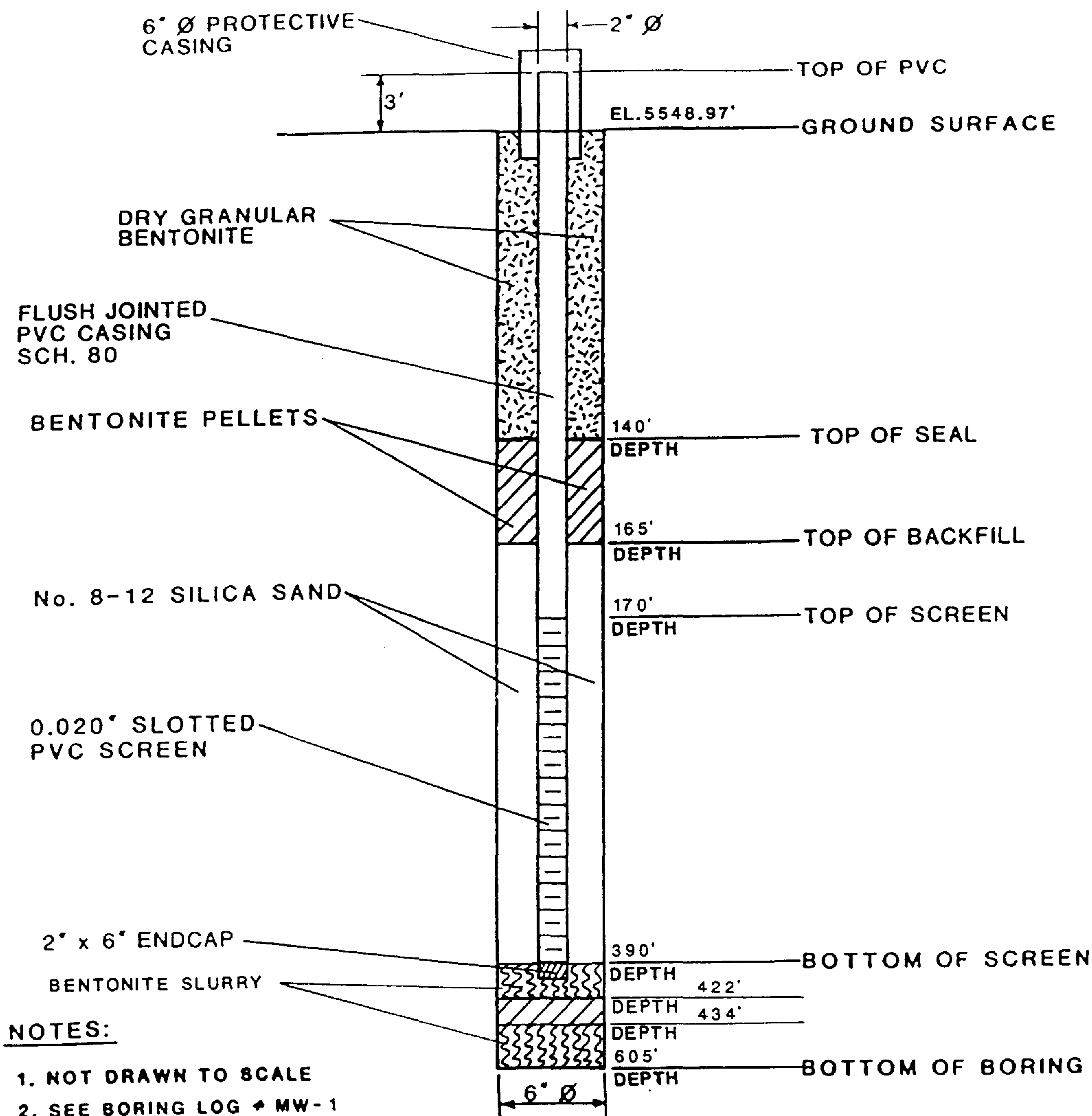
NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 10 FT. TO 423 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 80 FT.
4. SEE MW-2 FOR COMPLETION DETAILS.

STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	CLIENT GALATIC SERVICES INC. PROJECT QUARTZ MOUNTAIN PROJECT No. 11806.07 DATE 1/2/88	WELL No. MW-1 BY B.BASSE

WELL LOCATION N240,193.287 E1,917,087.291

MONITORING WELL DETAILS



NOTES:

1. NOT DRAWN TO SCALE
2. SEE BORING LOG # MW-1 FOR DETAILED ROCK DESCRIPTION
3. ALL ELEVATIONS APPROXIMATE
4. 270'-350' CONTINUOUS SCREEN
5. 160'-270' AND 350'-390';10' OF BLANK & 20' SCREEN ALTERNATING

STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers

CLIENT	GALATIC RESOURCES INC.
PROJECT	QUARTZ MOUNTAIN
PROJECT No.	11606
DATE DRILLED	12/22/87
DRILLER	ROGER CHANCELLOR
BOREHOLE No.	MW-1
SHEET	1 OF 2
INSPECTOR	D.G.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES

SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
	HIGHLY ALTERED, WHITE/PINK, HARD RHYOLITE	
50	(60)	
100	HARD, ANGULAR, HIGHLY MINERALIZED RHYOLITE INCREASING HARDNESS WITH DEPTH	
150	(185)	
200	LIGHT GREY, HARD, HIGHLY MINERALIZED RHYOLITE	(222) 0.5
	(230)	
	(245) LAYERED CLAY AND GREY ALTERED FLOW MATERIAL	
250	GREY, HARD, ANGULAR, MINERALIZED RHYOLITE	(262) 25
		(282) 30
300		(302) 50
		(342) 55
350		
		(382) 58
400		

NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 5 FT. TO 602 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 222 FT.
4. SEE MW-1 FOR COMPLETION DETAILS.

8.10 REFERENCES CITED

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Marinelli, F. 1984. Analysis of Constant Head Injection Tests in Single, Partially Penetrating Boreholes. University of Arizona Masters Thesis. Available from University Microfilms International

Theis, C.V. 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage. American Geophysical Union Transactions, vol. 16, pp. 519-524.

8.8 GLOSSARY

ARTESIAN - A condition in which the water level at depth is higher in elevation than the ground water.

CONFINED AQUIFER - An aquifer in which the water level rises above the top of the aquifer. A confined aquifer is not necessarily artesian.

DISCHARGE AREA - An area where there is a net loss of water flow from the groundwater system.

HYDRAULIC GRADIENT - The slope and direction of the maximum rate of change in elevation of the potentiometric surface. Defined as the rate of change in hydraulic head divided by the length of the flow path. (Dimensionless).

HYDRAULIC CONDUCTIVITY - A measure of ease of groundwater movement through porous or fractured materials. Defined as the rate of flow of water through a unit cross-sectional area under a unit hydraulic gradient. (Dimension = Length/Time).

PNEUMATIC - operates by gas, often compressed gas.

RECHARGE AREA - An area where there is a net addition of water to the groundwater system.

THEIS - The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage.

TRANSMISSIVITY - Capacity of an aquifer to transmit water through its entire thickness; equal to the average hydraulic conductivity multiplied by the saturated thickness of the aquifer. (Dimension = Length^2/Time).

UNCONFINED AQUIFER - An aquifer in which the water table forms the upper boundary of the aquifer.

A common representation of water chemistry data is the Piper trilinear diagram. This shows graphically the relative concentration of major anions and cations in the water, so that the water can be typed. Trilinear plots for fourteen groundwater samples obtained during the first sampling round (including Quartz Mountain Spring) are shown in Figures 8.7-2a through 8.7-2c.

Generally, the groundwater is a calcium-bicarbonate to sodium-magnesium bicarbonate composition. Groundwater at MW-1 is anomalous in that it is classified as a calcium-sulfate composition. This may be related to its close proximity to the Crone Hill ore body.

8.7.3.2 Distribution of Trace Elements and Metals

Trace elements, metals, and indicator parameters are reported in Appendix 8-D. Most of the trace constituents were either not detected in any of the groundwater samples, or were detected at levels near the detection limit.

Trace constituents measured above the detection limit with some frequency include arsenic, mercury, silver, and zinc. Primary metals identified at appreciable concentrations are iron and manganese. The occurrence of these trace elements is consistent with the emplacement mechanism of the ore body.

The presence of radionuclides was investigated by measurement of gross alpha and gross beta activity. Significant gross alpha and beta activity has been identified in numerous groundwater samples. The very high values detected in well MW-9 are thought to be due to the presence of suspended clay particles in the sample, and not due inherent characteristics of the groundwater.

8.7.3.3 Comparison of Water Quality to Health Standards

The Environmental Protection Agency (EPA) promulgates water quality standards for the protection of public health. Among these are primary drinking water standards, which

On several occasions, field pH and conductivity values were not obtained due to equipment breakdowns (including backup instruments). These parameters, however, were subsequently measured in the laboratory.

8.7.3 Analysis and Interpretation

Hydrochemical data from the four sampling rounds are compiled in Appendix 8.D. Analyzed chemical parameters included the following constituents:

- General field and laboratory parameters
- Major cations and anions
- Metals and trace constituents
- Radionuclides

The specific parameters analyzed are shown in Table 8.7-2.

From the hydrochemical results, conclusions can be drawn regarding the general composition and variability of groundwater chemistry below the site. In addition, the usefulness of groundwater for drinking and agricultural use can also be assessed.

Monitor well MW-1 has experienced significant variations in groundwater chemistry through the first four sampling rounds. This has been indicated by a decrease in pH from 7.5 to 4.4 between January and September, 1988, accompanied by an increase in total dissolved solids (TDS). During the same period, concentrations of potassium, sulfate, and some trace constituents have been observed to increased. The reasons for the anomalous chemical behavior in MW-1 are uncertain. Variations in water chemistry may have resulted from injection packer tests which were only conducted in this borehole, and also from the fact that it is located adjacent to the Crone Hill ore body which is composed of anomalous rock chemistry.

8.7.3.1 General Composition of Groundwater

The groundwater in the project area is characterized by a relatively low TDS content on the order of 200 mg/l. This is both typical to groundwater in the general region and consistent with the fact that recharge water has had relatively little time to interact with the surrounding rock, and thus does not dissolve large quantities of minerals. Note that the extremely high TDS reported in MW-9 is erroneous, resulting from the presence of suspended clay solids.

8.7 WATER QUALITY SAMPLING

The first quarter baseline groundwater sampling round was initiated on December 28, 1987, and was completed on January 3, 1988. During this period, 15 of the 16 monitoring wells were sampled. Well MW-13 was not sampled because of an obstruction which prevented placement of a sampling pump below the water table. SRK appointed personnel supervised all sampling activities including:

1. Installation of positive displacement pneumatic sampling pumps;

2. Purging of wells; and

3. Collection of groundwater samples.

Subsequent groundwater sampling rounds occurred during late February, April/May, and mid-September, 1988. Due to well completion problems, it was only possible to sample MW-13 during the April/May sampling round. Activities associated with groundwater sampling are described in the following sections.

8.7.1 Groundwater Samplers

Dedicated positive displacement pneumatic samplers were installed in 14 of the 16 onsite monitor wells. MW-16 is a flowing artesian well and hence, did not require any artificial means of removing water from the well. A sampler was not installed in MW-13 due to the casing obstruction previously mentioned. Samplers were generally installed so that the top of the sampler was 50 feet below the static water level in the well. Table 8.7-1 summarizes sampler installation depths, and the length of each sample chamber.

Figure 8.7-1 illustrates the construction of a typical positive displacement sampler. Essentially, the pneumatic sampler is a closed pressure chamber which pumps water to ground surface by alternately pressurizing and bleeding the chamber with compressed nitrogen. A description of the pumping process is given below.

Pressurization: One-quarter inch O.D. high-pressure nylon tubing transmits a pressure pulse from the surface source to the sample chamber. This closes a ball valve at the bottom of the sampler and displaces water up a 3/8-inch PVC discharge pipe to ground surface.

8.6 FLOW MONITORING AT QUARTZ MOUNTAIN SPRING

Quartz Mountain Spring, located west of Crone Hill (Figure 8.2-1), is a perennial spring providing water supply to several residents in the settlement of Quartz Mountain. During the fall of 1987, Quartz Mountain Gold rebuilt the spring box and installed a permanent totalizing flow meter to monitor discharge rates from the spring. Flow rates were measured on a periodic basis by Ken Rodgers of the U.S. Forest Service. In addition to the flow meter at the spring, Mr. Rodgers also measured overflows at the upper and lower cisterns to check the accuracy of the meter. The latter overflow measurements were obtained using a five gallon bucket and stopwatch.

Prior to November 4, 1987, control valves downstream of the flow meter were set at their maximum opening. Since there was no back-pressure on the system, the inlet line to the meter was only partially full of water, resulting in an erroneous flow meter reading which overestimated the true flow rate. This was evidenced by the consistently higher flow values determined from the meter (25-28 gpm) compared to the overflow measurements (10-11 gpm). On November 3, 1987, Mr. Rodgers and Fred Marinelli (ABC project manager for groundwater studies) partially closed the downstream valves, creating the necessary back-pressure to fill the inlet pipe. Since that time, there has been good agreement between the flow meter readings and overflow measurements.

A record of discharge measurements at the Quartz Mountain Spring is provided in Table 8.6-1. Due to the back-pressure problem discussed above, all flow meter measurements prior to November 4, 1987, should be disregarded. The remaining data indicate that discharge from the spring was relatively constant during the months of November and December, 1987, ranging between 10.0 and 11.5 gpm.

TABLE 8.5-2

RESULTS OF GROUNDWATER FLOW RATE CALCULATIONS

a. Darcy's Law

LOCATION	i ( )	B (ft)	W (ft)	K (cm/s)		Q (gpm)
EWAUNA	0.14	100	3000	3.8×10^{-4}	(a)	230
ANGEL CK.	0.13	100	5000	5.7 x 10-4	(b)	550

b. Percolation

LOCATION	P (ft/yr)	A (mi^2)	Q (gpm)
EWAUNA	0.25	1.8	180
ANGEL CK.	0.25	5.0	500

(a) Geometric mean of permeability tests conducted in MW-1, MW-2, MW-10, and MW-12.

(b) Geometric mean of permeability tests conducted in MW-3, MW-5, MW-6, and MW-18.

8.5.2.3 Surface/Groundwater Relationships

The relationship between surface water and ground water was investigated by comparing elevations on the water level contour map in Figure 8.5-1 with the land surface topography. When the potentiometric surface (the level to which water will rise in a well) is above the ground surface, artesian conditions are indicated and groundwater will have an upward component of flow. If the groundwater flow system is unconfined, the following surface water features may result:

- o Springs
- o A perennial (permanently flowing) stream which is supplied in part by groundwater discharge.
- o A wetland (swampy) area where groundwater discharge is achieved in part by evapotranspiration.

Artesian conditions have been identified at two locations on site:

- o Angel Camp
- o Drews Creek at wells MW-16 and MW-17.

At Angel Camp, interpreted water level contours in Figure 8.5-1 are above ground surface and the expected occurrence of artesian conditions has been verified by a spring identified at the eastern extreme of the drainage leading into the Angel Camp. Considering the configuration of contours in Figure 8.5-1, this artesian area is expected to have a very limited areal extent.

Along Drews Creek, perennial surface water flow and the existence of wet ground conditions are interpreted to represent artesian conditions that result in ground water discharge. This has been verified at two monitor wells along Drews Creek (MW-16 and MW-17) where static water levels rise above ground surface.

Other drainages, such as Angel Creek, the valley between Crone Hill and Quartz Butte, and Quartz Creek (up stream of Drews Creek) are interpreted represent non-artesian groundwater conditions. This is evidenced by the ephemeral nature of surface water flow in these drainages and the existence of ground water levels which are at least tens of feet below ground surface. Ground water discharge is not expected to occur along these drainages.

Local wetland conditions in Quartz Valley and some of its tributaries are not attributed to groundwater discharge from

Quartz Creek stream channel in the southwestern portion of the site. Artesian conditions (groundwater elevations above ground surface) have been identified near Angel Camp and along portions of Drews Creek.

8.5.2 Results of Water Level Monitoring

Using the average water level elevations computed in Table 8.5-1, a groundwater contour map has been constructed (Figure 8.5-1). Based on this map, the following characteristics of the groundwater flow system were investigated:

- o Direction of regional groundwater flow;
- o Influence of topographic relief and structural features on local directions of groundwater flow;
- o Relationship between the groundwater flow system and surface water; and
- o Quantification of groundwater flux rates.

The interpretations presented herein were corroborated, when appropriate, with groundwater chemistry data (Section 8.7.3), and hydraulic test data previously presented (Section 8.4.5). The combination of this data has resulted in a coherent interpretation of the groundwater regime, and its relation to surface water.

8.5.2.1 Direction of Groundwater Flow

Groundwater in the bedrock aquifer is for the most part unconfined, with both regional and local topographic features responsible for the direction of flow. As a result, the water level surface for the groundwater system tends to be a subdued reflection of the overlying topography. Groundwater flow directions are expected to be perpendicular to the contours shown on Figure 8.5-1, in the direction of decreasing water levels. As shown, groundwater flow directions are roughly to the slope of topography.

Recharge in and around the project area occurs as infiltration of precipitation and snowmelt. Recharge areas are identified in Figure 8.5-1 by divergent groundwater flow, which is generally observed below topographic highs. Both the regional and local recharge areas are displayed. On the regional scale, groundwater flow through the site is from northeast to southwest. Groundwater recharge occurs north of the site, along topographic highs which extend as far as the Coleman Rim (Figure 8.5-2). On a local scale, recharge likewise occurs below topographic highs. The groundwater contours shown on

8.5 WATER LEVEL MONITORING

8.5.1 Introduction

Depth-to-water measurements have been taken at the site monitor wells on a regular basis since their installation. Using surveyed measuring point elevations at each well site (top of PVC casing), these data have been converted to water level elevations, which can be contoured on maps to quantify lateral hydraulic gradients. This information is then used in conjunction with the hydraulic testing results to determine groundwater flow directions and flux rates across the project area.

8.5.1.1 Database

Three rounds of water level measurements have been taken at the Quartz Mountain site. Water levels were measured during the month of January, 1988 and on March 29 and May 31, 1988. These measurements were made during periods when groundwater sampling was not being conducted, to ensure that water levels were not affected by well purging. It was not possible to obtain a complete set of water levels during any one round. The reasons for this included:

- Limited access during the winter months prevented site personnel from obtaining water levels in some wells.
- Some wells had obstructions which prevented lowering of a water level probe. Some of these obstructions were subsequently removed so that water levels could be taken during later rounds.
- Water levels were not taken in MW-16 and MW-17 during some of the rounds due to difficulties in measuring artesian heads (i.e., static water levels above ground surface).

Based on the available data, average water levels are computed in Table 8.5-1 for each well location. As indicated in the table, three measurements are considered questionable and were not used in computing the average water levels. Although some variations in water levels are noted, the average values computed in Table 8.5-1 are considered to be representative of the site groundwater flow hydraulics.

Groundwater occurs within the study area at depths ranging from 15 feet above ground surface (artesian), to approximately 350 feet below ground surface. Groundwater elevations are typically 5,400 feet below stream valleys, above 5,500 feet below the hilltops, and 5,100 feet below the

TABLE 8.4-3

DISCHARGE OBSERVATIONS DURING DRILLING OF EXPLORATION HOLES AT CRONE HILL

a. All Discharge Observations (minor, moderate, major)

ROCK TYPE	NUMBER OF OBSERVATIONS
REDENT	0
BASALT	51
HYDROCLASTIC (RHYOLITIC)	8
HYDROCLASTIC (BASALTIC)	14
HYDROCLASTIC (MIXED)	16
RHYOLITE	7
VITROPHYRE	8
TOTAL:	104

b. All Discharge Observations in Basalt (minor, moderate, major)

BASALT MODIFIER	NUMBER OF OBSERVATIONS
UNDIFFERENTIATED	18
VESICULAR	26
PORPHYRITIC PLUG	3
SCORIACEOUS	1
PYROCLASTIC	3
TOTAL:	51

4. The pump was turned off; and

5. During the recovery period, water levels were monitored on a regular basis until nearly complete recovery had been achieved.

The pump test was conducted between 2:50 PM and 6:00 PM on November 18, 1987. The pumping duration was one hour and subsequent recovery was monitored for two hours. During both the pumping and recovery periods, water levels in the well casing were monitored by ABC/SRK personnel using an electric water level probe. Flow rate was measured with an orifice-plate flow meter placed at the end of the pump discharge pipe.

During pumping, an approximately constant flow rate of 250 ± 10 percent gpm was maintained. A hydrograph of water levels during the test is shown on Figure 8.4-2.

8.4.3.2 Analysis and Results

Pumping Data

The Cooper-Jacob (1947) straight line semilog method was used to calculate transmissivity from pumping data. For this method, a plot of log time (t) vs arithmetic drawdown (s) is prepared on semilog paper. With the exception of very early time data, a "best-fit" straight line is then drawn through the data points. Transmissivity is determined from the slope of this line based on the following equation:

$$T = \frac{2.303\ Q}{4\ pi\ s_{10}} \qquad \text{(eq.8.4-7)}$$

where:

T = transmissivity
Q = pumping discharge rate
pi = 3.14159
s_{10} = change in drawdown over one log cycle of time (for the straight line fit).

The semilog time-drawdown plot for pumping period data is shown in Figure 8.4-3. The best fit line to the data results in a transmissivity equal to 10,400 gpd/ft.

Recovery Data

Recovery data were analyzed using the Theis (1935) semilog recovery method. By this method, on a semilog plot of log (t/t') vs arithmetic residual drawdown (s) is prepared on semilog paper. In this case, t is the time since pumping began and t' is the time since pumping stopped (recovery bottom, discontinuing the gas flow, and then reading the downhole pressure at ground surface using a high quality mechanical pressure gauge. Although not as accurate as the electrical transducer, the gas bubbler was considered to have sufficient resolution for computing head buildup during the flow injection period. When flow rates were measured within the riser pipe using an electric probe, head buildup was determined by computing the change in water level (during the measurement) from static conditions. In this case, the gas bubbler was not utilized.

8.4.2.2 Analysis and Results

Constant head packer tests were analyzed using equations 8.4-5 and 8.4-6. Based on these equations, calculations for transmissivity and average hydraulic conductivity are summarized in Table 8.4-2. As shown, average hydraulic conductivity of the test intervals range over three orders of magnitude from 1×10^{-6} to 4×10^{-3} cm/s. The highest conductivity was measured in an interval from 273 to 333 feet BGS. This corresponds with drilling discharge measurements which documented a major increase in flow within this zone.

8.4.3 Pump Testing at the Quartz Mountain Water Supply Well

A single borehole pump test was conducted at the site water supply well located southeast of Crone Hill (Figure 8.2-1). Since this production well is situated near the southeastern portion of the proposed Crone Hill pit, test results provided information of value in assessing pit dewatering requirements. In addition, the test resulted in an additional value of transmissivity which could be used (in conjunction with the monitor well tests) to assess permeability variations across the site.

This relatively high capacity well has provided water on a regular basis for drilling operations. At the time of the pump test, the well was fitted with an electric submersible pump and had a dedicated diesel generator on site.

8.4.3.1 Field Procedures for Pumping/Recovery Test

The pump test at the water supply well was performed as follows:

1. Pre-test water levels were monitored for a period of time to confirm the existence of static conditions;

2. The pump was turned on;

3. During the pumping period, water levels and flow rates were measured on a regular basis;

TABLE 8.4-1

RESULTS OF MONITOR WELL HYDRAULIC TESTS

a. Falling Head Tests

MONITOR WELL	RISER TYPE	RISER AREA A (ft^2)	DATA SLOPE t10 (min)	TRANS T (gpd/ft)	TEST INTERVAL LENGTH B (ft)	AVERAGE HYDRAULIC COND. K (cm/s)	COMMENTS
MW-2	1	0.022	6.62	82	83	4.6E-05	
MW-6	1	0.022	0.74	731	65	5.3E-04	
MW-7	2	0.074	453	4	147	1.3E-06	
MW-9	4	0.196	3950	1	238	2.4E-07	
MW-10	4	0.196	0.834	5839	112	2.5E-03	
MW-11	2	0.074	5000	0.4	235	7.4E-08	Upper-bound values of T and K
MW-12	1	0.022	1.27	426	67	3.0E-04	
MW-13	1	0.022	3.19	170	72	1.1E-04	
MW-14	1	0.022	4.54	119	63	8.9E-05	
MW-15	2	0.074	1990	1	316	1.4E-07	
MW-17	3	0.573	4.55	3124	62	2.4E-03	
MW-18	1	0.022	1.12	483	65	3.5E-04	

RISER TYPE: 1 = 2 inch PVC Well Casing
2 = Completion Interval (includes screen and sand pack)
3 = Well Casing Extension (five gallon bucket)
4 = Open Hole (6 inch diam)

b. Constant Head Tests

MONITOR WELL	TEST TYPE	FLOW RATE Q (gpm)	BUILDUP/ DRAWDOWN 5W (ft)	TRANS T (gpd/ft)	TEST INTERVAL LENGTH B (ft)	AVERAGE HYDRAULIC COND. K (cm/s)	COMMENTS
MW-3	I	71.1	37.3	2745	67	1.9E-03	
MW-5	W	8.1	21.4	545	85	3.0E-04	Air-lift
MW-16	W	2.7	12.0	318	86	1.7E-04	

TEST TYPE: W = Withdrawal
I = Injection

For well installations with relatively large length to radius ratios, the shape factor generally assumes a value between 6 and 6.5. As a result, it is common to assume that the shape factor (C) has a value approximately equal to (2 pi). Making this substitution results in the final equation used to analyze the Modified Hvorslev Plots:

$$T = \frac{2.303\ A}{t_{10}} \qquad \text{(eq. 8.4-3)}$$

Constant Head Tests

Analysis of constant head buildup/withdrawal tests is based on the following equation (Marinelli 1984):

$$Q = \frac{2\ pi\ T\ sw}{C} \qquad \text{(eq. 8.4-4)}$$

where:

Q = steady-state flow rate
sw = steady-state hydraulic buildup or drawdown

and other parameters are defined previously. Making the assumption that the shape factor (C) is approximately equal to (2 pi) and solving for transmissivity, results in the final equation used for analyzing constant head tests:

$$T = Q/sw \qquad \text{(eq. 8.4-5)}$$

Hydraulic Conductivity

The average hydraulic conductivity of geologic materials within the test interval is given by:

$$K = T/B \qquad \text{(eq. 8.4-6)}$$

where:

K = hydraulic conductivity
B = length of the test interval

It should be noted that sole reliance on average hydraulic conductivity values may lead to erroneous conclusions regarding the permeability characteristics of the rock mass. This is because in many test wells, a high proportion of the total flow issued from a limited number of discrete features (typically narrow fracture zones) intercepted by the borehole. In this case, the average (computed) hydraulic conductivity for the borehole test interval may be significantly lower than the actual

Injection water was obtained from a water truck, with a calibrated 1200 gallon tank, provided by a drilling contractor at the site. During injection, the depth to water in the tank was periodically measured with an electric probe. Using the calibration equation for the tank, flow rates were then computed by the incremental change in volume between the timed depth measurements. Within the errors of the volume measurements, it was determined that a relatively constant flow rate of 71 gpm was maintained during the test.

