007/001 #6

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DIVISION OF
OIL GAS & MINING

COAL MINING AND RECLAMATION OPERATIONS FOR 1990

(Must be submitted to the Division by March 31, 1991)

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining
3 Triad Centter, Suite 350
355 West North Temple
Salt Lake City, Utah 84180-1203

(801) 538-5340

Permittee:	Valley Camp of Utah, Inc.
Mine Name:	Belina Complex
Mailing Address:	Scofield Route Helper, UT 84526
Company Representative:	W. L. Wright
Resident Agent:	W. L. Wright
Permit Number:	ACT/007/001
Date of Initial Permanent Program Permit	April 1987
Date of Permit Renewal:	July 1990 thru August 1994
Quantity of Coal Mined (tonnage) 1990:	610,374

Attach Updated Mine Sequence Map.

All monitoring activities during the report period must be submitted with this report (including, but not limited to):

A. Summarized Water Monitoring Data

B. Precipitation or Other Climatological Data

C. Subsidence Monitoring Report

D. Vegetation Data (test plots) or Revegetation Success Monitoring (includes interim and final)

E. Annual Impoundment Inspection

F. Permit Stipulation Status, if applicable. Status of Division Orders, if applicable.

jbe
A:/Annual

CONSULTANTS-ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station VC-1
Location Mud Creek below Utah #2 Mine

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP. (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITROGEN NITRATE as NO_3-N (MG/L)	NITROGEN NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)
4-25-89	14:25	10.77	6	6	7.6							10.2			<0.2	0.120	<0.01		
5-23-89	17:10	12.05	17	10	7.5							8.0							
6-21-89	17:30	6.21	13	16	7.6							8.8	<0.5						
7-19-89	15:55	4.35	25	20	7.4														
9-25-89	14:30	5.54	21	13	7.5							10.7	<0.5						
4-16-90	12:50	10.41	17	11	7.4														
5-22-90	11:20	12.51	20	11	7.4														
6-14-90	17:50	10.08	18	17	7.9							7.3							
7-23-90	18:40	3.41	17	15	7.9							11.3							
8-14-90	17:30	4.77	15	20	7.5							9.8							
10-11-90	16:15	3.79	10	8	7.3							14.0	2.4		<0.1	0.11	<0.01		

DATE	PHOSPHATE TOTAL as PO_4-P (MG/L)	PHOSPHATE ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	HYDROXIDE as OH (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	SOLIDS TOTAL SETTLEABLE SOLIDS (ML/L)	SOLIDS T.D.S. (MG/L)	SOLIDS TOTAL SOLIDS (MG/L)	SOLIDS TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC COND. (µMHOS)	TURBIDITY (FTU)	CARBONATE ALK. CO_3 (MG/L)	BI-CARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIO-ACTIVITY (pCi/L)	BETA RADIO-ACTIVITY (pCi/L)
4-25-89	0.046		64			30		311		44	515			220		245			
5-23-89			77.0			30		285			480		0	223					
6-21-89			66			14	<0.1	381			562		0	234			<10		
7-19-89			107					437			660		0	285					
9-25-89			147			12	<0.1	425			704		0	271		316	12		
4-16-90			90			22		431			748		0	252					
5-22-90			73			48		276			466		0	216					
6-14-90			56			64	<0.1	343			490		0	246		246	<10		
7-23-90			114			18		403			732		2.5	271		286			
8-14-90			106			29	<0.1	389			660		6.1	238					
10-11-90	<0.01		102			8.4	<0.1	368			586		6.1	286		312	<10		

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEX. as CR (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	GERMANIUM TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)	LEAD TOTAL (MG/L)
4-25-89	<0.1						<0.01	71.2	28.0			<0.01					0.56	<0.01
5-23-89								38.4	16.1									
6-21-89								44.2	19.1									
7-19-89								49.8	18.3									
9-25-89								68.0	21.4								0.205	
4-16-90								58.2	54									
5-22-90								49.4	13.3									
6-14-90								59.4	17.4							<0.01	0.795	
7-23-90								59.8	18.3									
8-14-90								52.3	19.0									
10-11-90	<0.1		<0.01	<0.01		0.18	<0.01	71.8	18.9	<0.01		<0.01		0.21		<0.01	0.195	<0.01

DATE	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89	21.2	0.030		<0.01	<0.01	1.9	<0.0002			15.1	0.188		<0.1	6.00	5.67	2.82	
5-23-89	30.8					1.9				13.1				5.07	5.71	5.97	
6-21-89	32.8					3.1				17.2				5.73	5.75	0.14	
7-19-89	42.9					4.0				18.2				6.91	7.41	3.53	
9-25-89	48.8	0.028				4.9				23.1				8.54	8.11	2.60	
4-16-90	37.4					3.4				26.6				7.03	7.53	3.44	
5-22-90	24.2					1.8				10.9				4.98	5.44	4.40	
6-14-90	26.2	0.060				2.5				11.2				5.67	5.69	0.15	
7-23-90	46.4					3.8				14.3				7.27	7.41	0.97	
8-14-90	46.1					3.9				14.8				7.15	6.85	2.14	
10-11-90	41.7	0.028	<0.0002	<0.01	<0.01	2.9	<0.002			12.1	<0.01		<0.1	7.62	7.56	0.44	

CONSULTANTS · ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station VC-2
Location Mud Creek above Utah #2 mine

DATE	TIME	FLOW	TEMPERATURE AIR	TEMPERATURE WATER	pH	COLIFORM TOTAL	COLIFORM FECAL	FECAL STREP	C.O.D.	B.O.D.	T.O.C.	DISSOLVED OXYGEN	OIL & GREASE	PHENOL	NITROGEN AMMONIA as NH_3-N	NITRATE as NO_3-N	NITRITE as NO_2-N	NITROGEN TOTAL KJELDAHL	NITROGEN ORGANIC
		CFS	°C	°C		MPN	MPN	MPN	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
4-25-89	13:35	10.23	6	6	7.6							10.2			<0.2	0.098	<0.01		
5-23-89	16:35	10.58	15	10	7.6							8.3							
6-21-89	17:00	5.74	15	15	7.6							9.0	<0.5						
7-19-89	15:10	5.18	27	21	7.4														
9-25-89	13:55	5.23	22	13	7.5							11.9	0.94						
4-16-90	12:33	9.30	19	11	7.5														
5-22-90	10:50	11.88	18	10	7.5														
6-14-90	17:15	9.46	18	14	7.8							6.3							
7-23-90	18:15	4.05	18	16	7.8							13.0							
8-14-90	16:45	4.13	22	19	7.5							10.1							
10-1-90	15:30	3.14	10	8	7.3							13.5			<0.1	0.15	<0.01		

DATE	PHOSPHATE TOTAL as PO_4-P	PHOSPHATE ORTHO as PO_4-P	SULFATE as SO_4	HYDROXIDE as OH	SURFACTANT as MBAS	SOLIDS TSS	TOTAL SETTLEABLE SOLIDS	T.D.S.	TOTAL SOLIDS	TOTAL VOLATILE SOLIDS	SPECIFIC COND.	TURBIDITY	CARBONATE ALK. as CO_3	BI-CARBONATE ALK. as HCO_3	TOTAL ALK. as $CaCO_3$	TOTAL HARDNESS as $CaCO_3$	ACIDITY as $CaCO_3$	ALPHA RADIO-ACTIVITY	BETA RADIO-ACTIVITY
	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	ML/L	MG/L	MG/L	MG/L	µmhos/cm	FTU	MG/L	MG/L	MG/L	MG/L	MG/L	pCi/L	pCi/L
4-25-89	0.047		49.8			32		292		64	483			214		226			
5-23-89			110			29		[illegible]			454		0	220					
6-21-89			97.9			27	<0.1	373			572		0	234			<10		
7-19-89			105					401			600		0	273					
9-25-89			158			20	<0.1	441			730		0	288		334	<10		
4-16-90			91			26		411			626		0	241					
5-22-90			76			49		307			468		0	221					
6-14-90			43			68	<0.1	344			519		0	236		245	<10		
7-23-90			84			44		385			629		1.2	268		276			
8-14-90			125			21	<0.1	447			666		4.4	232					
10-1-90	0.012		96			5.6	<0.1	373			579		6.1	268		309	<10		

DATE	ALUMINUM TOTAL	ANTIMONY TOTAL	ARSENIC TOTAL	BARIUM TOTAL	BERYLLIUM TOTAL	BORON TOTAL	CADMIUM TOTAL	CALCIUM TOTAL	CHLORIDE DISS.	CHROMIUM HEX. as CR	COBALT TOTAL	COPPER TOTAL	CYANIDE as CN	FLUORIDE DISS.	GERMANIUM TOTAL	IRON DISS.	IRON TOTAL	LEAD TOTAL
	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
4-25-89	<0.1						<0.01	66.4	25.9			<0.01					0.82	<0.01
5-23-89								42.9	13.7									
6-21-89								38.6	18.3									
7-19-89								50.1	20.8									
9-25-89								69.9	24.2								0.503	
4-16-90								40.2	44									
5-22-90								49.2	11.8									
6-14-90								60.4	16.3							<0.01	1.17	
7-23-90								50.4	17.2									
8-14-90								55.1	18.0									
10-1-90	<0.1		<0.01	<0.01		0.17	<0.01	73.3	17.6	<0.01		<0.01		0.24		<0.01	0.175	<0.01

DATE	MAGNESIUM TOTAL	MANGANESE TOTAL	MERCURY TOTAL	MOLYBDENUM TOTAL	NICKEL TOTAL	POTASSIUM TOTAL	SELENIUM TOTAL	SILICA as SiO_2	SILVER TOTAL	SODIUM TOTAL	ZINC TOTAL	VANADIUM TOTAL	SULFIDE as S	MAJOR CATIONS	MAJOR ANIONS	$\frac{C-A}{C+A} \cdot 100$	COMMENTS
	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MEQ/L	MEQ/L		
4-25-89	29.4	0.022		<0.01	<0.01	1.4	0.0027			12.1	0.252		<0.1	6.29	5.27	8.82	
5-23-89	44.9					1.8				12.4				6.42	6.28	1.09	
6-21-89	45.1					3.1				15.6				6.40	6.39	0.04	
7-19-89	34.8					3.9				36.2				7.04	7.24	1.46	
9-25-89	50.2	0.040				5.2				24.1				8.80	8.69	0.62	
4-16-90	38.8					3.4				26.8				6.45	7.09	4.69	
5-22-90	25.1					2.0				11.8				5.09	5.54	4.26	
6-14-90	24.6	0.030				2.4				10.3				5.55	5.22	3.01	
7-23-90	46.1					3.4				13.4				6.98	6.67	2.29	
8-14-90	47.9					4.3				14.8				7.44	7.06	2.66	
10-1-90	40.9	0.030	<0.0002	<0.01	<0.01	2.9	<0.002			12.9	<0.01		<0.1	7.66	7.11	4.13	