8.4.1.3 Procedure for Air-Lift Test at MW-5

An air-lift withdrawal test was conducted in MW-5 according to the following procedure:

1. A pressure transducer was lowered into the borehole to a depth below the water level;

2. A flexible plastic hose was lowered to about 40 feet above the transducer; the hose was connected to a high capacity air compressor;

3. Water levels were monitored with the transducer for a period of time to verify that static conditions prevailed;

4. The air compressor was turned on; this resulted in water being air-lifted out of the well casing; and

5. Air-lifting was continued until the discharge flow rate and downhole pressures stabilized.

Discharge from the wellbore was channeled into a 10 foot section of 6 inch PVC pipe, which allowed air bubbles to escape and produced a steady stream of water. At the end of the pipe, flow rates were measured using a 5 gallon bucket and stopwatch. After an initial period of fluctuation, the discharge flow rate stabilized at a rate of 8.1 gpm.

8.4.1.4 Field Procedure for Constant Drawdown Test at MW-16

Artesian (flowing) conditions at MW-16 precluded performance of a falling head test. Hydraulic testing of this monitor well was accomplished by performing a constant drawdown test according to the following procedure:

1. A twenty-foot section of PVC pipe was added to the top of PVC well casing; this pipe was supported by the mast of the drill rig;

2. Water level was monitored in the extension pipe using a Solinst electric probe until static

8.4 HYDRAULIC TESTING

8.4.1 Monitor Well Hydraulic Testing

The purpose of the monitor well hydraulic testing was to obtain estimates of transmissivity or hydraulic conductivity of the bedrock aquifer to be used in evaluating the variability in permeability across the site and for determining rates of groundwater movement. In addition, the monitor well tests were used to identify the location of high permeability areas for development of a groundwater supply for mining operations. Monitor well tests in the vicinity of the pit also provided information upon which pit dewatering requirements will be assessed.

Falling head slug tests were conducted in 12 monitor wells during the period, December 6 through December 18, 1987. A falling head test was not conducted in MW-1, which was straddle-packer tested prior to completion (see Section 8.4.2). A constant head drawdown test (rather than falling head) was conducted in MW-16 due to flowing artesian conditions, and a constant head injection test was performed at MW-3 when it was determined that transmissivity at this location was too high for a falling head test to be feasible. In addition, an air-lift pumping test was performed at MW-5. All tests were performed by an ABC- or SRK-appointed field engineer/geologist with experience in the type of hydraulic test performed.

8.4.1.1 Field Procedure For Falling Head Tests

The procedure used to conduct falling head tests was as follows:

1. Static water level in the hole was measured using an electric water level probe;

2. A pressure transducer was lowered to some depth (generally 50 feet) below the water level in the hole;

3. Transducer calibration was checked by comparing the computed water level based on transducer pressure with water level determined by the probe;

4. Water levels were monitored with the transducer for a sufficient period of time to verify that static conditions prevailed or to define any background trends;

until the top of the slurry was about 20 feet below ground surface. The upper 20 feet of the borehole was then sealed with dry granular bentonite as directed by the Oregon Department of Water Resources. In cases where the borehole water level was less than 10 feet above the pellet seal and no perched water was present, the annulus was sealed by pouring dry granular bentonite down the annulus. The granular bentonite seal extended from the pellet seal to ground surface.

Variances to the general completion procedure occurred in the following wells:

- In MW-1, "squeezing" clays caused a major borehole constriction at 440 feet BGS, which would not allow passage of the 2 inch PVC screen/casing. After drilling through the constriction, another unsuccessful attempt was made to reset the casing. The lower portion of the hole (434 to 605 feet) was then sealed with a bentonite slurry, above which was placed a 12 foot bentonite pellet seal. Above the pellet seal, the monitor well was completed in the usual manner.

- After placement of screen/casing in MW-7, a borehole restriction occurred at an unknown depth due to squeezing clays. During subsequent placement of the sand pack, the restriction caused a bridge which resulted in the sand pack being extended well above the water table. Since the borehole annulus was dry above the sand pack, a bentonite pellet seal was unnecessary and granular bentonite was added to ground surface.

- In MW-11, a borehole constriction from squeezing clay created a bridge in the sand pack which resulted in an open annulus from 497 feet BGS (bottom of hole) to 256 feet. After placing some additional sand, a second bridge created an open annulus from about 231 to 185 feet. The bentonite pellet seal was placed at this depth and the remainder of the hole (above the water table) was completed with granular bentonite.

- In MW-12, sand was added above the first bentonite pellet seal to raise the backfill materials above the water table. This completion option was chosen to preclude the pumping of a deep bentonite slurry. A second bentonite pellet seal was then placed to provide a positive seal below any perched water that might have been present at shallower depths. The remainder of the hole was completed with dry granular bentonite.

- In MW-13, the bentonite pellet seal bridged, resulting in an open annulus from 270 to 380 feet. To provide the

8.3.3 Monitor Well Installation

After drilling, each open borehole was completed as a single interval monitoring well. Well completion details are shown in Table 8.3-1 and "As-Built" diagrams for each well are shown in Appendix 8.A. Materials and procedures used to install the monitoring wells were in full compliance with State of Oregon regulations for completion of monitoring wells.

In general, the monitored interval consisted of 50 feet of 2 inch Schedule 80, threaded and flush-coupled, PVC screen with 0.020 inch mill slots. The screen was positioned so that it was adjacent to the water producing zone(s) identified during drilling. In some cases, longer screen lengths were selected so that multiple water bearing zones could be monitored. The screen was coupled to 2 inch Schedule 80 flush-joint PVC pipe which extended to above ground surface. In MW-7, MW-9, and MW-15, where very small amounts of water were encountered, 10-ft. sections of screen were alternated with 20-ft. sections of non-perforated PVC. This type of well string was positioned within the entire saturated thickness of the hole to allow a maximum amount of groundwater to be available to the well.

After positioning the PVC, a sand pack consisting of 8-12 Colorado silica sand was placed in the annulus between the screen and the borehole wall. During emplacement, the sand was poured at a slow and steady rate to prevent bridging between the PVC and the borehole wall. To identify possible bridging, the sand level in the hole was checked periodically with a weighted tape. The sand pack was extended a minimum of 10 feet above the upper-most section of slotted PVC screen.

A minimum 5 foot seal of 1/4 inch bentonite pellets was then placed on top of the sand pack by slow and steady pouring down the borehole annulus. The top of the seal was checked with a weighted tape to identify bridging.

Two different sealing techniques were employed above the bentonite pellet seal, depending on the condition of the annulus and the position of the water level in the hole. In cases where the water level was more than about 10 feet above the pellet seal or where perched (cascading) water was present, a bentonite slurry was placed using a 1 inch tremie pipe lowered to near the top of the pellet seal. In some cases, five feet of sand was placed on top of the pellet seal to protect it from erosion during pumping of the slurry. The bentonite slurry mixture consisted of 20 pounds of powdered bentonite for each 30 gallons of water. The resulting slurry was pumped into the tremie pipe using a compressed air-driven diaphragm pump. Pumping was continued

8.3 DRILLING PROGRAM

Sixteen boreholes were drilled and completed as monitoring wells during the period, October 1987 to mid January 1988. The locations of the wells are shown on Figure 1.2-1. The rationale for the well locations was to:

1. Provide site-wide coverage of the groundwater system which could be impacted by future mining operations;

2. Cover both topographic lows and highs (stream channels, surface water divides) so that groundwater levels could be correlated with topography;

3. To monitor specific locations near future mine facilities (e.g., heap leach pads and open pit) where operations could potentially impact the groundwater system; and

4. Identify target areas for groundwater resource development.

Constraints on well locations included site access (wells were located to the extent possible on existing roads), and avoidance of locations where wells would interfere with the operation of future mine facilities.

During drilling, cuttings from the circulation return were sampled and described to provide a geologic log for each borehole. In addition, water production rates were measured on a continual basis to identify depth to the water table and zones of greatest water production potential. This information was used to select the completion interval for each monitor well.

8.3.1 Method of Drilling

All wells were drilled by Roger Chancellor Well Drilling of Klamath Falls, Oregon. The driller is a licenced water well driller in the State of Oregon. The drilling program commenced on October 12, 1987 and was substantially completed by December 20, 1987. The last borehole (MW-1) was left as an open hole for straddle packer permeability testing. After this testing was accomplished, the borehole was completed as the final monitoring well on January 13, 1988. Drilling was performed using a standard air rotary drill rig equipped with a 6-inch diameter hammer bit. A tricone bit was utilized when clayey materials were encountered at depths greater than 300 ft.

8.1.3 Baseline Investigation

To meet the specified objectives of the groundwater characterization program, a field investigation was undertaken beginning in October 1987. The field investigation consisted of:

1. Drilling and completion of 16 on-site monitoring wells;

2. Permeability testing of the first 15 completed monitor wells;

3. Straddle packer testing of an open borehole (subsequently completed into the 16th monitor well);

4. Aquifer pump testing of the site's existing water supply well;

5. Water level measurements on a periodic basis;

6. Quarterly groundwater sampling of 15 monitor wells, beginning in December, 1987;

7. Chemical analysis of groundwater samples, including general parameters, major cations/anions, tracers/metals, and radionuclides.

The baseline groundwater characterization is ongoing, particularly with regard to water level and water quality monitoring. The data will be used to assess temporal fluctuations of water levels and/or water quality, and will also allow for statistical analysis of water quality data.

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Maintain the QC data in a separate reference file. Eliminate them from the master data file to insure they will not enter the body of data for characterizing project waters or for monitoring (assessing) effects of operations.

G.3.3.2 Chain of Custody

Any sampling/analytical scheme must insure the integrity of samples from the time of collection to the completion of laboratory analysis and reporting the data. Possession and handling of samples must be traceable, a procedure known as chain of custody (COC).

The possibility, that the laboratory's data or the conclusions drawn from them may be used in litigation necessitates use of a COC. It also proves useful in routine control of sample flow and disposition. Its components include: sample labels, a field log book, a COC record, and a sample analysis request.

A person maintains custody of a sample when it remains (1) in that person's physical possession, (2) in view of that person during possession, or (3) secured by that person so that no one can tamper with it or in a restricted area accessed only by authorized personnel.

1. Label. Affix a gummed label to the container prior to or at the time of sample collection. Fill it out at the time of collection. Insure that the information on it corresponds to that on the seal. See Figure 7.G.1 for an example.

2. Log Book. Record all pertinent information about the site and the sample in a log book prior to leaving the site. It should be bound with consecutively numbered pages. The preferred size is 8 1/2"x11". As a minimum include the following entries:

   - Project name;
   - Name and ID number of the sampling point;
   - Name(s), address(es) and telephone number(s) of the collector(s);
   - Type of sample (e.g., raw water);
   - Description of the sample point (e.g.,legal description, grid location, location from road crossing, powerline, tributary stream confluence);
   - Sampling methodology (e.g., grab, depth integrated, EWI, pumping);

G.3 PRESERVATION AND DISPOSITION

G.3.1 Preservation

Keep sample cooled to not more than 10°C (50°F) from collection through delivery to the laboratory where lab personnel will store them in a refrigerator pending analysis. The lab provides not only sample bottles and labels but also large coolers. With ice, three samples (12 bottles) fit snugly into one cooler. A 10-pound bag of crushed or cube ice will keep two coolers at the desired temperature in all but the warmest weather. If stored overnight at a motel or residence prior to shipping, an additional bag of ice may be necessary after draining off the melt water.

Store the ice in the coolers in plastic bags to keep the container labels reasonably dry. The plastic wrapper holding the ice at time of purchase is usually poorly suited to use in the cooler.

Two sample bottles for each sampled site contain a chemical preservative. One-one liter bottle contains 2 ml of HNO_3 to fix dissolved metals. The other one liter bottle contains 2 ml of NaOH to fix the cyanide. Neither the two liter glass nor the 500 ml cubitainer contain a preservative. The cubitainer holds the sample for radionucleide analysis.

G.3.2 Disposition

Ship samples to KES via Red Ball Stage Lines, Inc., Klamath Falls. These make two round trips daily except weekends and holidays between Lakeview and Klamath Falls, making flag stops along the way to pick up shipments, such as at the Bly Ranger Station and the Beatty Store. KES maintains an account with Red Ball which allows COD shipments to them. Use of this service relieves the sample collector of time consuming, non-productive travel. Notify KES of the ETA of samples in Klamath Falls.

If the collector chooses to hand-carry the samples to KES, notify them of the ETA so that a lab person can meet the shipment and log it into the lab's care. The lab's working hours run from 0900 until 1700 though after-hours delivery may be arranged.

Whichever the method of delivery used, insure the samples reach KES within 48 hours.

KES will ship empty containers and coolers by Red Ball to any of its delivery/pick-up points.

EWI sampling exceeds by a factor of 5 to 10 the time and cost of grab sampling or of simple depth-integrated sampling and should be avoided whenever possible.

Both depth-integrated and EWI sampling require the sample collector to physically take the sample by hand while the pumping sampler collects it automatically. Neither hand sampling technique limits the array of species to be analyzed at the laboratory.

With automatic samplers, one services the site at weekly or longer intervals depending on the number of sample containers it holds and the sampling frequency. Many species deteriorate over time without preservation or refrigeration. Others do not. This severely limits the species array unless one accepts that change due to prolonged storage at the sample site. Grab sample and automatic sample data may not be comparable.

G.2.3 Other Data

Record data collected at the time of sampling in the log book as well as on the chain of custody form. These data include:

- Air and water temperature,
- Stream or spring flow,
- Stream stage, if appropriate,
- Crest stage, if appropriate,
- pH, and
- Electrical Conductivity.

1. Always measure ambient air and water temperature in the shade, never in direct sunlight. Calibrate the thermometer selected for use, whether mercury, dial, or digital or analog electronic, against the KES standard thermometer. Insure that the thermometer selected measures at least to the nearest whole degree.

2. Streamflow measurement utilizes one of two methods: the six-tenths depth or the two-point method with either a rod or a cable suspension for the meter. The six-tenth method sets the flow meter at six-tenths of the depth measured from the surface; the two-point method, at two- and eight-tenths of the depth. The six-tenths method prevails in streams where the water depth is two feet or less.

   Measure stream flow with a flow meter equipped with either a bucket-wheel, a propeller, or an electromagnetic sensor. Follow the technique known as the mid-section method, fully described in the USDI-Water Measurement

11. Before leaving the site record all pertinent information about the collection and site conditions in a log book (see 7.5.4.4.2 (2)).

G.2.1 Grab Samples

Area streams are small and turbulent, well-adapted to grab sampling because dissolved and suspended species are well mixed. In such cases the only location to avoid is that close to the water's edge. Shallowness alone may preclude sampling there.

Streams display poorer mixing qualities during low flows than during high when normally turbulent flow may approach laminar flow. During low flows, consider compositing a sample from at least two different portions of the stream cross-section, and then combining them into one sample containing proportional amounts of the different portions sampled. In most cases, proportion the stream by ocular estimate.

Whenever compositing, even in very small streams, collect the sample in a separate, thoroughly rinsed container and pour its contents into the one provided by the laboratory. Using a funnel, also thoroughly rinsed, helps reduce spillage. Rinsing should always be carefully done in the same water which is to be sampled.

When grab sampling, hold the collecting container with its mouth mid-way between the water surface and the channel bottom in shallow streams. In deeper streams, a sample from six to twelve inches below the surface usually proves adequate. In no case allow the mouth to lie on the bottom. Choose a spot along the cross-section that represents the largest discharge and best mixing per foot of stream width.

Sampling springs that issue from a pipe present few problems. Simply let the water flow into the sample container being careful not to overfill it.

Springs having little or no development, and diffuse or dispersed flow into one or more channels showing little or no incision, present a challenge to sampling both yield and quality. One may have to excavate a sampling site even to the point of installing a small portable weir such that the water flowing over it falls freely, leaving an airspace under and around the jet. Collect the sample from the jet, not from the small pond behind the weir. However, insure that the flow quality has stabilized before sampling.

G.1 INTRODUCTION

For sample data to be useful, data collection must occur in a consistent manner and according to certain standard procedures. This section describes the procedures to be followed for sampling of surface waters at Quartz Mountain.

TABLE 20

WATER QUALITY CRITERIA SUMMARY (continued)

g = grams
mg = milligrams
ug = micrograms
ng = nanograms
f = fibers

Y = YES
N = NO

M.C.L. = MAXIMUM CONTAMINANT LEVEL

\+ = Hardness Dependent Criteria (100 mg/L used)

* = Insufficient Data to Develop Criteria
Value Presented is the L.O.E.L. — Lowest Observed Effect Level

** = Human Health Criteria for Carcinogens Reported for Three Risk Levels. Value Presented is the 10-6 Risk Level which means the probability of one cancer case per one million people at the stated concentration

*** = pH Dependent Criteria (7.8 pH used)

1 = Values in Table 20 are applicable to all basins as follows:

Basin	Rule
North Coast	340-41-205(p)
Mid Coast	340-41-245(p)
Umpqua	340-41-285(p)
South Coast	340-41-325(p)
Rogue	340-41-365(p)
Willamette	340-41-445(p)
Sandy	340-41-485(p)
Hood	340-41-525(p)
Deschutes	340-41-565(p)
John Day	340-41-605(p)
Umatilla	340-41-645(p)
Walla Walla	340-41-685(p)
Grande Ronde	340-41-725(p)
Powder	340-41-765(p)
Malheur River	340-41-805(p)
Owyhee	340-41-845(p)
Malheur Lake	340-41-885(p)
Goose and Summer Lakes	340-41-925(p)
Klamath	340-41-965(p)

Water and Fish Ingestion

Values represent the maximum ambient water concentration for consumption of both contaminated water and fish or other aquatic organisms.

Fish Ingestion

Values represent the maximum ambient water concentration for consumption of fish or other aquatic organisms.

TABLE 20
WATER QUALITY CRITERIA SUMMARY (continued)

COMPOUND NAME (OR CLASS)	PRIORITY POLLUTANT	CARCINOGEN	Concentration in Micrograms Per Liter For Protection of Aquatic Life: FRESH ACUTE CRITERIA	FRESH CHRONIC CRITERIA	MARINE ACUTE CRITERIA	MARINE CHRONIC CRITERIA	Concentration in Units Per Liter For Protection of Human Health: WATER AND FISH INGESTION	FISH CONSUMPTION ONLY	DRINKING WATER M.C.L.
MANGANESE	N	N					50.ug	100.ug	
MERCURY	Y	N	2.4	0.012	2.1	0.025	144.ng	146.ng	0.002mg
METHOXYCHLOR	N	N		0.03		0.03	100.ug		0.1mg
MIREX	N	N		0.001		0.001			
MONOCHLOROBENZENE	Y	N					488.ug		
NAPHTHALENE	Y	N	*2,300.	*620.	*2,350.				
NICKEL	Y	N	1,400.+	160+	75	8.3	13.4ug	100.ug	
NITRATES	N	N					10.mg		10.mg
NITROBENZENE	Y	N	*27,000.		*6,680.		19.8mg		
NITROPHENOLS	Y	N	*230.	*150.	*4,850.				
NITROSAMINES	Y	Y	*5,850.		*3,300,000		0.8ng**	1240.ng**	
NITROSODIBUTYLAMINE N	Y	Y					6.4ng**	587.ng**	
NITROSODIETHYLAMINE N	Y	Y					0.8ng**	1,240.ng**	
NITROSODIMETHYLAMINE N	Y	Y					1.4ng**	16,000.ng**	
NITROSODIPHENYLAMINE N	Y	Y					4,900.ng**	16,100.ng**	
NITROSOPHYRROLIDINE N	Y	Y					16.ng**	91,900.ng**	
PARATHION	N	N	0.065	0.013					
PCB's	Y	Y	2.0	0.014	10.	0.03	0.079ng**	0.079ng**	
PENTACHLORINATED ETHANES	N	N	*7,240.	*1,100.	*390.	*281.			
PENTACHLOROBENZENE	N	N					74.ug	85.ug	
PENTACHLOROPHENOL	Y	N	***20.	***13.	13.	*7.9	1.01mg		
PHENOL	Y	N	*10,200.	*2,560.	*5,800.		3.5mg		
PHOSPHORUS ELEMENTAL	N	N				0.1			
PHTHALATE ESTERS	Y	N	*940.	*3.	*2,944.	*3.4			
POLYNUCLEAR AROMATIC HYDROCARBONS	Y	Y			*300.		2.8ng**	31.1ng**	
SELENIUM	Y	N	260.	35.	410.	54.	10.ug		0.01mg
SILVER	Y	N	4.1+	0.12	2.3		50.ug		0.05mg
SULFIDE-HYDROGENSULFIDE	N	N		2.0		2.0			
TETRACHLORINATED ETHANES	Y	N	*9,320.						
TETRACHLOROBENZENE 1,2,4,5	Y	N					38.ug	48.ug	
TETRACHLOROETHANE 1,1,2,2	Y	Y		*2,400.	*9,020.		0.17ug**	10.7ug**	
TETRACHLOROETHANES	Y	N	*9,320.						
TETRACHLOROETHYLENE	Y	Y	*5,200.	*840.	*10,200.	*450.	0.8ug**	8.85ug**	
TETRACHLOROPHENOL 2,3,5,6	Y	N				*440.			
THALLIUM	Y	N	*1,400.	*40.	*2,130.		13.ug	48.ug	
TOLUENE	Y	N	*17,500.		*6,300.	*5,000.	14.3mg	424.ug	
TOXAPHENE	Y	Y	0.73	0.0002	0.21	0.0002	0.71ng**	0.73ng**	0.0005mg
TRICHLORINATED ETHANES	Y	Y	*18,000.						
TRICHLOROETHANE 1,1,1	Y	N			*31,200.		18.4mg	1.03g	
TRICHLOROETHANE 1,1,2	Y	Y		*9,400.			0.6ug**	41.8ug**	
TRICHLOROETHYLENE	Y	Y	*45,000.	*21,900.	*2,000.		2.7ug**	80.7ug**	
TRICHLOROPHENOL 2,4,5	N	N					2,600.ug		
TRICHLOROPHENOL 2,4,6	Y	Y		*970.			1.2ug**	3.6ug**	
VINYL CHLORIDE	Y	Y					2.ug**	525.ug**	
ZINC	Y	N	120.+	110+	95	86			

APPENDIX 7.G

SAMPLING PROCEDURES

G.2 SAMPLING TECHNIQUES

Standard sampling procedures are used when collecting a water sample at any site. For many water quality sampling programs the sampling procedures are undocumented, especially samples collected that are sent to a laboratory for analysis of an array of chemical, physical, biological, bacteriological, and radiological species. The standard sampling procedures or techniques used during this study are documented here, and are as follows:

1. Complete the label attached to the sample container;

2. Rinse off the sample container at the sample site with water to be sampled before removing its cap;

3. Select a collection site representative of the entire site. In some cases, this may require a composite sample;

4. Be consistent. In flowing waters at a specific site, collect the sample always from a pool or always from a riffle. Do not sample a riffle one time and a pool the next. If more than one site is located along the stream, select the same type of collection point from site to site;

5. Keep fingers away from the rim of the container;

6. When collecting, point the mouth of the container upstream with the mouth slightly higher than the bottom so that the water flowing past or into the container does not back in to it or flow across one's hand before entering;

7. Avoid stirring up bottom sediments. If unavoidable, wait several minutes to allow the site to stabilize before making the collection. If it will not stabilize, select a new collection site upstream of the old, not downstream;

8. Fill the container to its shoulder. Do not overfill;

9. Store and ship samples in an iced cooler to maintain sample temperature at 10°C (50°F) or less from collection to receipt of the sample at the laboratory;

10. Establish a chain of custody record for each sample (see 7.5.4.4.2 (3)); and

G.2.2 Other Sampling Techniques

These techniques may prove suitable as the project moves into an operational phase or if grab sampling proves inadvisable due to flow or other site restrictions. All are particularly adapted for those physical water quality species of suspended and saltation sediment, turbidity, color, etc., and may be poorly suited for some chemical, biological, bacteriological, and radiological species.