CONSULTANTS ENGINEERS
HANSEN ALLEN & LUCE INC
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station VC-4
Location Whiskey Canyon Creek above Belina Mine

Date	Time	Flow (CFS)	Temperature Air (°C)	Temperature Water (°C)	pH	Coliform Total (MPN)	Coliform Fecal (MPN)	Fecal Strep (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	Dissolved Oxygen (MG/L)	Oil & Grease (MG/L)	Phenol (MG/L)	Nitrogen Ammonia as NH_3-N (MG/L)	Nitrogen Nitrate as NO_3-N (MG/L)	Nitrogen Nitrite as NO_2-N (MG/L)	Nitrogen Total Kjeldahl (MG/L)	Nitrogen Organic (MG/L)
4-25-89	12:40	0.052	6	4	7.7							9.6			<0.2	0.125	<0.1		
5-23-89	15:50	0.088	15	6	7.4							8.6							
6-21-89	15:45	0.016	10	11	7.9							7.9	<0.5						
7-19-89	14:20	0.0004	25	17	7.8														
9-25-89	12:00	-0-																	
4-16-90	11:30		Inaccessible																
5-22-90	09:20	0.041	17	9	8.0														
6-14-90	12:00	0.046	14	11	7.7							7.6	<0.5						
7-23-90	13:02	0.003	22	15	7.3							11.0							
8-14-90	16:00	0.0003	19	14	7.4							7.1	<0.5						
10-11-90	14:00	-0-																	

Date	Phosphate Total as PO_4-P (MG/L)	Phosphate Ortho as PO_4-P (MG/L)	Sulfate as SO_4 (MG/L)	Hydroxide as OH (MG/L)	Surfactant MBAS (MG/L)	Solids TSS (MG/L)	Solids Total Settleable Solids (ML/L)	Solids TDS (MG/L)	Total Solids (MG/L)	Total Volatile Solids (MG/L)	Specific Cond (µmhos/cm)	Turbidity (FTU)	Carbonate Alk. CO_3 (MG/L)	Bicarbonate Alk. as HCO_3 (MG/L)	Total Alk. as $CaCO_3$ (MG/L)	Total Hardness as $CaCO_3$ (MG/L)	Acidity as $CaCO_3$ (MG/L)	Alpha Radioactivity (pCi/L)	Beta Radioactivity (pCi/L)
4-25-89	0.083		2.9			13		96		42	114			69.9		8.1			
5-23-89			8.5			74		86			98		0	62.9					
6-21-89			45.6			14	<0.1	147			148		0	243			29.8		
7-19-89			71					215			296		0	217					
9-25-89																			
4-16-90																			
5-22-90			0.8			27		75			108		0	62.1					
6-14-90			<0.5			44	<0.1	118			106		0	67.2		54	<10		
7-23-90			10.5			33	<0.1	188			341		2.5	208		173			
8-14-90			<1.0			6.0	<0.1	190			350		4.9	232					
10-11-90																			

Date	Aluminum Total (MG/L)	Antimony Total (MG/L)	Arsenic Total (MG/L)	Barium Total (MG/L)	Beryllium Total (MG/L)	Boron Total (MG/L)	Cadmium Total (MG/L)	Calcium Total (MG/L)	Chloride Diss. (MG/L)	Chromium Hex. as Cr (MG/L)	Cobalt Total (MG/L)	Copper Total (MG/L)	Cyanide as CN (MG/L)	Fluoride Diss. (MG/L)	Germanium Total (MG/L)	Iron Diss. (MG/L)	Iron Total (MG/L)	Lead Total (MG/L)
4-25-89	<0.1						<0.01	19.2	3.6			<0.01					0.85	<0.01
5-23-89								15.7	1.9									
6-21-89								22.6	7.6									
7-19-89								46.5	5.2									
9-25-89																		
4-16-90																		
5-22-90								15.2	0.65									
6-14-90								16.4	2.2							<0.01	1.59	
7-23-90								45.2	0.33									
8-14-90								52.7	<0.5									
10-11-90																		

Date	Magnesium Total (MG/L)	Manganese Total (MG/L)	Mercury Total (MG/L)	Molybdenum Total (MG/L)	Nickel Total (MG/L)	Potassium Total (MG/L)	Selenium Total (MG/L)	Silica as SiO_2 (MG/L)	Silver Total (MG/L)	Sodium Total (MG/L)	Zinc Total (MG/L)	Vanadium Total (MG/L)	Sulfide as S (MG/L)	Major Cations (MEQ/L)	Major Anions (MEQ/L)	$\frac{C-A}{C+A} \times 100$	Comments
4-25-89	3.5	0.020		<0.01	<0.01	0.2	<0.002			3.8	0.215		<0.1	1.42	1.31	3.78	
5-23-89	4.9					0.6				1.2				1.25	1.26	0.29	
6-21-89	4.4					0.4				0.4				1.52	1.56	1.45	
7-19-89	31.7					0.3				0.9				4.97	5.18	2.03	
9-25-89																	
4-16-90																	Covered with Snow
5-22-90	3.2					0.5				1.4				1.10	1.05	1.99	
6-14-90	4.2	<0.01				0.7				2.4				1.29	1.17	4.75	
7-23-90	14.3					0.7				1.8				3.53	3.72	2.65	
8-14-90	13.6					1.0				2.0				3.86	3.99	1.61	
10-11-90																	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE INC
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station: VC-5
Location: Whiskey Canyon Creek below Belina Mine

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITRATE as NO_3-N (MG/L)	NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)	PHOSPHATE TOTAL as PO_4-P (MG/L)	PHOSPHATE ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	HYDROXIDE as OH (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	TOTAL SETTLEABLE SOLIDS (ML/L)	T.D.S. (MG/L)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC COND. (µMHOS/CM)	TURBIDITY (FTU)	CARBONATE ALK. as CO_3 (MG/L)	BICARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIOACTIVITY (pCi/L)	BETA RADIOACTIVITY (pCi/L)
4-25-89	13:15	0.59	6	4	7.7							9.4			<0.2	0.067	<0.01			0.055		97.2			36		457		47	707			218		308			
5-23-89	16:05	0.49	17	8	7.4							8.4										85			7.0		387			622		0	232					
6-21-89	16:35	0.36	16	13	7.6							8.2	<0.5									77			39	<0.1	379			580		0	237			<10		
7-19-89	14:40	0.15	25	19	7.8																	123					425			622		10.5	221					
9-25-89	11:25	0.33	20	4	7.6							10.1	<0.5									129			14	<0.1	423			690		0	268		324	21.4		
4-16-90	11:50	0.32	16	5	7.5																	70			57		462			837		0	221					
5-22-90	10:20	0.23	16	9	7.4																	41			10		327			499		0	176					
6-14-90	12:15	0.31	18	10	7.4							8.1	<0.5									63			81	<0.1	379			522		12.2	216		273	<10		
7-23-90	14:55	0.20	18	18	7.6							11.8										105			42	<0.1	352			593		19.8	210		286			
8-14-90	16:15	0.13	24	18	7.5							9.3	<0.5									94			22	<0.1	338			636		9.8	223					
10-11-90	15:10	0.02	9	4	7.3							12.8	6.6		<0.1	0.06	<0.01			0.017		183			12	<0.1	528			757		8.6	256		417	<10		

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEX as CR (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	GERMANIUM TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)	LEAD TOTAL (MG/L)	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89	<0.1						<0.01	74.8	73.0			<0.01					0.57	<0.01	31.2	0.060		<0.01	<0.01	3.2	0.0048			31.6	0.707		<0.1	7.76	7.66	0.65	
5-23-89								42.4	33.2										42.1					2.8				17.9				6.43	6.51	0.61	
6-21-89								35.3	23.7										44.6					3.9				9.6				5.95	6.16	1.71	
7-19-89								46.4	26.1										42.4					4.7				13.8				6.53	7.27	5.40	
9-25-89								71.4	16.3								0.050		43.9	<0.01				4.2				8.4				7.65	7.54	0.73	
4-16-90								58.1	116										36.7					2.8				52.9				8.29	8.35	0.36	
5-22-90								47.4	56.3										19.8					1.8				32.2				5.44	5.33	1.07	
6-14-90								59.2	26.6							<0.01	0.648		33.2	<0.01				3.3				14.9				6.44	6.00	3.55	
7-23-90								42.1	18.6										46.2					4.3				12.9				6.57	6.81	1.78	
8-14-90								45.1	23.3										47.3					4.6				16.6				6.98	6.60	2.85	
10-11-90	<0.1	<0.01		<0.01		0.23	<0.01	55.8	18.2	<0.01		<0.01		0.21		<0.01	0.130	<0.01	60.9	<0.01	<0.002	<0.01	<0.01	5.1	<0.002			15.1	<0.01		<0.1	8.58	8.52	1.38	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station: VC-10
Location: South Fork Eccles Creek above Eccles Creek

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITROGEN NITRATE as NO_3-N (MG/L)	NITROGEN NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)	PHOSPHATE TOTAL as PO_4-P (MG/L)	PHOSPHATE ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	HYDROXIDE as OH (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	SOLIDS TOTAL SETTLEABLE SOLIDS (ML/L)	SOLIDS T.D.S. (MG/L)	SOLIDS TOTAL SOLIDS (MG/L)	SOLIDS TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC COND. (μMHOS/CM)	TURBIDITY (FTU)	CARBONATE ALK. CO_3 (MG/L)	BI-CARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIO-ACTIVITY (pCi/L)	BETA RADIO-ACTIVITY (pCi/L)
4-25-89	11:30	0.73	6	4	7.0							9.8			<0.2	0.304	<0.01			0.034		18.8			7.5		215		34	315			216		170			
5-23-89	14:10	1.17	20	7	7.4							8.3										100			6.5		166			280		0	172					
6-21-89	16:18	0.32	15	14	7.5							7.9	<0.5									102			6.4	<0.1	323			329		0	228			<10		
7-19-89	13:40	0.13	26	18	7.7																	138					344			359		8.8	232					
9-25-89	10:55	0.03	13	8	7.5							10.6	<0.5									368			22	<0.1	721			1087		0	241		414	<10		
4-16-90	11:06	0.38	16	9	7.6																	22			17		236			341		0	228					
5-22-90	09:56	1.24	16	6	7.4																	<0.5			7.0		176			285		0	173					
6-14-90	10:45	0.83	16	7	7.5							9.1										22.7			5.0	<0.1	237			303		0	207		177	<10		
7-23-90	14:30	0.13	19	18	7.4							11.5										18.1			75	<0.1	203			368		87.4	0		195			
8-14-90	15:40	0.058	21	17	7.4							9.3										24			7	<0.1	237			350		6.1	212					
10-4-90	14:50	0.03	10	3	7.3							15.1			<0.1	0.06	<0.01			0.025		16.4			1.6	<0.1	228			477		6.1	264		220	<10		