1. Pumping Sampler. A pumping sampler samples from a fixed point in the stream profile at a fixed rate, usually once every 24 hours. In some cases, the sampler may be activated at a predetermined depth of water which initiates either the start of sampling or changes the sampling frequency from the normal once-a-day rate to two to four or more sample collections per day. Using such a sampler substantially increases the number of samples and restricts the types of species selected for analysis. Operation in cold weather often leads to ice in lines and samples unless one employs special techniques to maintain the samples and lines at above freezing temperatures. Another problem involves the residual of the previous samples remaining in the lines even after the sampler goes through its flushing cycle.

2. Depth-integrated Sampling. This method samples almost the full depth of the stream to within a few inches of the channel bottom. Ideally, the sample container is lowered to the channel bottom and raised back to the surface at a constant rate, or equal transit rate (ETR), so that the container completes filling just as it breaks the surface. This usually involves sampling only one vertical in a well-mixed turbulent stream and is particularly well adapted to collecting suspended sediment samples.

3. Equal Width Increment Sampling. In cases where one vertical proves inadequate to represent the entire cross-section, employ equal width increment sampling (EWI). Divide the channel into several, usually ten or more, increments of equal width. At the increment of maximum discharge, establish the ETR. Sample all other increments at the same ETR. In many cases, one must sample two or more increments to fill one container. Label each container separately then split the contents of all containers such that the sample going to the laboratory proportionally represents each increment according to its incremental discharge.

Manual or in other appropriate manuals of the USDI-Geological Survey, USDA-Soil Conservation Service.

Measure springflow by timing the discharge necessary to fill a graduated bucket. Only two springs present little difficulty-Quartz Mountain and Buckhorn springs, each of which discharges through an overflow pipe. All others will require some modification of the site to permit sampling. In some cases, such as the intermittent Ewauna, Angel, and Quartz Valley Springs, measuring flow will be impossible without major modification of the site.

3. Record stream stage to the nearest hundredths of a foot from the staff gauge at the site. If during the measurement of streamflow stage changes rapidly, not due to fluctuations caused by flow turbulence, record the time the water sample was collected and the time flow measurements began and ended as well as the stage at those times. Compute the average for the measurement period. Only stream sites have staff gauges.

   Crest stage measures the instantaneous peak stage that occurred between the current and the previous service trip to the site. Record the crest stage to the nearest hundredths of a foot at the base of the cork ring adhering to the inner wall of the plastic tube. Then remove the cap or plug and wash the cork down to the current water level. Only streams have crest gauges.

4. Utilize an analog or a digital pH meter, measuring to not less than 0.1 unit. Calorimetric methods are unreliable and inexact, providing only a gross approximation. Choose a meter which compensates for the temperature of the liquid being tested. Calibrate frequently, especially at the beginning of a sampling day. Replace calibration buffers at least semi-annually. Collect and measure the sample in a thoroughly rinsed, wide-mouth, polypropylene jar or bottle.

5. Meters to measure electrical conductivity (EC) come in both analog and digital models. Choose a meter whose error does not exceed 3%, most are about 1%, and that compensates for the temperature of the liquid being sampled. Frequently calibrate against standard solutions of 50-80 umhos/cm and 180-220 umhos/cm, the expected range of EC in project surface waters, replacing the standards at least semi-annually. Collect the sample in a thoroughly rinsed, wide-mouth, polyproplyene bottle or jar.

Each person who handles the coolers in shipment must sign a chain of custody form accompanying the shipment upon receiving as well as relinquishing it to another person. See discussion in Section G.3.3.2.

G.3.3 Quality Assurance and Quality Control

Quality assurance (QA) can be defined briefly as the process for ensuring that all data and the decisions based on them are technically sound, statistically valid, and properly documented. One might consider this monitoring plan as defining the QA process. Quality control (QC) provides the tools to measure the degree of QA attainment. QC also calls for an analysis of the QA process and of the problems encountered, how they were resolved, and how to avoid them or accommodate them in the future.

G.3.3.1 Duplicate and Spiked Samples

Following QC procedures insures and documents the accuracy and precision of sample data.

1. Collect a field duplicate, at least twice each year from at least one sampling site in containers supplied by KES with the appropriate preservative added. Arrange for another lab other than KES but also certified by EPA and the State of Oregon to analyze the sample following standard methods.

   A second comparative procedure also involves collecting a duplicate sample. In this case KES will analyze both samples, one of which will have a different identity to separate its data from the "real" data. Such bogus data must not be included in any analysis as they will distort the results.

2. Field spikes involve adding a known quantity of some species in the routine sampling array to a duplicate for KES to analyze. It may also consist of a full sample from another operation transferred into KES-supplied containers. Identify the sample as one from a project site but flag it so it will not be included in the data to be analyzed and reported.

   Employ either duplicate or spiked samples at least twice each year as a QC check on KES or any other laboratory retained by the project for water analysis.

   Inform KES of the inclusion of an "unnatural" sample among the routine ones after completion of the lab analysis. If using a "check" lab, notifying KES of the QC check sample is permissive.

SRK
3232 So. Vance St. Suite 210
Lakewood, CO 80227
(303) 985-1333

____
Company Name

____
Sample Description

____
Date/Time Sampled Init.

____
Misc. Information (Field Data)

Preservative
(circle one)

NONE	HNO_3
HCl	H_2SO_4
STERILE	ZnAc
NaOH	H_3PO_4 / $CuSO_4$

Other __________

FILTERED
UNFILTERED

____

____

FIGURE 7.G-1

BOTTLE LABEL

- Purpose of sampling (e.g., characterization, assessment, surveillance);
- Date and time sample(s) collected;
- Distribution of sample(s) (e.g., name of laboratory, shipper);
- Sample ID numbers;
- Number and volume of sample(s) including preservative, if any;
- Field measurements (e.g., air and water temp., EC, pH, discharge);
- Field observations (e.g., weather, site conditions);
- References (e.g., maps, photographs) ;
- Signature(s) of collector(s); and
- Remarks/Comments.

While there is no hard and fast rule as to what information must be entered in the log book, a good rule of thumb is to record sufficient information so that anyone can reconstruct sampling at any given site without having to rely on memory, presumption or guesswork.

3. Chain of Custody Record. This document accompanies each sample from the time of collection until its receipt by the laboratory performing the analysis. Each person who has custody must certify to that fact when receiving or relinquishing the sample(s). If the data from the sample(s) become evidence in court litigation, one cannot overemphasize this record's importance.

At a minimum, the record must include the following information:

- Sample number;
- Signature (s) of collector(s);
- Date and time of collection;
- Collection site name and ID number;
- Type of source;
- Signature(s) of person(s) involved in the chain of custody; and
- Inclusive dates of possession.

Figure 7.G.2 illustrates the records used in this project. The laboratory retains the original with a copy sent to the principal investigator with ultimate retention in the project master file.

FIGURE 7.G-2

PREPARED BY

STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers

Project ____________ No. ______

Feature ____________

Collected by ____________

Sheet ____ of ____

CHAIN OF CUSTODY RECORD

LOCATION OF SAMPLING: ____ Producer ____ Hauler ____ Disposal Site

____ Other: ____________

COMPANY'S NAME: ____________ Telephone(____) ________

Number Street City State Zip

ADDRESS: ____________

COLLECTOR'S NAME: ____________ Telephone(____) ________

Signature

DATE SAMPLED: ____________ TIME SAMPLED: ________Hours

Type of Process Producing Waste ____________

Waste Type Code ________ Other ____________

FIELD INFORMATION: ____________

____

____

COLLECTOR'S SAMPLE NO. ____________

____

SAMPLE ALLOCATION:

1. ____________
Name of Organization

2. ____________
Name of Organization

3. ____________
Name of Organization

CHAIN OF POSSESSION:

1. ________ ________ ________
Signature Title Inclusive Dates

2. ________ ________ ________
Signature Title Inclusive Dates

3. ________ ________ ________
Signature Title Inclusive Dates

4. <u>Sample Analysis Request Sheet</u>. This document accompanies the samples, though it need not be completed in the field at the time of collection. The request sheet used on this project provides space for up to ten samples.

Normally the person collecting the sample(s) completes the request form's field section relying on information recorded in the log book.

The person receiving the sample at the laboratory must be authorized to do so and completes the laboratory section, which must include:

- Name and/or signature of person receiving the sample(s);
- Laboratory sample number(s);
- Date and time sample received;
- Sample allocation; and
- Analyses to be performed.

8.0 GROUNDWATER

TECHNICAL REPORT NO. 8

GROUNDWATER

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

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Reno, Nevada 89502

Revised December 1988

FOREWORD

This report was prepared by Adrian Brown Consultants (ABC) and Steffen Robertson and Kirsten (COLORADO) Inc. (SRK) for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
F. Marinelli	Project Manager (6/87 - 1/88)	ABC
J. Siegel	Project Manager (2/88 - 8/88); Sampling	SRK
D. Gibbs	Drilling Supervision	SRK
M. Galloway	Drilling Supervision	ABC
B. Basse	Field Testing; Sampling	ABC
D. Carrol	Sampler Installation	SRK

In addition to the above personnel, considerable assistance in the field was provided by the staff of Quartz Mountain Gold, Corp. and it's subcontractors.

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LIST OF FIGURES

SUMMARY

Groundwater flow in the bedrock aquifer of the study area is for the most part unconfined, with regional and local topographic features responsible for the direction of flow. Recharge occurs as the result of infiltration of precipitation and snowmelt which reaches the groundwater table. On a regional scale, groundwater flow through the site is from the northeast to southwest. In general, flow converges towards the center of stream valleys and then flows parallel to the valleys downslope.

Groundwater occurs in the study area at depths ranging from 15 feet above ground surface (artesian) to approximately 350 feet below ground surface. Groundwater elevations are typically 5,400 feet in the valleys and greater than 5,500 feet below hilltops. Discharge occurs at Angels Camp as spring flow and wetland conditions, and along a portion of Drews Creek. The perennial nature of Drews Creek is related in part to continuous groundwater discharge. Flow from Quartz Mountain Spring is not attributed to discharge of the bedrock aquifer but is probably the result of a shallow perched water body unrelated to the regional flow system. Likewise, wetland conditions along Quartz Creek are due to poor surface water drainage and not regional groundwater discharge.

The groundwater in the study area has a calcium bicarbonate to sodium-magnesium bicarbonate composition and a low TDS content typical of the water quality of groundwater in the region. However, calcium-sulfate groundwater appears to be present in the immediate vicinity of the Crone Hill ore body. The overall uniform composition of groundwater samples collected from monitoring wells throughout the project area suggests that they are from a single aquifer. Most trace elements are present in concentrations below or near the lower detection limit of the laboratory instruments, with the exception of iron, manganese, and arsenic. These elements are typically associated with hydrothermal ore deposits such as that found at the Quartz Mountain Gold Project. The presence of some trace elements at concentrations above primary and secondary water standards indicates that the water is not suitable for drinking water without treatment.

8.0 GROUNDWATER TECHNICAL REPORT

8.1 INTRODUCTION

8.1.1 Objectives

The purpose of the Quartz Mountain groundwater baseline investigation was as follows:

1. To identify the hydrogeologic setting of the site on a local scale, including aquifers present and their geologic controls, recharge/discharge areas, and the interrelationship of groundwater to surface water systems;

2. To characterize the baseline water quality and water chemistry of the aquifer to provide a reference from which future data can be compared to identify impacts from the proposed mining and heap leach processing operation;

3. To characterize hydraulic properties of the aquifer including the spatial distribution of hydraulic conductivity and hydraulic gradients;

4. To develop a conceptual model of the groundwater flow system which incorporates the known hydrogeology, hydrochemistry, and hydraulic characteristics identified above; and

5. To quantify the conceptual model (e.g., groundwater flow directions and flux rates) to provide a technical basis for hydrologic impact analysis.

Other purposes of the investigation included identification of target areas for development of a groundwater supply for mining operations, and an initial evaluation of mine dewatering requirements.

8.1.2 Study Area

The study area for groundwater characterization may be considered to be the project lease boundary, and the area surrounding the project boundary where data, such as groundwater contours, can be reasonably extrapolated.

8.2 HYDROGEOLOGIC SETTING

8.2.1 General

The project area consists of gently dipping Pliocene lava flows and pyroclastics which are intruded by younger Pliocene rhyolitic bodies. The intrusion events created hydrothermal fluids which permeated the fractured extrusive rocks and porous tuff along the intrusive contacts. Migrating hydrothermal fluids resulted in varying degrees of clay and silicic alteration within the country rock.

Fault structures have been mapped throughout the project area. The site appears to be located within a regional northwest trending structural zone. In addition, numerous faults have been identified along stream valleys within the project area. A map depicting faults and fracture zones on the site is shown on Figure 2.3-1 and 8.2-1.

Groundwater movement and availability appear to be strongly controlled by the presence of rock discontinuities such as faults and fractures. Flow discharge observations during the drilling of site exploration wells consistently show that the boreholes tend to produce water from discrete zones, and that the depth of zones contributing to flow differ greatly between boreholes. An important consideration in the site characterization study was to assess the degree of interconnection between permeable fracture zones and to determine if local/regional faults exert a strong influence on the groundwater flow system.

The bedrock aquifer system is unconfined with groundwater flow topographically controlled. According to this conceptualization, groundwater flow is roughly in the direction of decreasing topographic slope (i.e., from topographic highs toward major stream valleys). Groundwater recharge occurs in upland areas as a result of infiltration of precipitation and snowmelt. Groundwater discharge occurs as effluent seepage into perennial streams and evapotranspiration in lowland marsh areas. Site characterization studies were designed to evaluate and refine this initial conceptual flow model.

8.2.2 Crone Hill Area

Crone Hill is the surface expression of a rhyolite intrusive body which is more resistent to erosion than the adjacent country rock. Surrounding the intrusion are gently dipping basalt flows and pyroclastic deposits. Numerous northwest trending faults and fractures have been identified from borehole data and geologic mapping. In addition, major faults have been mapped along ephemeral stream valleys adjacent to Crone Hill.

Quartz Mountain Spring, west of Crone Hill (Figure 8.2-1), is a perennial spring which provides a water supply for several residents in the settlement of Quartz Mountain. This spring could represent groundwater discharge from the aquifer system or may result from local discharge of perched groundwater originating on Quartz Butte. A goal of the groundwater site characterization was to determine the source of this spring and to what extent its quantity and quality might be affected by mining operations.

Initially, each borehole was drilled oversize down to unweathered bedrock (depths ranging from 4 to 10 feet) and temporary conductor casing was installed. The depth of the conductor casing depended on the thickness of soil and weathered bedrock encountered. The conductor casing was utilized to prevent washout of the drill hole near the surface and to channel water discharge to a location where it could be accurately measured.

In most cases, drilling was continued to about 30 feet below the first significant water producing zone (greater than 5 gpm during airlifting). If no water producing zones were encountered (e.g., airlift discharge rate less than 0.25 gpm), drilling was generally continued to a final depth of 600 feet. An exception to this strategy was monitor well MW-7 which was terminated at a depth of 500 feet because the rock lithology and lack of fractures suggested that additional drilling would not likely encounter a significant water producing zone. Subsequent sampling, however, indicated that MW-7 produces sufficient water for monitoring purposes. In addition, MW-1, a high producing hole at depths between 213 and 333 feet, was drilled to 600 feet to provide an open borehole of sufficient depth for packer testing.

After each borehole was advanced to total depth, the hole was blown with air only for an extended period to clean and develop the borehole. This prolonged air-lifting of formation water served to effectively develop the geologic materials penetrated by the borehole prior to completion. After completion, additional well development was performed to clean the sand pack and casing materials.

Throughout the entire drilling and installation program, at least one experienced ABC- or SRK-appointed engineer or geologist was on site. The field engineer/geologist maintained daily activity logs and was responsible for selecting the completion interval for each well.

8.3.2 Borehole Logging

During drilling, samples of drill cuttings were taken every five feet by Quartz Mountain Gold personnel. From these samples and turbidity/color of the drilling discharge fluid, the site engineer/geologist produced a general geologic log showing changes in rock lithology for each hole. Logs also indicate the estimated depth of the water table and the location of significant water-producing zones. Boring logs for each monitor well are shown in Appendix 8.A.

TABLE 8.3-1

MONITOR WELL COMPLETION DATA

MONITOR WELL NO.	COORDINATES[1] NORTHING (ft)	EASTING (ft)	PVC CASING ELEV.[2] (ft.MSL)	GROUND SURFACE ELEV. (ft.MSL)	BORING DEPTH (ft.BGS)	SCREEN BOTTOM (ft.BGS)	SCREEN TOP (ft.BGS)
MW-1	240193	1917087	5552.0	5549	605	380	160
MW-2	244113	1922847	5665.1	5662	410	410	350
MW-3	242069	1928120	5522.6	5520	202	199	149
MW-4	Not drilled						
MW-5	239055	1929531	5462.0	5459	162	162	92
MW-6	239474	1926991	5659.6	5657	409	409	359
MW-7	237993	1917533	5377.8	5375	500	500	200
MW-8	Not drilled						
MW-9	241600	1915912	5839.6	5837	602	555	355
MW-10	240740	1919690	5479.3	5477	162	162	112
MW-11	241273	1921496	5773.5	5770	497	496	266
MW-12	245653	1919307	5687.0	5684	382	382	332
MW-13	246369	1927431	5812.3	5809	485	485	435
MW-14	243772	1931535	5964.9	5962	303	303	253
MW-15	239626	1935192	6121.0	6118	605	605	305
MW-16	239667	1939876	5740.7	5738	141	141	91
MW-17	231207	1932848	5399.2	5396	102	102	52
MW-18	232413	1925244	5306.1	5303	202	202	152

MSL = mean sea level

BGS = below ground surface

[1] Site coordinate system; surveyed by Richard C. Skinner, Junction City, Oregon.

[2] Top of PVC casing used as measuring point (MP) for water level measurements.

best seal possible and prevent downward migration of perched water, a long bentonite pellet seal was placed above the open annulus from 270 to 180 feet.

- Artesian conditions were present in monitor wells MW-16 and MW-17. To control artesian flows in these holes, a seal consisting of Portland neat cement with 5 percent bentonite was trimmed above the bentonite pellet seal to within 5 feet of ground surface. The upper 5 feet of these holes were then sealed using a thick cement slurry poured from ground surface.

The use of bentonite for borehole sealing differs from the more traditionally used cement grout. The bentonite sealing strategy was chosen to avoid potential grout contamination of groundwater within the well. Elevated pH, resulting from the grout, could adversely affect the representativeness of water samples obtained from the well. Artesian wells sealed with cement grout (MW-16, MW-17) are not expected to experience grout contamination problems since the potential for vertical flow in these wells is upward (from the test interval towards the seal).

5. A volume of water was introduced into the borehole. This was generally accomplished by rapidly pouring 10 to 20 gallons of water into the PVC casing using a bucket and funnel;

6. The initial water level rise and subsequent recovery was monitored based on transducer pressures; and

7. The test was terminated when 80 percent or more recovery was achieved (moderate to high permeability) or when the recovery trend was clearly defined (low permeability).

Static water levels were measured to ±0.02 feet using a Solinst electric water level probe or to ±0.1 feet using a large depth-capacity Powers electric probe. Resolution of recovery data was enhanced by use of a Druck 0-100 psi pressure transducer and a Terra 8 datalogger which allowed for accurate and rapid transducer pressure readings. After a test was completed, pressure readings stored by the datalogger were down-loaded to a portable computer and stored in a Lotus 1-2-3 spreadsheet file for subsequent data reduction and graphics generation.

8.4.1.2 <u>Field Procedure for Constant Head Injection Test at MW-3</u>

A falling head test at MW-3 was attempted, but was unsuccessful because the high transmissivity resulted in a recovery response which was too rapid to provide for an accurate analysis. As an alternative, a constant head injection test was performed according to the following procedure:

1. A pressure transducer was lowered into the borehole to a depth below the water level;

2. Water levels were monitored with the transducer for a period of time to verify that static conditions prevailed;

3. Water was injected into the well casing, imposing an approximately constant head buildup in the well;

4. Flow during the test was continuously monitored until the injection flow rate stabilized; and

5. After testing, the monitor well was air-lifted for an extended period to remove water from the formation which had been introduced during the test.

conditions prevailed; the water level ultimately stabilized at about 15 feet above ground surface;

3. The extension pipe was removed causing water to overflow the well casing; this imposed a constant drawdown in the well; and

4. Flow rates were measured until the borehole discharge rate stabilized.

During the flow period, well discharge was collected in a shallow ditch and discharged through a spillway constructed of 6 inch PVC pipe. Flow rates were then measured using a five gallon bucket and stopwatch.

8.4.1.5 Analysis

Falling Head Tests

Falling head tests were analyzed using a modified Hvorslev analysis. This analysis is based on the following equation which describes the change in hydraulic buildup after the slug is initiated (modified after Hvorslev 1951):

$$T = \frac{2.303\ C\ A}{2\ pi\ (t_2 - t_1)} \log(s_1/s_2) \qquad \text{(eq. 8.4-1)}$$

where:

T = aquifer transmissivity
A = cross-sectional area of the riser pipe
s = hydraulic buildup
t = recovery time
C = shape factor for the geometry of the wellbore
pi = 3.14159

In the above equation, subscripts identify contemporaneous time/buildup events (e.g., s_1 is the buildup occurring at time t_1) and "log" indicates a base 10 logarithm. This equation predicts that a semilogarithmic plot of arithmetic t vs log(s) should be a straight line. Such plots are referred to in this report as "Modified Hvorslev Plots". If one considers a time period over which the buildup changes by a factor of ten, the following equation results:

$$T = \frac{C}{2\ pi} \frac{2.303\ A}{t_{10}} \qquad \text{(eq. 8.4-2)}$$

where:

t_{10} = the change in time over one log cycle of buildup conductivity existing within the feature(s) contributing to the observed flow.

8.4.1.6 Results

Table 8.4-1a summarizes calculations of transmissivity and average hydraulic conductivity for the 12 falling head tests conducted in monitor wells. Field data for the falling head tests, including water level hydrographs and Modified Hvorslev Plots, are provided in Appendix 8.B. Table 8.4-1b summarizes transmissivity/conductivity calculations for constant head tests conducted in MW-3, MW-5, and MW-16.

The test results indicate average hydraulic conductivity values which range over nearly 5 orders of magnitude from 7 X 10^{-8} to 2 X 10^{-3} cm/s. Lower values of conductivity generally correlate with rhyolite and higher values with basalt. Higher values also tend to occur in areas identified as having fault zones and associated fracturing.

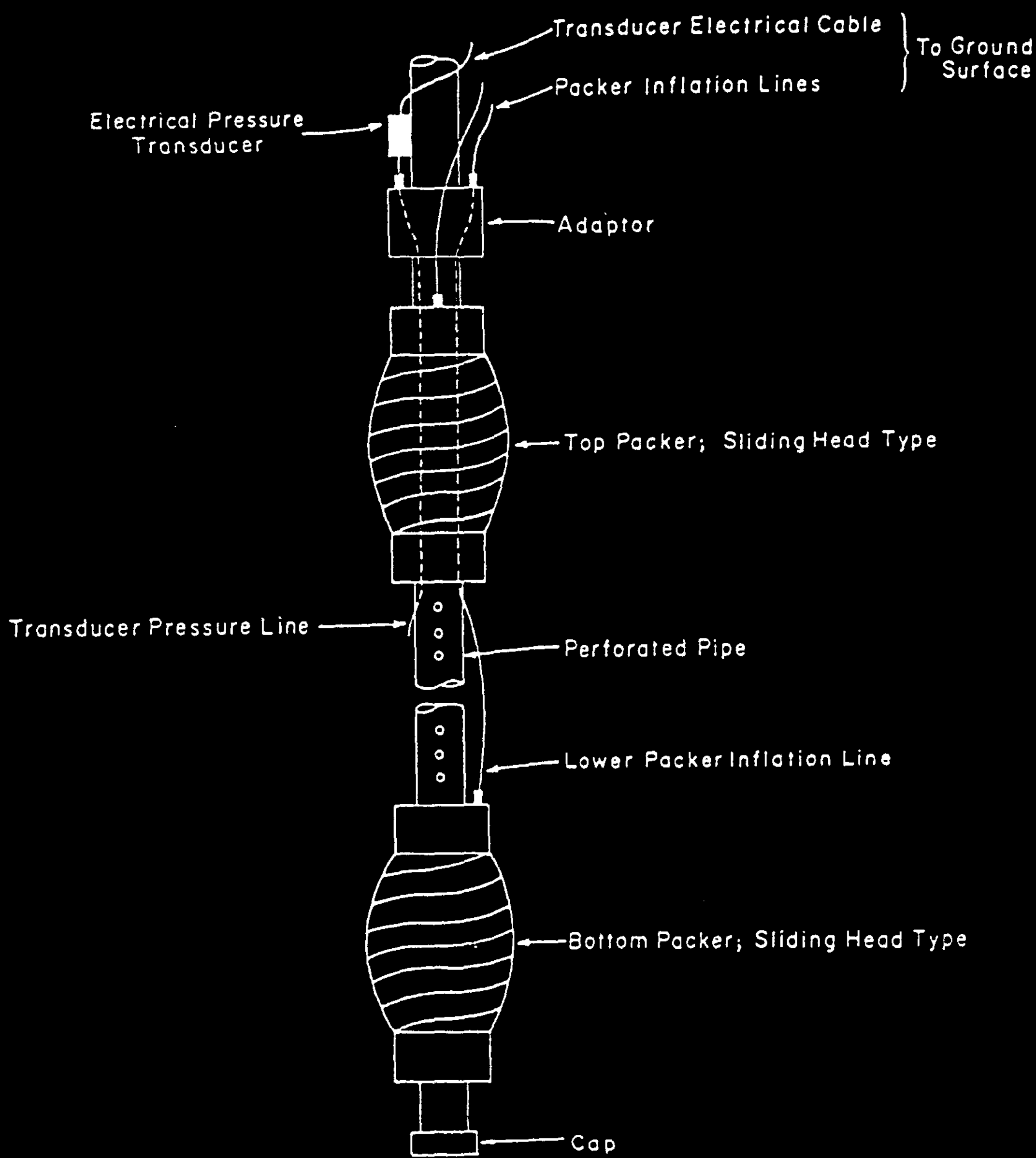
8.4.2 Packer Testing at MW-1

An important aspect of the field program was to provide data which could be used to assess the potential need for pit dewatering during mining operations. Since the pit will be deepened in stages, it was important for this evaluation to have a knowledge of the variation in rock permeability with depth. To accomplish this in a preliminary manner, borehole MW-1 (located near the proposed Crone Hill pit) was selected for packer testing prior to completion.