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEX. as CR (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	GERMANIUM TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)	LEAD TOTAL (MG/L)	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89	<0.1						<0.01	55.7	6.9			<0.01					0.32	<0.01	12.9	0.055		<0.01	<0.01	0.2	<0.002			4.7	0.235		<0.1	4.05	4.13	0.93	
5-23-89								40.9	4.5										34.1					0.6				0.8				4.90	5.03	1.32	
6-21-89								61.0	8.6										34.9					0.7				1.4				5.99	6.10	0.90	
7-19-89								43.8	4.9										58.6					0.7				1.2				7.08	7.11	0.21	
9-25-89								71.5	15.1								0.255		60.3	0.053				12.1				58.3				11.38	12.04	2.83	
4-16-90								43.7	6.0										20.6					1.2				12.1				4.49	4.36	0.78	
5-22-90								36.9	1.2										11.6					0.6				2.2				2.91	2.88	0.47	
6-14-90								55.2	3.2							<0.01	0.230		14.2	<0.01				1.0				3.1				4.08	3.96	1.59	
7-23-90								38.4	0.41										18.9					0.8				2.2				3.59	3.30	4.15	
8-14-90								44.2	0.86										20.5					1.0				3.0				4.05	4.20	1.86	
10-4-90	<0.1		<0.01	<0.01		0.12	<0.01	64.2	2.2	<0.01		<0.01		<0.1		<0.01	0.160	<0.01	19.8	0.023	<0.0002	<0.01	<0.01	0.7	<0.002			2.2	<0.01		<0.1	4.94	4.94	0.00	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station VC-11
Location Boardinghouse Creek above Spring houses

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP. (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITROGEN NITRATE as NO_3-N (MG/L)	NITROGEN NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)
4-25-89	10:37	1.24	6	3	7.4							9.4			<0.2	0.243	<0.01		
5-23-89	10:26	1.30	17	7	7.3							8.5							
6-21-89	10:40	0.63	5	6	7.1							8.9	<0.5						
7-19-89	8:55	0.33	13	9	7.5														
9-26-89	12:25	0.226	20	8	7.6							10.5	<0.5						
4-16-90	09:28	0.64	15	9	7.5														
5-22-90	12:20	1.60	18	13	7.4														
6-14-90	13:10	1.00	20	13	7.4							7.4							
7-23-90	11:35	0.184	22	13	7.3							12.0							
8-14-90	14:54	0.27	23	15	7.4							9.8							
10-11-90	09:45	0.11	3	4	7.5							11.4			<0.1	0.05	<0.01		

DATE	PHOSPHATE TOTAL as PO_4-P (MG/L)	PHOSPHATE ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	HYDROXIDE as OH (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	SOLIDS TOTAL SETTLEABLE SOLIDS (ML/L)	SOLIDS T.D.S. (MG/L)	SOLIDS TOTAL SOLIDS (MG/L)	SOLIDS TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC COND. (µMHOS/CM)	TURBIDITY (FTU)	CARBONATE ALK. as CO_3 (MG/L)	BI-CARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIO-ACTIVITY (pCi/L)	BETA RADIO-ACTIVITY (pCi/L)
4-25-89	0.059		18.3			15		196		59	320			188		178			
5-23-89			130			7.0		164			296		0	177					
6-21-89			29.0			8.0	<0.1	234			379		0	258			<10		
7-19-89			76					300			500		0	307					
9-26-89			33			2.5	<0.1	276			510		0	317		269	<10		
4-16-90			28			11		217			520		0	214					
5-22-90			<0.5			7.5		164			249		0	158					
6-14-90			21.2			19	<0.1	222			271		0	190		170	<10		
7-23-90			28.6			14	<0.1	261			374		0	257		221			
8-14-90			36			28	<0.1	278			496		4.9	290					
10-11-90	0.015		266			8.4	<0.1	289			476		11.1	307		279	<10		

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEX. as CR (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	GERMANIUM TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)
4-25-89	<0.1						<0.01	46.8	8.1			<0.01					0.76
5-23-89								40.2	5.4								
6-21-89								47.1	11.3								
7-19-89								51.9	7.3								
9-25-89								70.2	8.2								0.310
4-16-90								39.5	4.8								
5-22-90								32.8	1.4								
6-14-90								50.2	3.6							<0.01	0.456
7-23-90								44.4	1.73								
8-14-90								48.2	2.47								
10-11-90	<0.1		<0.01	<0.01		0.12	<0.01	75.2	3.3	<0.01		<0.01		<0.1		<0.01	0.220