The open borehole was tested on December 31, 1987 and January 1, 1988, using a straddle packer test tool with pneumatic packers and a downhole pressure transducer (Figure 8.4-1). The test tool allowed for constant head injection tests to be performed at specified depth intervals within the hole. Since all portions of the open hole below the water table were tested, this activity resulted in a continuous permeability profile from a depth of 152 feet below ground surface (static water level) to 603 feet (bottom of the hole).

The primary purpose of this testing was to identify zones within the borehole with high permeability (i.e., those having the greatest impact with regard to pit dewatering). As a consequence, the general strategy was to conduct tests with relatively small (60 foot) packer spacings in portions of the hole exhibiting moderate to high transmissivity. Tests over larger depth intervals were performed where low permeability conditions were indicated. Discharge rates measured during the drilling process provided information from which the borehole test intervals were planned.

Figure 8.4-1
Straddle Packer Test Tool



8.4.2.1 Field Procedure For Packer Testing

Constant head injection tests were performed as follows:

1. The straddle packer test tool was assembled and connected to an adaptor having threads compatible with drilling rod at the site;

2. The tool was lowered in the borehole by adding sections of drill rod;

3. After being positioned at the selected test interval, the pneumatic packers were inflated with compressed nitrogen to about 200 psi over the existing fluid pressure;

4. Water level in the riser pipe (drill rod) was monitored using an electric probe until static conditions prevailed;

5. Transducer calibration was checked by comparing water levels computed from pressure readings with the static water level measured by the electric probe;

6. Water was injected down the riser pipe until hydraulic buildup in the test interval and the injection flow rate stabilized; and

7. Water injection was discontinued, the packers deflated, and the test tool positioned at the next test interval.

Injection water was obtained from a 4000 gallon water truck provided by a construction contractor at the site. For zones with relatively high injection rates (moderate to high permeability), flow rates were measured by a totalizing flow meter installed on the water truck. In low permeability zones with small water takes, the injection flow rate was determined by measuring the rate at which water level in the riser pipe (of known cross-sectional area) declined after a period of injection. This latter measurement was performed using an electric water level probe.

While lowering the straddle packer tool to the first test interval, the transducer electrical cable was sheared by a rock fragment which wedged between the drill rod and the borehole wall. The tool was raised to ground surface and the transducer removed. In its place, a gas bubbler pressure line was installed to measure downhole pressures within the test interval. The gas bubbler was operated by bleeding compressed nitrogen through the pressure line until gas bubbled out the

TABLE 8.4-2

RESULTS OF PACKER TESTS AT MW-1

CONSTANT HEAD PACKER TESTS IN MW-1

TEST NO.	TOP INTERVAL (ft BGS)	BOTTOM INTERVAL (ft BGS)	FLOW RATE Q (gpm)	BUILDUP SW (ft)	TRANS T (gpd/ft)	INTERVAL LENGTH B (ft)	AVERAGE HYDRAULIC COND. K (cm/s)
1	152.6	212.6	0.293	106.0	4	60.0	3.1E-06
2	212.6	272.6	63	107.5	844	60.0	6.6E-04
3	272.6	332.6	66	18.5	5137	60.0	4.0E-03
4	332.6	392.6	3.85	105.5	53	60.0	4.1E-05
5	386.9	603.0	0.601	156.7	6	216.1	1.2E-06
			TOTAL BOREHOLE:		6043	450.4	6.3E-04

Figure 8.4-2
Hydrograph for the Water Well Pump Test

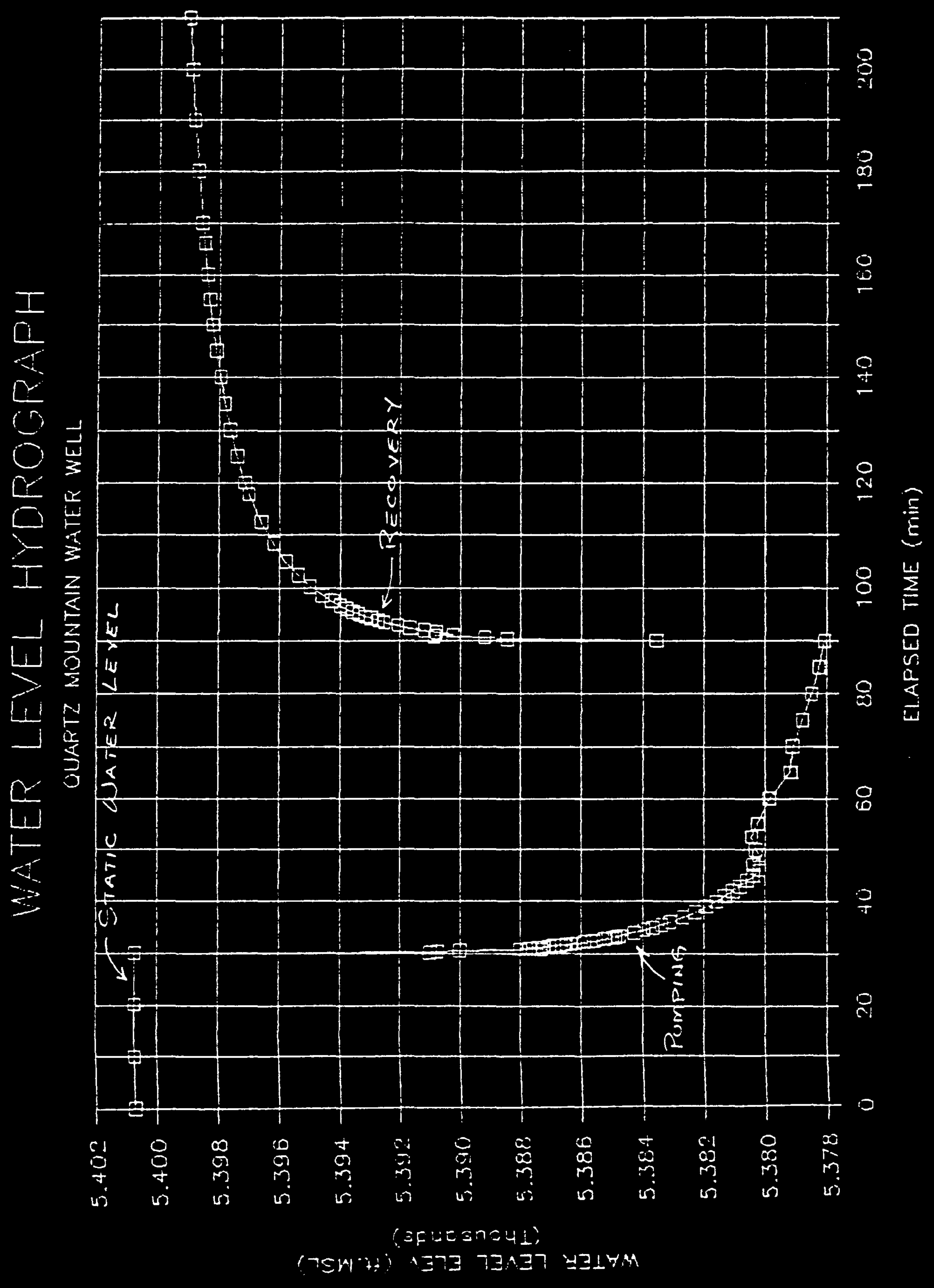
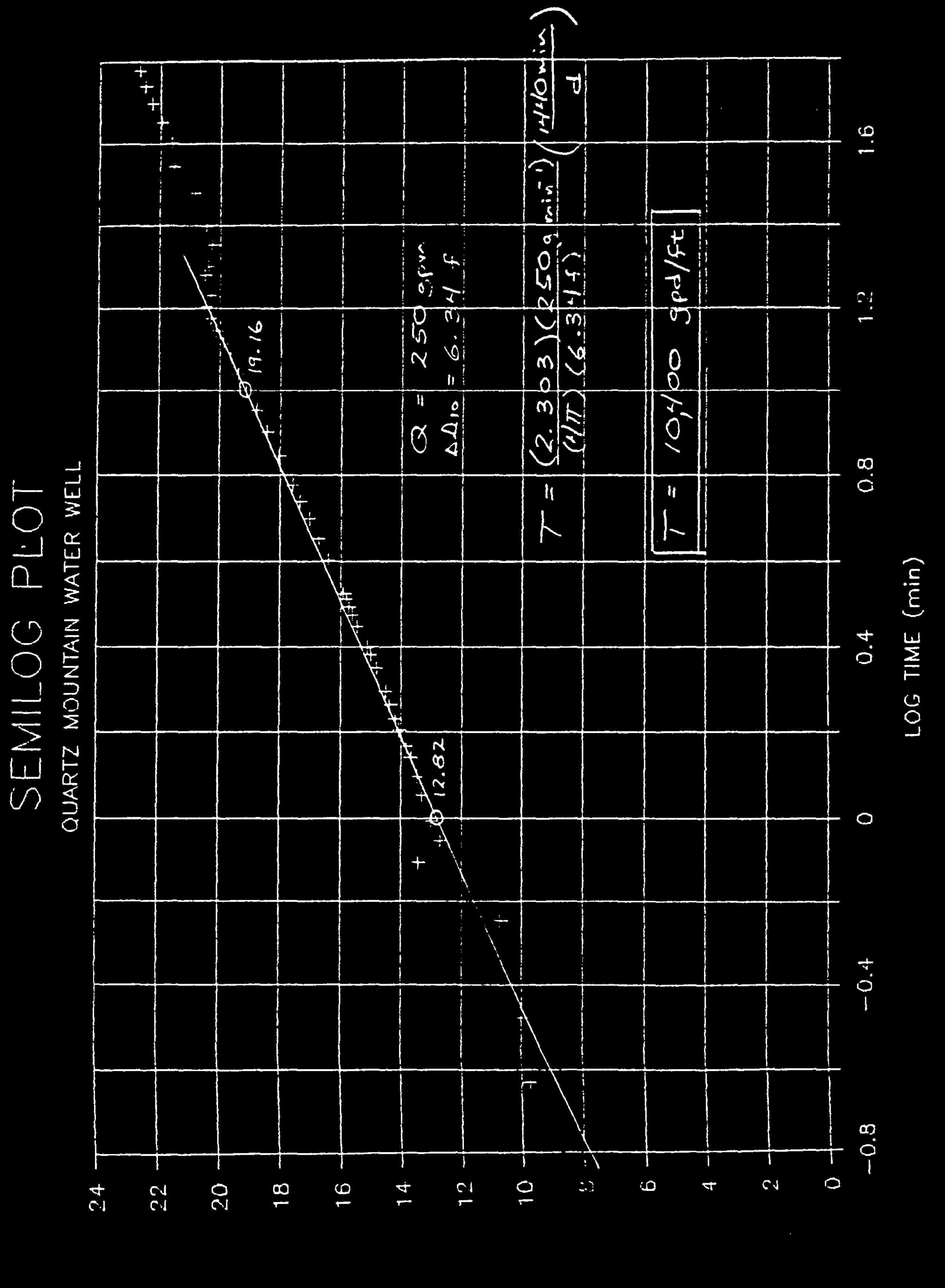


Figure 8.4-3
Semilog Time-Drawdown Plot
For the Water Well Pump Test



time). A straight line is then fit to the data, usually giving preference to data points with lower (t/t') values. Transmissivity is computed using the same equation given above for analysis of pumping data. The semilog Theis Recovery Plot for recovery data is shown in Figure 8.4-4. The straight line fit to the data gives a transmissivity equal to 11,100 gpd/ft. This value is similar to the transmissivity determined from the pumping period data.

If transmissivity is taken as 11,000 gpd/ft and the zone contributing to water production is assumed to be 100 feet thick, the average hydraulic conductivity of permeable materials penetrated by the water well is computed to be 5 X 10^{-3} cm/s. This conductivity is similar to the highest value measured by the monitor well tests (2 X 10^{-3}) and also the highest conductivity measured by packer tests conducted in well MW-1 (4 X 10^{-3}).

The Quartz Mountain water well is drilled into basalt in an area mapped as having multiple fault zones. The relatively high conductivity measured at this location suggests that in the vicinity of Crone Hill, faulted/fractured basalt may have relatively high permeability.

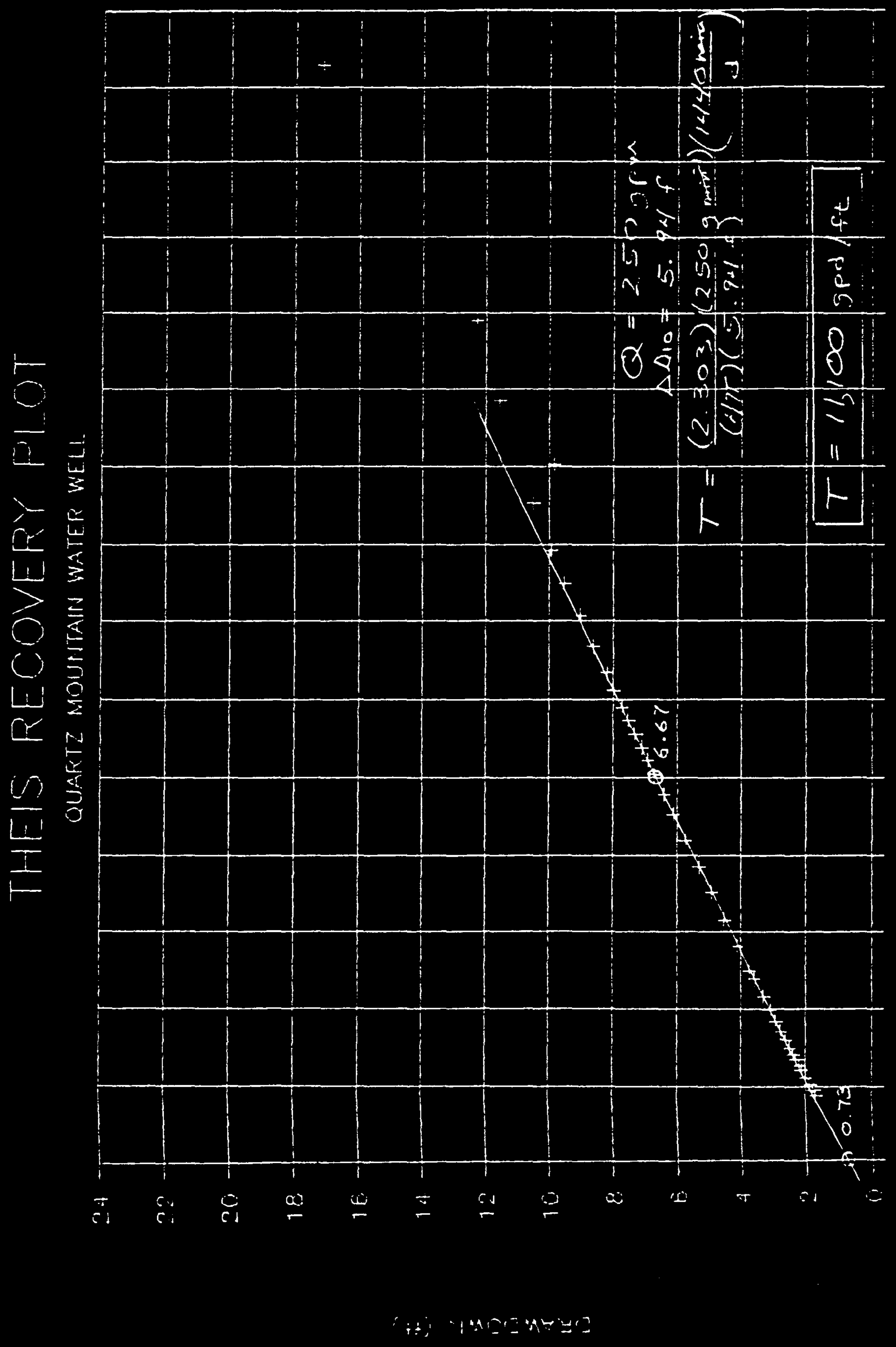
8.4.4 Drilling Discharge Observations

8.4.4.1 Measurements During Monitor Well Drilling

The field engineer/geologist, in consultation with the driller, estimated the approximate depth of all significant water bearing zones encountered during drilling. Such permeable zones were generally identified by a visual increase in the water discharge rate as the bit advanced. Geologic logs in Appendix 8.A show the locations of significant water producing zones in each monitor well.

During the drilling of monitor wells, about 4 gpm ("make-up" water) was added to the air stream to improve circulation return. At the end of each drill rod (twenty foot increments), the driller discontinued adding make-up water and the hole was blown with air only (i.e., air-lifted) for several minutes to determine the actual discharge being produced from water bearing zones. The resulting flow was either estimated (if less than 0.5 gpm) or directly measured using a 5 gallon bucket and stopwatch. Direct measurement was performed by diverting all flow down a narrow channel and through a "spillway" constructed from 6 inch PVC pipe. By this procedure, a cumulative discharge profile was produced for each borehole.

Figure 8.4-4
Theis Recovery Plot
For the Water Well Pump Test



8.4.4.2 Observations during Exploration Well Drilling

Mineral exploration holes at Quartz Mountain have been drilled using double-tube reverse circulation (RC) air rotary. This drilling method continuously air-lifts formation water from the hole and can provide drilling discharge information similar to that described in the previous section. During the drilling of exploration boreholes, Quartz Mountain site personnel noted visual changes in the discharge rate as the bit advanced. These changes were generally described as follows:

Minor:	change in flow rate between 2 to 5 gpm
Moderate:	change is flow rate between 5 to 20 gpm
Major:	change in flow rate greater than 20 gpm

When a discharge increase was observed, the approximate depth of the bit was recorded. It should be noted that as the cumulative flow rate from the borehole increased (with increasing depth), it generally became more difficult to identify minor and/or moderate producing zones. Although these descriptions are qualitative in nature, the large number of observations provide a useful database for assessing the statistical occurrence of water producing zones.

8.4.4.3 Analysis and Interpretation

Discharge profiles for the 16 monitor wells drilled during the baseline investigation are provide in Appendix 8.A. The profiles have a tendency to show sharp increases in flow rate over narrow borehole intervals, rather than continuous systematic increases in flow with depth. In many holes, the site engineer/geologist indicated that significant flow increases occurred within zones only a few feet thick. These were generally interpreted to be fracture zones, identified by vibrations in the drill pipe as the bit advanced through the zone. The above measurements and observations suggest that groundwater flow at the site is strongly controlled by discrete fault and/or fracture zones, with less fractured rock contributing little to the overall transmissivity of the bedrock aquifer.

Discharge observations during the drilling of Crone Hill exploration holes are provided in Appendix 8.C. In this appendix, discharge information has been combined with rock type and alteration data obtained from a computerized database developed by Quartz Mountain Gold. A summary of the discharge observations is given in Table 8.4-3a. The table shows that 51 of the 104 discharge observations took place while drilling in basalt, and that only 7 observations were associated with rhyolite. This is consistent with the results of monitor well tests which indicated that basalt tends to be more permeable than rhyolite. For observations in basalt (Table 8.4-3b), the majority of discharge increases took place in vesicular and undifferentiated rock zones.

8.4.5 Interpretation of Hydraulic Testing Results

Based on results of the hydraulic testing program, the following general conclusions are reached:

- o Groundwater flow across the site is controlled by the presence of rock discontinuities. These generally consist of fault and/or fracture zones. Less fractured rock between the discontinuities has significantly lower hydraulic conductivity.

- o Rhyolitic intrusive bodies tend to have relatively low permeability. This may not be true where major structures cut through the rhyolite bodies.

- o There is a correlation between high permeability in stream valleys and low permeability along topographic highs. This is explained in part by the presence of faults and associated fracture zones along the base of many valleys and because resistent rhyolite is commonly responsible for high topographic relief.

The following conclusions apply to the Crone Hill area:

- o The most permeable rocks consist of basalt in areas with increased faulting and fracturing. This includes the northwest and southeast flanks of Crone Hill along a mapped structural zone trending N60W. High permeability within this zone is evidenced by the relatively high hydraulic conductivities measured in MW-1 and in the Quartz Mountain water well.

- o High permeability is expected in basalt along the axis of the unnamed ephemeral drainage east and north of Crone Hill. A major fault (Retort Fault) is mapped along this valley which may be responsible for the relatively high hydraulic conductivity measured in MW-10.

- o Rhyolitic intrusive rocks below the central portion of Crone Hill are expected to have relatively low permeability.

TABLE 8.5-1

WATER LEVEL DATA FROM ONSITE MONITOR WELLS

MONITOR WELL NO.	COORDINATES NORTHING (ft)	COORDINATES EASTING (ft)	MEASURING POINT ELEV.(a) (ft.MSL)	JAN-88 WATER DEPTH (ft.BMP)	JAN-88 WATER ELEV. (ft.MSL)	MAR-29-88 WATER DEPTH (ft.BMP)	MAR-29-88 WATER ELEV. (ft.MSL)	MAY-31-88 WATER DEPTH (ft.BMP)	MAY-31-88 WATER ELEV. (ft.MSL)	AVERAGE WATER ELEV. (ft.MSL)
MW-1	240193	1917087	5522.0			152.6	5369	150.1	5372	5371
MW-2	244113	1922847	5665.1					350.3	5315	5315
MW-3	242069	1928120	5522.6	71.5	5451 (a)	120.0	5403	119.6	5403	5403
MW-5	239055	1929531	5462.0	21.8	5440	70.2	5392 (a)	19.9	5442	5441
MW-6	239474	1926991	5659.6	279.7	5380	280.0	5380	280.3	5379	5380
MW-7	237993	1917533	5377.8	339.7	5038					5038
MW-9	241600	1915912	5839.6	344.9	5495	325.6	5514	293.7	5546	5518
MW-10	240740	1919690	5479.3	50.5	5429	50.4	5429	50.1	5429	5429
MW-11	241273	1921496	5773.5	202.9	5571	206.8	5567	203.0	5571	5569
MW-12	245653	1919307	5687.0	317.5	5370	317.8	5369	308.0	5379	5373
MW-13	246369	1927431	5812.3					314.8	5498	5498
MW-14	243772	1931535	5964.9	241.0	5724	241.7	5723	242.0	5723	5723
MW-15	239626	1935192	6121.0	304.3	5817	337.5	5784 (a)	304.6	5816	5817
MW-16	239667	1939876	5740.7	-12	5753					5753
MW-17	231207	1932848	5399.2	1.1	5398					5398
MW-18	232413	1925244	5306.1	150.0	5156	150.0	5156	149.6	5157	5156

MSL = mean sea level

BMP = below measuring point

(a) Measurement questionable. Not used to compute average water level.

Figure 8.5-1, indicate that both Quartz Butte and the topographic high immediately northwest of the butte are recharge areas. Other local recharge areas include the topographic high northwest of Crone Hill and the surface water divide between Angel and Drews Creeks.

On a local scale, discharge areas include an isolated area near Angel Camp and along at least some portions of Drews Creek. At these locations, artesian groundwater conditions have been identified in monitor wells and/or by the presence of springs. In the artesian areas, water level contours are at or above ground surface. In other stream valleys, groundwater elevations are not high enough to intersect the ground surface, and thus groundwater discharge is not expected to occur. However, the groundwater contours indicate that flow tends to converge along these stream valleys and then migrates in the downslope direction of the valleys.

The McLoughlin Lineament, parallel to Quartz Creek, appears to have a significant impact on regional groundwater flow. As this feature is approached from the northeast, water level contours steepen so that the depth to water increases significantly near the lineament. This occurrence is anomalous to other parts of the site where the depth to water is generally observed to decrease below stream valleys. Although water level measurements are not available southwest of the McLoughlin Lineament, it is expected that this feature is characterized by convergent groundwater flow. However, water levels below Quartz Creek are too low to provide a condition for groundwater discharge. A plausible hypothesis is that the lineament represents a zone of increased fracturing (and possibly faulting) which results in higher rock permeability. In this case, groundwater flow would converge on the McLoughlin Lineament and then migrate laterally and/or vertically downward along the feature. The direction in which groundwater flow is directed and its ultimate discharge area is unknown at this time.