DATE	LEAD TOTAL (MG/L)	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89	0.030	12.0	0.085		<0.01	<0.01	1.2	<0.002			5.8	0.255		<0.1	3.61	3.69	1.10	
5-23-89		42.2					0.7				1.8				5.57	5.76	1.63	
6-21-89		28.5					0.8				2.0				4.80	5.15	3.50	
7-19-89		47.9					0.9				3.2				6.69	6.82	0.93	
9-25-89		35.4	<0.01				1.1				4.0				6.62	6.11	3.96	
4-16-90		21.6					1.2				10.6				4.24	4.23	0.17	
5-22-90		11.0					0.7				1.8				2.64	2.64	0.03	
6-14-90		14.3	<0.01				1.2				3.1				3.85	3.66	2.53	
7-23-90		27.2					1.1				22.9				5.48	5.35	1.20	
8-14-90		30.6					1.6				3.2				5.10	5.74	5.83	
10-11-90	<0.01	30.1	0.013	<0.0002	<0.01	<0.01	1.3	<0.002			2.9	<0.01		<0.1	6.38	6.03	2.65	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE INC
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station VC-12
Location Finn Canyon Creek above Clear Creek

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITROGEN NITRATE as NO_3-N (MG/L)	NITROGEN NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)	PHOSPHATE TOTAL as PO_4-P (MG/L)	PHOSPHATE ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	HYDROXIDE as OH (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	SOLIDS TOTAL SETTLEABLE SOLIDS (ML/L)	SOLIDS T.D.S. (MG/L)	SOLIDS TOTAL SOLIDS (MG/L)	SOLIDS TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC CONDUCTANCE (µMHOS/CM)	TURBIDITY (FTU)	CARBONATE ALK. as CO_3 (MG/L)	BI-CARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIO-ACTIVITY (pCi/L)	BETA RADIO-ACTIVITY (pCi/L)
4-25-89	10:00	0.153	8	5	8.2							8.6			<0.2	0.255	<0.01			0.055		17.8			8.5		205		67	329			216		174			
5-23-89	09:38	0.424	16	8	7.7							9.2										89.8			11		154			242		0	172					
6-21-89	09:40	0.101	5	7	7.3							7.8	<0.5									88			8.4	<0.1	218			283		0	228			<10		
7-19-89	08:30	0.002	18	9	7.3																	48					321			347		0	320					
9-25-89	15:20	0.0004	19	10	7.8							7.9	<0.5									45			61	<0.1	354			544		0	341		314	<10		
4-16-90	10:45	0.0225	15	8	7.4																	36			52		287			486		0	302					
5-22-90	11:55	0.343	17	7	7.5																	<0.5			24		156			244		0	158					
6-19-90	16:50	0.52	18	13	8.0							7.1										<0.5			41	<0.1	173			229		0	151		125	<10		
7-23-90	10:40	0.005	24	11	7.5							6.8										32.6			7.5	<0.1	268			473		0	282		248			
8-14-90	14:15	Dry																																				
10-11-90	09:06	0.001	4	5	7.5							4.0			<0.1	0.06	<0.01			0.069		42.7			14	<0.1	331			527		8.6	338		298	<10		

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEX. as CR (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	[illegible] TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)	LEAD TOTAL (MG/L)	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89	<0.1						<0.01	51.6	7.9			<0.01					0.44	0.065	14.8	0.045		<0.01	<0.01	0.8	<0.002			4.6	0.315		<0.1	4.01	4.13	1.48	
5-23-89								32.1	3.2										39.1					0.7				1.4				4.90	4.78	1.23	
6-21-89								53.2	10.9										33.2					0.6				2.1				5.49	5.88	3.37	
7-19-89								31.8	6.4										58.9					1.4				1.9				6.55	6.42	0.98	
9-25-89								78.8	7.7								0.770		39.8	0.060				1.4				39				7.41	6.74	4.73	
4-16-90								42.9	5.3										32.7					1.9				12.9				6.44	5.85	3.61	
5-22-90								32.7	0.8										11.2					0.6				2.0				2.66	2.62	0.63	
6-14-90								37.3	3.4							<0.01	1.41		9.8	0.020				1.0				2.9				2.82	2.58	4.45	
7-23-90								48.8	1.3										27.4					1.0				2.9				4.84	5.34	4.87	
8-14-90																																			
10-11-90	<0.1		<0.01	<0.01		0.14	<0.01	79.1	3.6	<0.01		<0.01		0.12		<0.01	0.495	<0.01	33.5	0.130	<0.0002	<0.01	<0.01	1.6	<0.002			3.3	<0.01		<0.1	6.89	6.82	0.51	

CONSULTANTS ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station S 7-11
Location