8.5.2.2 <u>Structural Control of Groundwater Flow</u>

The structural features shown on Figure 8.2-1 are interpreted to behave as relatively high permeability zones within the bedrock aquifer. As a consequence, groundwater tends to converge towards these features and is then conveyed laterally along the features. As discussed in the previous section, the McLoughlin Lineament may represent a large-scale structural feature which has a significant impact on regional groundwater flow. The other structural features, such as the Retort and Angel Creek faults, provide a similar mechanism for convergent groundwater flow, but on a more local scale.

the regional flow system. This conclusion is supported by wells MW-1, MW-7, MW-10, and MW-18, all of which have water levels at least 50 feet below ground surface. Clearly, the groundwater levels at these locations are too deep to support wetland conditions. Rather, these locally wet areas are likely caused by the relatively flat slope of the valleys which inhibits surface water drainage and may result in perched groundwater within soil materials overlying bedrock.

Flow at Quartz Mountain Spring does not appear to be attributed to groundwater discharge from the regional bedrock aquifer. The conclusion is supported by water level surface in Figure 8.5-1 which is on the order of 200 feet below the elevation of the spring. Thus, flow from the spring is issuing at a much higher elevation than the regional water table. Quartz Mountain Spring is likely the result of a local perched water system which is unrelated to regional flow in the bedrock aquifer.

8.5.2.4 Groundwater Flux Rates

Within the project area, the most significant groundwater flow is expected to occur within Angel Creek valley and below the ephemeral drainage between Crone Hill and Quartz Butte (referred to here as the Ewauna Drainage). Increased groundwater flow along these drainages is suggest by the following:

- o A tendency for higher hydraulic conductivities measured in monitor wells within these valleys.
- o The presence of mapped faults (and associated fracturing) along the valleys. These include the Retort Fault between Crone Hill and Quartz Butte, and the Angel Creek Fault.

Groundwater flow rates within these valleys have been estimated using the following form of Darcy's law:

$$Q = K W B i \qquad \text{(eq. 8.5-1)}$$

where:

Q = groundwater flow rate across the mouth of the valley
K = hydraulic conductivity
i = hydraulic gradient
W = width of the mouth of the valley
B = effective thickness of groundwater flow

The results of Darcy's law calculations are shown in Table 8.5-2a. Hydraulic conductivity values used in these calculations were based on the geometric mean of permeability test results for monitor wells within the drainage valley of interest (Tables 8.4-1 and 8.4-2). The geometric mean of point measurements (i.e., single borehole test results) is generally considered the best method for arriving at a single hydraulic conductivity value that best characterizes the rock mass. As shown in Table 8.5-2a, the predicted groundwater flow rates in the Ewauna and Angel Creek valleys is 230 and 550 gallons per minute (gpm), respectively.

Another method for predicting the groundwater flow rate is to compute the rate of percolation (infiltration of precipitation and snow melt) within the total recharge area associated with the drainage valley of interest. This computation is based on the following equation:

$$Q = P A \quad \text{(eq. 8.5-2)}$$

where:

Q = groundwater flow rate below drainage
P = recharge percolation rate
A = area of recharge associated with drainage

Results of the percolation calculations are summarized in Table 8.5-2b. In these calculations it was assumed that the average rate of percolation was approximately equal to 10 percent of the mean annual precipitation at the site. This "rule-of-thumb" is commonly applied to semi-arid regions. Considering that the mean annual precipitation ranges from 25 to 30 inches per year, this assumption predicts a percolation rate of about 0.25 ft/yr. The total groundwater recharge area for the valley of interest was assumed to be equal to the surface water drainage area associated with the valley. This assumption is reasonable because groundwater flow is topographically controlled so that groundwater recharge divides tend to be coincident with surface water divides. As shown in Table 8.5-2b, the predicted groundwater flow rates in the Ewauna and Angel Creek valleys are 180 and 500 gpm, respectively. These values compare favorably with the groundwater flow rates determined from Darcy's law.

Each of the approaches used above to compute groundwater flow rate is subject to considerable uncertainty. However, the relatively good agreement between these two independent methods lends credibility to the results. Based on this evaluation, it is concluded that the groundwater flow rate below the Ewauna valley is on the order or 200 gpm and the flow rate below the Angel Creek valley is about 500 gpm.

Table 8.6-1
Discharges Measured at Quartz Mountain Spring

DATE	TIME (24 HR)	METER READING	GPM[1]	FLOW RATE (SEC/10G)	GPM[2]	UPPER CISTERN (SEC/5.7G)	GPM[3]	LOWER CISTERN (SEC/5.7G)	GPM[4]	TOTAL GPM	
10/23/87	1638	4050	-	24	25.0	-	-	142	2.4	-	
10/24/87	0916	29160	25.9	24	25.0	-	-	-	-	-	
10/24/87	1612	39660	25.2	24	25.0	-	-	-	-	-	
10/25/87	1004	68775	27.3	23	26.1	-	-	-	-	-	
10/26/87	0752	102490	25.8	23	26.1	29	11.7	-	-	-	
10/26/87	1705	116420	28.3	24	25.0	60	5.7	70	4.9	10.6	1/
10/27/87	1116	144430	25.7	24	25.0	60	5.7	75	4.6	10.3	
10/28/87	1508	187345	25.6	22	27.3	49	7.0	115	3.0	10.0	
10/29/87	1551	225570	25.8	23	26.1	50	6.8	95	3.6	10.4	
11/02/87	1636	378270	26.3	24	25.0	39	8.8	235	1.5	10.3	
11/03/87	1027	406400	26.3	22	27.3	-	-	-	-	-	
11/03/87	1138	407280	14.1	56	10.7	57	6.0	75	4.6	10.6	2/
11/05/87	1420	439100	10.5	60	10.0	72	4.7	65	5.3	10.0	
11/06/87	1245	453200	10.5	-	-	72	4.7	70	4.9	9.6	
11/09/87	1445	499870	10.5	58	10.3	72	4.7	64	5.3	10.0	
11/18/87	1450	637425	10.6	58	10.3	76	4.5	80	4.3	8.8	
11/18/87	1638	638580	10.7	58	10.3	-	-	-	-	-	
11/19/87	1430	652590	10.7	56	10.7	60	5.7	86	4.0	9.7	
11/20/87	1430	667980	10.7	56	10.7	57	6.0	85	4.0	10.0	
11/21/87	0734	678910	10.7	57	10.5	105	3.3	82	4.2	7.5	3/
11/22/87	1725	700170	10.5	-	-	-	-	-	-	-	
11/23/87	1441	714390	11.1	55	10.9	57	6.0	85	4.0	10.0	
11/24/87	1628	731020	10.7	57	10.5	60	5.7	80	4.3	10.0	
11/30/87	1425	822790	10.8	55	10.9	-	-	-	-	-	
12/01/87	1620	839600	10.8	55	10.9	55	6.2	81	4.2	10.4	
12/02/87	1355	853930	11.1	52	11.5	57	6.0	80	4.3	10.3	
12/03/87	1151	868320	10.9	55	10.9	59	5.8	82	4.2	10.0	
12/07/87	1628	934475	10.6	56	10.7	55	6.2	80	4.3	10.5	
12/09/87	1414	964700	11.0	55	10.9	57	6.0	82	4.2	10.2	
12/10/87	1612	982100	11.2	53	11.3	57	6.0	80	4.3	10.3	
12/11/87	1137	995000	11.1	54	11.1	57	6.0	83	4.1	10.1	
12/14/87	1122	1042565	11.0	54	11.1	59	5.8	81	4.2	10.0	
12/15/87	1642	1061970	11.0	57	10.5	57	6.0	82	4.2	10.2	
12/17/87	1127	1090200	11.0	55	10.9	59	5.8	82	4.2	10.0	
12/18/87	1536	1108810	11.0	54	11.1	59	5.8	82	4.2	10.0	
12/21/87	1636	1157300	11.1	53	11.3	58	5.9	87	3.9	9.8	

GPM[1] = Gallons Per Minute based on differences in meter readings
GPM[2] = Gallons Per Minute based on meter dial
GPM[3] = Gallons Per Minute based on measurement of upper cistern overflow
GPM[4] = Gallons Per Minute based on measurement of lower cistern overflow
TOTAL GPM =Gallons Per Minute based on sum of overflow from both cisterns

1/ Valve adjustment to balance flow to system

2/ Meter box releveled. valve adjustment to balance flow to system and to create slight backpressure on meter to reduce water meter cavitation and erroneous readings

3/ Demand on upper cistern in system during measurement

TABLE 8.7-1

INSTALLATION DEPTHS FOR GROUNDWATER SAMPLERS

MONITOR	DEPTH TO WATER[1]	APPROXIMATE DEPTH TO TOP OF SAMPLER	LENGTH OF SAMPLE CHAMBER	NOTES
MW-1	152[3]	210	10	
MW-2	283[2]	350	10	
MW-3	69	70	50	
MW-5	19	120	50	
MW-6	277	330	10	
MW-7	377	400	10	
MW-9	342	400	10	
MW-10	48	100	10	
MW-11	200	290	10	
MW-12	315	350	10	
MW-13	316[2]	-	-	Not installed due to casing obstruction.
MW-14	242	300	10	
MW-15	302	350	10	
MW-16	(-) 15	N/A	N/A	Artesian; no sampler required.
MW-17	(-) 1	50	10	
MW-18	147	200	10	

[1]January 28-29, 1988
[2]December 1987
[3]February 1988

A. 1-1/4" SCH. 80 PVC PIPE 10' SECTIONS WITH MACHINED ENDS.

B. TOP OF SAMPLER MACHINED PVC PIPE.

C. BOTTOM OF SAMPLER MACHINED PVC WITH 3/4' NYLON BALL.

D. SOLID PVC PIN.

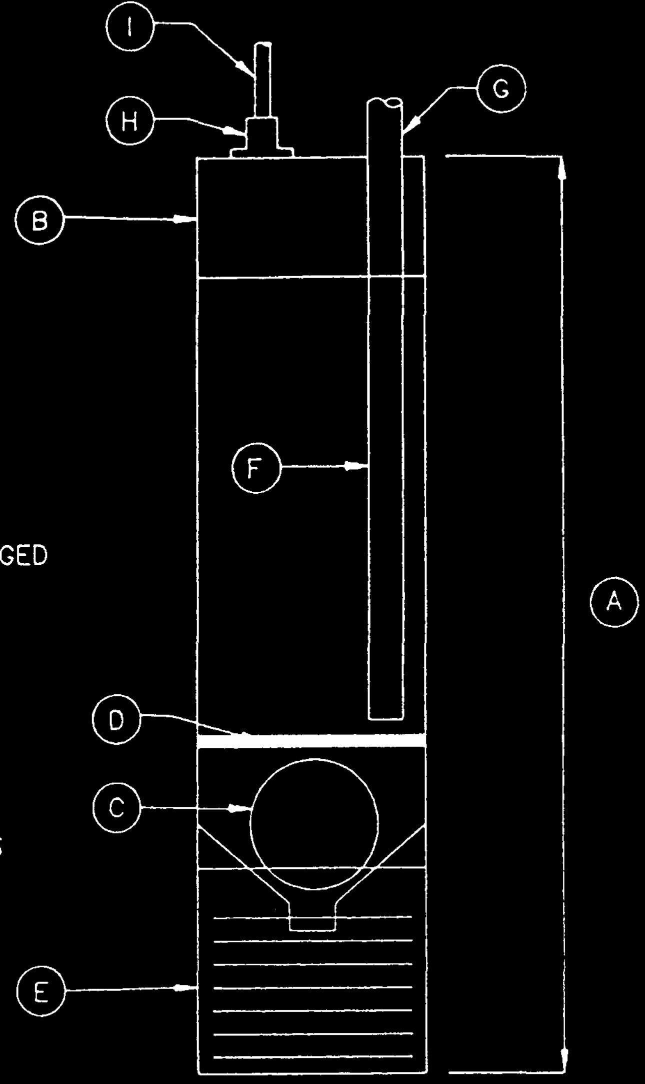
E. 2'X 1-1/4" SCH 80 PVC PIPE SCREENED WITH 0.010 SLOTS PLUGGED AT BOTTOM.

F. 3/8" SCH. 80 PVC PIPE, 10" SECTIONS, WATER DISCHARGE LINE EACH SECTION THREADED AND COULPED TOGETHER

G. 3/8" PVC SCH. 80 PIPE TO SURFACE (10" THREADED SECTIONS COUPLED TOGETHER.)

H. 1/4" SWAGELOK NYLON FITTING FOR AIR INLET LINE.

I. 1/4" O.D. PLACTIC TUBING RATED AT 250 PSI FOR AIR INLET.



PROJECT No. 11808	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 8.7-1 GROUNDWATER SAMPLER DESIGN
DATE 3/88		
REVISION 0		

Bleed: The nylon tubing is vented at the ground surface, which depressurizes the chamber and allows water in the well to flow through the ball valve into the chamber. The efficiency of some samplers is enhanced by a check valve installed at the bottom of the discharge pipe, which prevents backflow of water into the chamber during the bleed cycle.

Each sampler was completed with a surface cap at the top of the two inch PVC well casing. The cap contains permanent access ports for the nylon pressure line, discharge pipe, and in some cases, an independent access tube for an electric water level probe.

8.7.2 Sampling Protocol

Using the positive displacement samplers, a minimum of 3 casing volumes of water were removed from each well prior to sampling. Evacuation of the casing volumes was aided by use of timing devices which automatically regulated both the pressurization and bleed cycles.

Sampling was accomplished by filling one unused, five-gallon plastic container at each monitor well. After measuring the water temperature, pH, and conductivity at the well site, the sample was then processed as quickly as possible at the site office. Sample processing included filtering approximately one liter of water for dissolved metals analysis and filling pre-treated bottles provided by the laboratory. All bottles were kept on ice in coolers until delivery to the laboratory. Klamath Falls Environmental Laboratory was utilized for chemical analysis. All coolers and suites of samples were accompanied by appropriate chain-of-custody documentation.

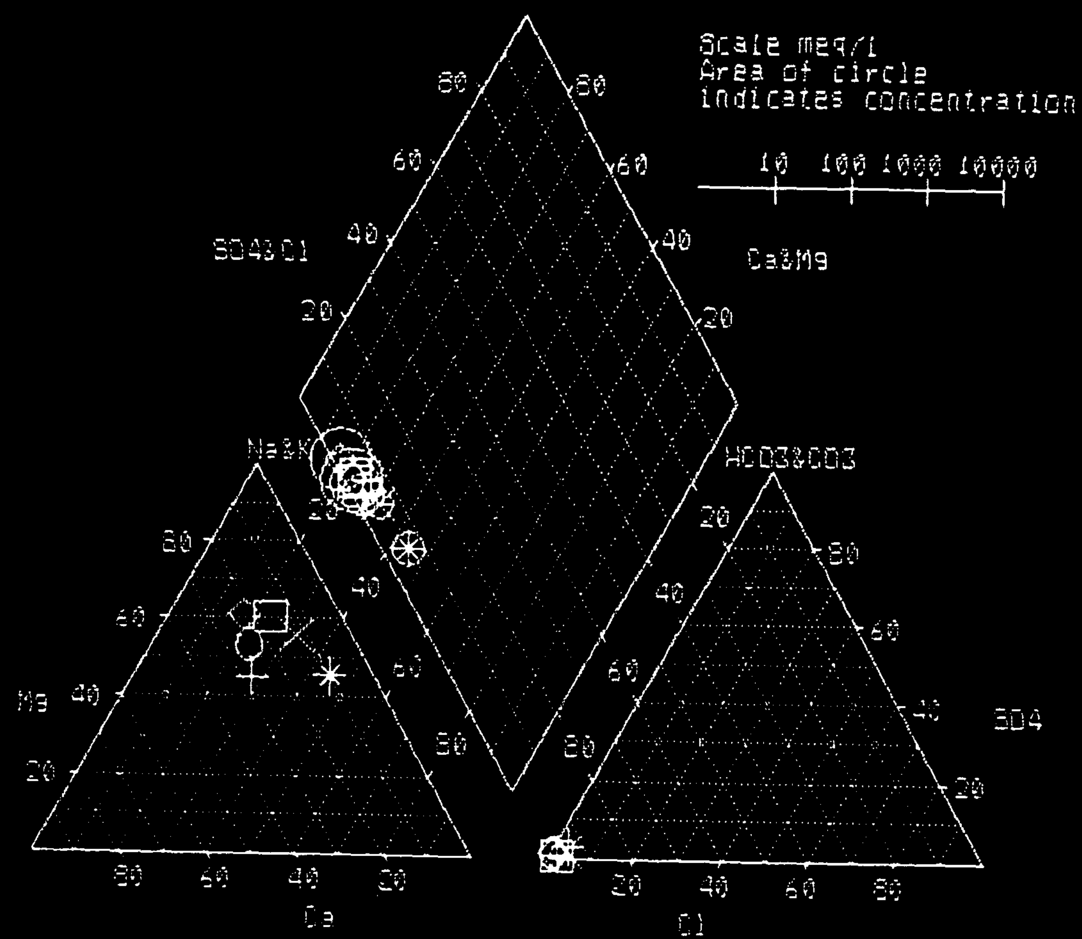
In processing samples from well MW-9, it has been noted that the water is clouded with suspended clay solids. This well produced very little water during drilling and development. Thus, drill cuttings may not have been efficiently removed from the borehole. Another potential source for the suspended clay particles is the bentonite pellet and/or slurry seal. The presence of suspended clay solids in MW-9 water has led to erroneous laboratory results for total dissolved solids (TDS) and radionuclide parameters.

Quality control procedures for the sampling program included the processing of two duplicate samples to evaluate the quality of work performed by the analytical laboratory and one field blank to verify the lack of any induced contamination resulting from field procedures.

TABLE 8.7-2

LIST OF ANALYTICAL PARAMETERS

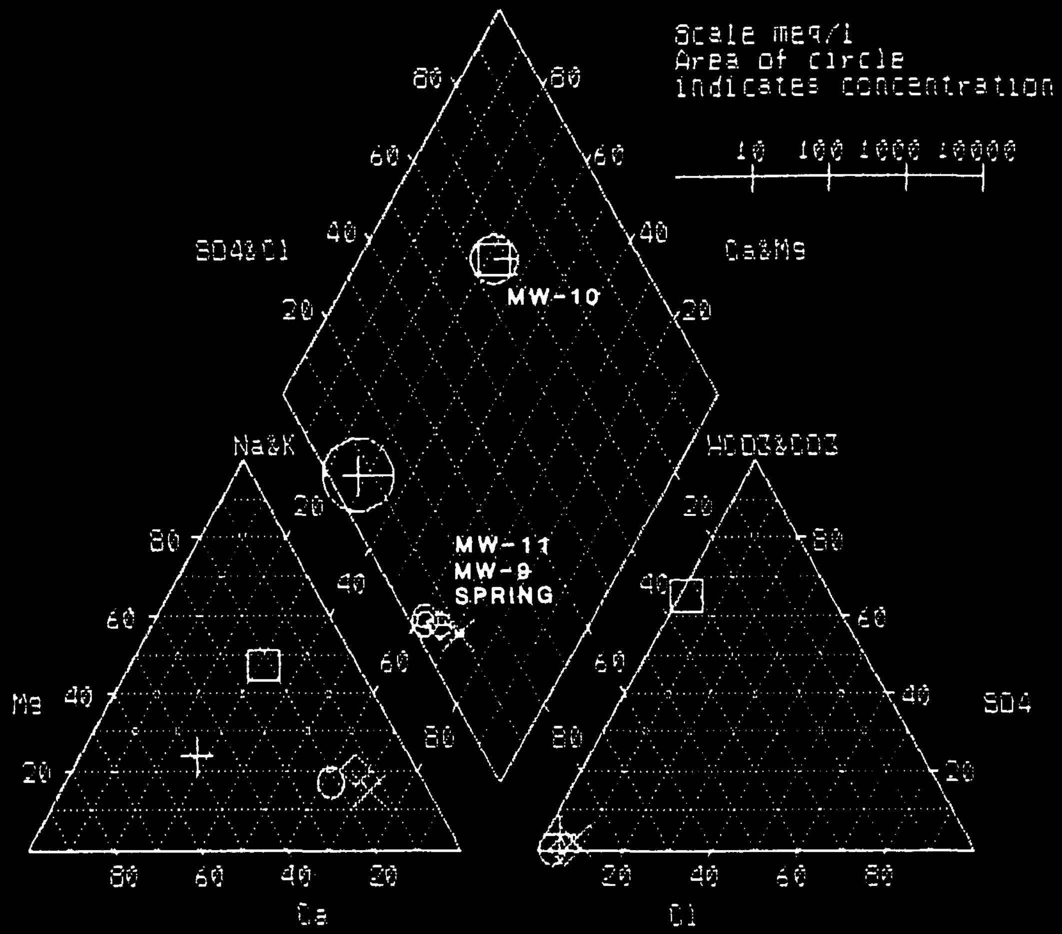
General		
temperature		
conductivity		
pH		
TDS		
Major Cations		Major Anions
sodium		carbonate
potassium		bicarbonate
calcium		sulfate
magnesium		chloride
		nitrate
		nitrate
Metals and Trace Constituents		
fluoride	chromium	zinc
total organic carbon	iron	total cyanide
phenols	lead	
boron	manganese	
arsenic	mercury	
barium	selenium	
cadmium	silver	
copper	antimony	
Radionuclides		
gross alpha emitters		
gross beta emitters		



LEGEND

+ - MW-1
◇ - MW-2
□ - MW-3
○ - MW-5
× - MW-6
✳ - MW-12

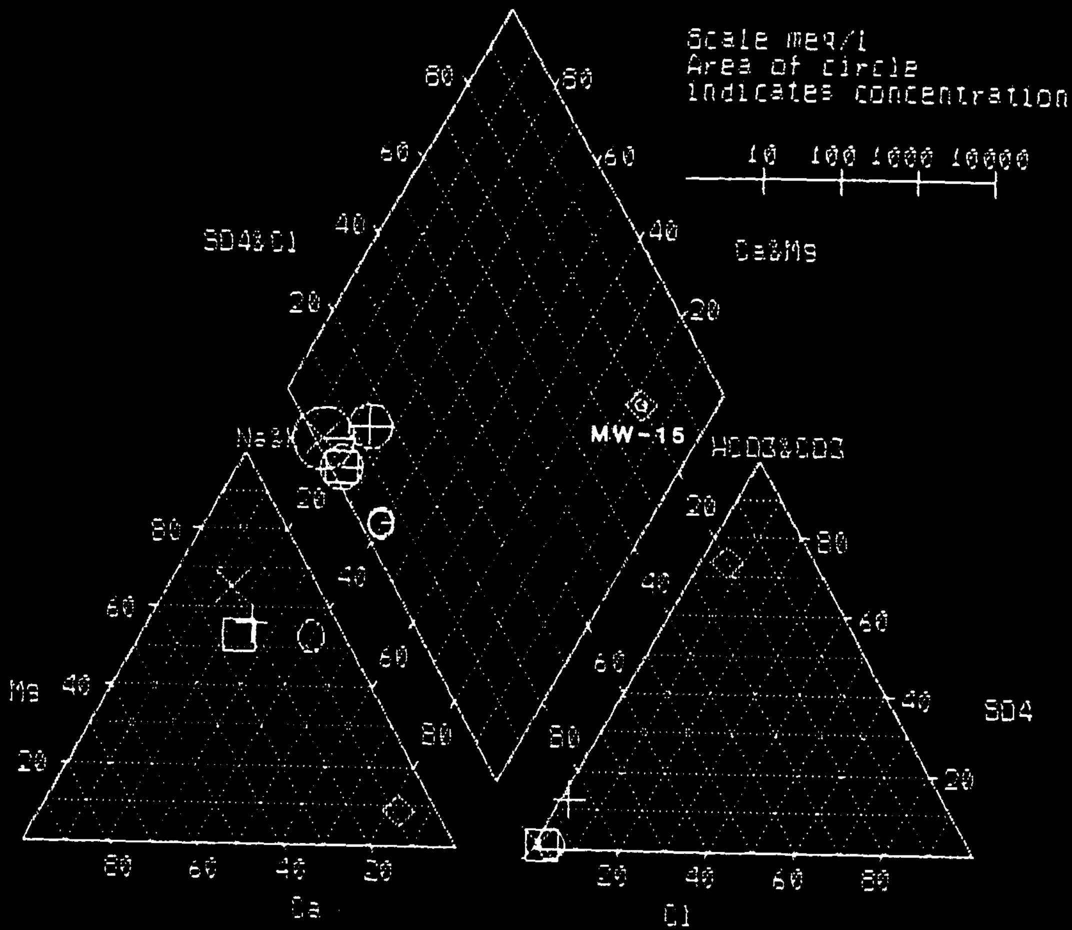
PROJECT No.	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 8.7-2(A)
11808		TRILINEAR PLOTS FOR GROUNDWATER SAMPLES
DATE		
3/15/88		
REVISION		



LEGEND

- + - MW-7
- ◇ - MW-9
- □ - MW-10
- ○ - MW-11
- X QUARTZ MTN SPRING

PROJECT No. 11806	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 8.7-2(B)
DATE 3/15/88		TRILINEAR PLOTS FOR GROUNDWATER SAMPLES
REVISION		



LEGEND

+ - MW-14
◇ - MW-15
□ - MW-16
○ - MW-17
× - MW-18

PROJECT No. 11806	STEFFEN ROBERTSON & KIRSTEN Consulting Engineers	FIGURE 8.7-2(C)
DATE 3/15/88		TRILINEAR PLOTS FOR GROUNDWATER SAMPLES
REVISION		

specifies the concentration levels above which certain elements in natural waters pose a health threat. Secondary standards are based on taste and aesthetics.

Water quality data were checked against these standards to determine the usefulness of groundwater for drinking purposes. Numerous samples exceeded EPA standards for arsenic, iron, and manganese. Some samples also exceeded the standards in mercury, silver, and zinc. As a result, groundwater within the study area is not considered to be a potential source of drinking water without treatment.

8.9 PUBLIC AND AGENCY CONTACTS

John Almy
Hydrologist
U.S. Forest Service
Supervisor's Office
Lakeview, Oregon

Ken Rodgers
Project Coordinator
U.S. Forest Service
Bly Ranger District
Bly, Oregon

Dick Nimrod
Tom Paul
Oregon Department of Water Resources
Albany, Oregon

8.11 LIST OF PRINCIPAL PREPARERS

8.11.1 Fred Marinelli

Fred Marinelli is a senior hydrogeologist at ABC with over 10 years experience in geotechnical consulting. His technical expertise includes analysis of aquifer tests, groundwater numerical modeling, field installation/testing, and geologic mapping. He has considerable experience in mine dewatering, groundwater resource development, and site characterization projects associated with mining and hazardous waste. Mr. Marinelli received a B.A. in geology from The University of Colorado in 1975, and an M.S. in Hydrology-Groundwater from The University of Arizona in 1981.

8.11.2 Joel Siegel

Joel Siegel is a senior hydrogeologist at SRK with over 7 years experience in hydrological consulting. He has considerable expertise in aquifer testing and the modeling of groundwater systems. His background includes performance of virtually all types of aquifer tests, and interpretation of groundwater data for mining, industrial, and hazardous waste site permitting. Mr. Siegel received a B.E. in civil engineering from the Cooper Union for the Advancement of Art and Science in 1978, and an M.S. in Hydrology from New Mexico Institute of Mining and Technology in 1980.

APPENDIX 8.A

MONITOR WELL DRILLING, COMPLETION,
AND DISCHARGE DATA

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT GALATIC RESOURCES INC.		BOREHOLE No. MW-1
PROJECT QUARTZ MOUNTAIN		SHEET 2 OF 2
PROJECT No. 11806		
DATE DRILLED 12/22/87		INSPECTOR
DRILLER ROGER CHANCELLOR		D.G.

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES SURFACE ELEVATION

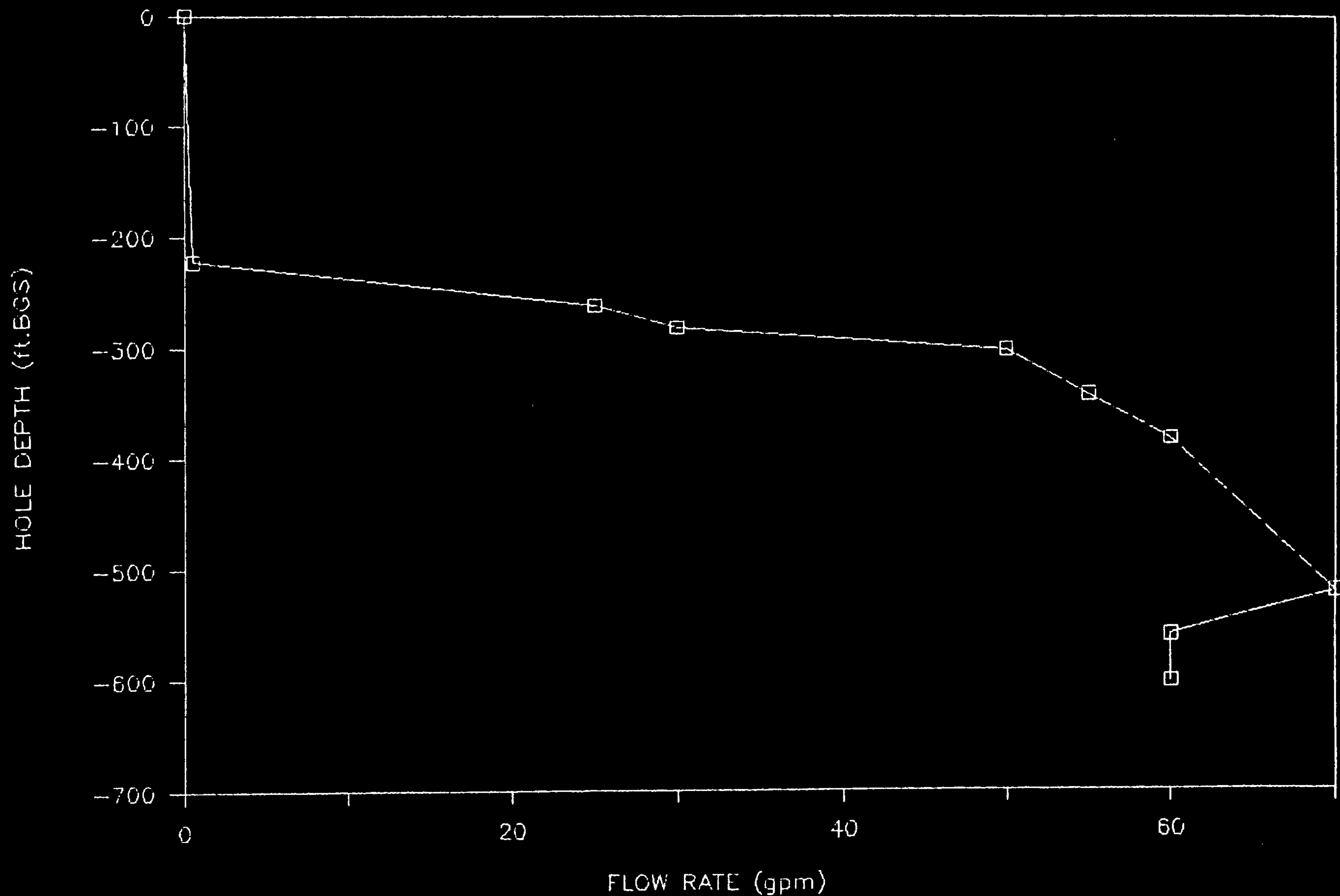
DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
	(420)	
	SOFT CLAY, HIGHLY ALTERED ?RHYOLITE?	
	(440)	
450		
500	GREY, HARD, ANGULAR, MINERALIZED RHYOLITE	
		(520) 70
550	(560)	(560) 80
	LAYERED BLUE CLAY AND ALTERED BLUE/GREY ?RHYOLITE?	
600		(602) 80
	BOTTOM OF BORING AT 602'	

NOTES:

1. BORING WAS DRILLED WITH AIR ROTARY METHOD AND 6" Ø HAMMER BIT.
2. WATER CIRCULATED FROM 5 FT. TO 602 FT. TO ENHANCE REMOVAL OF CUTTINGS.
3. WATER FIRST ENCOUNTERED AT 222 FT.
4. SEE MW-1 FOR COMPLETION DETAILS.

DRILLING DISCHARGE DATA

MW-1



STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

CLIENT	GALATIC RESOURCES INC.	BOREHOLE No.	MW-2
PROJECT	QUARTZ MOUNTAIN	SHEET	2 OF 2
PROJECT No.	11806		
DATE DRILLED	11/4/87	INSPECTOR	D.G.
DRILLER	ROGER CHANCELLOR		

LOCATION QUARTZ MOUNTAIN, OREGON

COORDINATES SURFACE ELEVATION

DEPTH (FEET)	DESCRIPTION	DISCHARGE (GPM)
225	HARD, DARK GREY, ANGULAR BASALT, SOME QUARTZITE	
	(248)	
250	SOFT ALTERED BASALT WITH CLAY MATRIX	
	(258)	
275		
300	HARD, DARK GREY, ANGULAR BASALT, SOME QUARTZITE AND CLAY	
325		
350		
	(365)	
375		(380) 4.5
	RED INTERFLOW, ALTERED BASALT, CLAY MATRIX BECOMES HARDER WITH DEPTH	
400		(400) 5.5
		(423) 5.5
	BOTTOM OF BORING AT 423'	
	(SEE NOTES ON SHEET 1)	

14.2.4 Noise Regulations of the State of Oregon

Division 35 of Chapter 340, Oregon Administrative Rules (amended April 1983), contain the noise control regulations for that state. Three portions of section 340-350035 are of particular importance to the Quartz Mountain project. Section B. concerns new sources located on previously unused sites. Subsection (i) states: "No person owning or controlling a new industrial or commercial noise source located on a previously unused industrial or commercial site shall cause or permit the operation of that noise source if the noise levels generated or indirectly caused by that noise source increases the ambient statistical noise levels L_{10} or L_{50}, by more than 10 dBA in any one hour, or exceed the levels specified in Table 8 (Appendix 14.A), as measured at an appropriate measurement point, as specified in subsection (3)(b) of this rule. Section (3)(b) defines the measuring point as being that point on the noise sensitive property which is farther from the noise source "(A) 25 feet (7.6 meters) toward the noise source from that point on the noise sensitive building nearest the noise source, or (B) that point on the noise sensitive property line nearest the noise source."

The Oregon Noise Control Regulations for Industry and Commerce, in section 340-35-035 (1)(B)(ii) state: "The ambient statistical noise level of a new industrial or commercial noise source on a previously unused industrial or commercial site shall include all noises generated or indirectly caused by or attributable to that source, including all of its related activities." Subsection (1)(d), in discussing impulse sounds states: "Notwithstanding the noise rules in Tables 7 through 9 (Appendix 14-A), no person owning or controlling an industrial or commercial noise source shall cause or permit the operation of that noise source if an impulsive sound is emitted in air by that source which exceeds the sound pressure levels specified below, as measured at an appropriate measurement point" (as specified above). For blasting, the maximum impulse sound is defined as 98 dBC, slow response, between the hours of 7 am and 10 pm and 93 dBC, slow response, between the hours of 10 pm and 7 am. All other impulse sounds are restricted to 100 dB, peak response, between the hours of 7 am and 10 pm and 80 dB, peak response, between the hours of 10 pm and 7 am.

The Oregon noise control regulations also include requirements pertaining to octave bands and audible discrete tones. These regulations are primarily directed toward higher frequency noises such as sawmills, etc.

The Oregon DEQ's Sound Measurement Procedures Manual (NPCS-1) (n.d.) served as the primary guide for the baseline monitoring program conducted for the Quartz Mountain project.

LIST OF PLATES

LIST OF TABLES CONTINUED

The octave band measurements for the downtown Lakeview location indicated no significant noise sources in the frequencies measured.

Wind speeds, temperature, humidity and cloud cover were either spot measurements made on site or estimates made by the observer at the time that the sample was taken.

14.3.3 Data Analysis

Frequencies of observations of sounds above the 1, 10, 50 and 90 percentiles were calculated for each site for each observation period. While not required by the Oregon DEQ, for ease of comparison of these measurements to those measured elsewhere, L_{eq} was also calculated using equation (4) above.

L_{dn}, the average day/night sound level (with a 10 dB penalty added to nighttime sounds) is often used to determine the impact of nighttime noise levels. The Oregon DEQ does not require the L_{dn}, and since the background noise levels at Quartz Mountain were not the result of industrial or other man-related activities, this statistic was not calculated.

Table 14.3-1 provides information on the results of the statistical analyses.

Table 14.3-2 provides information on the measurements of octave band sounds at two locations.

forested areas were then classified as having high screening ability.

13.4.2.4 Vegetation Regeneration Potential

Based on existing soils and vegetation properties, there are no areas on site that have low vegetation regeneration potential if proper techniques are used. Lands that can revegetate rapidly, reducing the length of time for visual contrasts, will have a higher VAC. Thus, areas were classified as either high (3) or medium (2) vegetation regeneration potential.

13.4.2.5 Soil Color Contrast

The color of exposed soil plays a large factor in how visible a disturbance may be. The darker the soil, the less it will potentially contrast with existing landcover. Lighter colored soils will be more noticeable when exposed and will have a lower VAC. Soil color for the Quartz Mountain site was mapped and classified into high VAC (3), medium VAC (2), and low VAC (1). The majority of the soils on the site are Reddish Brown to Brown and of medium VAC. There are several areas with whitish soils (low VAC) and areas with very dark, Black or Reddish soils that have high VAC. These dark areas are found primarily in the low-lying, wet areas.

13.4.2.6 Erosion Potential

Areas that have high erosion potential are difficult to stabilize and disturbances to these areas may remain visible for a long period of time. Erosion potential is directly related to slope and soil type. On the Quartz Mountain site, areas over 30 percent in slope were classified as having medium potential for erosion (VAC 2), and all other areas were classified as low erosion potential (VAC 3). There are no areas on site that were classified as having high erosion potential.

13.4.3 Composite VQO/VAC Map

The Visual Quality Objectives for the Quartz Mountain project site reflect the sensitivity and scenic value of the landscape. The Visual Absorption Capability is an indication of the amount of change a landscape can tolerate without substantial deterioration. When these two maps are overlaid together, the result is a composite map that both identifies management goals and gives an indication of how easy or difficult it might be to meet those goals. The Quartz Mountain site has six different composite categories that reflect these management goals (VQO's) and the relative ability to meet those goals (VAC's). These six categories

APPENDIX 3.E

GUIDE FOR TEXTURAL CLASSIFICATION IN SOIL FAMILIES

Lakeview water system under one of the following options proposed by the town.

The district may contract with the town for construction of distribution lines and water supply. District users would become part of the town's water system for billing and maintenance services.

Possibly the district may contract with others to construct distribution lines. The town would provide billing and maintenance services.

Lastly, the district may take full responsibility for construction, billing, and maintenance activities. The town would provide bulk water only to the district.

Operating and maintenance expenses in the district would be funded by a combination of tap fees and monthly usage charges. Presently the town provides water to some residents outside of town boundaries. It has not been decided whether these people would be included in the new district (Gray, pers. comm., 16 December 1987).

11.4.4.2.9 Lakeview Fiscal Analysis

General Fund Revenues (GFRs)

Tables 11.4-23, 11.4-24, and 11.4-25 present Lakeview general fund revenues by major category and major category as a percent of total for fiscal years 1985-86 through 1987-88 as well as the three year average, in nominal dollars, constant 1987 dollars, and GFRs per capita, respectively.

In nominal dollars (unadjusted for inflation), total revenues available to the general fund have increased from $616,000 in 1984-85 to a budgeted $855,000 in the current fiscal year. This represents an increase of nearly 39 percent during the four year period. When adjusted for inflation, revenues have increased by 27 percent, from $674,000 in 1984-85 to $855,000 currently budgeted.

Current and previous year local property tax has accounted for an average of 54 percent of total revenues since 1984-85. The second largest revenue source has been carryovers from previous budgets, averaging 18 percent of total revenues. Nonlocal revenues from state and federal sources have averaged less than 5 percent of total revenues. The heavy reliance on property tax revenues reflects the state's constitutional mandate for decentralized, locally controlled revenue sources. Per capita GFRs have averages $279 over the three year period.

13.4 VISUAL RESOURCES RESULTS AND DISCUSSION

13.4.1 Visual Quality Objectives

Visual Quality Objectives that were mapped by the Fremont National Forest were used in this study but were refined slightly to reflect a more detailed scale of mapping. Areas that were mapped "forest-wide" by the Forest Service were further analyzed at 1" = 1000' and modified to better reflect actual topographic features such as ridgelines and drainages. As a result of this mapping, approximately 41 percent of the site is classified as Modification, 26 percent as Partial Retention, and 33 percent as Retention (see Figure 13.3-3).

13.4.2 Visual Absorption Capability

Visual Absorption Capability zones were re-mapped based on current, detailed studies of the slope, soils, and vegetation of the project site. The result of this mapping, discussed below, is quite different from the forest-wide mapping that was done in the early 1980's. The differences are a result of the scale of the two mapping efforts, and the additional factors that were mapped at the project scale.

Some general principles that relate to Visual Absorption Capability are discussed here because they often do not end up on the 'factor' maps but must be considered when siting project elements relative to Visual Absorption Capability. Ridgetops, for example, are likely to have low VAC because they are often under constant scrutiny as focal elements in the landscape. The same can be said for landscape edges. While these edges often have high VAC due to their diversity in vegetation, they have low VAC because they are often viewed, along with ridgetops, as focal elements in the landscape. Thus, the edge between the meadow in Quartz Valley and the forested buttes, and the tops of the buttes, likely have a relatively low VAC. Additionally, in general, as the size of an activity increases, the VAC's decrease and as the duration of the visual impact increases, the VAC decreases.

The combined factors used to produce the VAC map indicate that there are no areas of low VAC on the Quartz Mountain site (Figure 13.3-4). The cumulative VAC scores range potentially from four to twenty-one. Scores from four to nine were considered low VAC, medium VAC ranged from ten to seventeen, and eighteen to twenty-one were considered high VAC. The entire site consists of medium (42 percent)and high (58 percent) VAC due mainly to the relatively flat slopes and high screening and revegetation potential. However, ridgetops, edges, and the meadow area should be treated with care because they are areas of potentially low VAC.

TABLE 3.D-1

TAXONOMY OF MODAL SOILS (ESTIMATED)[1]

Mapping Unit No.	Classification
3,4,4A,6	no classification estimated; misc. mapping units
16*	Cumulic Cryaquolls
18*	fine-loamy over clayey, mixed, Aquic Cryoboralfs
30A	fine, mixed, frigid Typic Argixerolls
31A	clayey-skeletal, mixed, frigid Typic Argixerolls
34A	loamy-skeletal, mixed, frigid Typic Argixerolls
34B	loamy-skeletal, mixed, frigid Typic Argixerolls
34B/R.O.	loamy-skeletal, mixed, frigid Typic Argixerolls
34C	loamy-skeletal, mixed, frigid Typic Argixerolls
34A*	loamy-skeletal, mixed, mesic Typic Argixerolls
34B*	loamy-skeletal, mixed, mesic Typic Argixerolls
34C*/R.O.	loamy-skeletal, mixed, mesic Typic Argixerolls
37A	loamy-skeletal, mixed, frigid Typic Argixerolls
37B	loamy-skeletal, mixed, frigid Typic Argixerolls
37B/R.O.	loamy-skeletal, mixed, frigid Typic Argixerolls
37C	loamy-skeletal, mixed, frigid Typic Argixerolls
40A	sandy-skeletal, mixed, mesic Typic Xerorthents
40B	sandy-skeletal, mixed, mesic Typic Xerorthents
40C	sandy-skeletal, mixed, mesic Typic Xerorthents
41A	sandy-skeletal, mixed, frigid Typic Xerorthents
41B	sandy-skeletal, mixed, frigid Typic Xerorthents
41C	sandy-skeletal, mixed, frigid Typic Xerorthents
64A	coarse-loamy, mixed, frigid Entic Haploxerolls

Table 11.4-24
Town of Lakeview, Oregon Fiscal Analysis
General Fund Revenues

1987 Dollars

Category	84-85	% Total Revenues	85-86	% Total Revenues	86-87	% Total Revenues	87-88	% Total Revenues	Average 84/85-87/88	% Total Revenues
Property Tax	314,871	46.7%	386,505	47.9%	385,270	51.1%	395,910	46.3%	370,639	48.0%
Previous Levied Tax	44,073	6.5%	42,230	5.2%	41,561	5.5%	62,500	7.3%	47,591	6.2%
Fines & Bail	9,818	1.5%	7,837	1.0%	7,481	1.0%	10,000	1.2%	8,784	1.1%
License & Franchise	69,352	10.3%	74,189	9.2%	67,537	9.0%	65,000	7.6%	69,019	8.9%
Cigarette Tax	6,158	0.9%	7,381	0.9%	11,507	1.5%	10,193	1.2%	8,810	1.1%
Liquor Tax	21,114	3.1%	19,847	2.5%	19,979	2.6%	19,355	2.3%	20,074	2.6%
Animal License	15,222	2.3%	9,464	1.2%	11,429	1.5%	12,000	1.4%	12,029	1.6%
Rural FD	8,144	1.2%	12,006	1.5%	11,429	1.5%	12,000	1.4%	10,895	1.4%
F. Serv. Contract	437	0.1%	0	0.0%	312	0.0%	300	0.0%	262	0.0%
9-1-1 Fund	10,403	1.5%	10,407	1.3%	45,717	6.1%	10,832	1.3%	19,340	2.5%
Other	7,633	1.1%	993	0.1%	5,195	0.7%	8,300	1.0%	5,530	0.7%
Transfers In	53,028	7.9%	51,204	6.4%	50,393	6.7%	42,500	5.0%	49,281	6.4%
Revenue Sharing	27,334	4.1%	0	0.0%	0	0.0%	0	0.0%	6,833	0.9%
Interest	8,628	1.3%	7,890	1.0%	6,234	0.8%	6,000	0.7%	7,188	0.9%
Beginning Balance	77,600	11.5%	176,189	21.9%	90,395	12.0%	200,500	23.4%	136,171	17.6%
Total Revenues	673,815	100.0%	806,143	100.0%	754,440	100.0%	855,390	100.0%	772,447	100.0%

Source: City of Lakeview 1987-88 budget;
Planning Information Corporation, January 1988.

4.0 VEGETATION

General Fund Expenditures (GFEs)

Tables 11.4-26, 11.4-27, and 11.4-28 present Lakeview general fund expenditures by major category and major category as a percent of total for fiscal years 1985-86 through 1987-88 as well as the three year average, in nominal dollars, constant 1987 dollars, and GFEs per capita, respectively.

Total general fund expenditures have increased in nominal dollars from $464,000 in 1984-85 to $855,000 in the current fiscal year, an increase of 84 percent. In constant 1987 dollars, expenditures increased from $508,000 to $855,000, an increase of 69 percent. These figures can be misleading because the current budget includes a transfer to the street fund of $113,000. The only previous transfer to the street fund totalled $3,000 in 1984-85. It is not known whether such a large a transfer will occur in the future. It should also be noted that current year expenditures are a budget figures tend to be higher than the amount actually spent during the year.

Operating expenditures (salaries, benefits, supplies) have increased less dramatically in nominal dollars, from $450,000 in 1984-85 to $616,000 currently. This represents an increase of 37 percent during the 4 year period. In constant 1987 dollars, the increase is 25 percent over the same period.

On average, nearly 62 percent of total expenditures are used to support public safety activities with Police and Fire/Disaster expenditures each averaging 31 percent of the total budget since 1984-85. The next largest expenditure category has been general government functions which has averaged 25 percent of total expenditures. The large transfer to the street fund represents approximately 12 percent of the current budget.

Per capita GFEs have averages $244 over the three year period, $35 less than per capita revenue.

Fiscal Balances

Lakeview has had positive fiscal balances in all years since 1984-85, ranging from a low of $71,000 (uninflated dollars) in 1984-85 to a high of the current year's $200,000. This has allowed the town to transfer funds to capital projects funds for the purchase of new equipment or replacement of facilities. The town appears to be fiscally well managed and is operating well within its means while maintaining adequate levels of service in all operating departments.

easier for the public to understand the analysis; (2) It combines the visual analysis process with the design of the project by providing visual information early enough in the process to allow project designers to quickly test visibility of alternatives from any point; and (3) The computer can simulate the detailed project design, landscape management, and landscape architecture designed to mitigate visual impacts. This is possible due to the computer's capability to model topography, land characteristics, and project elements such as roads, excavations, stockpiles, berms, structures, etc. Finally, the simulation can be viewed from any given point to evaluate the project's visibility and potential impact from key public viewpoints such as roads, residential areas, and nearby high points.

13.3.4.1 Data Selection and Input

Existing terrain of the Quartz Mountain project site and immediate surrounding region (including Fishhole Mountain and Gearhart Mountain) were entered into the database by digitizing coordinates and elevations of the topography from a 1" = 1000 ft contour map of the project site and 1:24000 USGS topographic maps of the surrounding region. The project site is modeled in detail to enable later inclusion and evaluation of project alternatives. The surrounding topography was included to provide context and background landforms for use in viewing the simulation database in three-dimensions from selected viewpoints (Figure 13.3-5).

Forest Service Visual Quality Objectives that were previously mapped and site specific Visual Absorption Capability Zones were also digitized into the database.

13.3.4.2 Application of Database

In addition to overlaying mapped Forest Service Visual Quality Objectives and Visual Absorption Capability zones with the site photos to be viewed on the landscape, the further usefulness of the simulation will become apparent in the evaluation of project alternatives. Changes in topography due to mining processes such as excavation and stockpiling can be quickly simulated and evaluated from key public viewpoints. This evaluation will involve placing the accurate three-dimensional simulation of the project into the context of the landscape to show the relationship of the project alternatives with existing surrounding topography and vegetation. These simulations will allow for better understanding of the visual impacts for professional analysis and to better communicate these visual impacts to affected publics.

TECHNICAL REPORT NO. 4

VEGETATION

Prepared for

THE QUARTZ MOUNTAIN GOLD PROJECT

GALACTIC SERVICES, INC.