Date	Time	Flow (CFS)	Temperature Air (°C)	Temperature Water (°C)	pH	Coliform Total (MPN)	Coliform Fecal (MPN)	Fecal Strep. (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	Dissolved Oxygen (MG/L)	Oil & Grease (MG/L)	Phenol (MG/L)	Nitrogen: Ammonia as NH_3-N (MG/L)	Nitrogen: Nitrate as NO_3-N (MG/L)	Nitrogen: Nitrite as NO_2-N (MG/L)	Nitrogen Total Kjeldahl (MG/L)	Nitrogen Organic (MG/L)	Phosphate Total as PO_4-P (MG/L)	Phosphate Ortho as PO_4-P (MG/L)	Sulfate as SO_4 (MG/L)	Hydroxide as OH (MG/L)	Surfactant as MBAS (MG/L)	Solids: TSS (MG/L)	Solids: Total Settleable Solids (ML/L)	Solids: T.D.S. (MG/L)	Solids: Total Solids (MG/L)	Solids: Total Volatile Solids (MG/L)	Specific Cond. (µmhos/cm)	Turbidity (FTU)	Carbonate Alk. as CO_3 (MG/L)	Bicarbonate Alk. as HCO_3 (MG/L)	Total Alk. as $CaCO_3$ (MG/L)	Total Hardness as $CaCO_3$ (MG/L)	Acidity as $CaCO_3$ (MG/L)	Alpha Radioactivity (pCi/L)	Beta Radioactivity (pCi/L)
4-25-89	11:00		Inaccessible																																			
5-23-89	11:30		Inaccessible																																			
6-21-89	12:57	0.013	7	7	7.8																	8.8					86			89		0	55.8		8.2	35.4		
7-19-89	10:30	0.0003	21	16	7.4																	[illegible]					193			299		0	176					
9-25-89	17:40	Seep		10	7.6																	16.4					284			410		0	199		210			
4-16-90	09:30		Inaccessible																																			
5-22-90	13:20		Inaccessible																																			
6-19-90	16:00		Inaccessible																																			
7-23-90	16:10	0.001	15	14	7.6																	23.5					251			427		2.1	188		222			
8-14-90	09:27	0.0007	11	8	7.6																	29					252			556		0	259					
10-11-90	11:25	0.0006	2	1	7.5										<0.1	2.19	<0.01			0.100		15.8					162			421		[illegible]	257		230			

Date	Aluminum Total (MG/L)	Antimony Total (MG/L)	Arsenic Total (MG/L)	Barium Total (MG/L)	Beryllium Total (MG/L)	Boron Total (MG/L)	Cadmium Total (MG/L)	Calcium Total (MG/L)	Chloride Diss. (MG/L)	Chromium Hexavalent (MG/L)	Cobalt Total (MG/L)	Copper Total (MG/L)	Cyanide as CN (MG/L)	Fluoride Diss. (MG/L)	[illegible] Total (MG/L)	Iron Diss. (MG/L)	Iron Total (MG/L)	Lead Total (MG/L)	Magnesium Total (MG/L)	Manganese Total (MG/L)	Mercury Total (MG/L)	Molybdenum Total (MG/L)	Nickel Total (MG/L)	Potassium Total (MG/L)	Selenium Total (MG/L)	Silica as SiO_2 (MG/L)	Silver Total (MG/L)	Sodium Total (MG/L)	Zinc Total (MG/L)	Vanadium Total (MG/L)	Sulfide as S (MG/L)	Major Cations (MEQ/L)	Major Anions (MEQ/L)	$\frac{C-A}{C+A} \times 100$	Comments
4-25-89																																			Road impassible - Snow
5-23-89																																			Road impassible - Snow
6-21-89								24.4	7.9							<0.01		<0.01	2.4					0.2				0.8				1.45	1.32	4.84	
7-19-89								42.4	11.4										9.6					<0.1				12.8				3.46	3.35	1.59	
9-25-89								50.8	15.7							<0.01	0.453		18.2	0.020				1.0				4.2				4.24	4.05	2.35	
4-16-90																																			Road impassible - Snow
5-22-90																																			Road impassible - Snow
6-14-90																																			Road impassible - Snow
7-23-90								51.2	13.9								<0.01		15.0	0.012				0.4				4.3				3.99	4.03	0.58	
8-14-90								71.8	17.8										16.9					0.8				6.6				5.28	5.35	0.66	
10-11-90	<0.1		<0.01	<0.01		<0.1	<0.01	74.4	13.2	<0.01		<0.01		<0.1		<0.01	2.48	<0.01	15.7	0.115	<0.0002	<0.01	<0.01	0.4	<0.002			3.2	0.013		<0.1	5.15	5.20	0.48	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE INC
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station S 24-12
Location

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITROGEN NITRATE as NO_3-N (MG/L)	NITROGEN NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)
4-25-89	11:40		Inaccessible																
5-23-89	13:30	0.001	14	9	7.3										0.36	<0.01	<0.005		
6-21-89	14:55	0.00014	17	9	7.4														
7-19-89	13:15	0.00013	23	14	7.6														
9-25-89	10:15	Seep	5	5	7.2														
4-16-90	11:20		Inaccessible																
5-22-90	13:20		Inaccessible																
6-14-90	10:05	0.0001	13	7	7.5														
7-23-90	14:04	0.0001	26	17	7.3														
8-7-90	16:12	0.0001	26	16	7.4														
10-11-90	19:40	Seep	No Sample																

DATE	PHOSPHATE TOTAL as PO_4-P (MG/L)	PHOSPHATE ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	HYDROXIDE as OH (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	SOLIDS TOTAL SETTLEABLE SOLIDS (ML/L)	SOLIDS T.D.S. (MG/L)	SOLIDS TOTAL SOLIDS (MG/L)	SOLIDS TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC COND. (µMHOS/CM)	TURBIDITY (FTU)	CARBONATE ALK. as CO_3 (MG/L)	BI-CARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIO-ACTIVITY (pCi/L)	BETA RADIO-ACTIVITY (pCi/L)
4-25-89																			
5-23-89		0.019	79					264			480		0	261		251			
6-21-89			45.0					287			478		0	241			<10		
7-19-89			46.2					299			494		8.8	255					
9-25-89			33.3					316			310		0	286		275			
4-16-90																			
5-22-90																			
6-14-90			26.1					285			429		12.2	238		245			
7-23-90			31.8					226			427		111	10		211			
8-7-90			38					239			402		1.2	250					
10-11-90																			