USDA FOREST SERVICE
FREMONT NATIONAL FOREST

Prepared by

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Revised December 1988

Table 11.4-27
Town of Lakeview, Oregon Fiscal Analysis
General Fund Expenditures

1987 Dollars

Department	84-85	% Total Expend	85-86	% Total Expend	86-87	% Total Expend	87-88	% Total Expend	Average 84/85-87/88	% Total Expend
Police										
O&M	180,362	95.8%	193,445	99.3%	212,527	94.5%	214,883	97.1%	200,304	96.6%
Capital	7,859	4.2%	1,358	0.7%	12,260	5.5%	6,500	2.9%	6,994	3.4%
Total	188,221	37.1%	194,803	33.2%	224,788	29.8%	221,383	25.9%	207,299	30.7%
Fire/Disaster										
O&M	181,014	100.0%	209,841	100.0%	218,822	97.0%	213,857	95.1%	205,884	97.9%
Capital	0	0.0%	0	0.0%	6,754	3.0%	11,000	4.9%	4,438	2.1%
Total	181,014	35.7%	209,841	35.8%	225,575	29.9%	224,857	26.3%	210,322	31.1%
Recorder										
O&M	52,351	100.0%	53,313	95.5%	55,507	77.0%	51,896	88.1%	53,267	89.1%
Capital	0	0.0%	2,525	4.5%	16,624	23.0%	7,040	11.9%	6,547	10.9%
Total	52,351	10.3%	55,838	9.5%	72,131	9.6%	58,936	6.9%	59,814	8.8%
Attorney										
O&M	15,350	100.0%	15,859	100.0%	18,121	100.0%	17,654	100.0%	16,746	100.0%
Capital	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Total	15,350	3.0%	15,859	2.7%	18,121	2.4%	17,654	2.1%	16,746	2.5%
General Gov't										
O&M	63,250	97.2%	58,940	100.0%	111,880	59.6%	118,066	67.2%	88,034	72.3%
Capital	1,843	2.8%	0	0.0%	75,837	40.4%	57,500	32.8%	33,795	27.7%
Total	65,093	12.8%	58,940	10.1%	187,717	24.9%	175,566	20.5%	121,829	18.0%
Transfers to Other Funds										
Build. & Fire Truck	0	0.0%	44,671	87.7%	24,835	95.1%	30,000	19.1%	24,877	41.5%
Planning	0	0.0%	961	1.9%	1,273	4.9%	1,000	0.6%	808	1.3%
Park	2,187	39.6%	5,291	10.4%	0	0.0%	12,841	8.2%	5,080	8.5%
HUD	0	0.0%	4	0.0%	0	0.0%	0	0.0%	1	0.0%
Street	3,331	60.4%	0	0.0%	0	0.0%	113,153	72.1%	29,121	48.6%
Total Transfers	5,518	1.1%	50,928	8.7%	26,108	3.5%	156,994	18.4%	59,887	8.9%
Total General Fund										
O&M	492,326	97.0%	531,398	90.6%	616,856	81.8%	616,356	72.1%	564,234	83.5%
Capital	9,702	1.9%	3,883	0.7%	111,476	14.8%	82,040	9.6%	51,775	7.7%
Transfers	5,518	1.1%	50,928	8.7%	26,108	3.5%	156,994	18.4%	59,887	8.9%
Total	507,547	100.0%	586,209	100.0%	754,440	100.0%	855,390	100.0%	675,896	100.0%

Source: City of Lakeview 1987-88 budget;
Planning Information Corporation, January 1988.

TABLE 3.B-1

SOIL CHEMICAL ANALYSIS - FIRST SERIES LAB DATA

Observ. Point #	Sample #	Soil Depth (In.)	pH	P ppm	K ppm	Ca meq/100g	Mg meq/100g	NA meq/100g	SS mohms/cm	NO_3 ppm	OM %	SAR
1	1	00-10	6.2	4	222	10.9	3.70	0.09	0.20	0.6	2.44	0.033310
1	2	10-20	5.5	4	179	14.2	7.80	0.16	0.15	0.3	1.11	0.048241
2	3	15-30	5.0	14	195	19.4	12.00	0.27	0.15	0.2	0.90	0.068141
3	4	00-24	6.4	2	308	8.3	1.20	0.09	0.15	0.3	3.66	0.041294
4	5	00-12	6.5	9	402	9.1	1.30	0.07	0.15	1.4	5.14	0.030697
5	6	00-20	6.5	8	371	9.6	1.00	0.08	0.15	0.4	5.19	0.034749
5	7	15-60	5.2	8	137	9.9	6.00	0.34	0.15	0.2	0.32	0.120525
6	8	00-24	6.7	3	296	7.6	0.62	0.08	0.15	0.5	2.65	0.039461
7	9	00-12	5.9	2	242	6.7	3.60	0.10	0.15	0.4	2.44	0.044065
7	10	12-40	4.8	9	230	19.7	12.00	0.29	0.15	0.1	1.80	0.072842
8	11	00-13	5.7	2	140	7.7	3.10	0.09	0.15	1.3	2.92	0.038729
9	12	00-13	6.2	4	195	10.0	3.80	0.08	0.15	0.5	3.82	0.030455
10	13	00-15	6.3	2	215	7.8	2.80	0.12	0.15	0.5	2.23	0.052124
11	14	00-10	6.5	13	386	9.8	1.10	0.07	0.15	0.7	3.18	0.029984
12	15	00-14	6.5	10	355	9.9	3.10	0.11	0.15	0.3	2.70	0.043145
12	16	14-32	6.6	4	324	8.1	3.50	0.18	0.15	0.3	0.11	0.074740
12	17	32-45	6.1	2	468	38.0	17.00	0.53	0.15	0.2	0.05	0.101067
13	18	00-08	6.5	7	300	12.9	6.10	0.19	0.15	0.3	2.49	0.061644
13	19	08-36	5.5	2	250	27.4	16.00	0.49	0.20	0.1	0.80	0.105188
14	20	00-23	6.5	11	374	11.5	4.00	0.13	0.15	0.3	1.43	0.046697
14	21	23-32	6.7	8	316	15.9	6.70	0.21	0.15	0.2	0.48	0.062471
15	22	09-18	5.9	3	218	12.1	4.90	0.13	0.15	0.3	1.43	0.044529
16	23	00-10	6.0	4	199	11.6	4.00	0.12	0.15	1.1	4.61	0.042966
17	24	00-15	6.2	4	187	8.5	3.00	0.09	0.15	0.4	1.96	0.037532
18	25	00-12	6.5	3	335	9.2	1.90	0.08	0.15	0.3	3.71	0.033958
19	26	00-18	6.3	8	231	8.7	1.20	0.07	0.15	0.4	2.81	0.031462
19	27	18-34	6.6	6	246	7.5	2.00	0.11	0.15	0.2	0.64	0.050471
20	28	00-12	6.1	2	269	9.0	3.20	0.14	0.15	0.2	2.92	0.056684
20	29	12-36	6.2	2	316	13.0	6.30	0.20	0.15	0.2	1.54	0.064382
21	30	00-15	6.6	43	975	10.0	2.50	0.09	0.20	0.2	2.28	0.036000
21	31	15-34	7.0	12	858	9.3	3.60	0.11	0.15	0.2	0.69	0.043312
22	32	00-10	6.7	35	523	13.0	3.70	0.09	0.15	0.3	2.49	0.031145
22	33	10-45	6.7	11	218	16.7	8.20	0.21	0.15	0.3	0.95	0.059516
23	34	00-08	6.7	35	456	11.7	2.30	0.09	0.15	0.2	1.96	0.034016
23	35	08-30	7.0	12	425	17.9	4.80	0.15	0.15	0.2	1.96	0.044523

11.4.4.3 Lakeview School District #7

Lakeview School District # 7 is classified as a Unified District, operating grades K - 12 in two elementary, one middle, and one high school. The district encompasses the town of Lakeview and its surrounding areas in unincorporated Lake County. In addition, the district provides high school education to students from the Union School District #5, which operates its own elementary schools and pays tuition to the Lakeview School District for its high school students.

The district is governed by a 5-member school board which has a legal responsibility to provide all children residing in the district with educational programs consistent with state statutes and rules adopted by the State Board of Education. The board appoints a 5-member budget committee composed of district residents who assist the board in preparing the district's annual operating budget. The board also appoints a superintendent who manages the operations of the district.

In addition to its own resources, the district has access to centralized staffing, equipment and programs through the Lake County Education Service District (ESD), an autonomous agency funded by its own property tax levy, state and federal funds. The ESD provides services such as central purchasing of library and audiovisual equipment, special teachers for Chapter I, Chapter I-Migrant, and special education students. The ESD serves all 6 school districts in Lake County and acts as an intermediary between the local districts and the state Department of Education.

Facilities

The Lakeview School District operates 2 elementary, one middle, and one high school. Under current district organization, elementary schools include grades K-5, middle school includes grades 6-8 and high school includes grades 9-12. The following Table 11.4-29 summarizes the status of the schools as of September, 1987.

Fremont Elementary School is currently operating at 94 percent capacity. Hay Elementary School is operating at 70 percent of capacity. The middle school is operating at 74 percent of capacity, however, the shop, and computer classrooms are currently at capacity. Lakeview High could accept another 123 students before its maximum capacity is reached. However, shop, home economics, and special ed classrooms are currently at capacity. The district currently has no plans for major capital construction or repair projects at any of its school buildings.

FOREWORD

This report was prepared by Loverna Wilson, Environmental Consultant, and Steffen Robertson and Kirsten (Colorado) Inc. for Galactic Services, Inc., operator of the proposed Quartz Mountain Gold Mine, and the Environmental Impact Statement lead agency, the USDA Forest Service, Fremont National Forest. Data collection, analysis, and presentation were the responsibilities of the following personnel:

Project Staff	Project Responsibility	Organization
M.L. Wilson	Vegetation/Range Task Leader	SRK
R.H. Wheeler	Surface Water/Forestry Task Leader	SRK
K.A. Menard	Graphics	SRK

Enrollment

Table 11.4-30 shows district enrollment trends since 1980-81. Figure 10.4-6 presents the same information in graphic form. Current district fall enrollment stands at 966, including 434 elementary, 205 middle and 327 high school students. Since the 1980-81 school year, district enrollment has shown a steady decline from a peak of 1,079 students in 1980-81 to a low of 943 in 1985-86. The declining trend appears to have been reversed with small growth in enrollment shown in both 1986-87 (955 students) and the current year. Current fall enrollment is 10.5 percent lower than that in 1980-81 (Oregon Department of Education 1987).

Enrollment comparisons among grade levels is difficult because the district restructured elementary and middle school grades (sixth grade was moved from elementary to middle school) in the 1985-86 school year. However combining elementary and middle school enrollments shows trends similar to those noted for the district as a whole: enrollments declined from 715 in 1980-81 to a low of 623 in 1985-86, increased to 643 in 1986-87, but declined again to 639 in the current year. High school enrollment declined from 364 in 1980-81 to a low of 296 in 1984-85, then increased to 320 in 1985-86 and to 327 in the current year.

Staff

In the current school year, district staffing totals 109.6 full time equivalent employees as categorized in Table 11.4-31.

The following tables illustrate staffing trends at the school level since the 1985-86 school year, when elementary and middle school reorganization took place. Table 11.4-32 shows full time equivalent staff levels in aggregated categories. Table 11.4-33 illustrates student to staff levels over the same time period. The tables do not include staff not assigned to a specific school, such as district administrators, bus drivers, and maintenance staff.

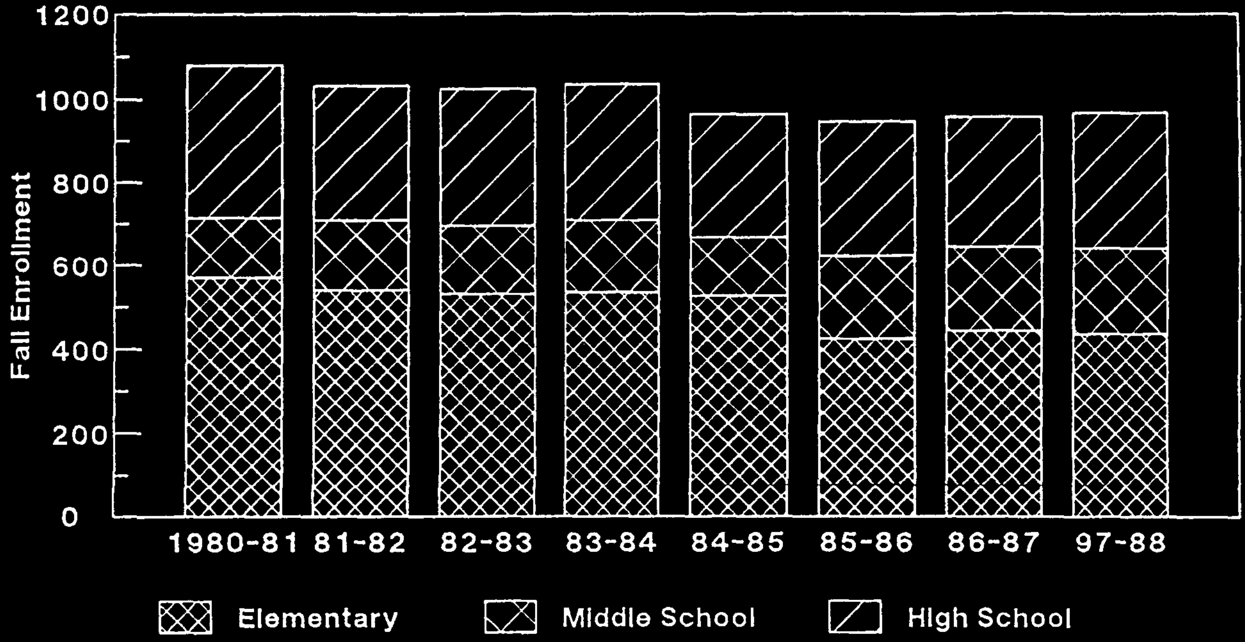
Staffing levels have remained nearly constant over the past three years, increasing slightly from 91.1 in 1985-86 to 94 in the current year. Elementary staffing increased from 35.3 to 36.7 FTE, middle school decreased from 23.8 to 23.7 and high school staffing increased from 32 to 36.6. Total staff at the schools increased from 91.1 to 94 since 1985-86. District-wide student/teacher ratios have remained constant at 16.8 students per teacher since 1985-86, however within each school, these ratios have shown more fluctuation: elementary student/teacher ratios increased from 18.4 in 1985-86 to 20.6 in 1986-87, then decreased to 18.7 in the current year.

TABLE 3.A-1

PARTICLE SIZE ANALYSIS - FIRST SERIES LAB DATA

Observ. Point #	Sample #	Soil Depth (In.)	%Sand	%Silt	%Clay	Textural Class
1	QMG 1	00-10	51.1	26.4	22.5	SANDY CLAY LOAM
1	QMG 2	10-20	56.1	17.9	25.7	SANDY CLAY LOAM
2	QMG 3	15-30	26.1	26.9	47.0	CLAY
3	QMG 4	00-24	11.7	35.5	19.8	LOAM
4	QMG 5	00-12	49.3	38.7	12.0	LOAM
5	QMG 6	00-20	50.3	30.4	11.4	LOAM
5	QMG 7	15-60	9.1	27.5	63.3	CLAY
6	QMG 8	00-24	62.6	28.2	9.2	SANDY LOAM
7	QMG 9	00-12	11.2	28.0	30.8	CLAY LOAM
7	QMG 10	12-40	12.9	11.6	75.5	CLAY
8	QMG 11	00-13	41.3	25.6	33.1	CLAY LOAM
9	QMG 12	00-13	37.0	36.1	26.9	LOAM/ CLAY LOAM
10	QMG 13	00-15	35.5	36.1	28.1	CLAY LOAM
11	QMG 14	00-10	12.2	40.1	17.7	LOAM
12	QMG 15	00-14	41.7	31.5	23.7	LOAM
12	QMG 16	14-32	43.0	26.7	29.5	CLAY LOAM
12	QMG 17	32-45	25.7	39.5	34.8	CLAY LOAM
13	QMG 18	00-08	30.7	30.4	30.9	CLAY LOAM
13	QMG 19	08-36	13.2	25.2	61.7	CLAY
14	QMG 20	00-23	35.3	38.0	26.7	LOAM/ CLAY LOAM
14	QMG 21	23-32	40.0	25.5	33.7	CLAY LOAM
15	QMG 22	09-18	31.0	22.5	46.6	CLAY
16	QMG 23	00-10	36.4	30.7	32.9	CLAY LOAM
17	QMG 24	00-15	42.1	32.9	25.0	LOAM
18	QMG 25	00-12	38.5	35.2	26.4	LOAM/ CLAY LOAM
19	QMG 26	00-18	44.6	31.3	24.1	LOAM
19	QMG 27	18-34	44.6	32.0	23.4	LOAM
20	QMG 28	00-12	44.7	28.7	26.5	LOAM
20	QMG 29	12-36	35.8	22.8	41.5	LOAM
21	QMG 30	00-15	47.3	33.0	19.7	LOAM
21	QMG 31	15-34	38.7	23.2	38.1	CLAY LOAM
22	QMG 32	00-10	32.1	39.6	28.4	CLAY LOAM
22	QMG 33	10-45	28.5	35.9	35.6	CLAY LOAM
23	QMG 34	00-08	40.5	37.8	21.7	LOAM
23	QMG 35	08-30	50.9	24.5	24.6	SANDY CLAY LOAM

Figure 11.4-6
Lakeview School District #7, Oregon
Enrollment Trends 1980-81 Thru 1987-88 School Year



Source: Lakeview School District #7;
Planning Information Corporation, January 1988.

3.10 LIST OF PRINCIPAL PREPARERS

3.10.1 Dennis M. Holloran

Mr. Holloran's expertise includes a broad background in soil survey techniques, and soil science disciplines required to develop interpretations and recommendations based on soil behavior, limitation sand potentials. He is familiar with the soils of much of the Northwest and the Rocky Mountain region. He obtained his B.S. in Agronomy and Soil Science at Ohio State University.

Mr. Holloran's experience includes soil survey mapping in Ohio, Oregon, Washington, California, Colorado and Wyoming, developing soil maps and interpretations based on National Cooperative Soil Survey standards, and also based on standards of the United States Forest Service. In addition to soil surveys for inventory and management interpretations, other areas of experience include soil classification studies, development of farm, ranch and timber management plans, and studies for environmental impacts and assessments for projects such as dams and mining.

Mr. Holloran was Soils Task Leader on this project. He was responsible for soils mapping, and topsoil assessment and analysis. Topsoil information was obtained to assist Reclamation Task Leader in developing the reclamation plan.

TABLE 11.4-32

LAKEVIEW SCHOOL DISTRICT #7, OREGON
FULL TIME EQUIVALENT STAFFING
1985-86 THROUGH 1987-88 SCHOOL YEAR

School	School Year 1985-86	1986-87	1987-88
Fremont/Hay Elementary			
Administrators	1	1	1
Teachers	23.1	21.5	23.2
Support	5.7	5.8	6.5
Non-professional	5.5	4.5	6
Total	35.3	32.8	36.7
Daly Middle			
Administrators	1	1	1
Teachers	13.4	13.2	12.6
Support	5	4	3.6
Non-professional	4.4	3.5	3.5
Total	23.8	21.7	20.7
Lakeview High School			
Administrators	1	2	2
Teachers	19.6	21.6	21.6
Support	4.1	5	4.5
Non-professional	7.3	7.5	8.5
Total	32	36.1	36.6
Total Staffing			
Administrators	3	4	4
Teachers	56.1	56.3	57.4
Support	14.8	14.8	14.6
Non-professional	17.2	15.5	18
Total	91.1	90.6	94

3.8 PUBLIC AND AGENCY CONTACTS

Ken Rodgers
District Ranger
USFS, Bly Ranger District
Bly, OR

Dave Wenzel
Soil Scientist
USFS, Supervisor's Office
Lakeview, OR

Middle school ratios have increased steadily from 14.9 in 1985-86 to 16.3 in the current school year while at the high school level, student/teacher ratios decreased from 16.3 to 15.1 over the same period.

District Finance

Revenues

Lakeview School District #7 relies heavily on two sources of operating revenue, the local property tax and federal forest fees. On average, over 60 percent of the district's revenues come from these sources, with 41 percent of total revenues derived from the property tax and 20 percent from forest fees. One other important source of revenue is the state distributed Basic School Support Fund, which has averaged 19 percent of total operating revenues (Lakeview School District #7 Annual Budgets, 1983-84 through 1987-88).

Despite the reliance on local property tax mandated by state law, there are severe restraints on the amount of this tax that can be raised without voter approval. Local school districts operate within a framework known as a tax base, a constitutionally guaranteed dollar amount of property taxes that the district may collect without further approval from district voters. Once the tax base is established, it may be increased by 6 percent each year to form the new tax base. A new tax base in excess of the guaranteed 6 percent yearly growth amount must be approved by voters; this new base forms the foundation from which the 6 percent yearly increase will be calculated and levied on district taxpayers (Oregon Department of Education, October 1987).

Voters in The Lakeview school district have not approved a new tax base in over 30 years, therefore the district is constitutionally guaranteed property tax revenues based on the original tax base from the 1940's increased by the 6 percent growth factor. This base is approximately one-third of the amount of property tax the district must impose to maintain its operating standards. For example in the current budget year (1987-88) the district has calculated a requirement for over $1.7 million in property tax revenues to balance its budget. The district's current tax base is $461,000. Without voter approval of an additional $1.2 million in property taxes, the district would not be able to operate (Ottman, pers. comm., 7 November 1987).

The district has three alternatives to present to the voters to insure that adequate property tax revenues are raised:

Forest Road 3715 provides access to the Fishhole Mountain area to the north and passes near Butcher Flats, Lofton Reservoir Campground, and a large burn area. There are views of the project site through several gaps in the existing trees along the road (Figure 13.3-2). The summit of Fishhole Mountain is not easily accessed and currently there are no recreational activities associated with the summit area. This road is used primarily for the logging industry, with recreation-oriented visitors as a secondary user because it provides direct access camping and other activities located in the immediate region. Forest Road 3660, passing through the site, is also used primarily for the logging industry, and also has recreation-oriented use associated with it. It is a major access route into the wilderness area.

13.3.2 USFS Visual Management System

The USFS Visual Management System (VMS) categorizes all Forest land into management classes that relate to the amount and type of visual change that can take place a given landscape and meet Forest Service objectives for scenic quality. This system is used to evaluate all Forest land in terms of existing visual quality of the landscape, the appropriate level of modification for each landscape, and the ability of that landscape to absorb change. At a forest management level, these objectives can be used for both long-range forest planning and for evaluating site-specific projects.

13.3.2.1 Variety Classes

The first step in the VMS process is to identify the level of variety or scenic quality of the landscape. There are three levels: Class A- Distinctive; Class B- Common; and Class C- Minimal. These classifications are determined based on the amount and relationship of landform, rockform, vegetation, lakes and streams. The Quartz Mountain project site has been identified by the Fremont National Forest as Class B with the exception of a corridor along Drews Creek approximately .5 to .7 miles wide, and a corridor along SH 140 that has been identified as Class A.

13.3.2.2 Sensitivity Levels

All Forest land is also classified according to sensitivity levels which are a measure of people's concern for scenic quality. Travel routes (roads and trails), use areas (campgrounds and visitor centers) and water bodies are assessed as either Level 1 (Highest Sensitivity), Level 2 (Average Sensitivity), and Level 3 (Lowest Sensitivity). Since it is assumed that all Forest Land will be observed from factors of parent material, climate (including moisture and temperature effects), macro-and micro-organisms, and topography, all acting over a period of time and producing a product--soil--that differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics.

SOIL CREEP - Slow mass movement of soil materials down slopes primarily under the influence of gravity, but facilitated by saturation with water and/or by alternating freezing and thawing.

SOIL SEPARATES - Mineral particles, less than 2.0 mm in diameter, ranging between specified size limits. The names and size limits of separates recognized in the United States are: sand, 2.0 to 0.5 mm; silt, 0.05 to 0.002 mm; and clay, less than 0.002 mm.

SOIL TEXTURE - The relative proportions of the various soil separates in a soil as described by the classes of soil texture. Twelve basic soil texture classes are recognized. The textural classes may be modified by the addition of suitable adjectives when coarse fragments are present in substantial amounts; for example, "stony loam."

SPOT SYMBOLS - Symbols used on soil maps to represent a landscape factor too small to delineate.

STONE - A rock fragment greater than 10 inches in diameter.

STONY - Used to modify textural classes and identifies that the volume of greater than 10 inch in diameter rock fragments in the soil ranges from 35 to 50 percent; very stony ranges from 50 to 80 percent; and extremely stony exceeds 80 percent.

STRUCTURE - The combination or arrangement of primary soil particles into secondary particles, units, or peds. These secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades, respectively.

SUBSOIL LAYERS - The soil materials lying between the surface layers and bedrock. They can include any soil horizon below the A horizon and differs from the surface layers significantly in soil characteristics.

SURFACE LAYERS - The portion of a soil extending from the duff layer down to a layer that differs significantly in soil characteristics.

county wide enrollment (Oregon Department of Education, October 1987).

In response to a request by the Lakeview School District, in September, 1987 the county commissioners approved a contribution of $318,300 to the County School Fund, of which the Lakeview district received $207,600, 65.2 percent of the total (Ottman November 7, 1987).

In general, it appears that the Lakeview School District faces a revenue crisis each new school year. Since voters have not approved a new tax base, the district must present a large property tax referendum every year which in recent history has not passed until the school year has already begun. The safety net and road fund transfer provisions allow the district a little more security, but both could have long term negative effects. The safety net revenue guarantee does not grow every year as does the tax base. Therefore, over time, inflation will increase expenditure demands while the revenue base remains static. The road fund transfers may convince district voters that a new tax base is not necessary, since any revenue shortfalls can be made up from this source without higher property taxes. However, since the majority of road fund revenues are derived from federal forest fees, it is possible that fluctuations in timber industry activity could reduce road fund revenues to a point that transfers out could not be considered. Should this happen, the district might have to submit a property tax levy that would be unacceptable to voters, and safety net guarantees might have become small enough that drastic expenditure cutbacks would be required to balance the district's annual budget.

Tables 11.4-34, 11.4-35, and 11.4-36 present Lakeview School District #7 revenues by source and revenues by source as a percent of total revenues for school year 1983-84 through 1987-88 as well as averages for those periods, in nominal dollars, constant 1987 dollars, and general fund per student revenues, respectively.

District revenues have remained fairly constant since the 1983-84 school year when expressed in nominal (not adjusted for inflation) dollars. Total revenues increased from $3.6 million in 1983-84 to a peak of $3.8 million in 1984-85, then decreased to $3.5 million in 1986-87. The current budget estimates revenues at just under $4.0 million. Local revenues (chiefly property tax) have been the largest revenue source, averaging 48 percent of the total since 1983-84. State and federal sources have each averaged 20 percent of total revenues over the same period. County revenues have accounted for less than 4 percent of district revenues on average. Figure 11.4-7 graphs revenues by category for the school years 1983-84 through 1987-88.

LAVA FLOW - A solidified mass of rock formed when a stream of viscous, molten lava from a volcano or fissure has cooled and congealed.

MAPPING UNIT - Any delineated area shown on a soil map that is identified by a number of letter code. A mapping unit may be a standard landtype, a miscellaneous landtype, or a complex.

MASS MOVEMENT - All movement of soil and bedrock materials occurring below the soil surface such as landslips, landflows, rock slides, slumps, etc.

MISCELLANEOUS LANDTYPES - A mapping for areas of land that have little or no natural soil or have properties that are too variable and unpredictable for classification.

MOISTURE TENSION - The equivalent negative pressure in the soil water. It is equal to the equivalent pressure that must be applied to the soil water to bring it to hydraulic equilibrium, through a porous permeable wall or membrane, with a pool of water of the same compositions.

OBSIDIAN - A massive, glassy, noncrystalline rock.

PARENT MATERIAL - The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of soils is developed by pedogenic processes.

PERCOLATION, SOIL WATER - The downward movement of water through soil, especially the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

PERMEABILITY, SOIL - The quality of a soil horizon that enables water or air to move through it. The permeability of a soil may be limited by the presence of one nearly impermeable horizon even though the others are permeable.

PHYSIOGRAPHIC DIVISIONS - Broad land groupings based on the physical features of the landscape.

PLASTIC SOIL - A soil capable of being molded or deformed continuously and permanently, by relatively moderate pressure into various shapes.

PUDDLING AND PUDDLED - The act of destroying soil structure by manipulating a soil when it is in a wet and plastic condition. Puddling reduces porosity and permeability and increases bulk density.

Table 11.4-35
Lakeview School District #7, Oregon
Revenue and Expenditure Analysis

General Fund Revenues (1987 $000's)

	Actual 1983-84	% Tot Rev	Actual 84-85	% Tot Rev	Actual 85-86	% Tot Rev	Actual 86-87	% Tot Rev	Budget 87-88	% Tot Rev	Average 83/84-87/88	% Tot Rev
Local Sources												
Prop Tax	1,379.5	33.6%	1,370.4	33.3%	1,235.9	32.9%	1,289.3	35.3%	1,416.1	35.4%	1,338.2	36.3%
Prior Year	156.8	3.8%	188.5	4.6%	322.6	8.6%	337.8	9.2%	439.0	11.0%	288.9	7.8%
Tuition	230.6	5.6%	156.4	3.8%	152.9	4.1%	161.9	4.4%	150.0	3.8%	170.3	4.6%
Transportation	15.4	0.4%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	3.1	0.1%
Invest. Earning	85.4	2.1%	92.7	2.3%	51.4	1.4%	33.2	0.9%	30.0	0.8%	58.6	1.6%
Other	20.7	0.5%	32.7	0.8%	16.4	0.4%	41.6	1.1%	14.5	0.4%	25.2	0.7%
Total	1,888.3	46.0%	1,840.7	44.7%	1,779.2	47.4%	1,863.8	51.0%	2,049.6	51.3%	1,884.3	51.1%
County Sources												
School Fund	82.6	2.0%	71.6	1.7%	80.4	2.1%	76.2	2.1%	65.0	1.6%	75.2	2.0%
Other	76.6	1.9%	0.0	0.0%	0.0	0.0%	0.0	0.0%	204.1	5.1%	56.1	1.5%
Total	159.2	3.9%	71.6	1.7%	80.4	2.1%	76.2	2.1%	269.1	6.7%	131.3	3.6%
State Sources												
BSSF	895.8	21.8%	735.1	17.8%	699.3	18.6%	698.1	19.1%	684.8	17.1%	742.6	20.1%
BSSF-Supp	4.4	0.1%	5.5	0.1%	0.0	0.0%	3.8	0.1%	3.5	0.1%	3.5	0.1%
Common SF	30.5	0.7%	29.5	0.7%	31.9	0.8%	33.4	0.9%	35.0	0.9%	32.1	0.9%
Special Ed.	12.3	0.3%	8.4	0.2%	12.8	0.3%	10.2	0.3%	12.0	0.3%	11.1	0.3%
Total	943.0	23.0%	778.5	18.9%	744.0	19.8%	745.5	20.4%	735.3	18.4%	789.3	21.4%
Federal Sources												
Forest Fees	693.6	16.9%	813.5	19.7%	755.0	20.1%	716.3	19.6%	910.0	22.8%	777.7	21.1%
Total	693.6	16.9%	813.5	19.7%	755.0	20.1%	716.3	19.6%	910.0	22.8%	777.7	21.1%
Other Sources	0.0	0.0%	1.6	0.0%	3.1	0.1%	0.0	0.0%	0.0	0.0%	0.9	0.0%
Beginning Bal.	424.4	10.3%	613.9	14.9%	392.5	10.5%	250.0	6.8%	34.6	0.9%	343.1	9.3%
TOTAL REVENUE	4,108.5	100.0%	4,119.8	100.0%	3,754.2	100.0%	3,651.8	100.0%	3,998.6	100.0%	3,926.6	106.4%

Source: Lakeview School District #7 Budget;
Planning Information Corporation, January 1987

13.3 METHODS

The methodology used to prepare for visual resources baseline study for the Quartz Mountain Gold Project included the following steps: (1) Describe the existing visual environment and the potential viewers of that environment, (2) Review the existing USFS visual studies and mapping for the area and revise or update as a result of more detailed site analysis, and (3) Identify opportunities and constraints relating to the visual resources of the study area.

This study incorporated the basic principles and methods of the USFS Visual Management System (VMS) combined with computer simulation technology to aid in identifying resources that are significant and/or likely to be affected.

13.3.1 Inventory

The visual resources inventory describes the existing visual landscape and the viewers of that landscape.

13.3.1.1 Landscape Description

The project site is located in the Fremont National Forest, adjacent to Oregon SH 140, known locally as part of the "Winnemucca-to-the-Sea" Highway. Sections of SH 140, including the portion near Quartz Mountain, are considered "visually sensitive routes" by the Fremont National Forest (USDA 1987) (Figure 13.3-1).

The Fremont National Forest is included in the Basin and Range physiographic province, dominated by northwest trending mountains and valleys with a variety of volcanic features such as lava domes and basalt flows. The landscape of the project area is characterized by heavily wooded round to oval-shaped buttes ranging in elevation from 5400 to 6600 feet with intermittent drainages between the buttes.

The vegetation on the buttes consists mainly of fairly dense Ponderosa pine, juniper, and white fir forests with associated species. The Quartz Valley area of the site, adjacent to SH 140, consists mainly of a 'shrub steppe' plant association with localized wetland areas. Portions of the area have been heavily grazed in the past. In the summer this meadows appears quite green, particularly in the wetland areas. Where the 'shrub steppe' meets the forested areas, a distinct line or edge in the landscape is created due to the contrast between the different colors and textures of the two vegetation zones.

result of the influence of the activities of man, or, in some cases, of other animals or natural catastrophes that expose mineral soil surfaces. For example - wild fire.

Geological Erosion - The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of flood plains, coastal plains, etc. Syn. for natural erosion.

Gully Erosion - The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 4 inches to as much as 75 to 100 feet.

Natural Erosion - Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc. undisturbed by man. Syn. for geologic erosion.

Rill Erosion - An erosion process in which numerous small channels less than 4 inches deep and 6 inches wide are formed.

Sheet Erosion - The removal of a fairly uniform layer of soil from the land surface by runoff water.

Splash Erosion - The spattering of small soil particles caused by the impact of raindrops on exposed mineral soil. The loosened and spattered articles may or may not be subsequently removed by surface runoff.

ERUPTIVE CENTER - An area of concentrated volcanic activity around a vent resulting in cone or dome-shaped landforms.

EVAPOTRANSPIRATION - Water transpired by vegetation plus that evaporated from the soil.

EXTRUSIVE BEDROCK - This applies to those igneous rocks derived form volcanic lavas that cooled on the surface of the earth. This lava cools rapidly and forms fine-textured rocks such as basalt and andesite.

FAULT - A fracture or fracture zone along which there has been displacement of one side with respect to the other.

FAULT ESCARPMENT - The steep slope along the face of a fault system.

One-year levy proposals set a tax base for the current school year only with no provision for continuing the base into the future.

Serial levy proposals create a new tax base for a specific length of time, but more than just the current school year. Serial levies may be approved as a fixed dollar amount to be levied in each year or a specified tax rate that may be applied to the district's assessed valuation in each year. When the serial levy expires, the district's tax base reverts to the amount in effect prior to the serial levy approval.

New tax base proposals attempt to create an increased base amount upon which the 6 percent annual growth factor may be applied. This proposal has the effect of permanently increasing the minimum property tax that may be levied.

The district has submitted all three types of proposals to district voters with varying degrees of success. Since 1977, serial levy proposals for repair and maintenance revenues have been defeated 3 times, new tax base proposals have been defeated 4 times, but one year levies have been approved each year.

In recent years, two state level authorizations have been enacted that provide a level of security to local school districts. One is a constitutional amendment that establishes a "safety net" principal that allows school districts a continuing authority to levy taxes equal to the amount levied in the previous fiscal year. In effect, the amendment allowed for the creation of a new tax base in each district without voter approval. Unlike a true new tax base, the safety net amount does not increase at the 6 percent per year rate. If district voters do not approve serial or one-year proposals in any year, the district is guaranteed property tax revenues equal to the safety net amount. As time goes by, however, the lack of annual increase to the safety net amount results in ever diminishing guaranteed revenues.

The second authorization allows certain counties to make voluntary contributions to their county school funds from their road funds. The law (ORS 294.060 [4] and [6]) permits any county in eastern Oregon with a 1980 census population of between 6,500 and 9,000 to transfer funds in excess of $2 million in the road fund to the County School Fund if the county commissioners decide that the excess is not needed for roads. Lake County is one of 5 counties qualifying for this type of contribution.

Once the contribution is made to the County School Fund, all districts in the county receive extra funds since the fund is allocated to each district based on its percentage of total

BULK DENSITY - The mass of dry soil per unit bulk volume; usually measured as grams per cubic centimeter.

C-HORIZON - A layer of unconsolidated material, relatively little affected by the influence of organisms and presumed to be similar in chemical, physical, and mineralogical composition to the material from which at least a portion of the overlying solum has developed.

CINDERS - Primarily uncemented, glossy, and vesicular volcanic ejecta.

CINDER CONE - A conical elevation formed by the accumulation of cinder material around a vent.

CIRQUE BASIN - A half-amphitheater formed by alpine glaciation with three steep sides. Usually found at upper ends of valleys and along ridges.

CLASSIFICATION - The systematic arrangement of soils into groups or categories on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties. On January 1, 1965, a new USDA soil classification system (soil taxonomy) was adopted for use in publications by the National Cooperative Soil Survey.

CLAY - A soil separate less than .002 mm in diameter. As a oil textural class--soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

COARSE FRAGMENTS - Rock or mineral particles greater than 2.0 millimeters in diameter.

COBBLE - a rock fragment between 3 and 10 inches in diameter.

COLLUVIUM - Soil material or rock fragments moved downslope by gravitational force in the form of soil creep, slides, and local wash.

COMPACTION - The packing together of soil particles by forces exerted at the soil surface, resulting in increased soil density.

COMPLEX - An association in which two or three mapping units or miscellaneous units are so intricately mixed that it is not practical to show them separately at the scale of mapping used.

TABLE 11.4-33

LAKEVIEW SCHOOL DISTRICT #7, OREGON
STUDENTS PER FULL TIME EQUIVALENT STAFF
1985-86 THROUGH 1987-88 SCHOOL YEAR

School	School Year 1985-86	1986-87	1987-88
Fremont/Hay Elementary			
Administrators	424	442	434
Teachers	18.4	20.6	18.7
Support	74.4	76.2	66.8
Non-professional	77.1	98.2	72.3
Total	12.0	13.5	11.8
Daly Middle School			
Administrators	199	201	205
Teachers	14.9	15.2	16.3
Support	39.8	50.3	56.9
Non-professional	45.2	57.4	58.6
Total	8.4	9.3	9.9
Lakeview High School			
Administrators	320	156	164
Teachers	16.3	14.4	15.1
Support	78.0	62.4	72.7
Non-professional	43.8	41.6	38.5
Total	10.0	8.6	8.9
Total Staffing			
Administrators	314.3	238.8	241.5
Teachers	16.8	17.0	16.8
Support	63.7	64.5	66.2
Non-professional	54.8	61.6	53.7
Total	10.4	10.5	10.3

3.6 SOIL CHARACTERISTICS AFFECTING RECLAMATION

In terms of topsoil suitability for reclamation purposes, all of the soils occurring on the area to be disturbed have loamy or sandy loam textures and exhibit no phytotoxic characteristics. Soil pH's range from a low of 5.0 to a high of about 7.0, with most samples falling in the range of 6.2 to 6.7. None of the site soils exhibit problems with regard to sodium absorption ratios (SAR) or electrical conductivities (EC). In addition, all topsoil materials have adequate organic material (OM) and nutrient levels to support healthy productive plant communities. Even so, soils will be tested at the time of soil replacement in order to determine the need for supplementary fertilization.

The only factor of any concern with regard to topsoil suitability relates to the localized presence of gravels and cobbles in the upper layers of some soil types. However, no evidence exists that these coarser materials are prevalent enough to create a serious problem with regard to overall soil suitability. At worst, small areas with high coarse material contents may have to be deleted during salvage operations.

TABLE 11.4-31

LAKEVIEW SCHOOL DISTRICT #7, OREGON
CURRENT STAFF BY CATEGORY

Category	Staffing (FTE)
Administrators	4.5
Principals	4.0
Library/Media	2.0
Elementary Teachers	29.5
Secondary Teachers	17.8
Other Teachers	11.2
Guidance and Counseling	2.0
Instructional Aides	6.5
Other Aides	4.5
Office/Clerical	6.5
Nonprofessional	21.1
Total	109.6

SOURCE: Oregon Department of Education

Quartz Mountain Gold Corp.

Feasibility Studies

1988

Box 18, Warehouse

RELATIONSHIP BETWEEN LOW GRADE GOLD DISSEMINATIONS AND HIGH GRADE VEINS IN THE QUARTZ MOUNTAIN DISTRICT, OREGON

V. F. Hollister and D.S. Jennings

Relationship Between Low Grade Gold Disseminations and High Grade Veins In the Quartz Mountain District, Oregon

V. F. Hollister and D. S. Jennings

Abstract

Epithermal hot spring related gold and mercury mineralization occurs spatially associated with rhyolite dome complexes in the Quartz Mountain district, Lake Co., Oregon. Drilling of over 800 holes from 1983 to 1991, mostly by Quartz Mountain Gold Corp., has developed a mineral inventory of at least 100,000,000 tons averaging 0.0255 ounces gold per ton in two near-surface, disseminated gold orebodies, Quartz Butte and Crone Hill. Extensive gold disseminations are underlain by and include rare, higher-grade veins that could be feeders for the near-surface, quasi-horizontal, pervasively mineralized gold dissemination. The veins contain about 2,000,000 tons averaging 0.29 ounces gold per ton. Approximately 750,000 tons of this underlie Quartz Butte and the remainder is included in Crone Hill low grade dissemination. With a mineral inventory of about 3,000,000 ounces, Quartz Mountain is currently the largest known gold deposit in Oregon.

As now known, the veins seem too few in number and sporadically positioned to account for the volume of near-surface gold disseminations. Hypotheses are offered to explain the apparent anomaly between the volume of disseminated gold ore and the paucity of feeders. Quartz Mountain has numerous alteration and mineralization similarities with the well studied Steamboat Springs district (White el at, 1964). Coincidences between the two districts are noted where these are significant.

Introduction

Quartz Mountain in Lake Co., Oregon, is currently the largest known gold deposit in Oregon. This article summarizes exploration to date and expands on previous descriptions of the district. Data for this article were generated mostly by Quartz Mountain Gold Corp. staff between 1985 and 1989, within the property boundary shown on Figure 1. Anaconda and others had previously carried out preliminary geological and geochemical studies, but Quartz Mountain's field personnel undertook most of the district's definitive exploration and associated geological investigations concommitant with numerous drilling campaigns. We thank the Quartz Mountain staff collectively for their very high level of professionalism in these many work programs. Dr. D. E. White offered numerous suggestions that improved the manuscript. In particular, his comments on mineralization in the Steamboat Springs district were helpful.

Geological Setting

Quartz Mountain is located in the northern part of the Basin and Range Province of south-central Oregon (Fig. 1). It occurs in a 15 mile long belt of rhyolite domes and dome complexes that are part of a Tertiary bimodal volcanic terrane. The district includes the Crone Hill and Quartz Butte disseminated gold deposits and their genetically related superjacent mercury occurrences. Both deposits are associated with high silica endogenous rhyolite domes. The district has numerous, exogenous, less siliceous rhyolitic domes, as well, most of which are not mineralized (Sawlin et al, 1991). Figure 1 shows 5 endogenous and numerous exogenous domes outcropping with the N 70 degree W trending district. The district lies within and is a small part of the N 50 degree W trending McLoughlin fracture zone (McLeod et al, 1975). McKee et al (1983) and McLeod et al (1975) have provided K-Ar ages from the domes that cluster around 7.0 Ma. The dome intrusive-extrusive complexes occur within, penetrate and overlie at least a 300-meter thickness of 13 Ma and younger volcanic rocks including dacite flows, flow breccias and tuffs, basalt and andesite flows and flow breccias. Volcaniclastics rocks occur haphazardly in this sequence. The domes are locally overlapped by thin, high-alumina, olivine tholeiite flows that may be penecontemporaneous with some domes. Similar basalts occur in the area ranging in age from Miocene to Quaternary. The regional geological relations are reviewed by Hart et al, 1984 and Sawlin et al, 1991.

Disseminated Gold and Mercury Mineralization

The two disseminated gold deposits, Crone Hill and Quartz Butte (Fig. 1), and their associated, relatively small endogenous rhyolite domes were erupted penecontemporaneously with high alumina basalt. Both deposits have very large, exposed, gold-bearing, kaolinitic and argillic alteration zones that surround the domes. A third exposed, similar alteration zone occurring around the Angel Peak dome has gold disseminations on its north and west sides (Fig. 1). The Angel Peak occurrences are insufficiently quantified to be included in a mineral inventory at this time and additional exploration is warranted.

Silberman et al (1979) cite K-Ar dating studies on igneous rocks at Steamboat Springs, Nevada, and elsewhere to substantiate long lived hydrothermal systems. Their data indicate hydrothermal activity in hot spring systems has persisted for two or more million years in some districts. A parallel is suggested for Quartz Mountain. Hydrothermal adularia from Crone Hill has yielded a 5.5 Ma K-Ar age (Quartz Mountain Gold Corp. Private Report, 1988, Figures 2 and 3). When combined with K-Ar ages for nearby domes, igneous and hydrothermal activity could span at least two million years. The repeated deposition of basalt flows with rhyolite domes over a large area for this time period is compatible with a large source magma chamber for these igneous rock and their gold ores. The spatial relationship between endogenous domes and disseminated gold ore is consistent with a genetic linking of the two.

Mercury ores have been mined from the Crone Hill, Quartz Butte, Angel Peak and Drews rhyolite domes, but gold deposits are significant only in and near Crone Hill, Quartz Butte, and Angel Peak (Fig. 1).

Mercury Deposits: Most mercury production has come from Crone Hill, Angel Peak and Quartz Butte. All mercury occurrences are characterized by acid-leached alteration suites comprised of opal, chalcedony, quartz, kaolin and alunite. Sulfur is locally and erratically present. The protolith for all mercury deposits is rhyolite and hot spring siliceous sinter.

Although oxidation persists to maximum depths of 360 feet at Quartz Butte and 165 feet at Crone Hill, cinnabar is the most important mercury mineral. Geochemical studies show only minor traces of arsenic and antimony accompany mercury.

Thick talus, in excess of 15 feet, composed mostly of opaline and chalcedonic silica is found in trenches around Crone Hill. Little such talus occurs below the other mercury deposits. Restoring the talus opalite back to its presumed, original mercury mine site on Crone Hill could have raised the hill's elevation as much as 100 feet at the time of mineralization. Significant mercury mineralization at Crone Hill could therefore have had a pre-erosion vertical extent of 120 feet but significant mercury mineralization at Quartz Butte may have had a pre-erosion vertical extent of only 60 feet.

Disseminated Gold Deposits: Disseminated gold occurs at both Crone Hill (Fig. 4) and Quartz Butte (Fig. 5 and 6), with most ores at Crone Hill appearing near the present topographic surface. The Crone Hill dome is largely brecciated but brecciation is only weakly developed in the other mineralized domes. Most disseminated gold ores at Quartz Butte do not outcrop. At Crone Hill, the top of gold disseminations grading above .008 ounces per ton is within 30 feet of the base of past mercury mining. Perhaps 100 feet separate the base of the mercury mine excavations at Quartz Butte and the top of .008 ounce gold disseminations. Drilling of 800 holes to 1991 had found a minimum of 100,000,000 tons averaging .0255 ounce gold per ton in the Crone Hill and Quartz Butte disseminated deposits.

In both orebodies, native gold occurs with adularia, quartz, marcasite, pyrite, pyrrhotite, stibnite, arsenopyrite, arsenian pyrite and rare traces of tetrahedrite, galena, chalcopyrite and barite in veins, veinlets, veinlet swarms and breccias. The Au:Ag ratio is 1.5:1. Because oxidation at Crone Hill extends to depths of only 165 feet, most of this orebody is sulfidic. Although oxidation extends to 360 feet at Quartz Butte, much of this orebody is also sulfidic. Both orebodies have irregular lower surfaces and tops (Fig. 4 and 6), but tend to be elongated sub-horizontally.

Most disseminated gold ores are found in volcanic wall rocks at Crone Hill (tuff-42%, basalt-32%) with only 26% occuring in the brecciated, endogenous rhyolite dome. At Quartz Butte, 68% of the gold ore occurs in the rhyolite dome, 28% in tuff, and 4% in basalt. Total sulfide at Crone Hill may average 8% but at Quartz Butte it averages about 3%. The high iron content of the basalt and its involvement as an ore host at Crone Hill may have influenced the high sulfide content of that ore.

Alteration in all rocks in the disseminated gold ores is predominantly argillic with silicification of the protolith well developed only in and near breccias and in the walls of veinlet swarms. Kaolinite is most common above the current water table, along with limonite, earthy alunite, jarosite, hematite, chalcedony and quartz. Part of this oxidized zone may have developed above the water table at the time of hydrothermal activity, with the water table dropping since mineralization. However, no water table present at the time of mineralization has been established. The common alteration assemblages below the water table include illite and illite-montmorillionite mixtures and chlorite, adularia, pyrite and zeolites. Sericitic alteration occurs locally with some structures at Quartz Butte below the argillic zone at depths greater than 200 feet (Fig. 6). Pervasive argillization irregularly weakens at about that level, mostly giving way to downward shrinking amoeboid "root zones" and narrowing tabular sheets of argillic alteration in propyllitically altered or fresh volcanic rocks. Most dissemianted gold occurs in the illite-bearing, argillic alteration suite.

High Grade Veins on Quartz Butte

Deep drilling has found a number of high grade gold intercepts in rhyolite below the Quartz Butte disseminated gold deposit. Most intercepts appear at depths greater than 200 feet below the surface.

Figures 5 and 6 show one of many interpretative vein configurations that may be derived from these intercepts. Other vein configurations are clearly possible. The interpretation in these figures is favored by the authors for the non-outcropping veins inferred from the drill intercepts, projected to the surface. The three veins shown are the largest. Other smaller, less certainly defined veins were also indicated, but these were omitted from the Figures because their positions and projections are most subjective. The link of intercepts shown on Figures 5 and 6 provide for a vein potential of 750,000 tons averaging 0.3 ounces gold per ton.