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEXA CR (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	GERMANIUM TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)	LEAD TOTAL (MG/L)
4-25-89																		
5-23-89	<0.1						<0.01	51.2	4.1			0.012				<0.01		<0.01
6-21-89								48.2	6.0									
7-19-89								43.9	6.4									
9-25-89								56.5	9.0							<0.01	0.120	
4-16-90																		
5-22-90																		
6-14-90								57.2	3.8							<0.01		
7-23-90								37.6	0.27									
8-7-90								37.1	0.87									
10-11-90																		

DATE	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89																	Road impossible - Snow
5-23-89	36.8	<0.01		<0.01		1.4	<0.002			2.4	0.050		<0.1	5.72	6.04	2.68	
6-21-89	30.7					2.0				2.4				5.09	5.06	0.30	
7-19-89	31.5					4.0				3.0				5.02	5.61	5.64	
9-25-89	31.2	<0.01				2.5				3.4				5.60	5.63	0.32	
4-16-90																	Road impossible - Snow
5-22-90																	Road impossible - Snow
6-14-90	24.5	<0.01				2.3				4.5				5.12	4.96	1.66	
7-23-90	30.9					1.2				2.7				4.57	4.53	0.37	
8-7-90	39.2					2.2				2.5				5.24	4.95	2.83	
10-11-90																	Unable to Collect Sample

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station S 25-13
Location

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITRATE as NO_3-N (MG/L)	NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)
4-25-89	12:25		Inaccessible																
5-23-89	15:15	0.052	15	5	7.2										<0.2	0.088	<0.005		
6-21-89	15:30	0.016	11	7	7.5														
7-19-89	14:05	0.002	25	11	7.9														
9-25-89	11:47	0.002	15	12	7.6														
4-16-90	11:30		Inaccessible																
5-22-90	09:40	0.0197	11	5	7.6														
6-14-90	11:40	0.0354	13	7	7.2														
7-23-90	13:08	0.0015	17	11	7.2														
8-8-90	11:05	0.0012	20	10	7.5														
10-4-90	14:00	0.006	10	8	7.4										<0.1	0.46	<0.01		

DATE	PHOSPHATE TOTAL as PO_4-P (MG/L)	ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	CYANIDE as CN (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	TOTAL SETTLEABLE SOLIDS (ML/L)	T.D.S. (MG/L)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC COND. (µMHOS/CM)	TURBIDITY (FTU)	CARBONATE ALK. CO_3 (MG/L)	BI-CARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIO-ACTIVITY (pCi/L)	BETA RADIO-ACTIVITY (pCi/L)
4-25-89																			
5-23-89		<0.01	55.4					51			76		0	41.5		<0.5			
6-21-89			50.1					106			120		0	70.2			228		
7-19-89			8.5					185			316		6.3	184					
9-25-89			9.6					193			265		0	184		159			
4-16-90																			
5-22-90			2.3					62			74		0	38.3					
6-14-90			20.5					108			73		0	37.8		40			
7-23-90			12.5					177			351		0	196		162			
8-8-90			18					150			246		0	154					
10-4-90	0.062		12.8					257			256		3.7	170		137			

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEX as CR (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	[illegible] TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)
4-25-89																	
5-23-89	<0.1						<0.01	14.6	3.9			0.020				<0.01	
6-21-89								16.9	4.0								
7-19-89								45.2	7.6								
9-25-89								53.9	10.1							<0.01	0.240
4-16-90																	
5-22-90								9.2	0.4								
6-14-90								14.1	2.2							<0.01	
7-23-90								40.2	0.41								
8-8-90								43.1	<0.1								
10-4-90	<0.1		<0.01	<0.01		0.10	<0.01	49.2	2.2	<0.01		<0.01		<0.1		<0.01	0.730

DATE	LEAD TOTAL (MG/L)	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89																		Covered with Snow
5-23-89	<0.01	12.5	<0.01		<0.01	<0.01	0.4	0.0034			0.4	0.218		<0.1	1.78	1.94	4.26	
6-21-89		13.8					0.5				0.5				2.01	2.31	6.78	
7-19-89		11.4					10.9				2.0				3.56	3.62	0.80	
9-25-89		12.1	0.015				1.0				2.4				3.82	3.50	4.41	
4-16-90																		Covered with Snow
5-22-90		1.7					0.5				0.7				0.64	0.69	3.24	
6-14-90		3.1	0.035				0.8				2.0				1.07	1.11	1.94	
7-23-90		12.7					0.4				2.2				3.16	3.48	4.93	
8-8-90		6.3					0.4				1.1				2.73	2.90	3.07	
10-4-90	<0.01	6.5	0.038	<0.0002	<0.01	<0.01	0.4	<0.002			1.1	<0.01		<0.1	3.04	3.24	3.18	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE INC
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station S31-13
Location ____________

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITRATE as NO_3-N (MG/L)	NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)	PHOSPHATE TOTAL as PO_4-P (MG/L)	ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	HYDROXIDE as OH (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	TOTAL SETTLEABLE SOLIDS (ML/L)	T.D.S. (MG/L)	TOTAL SOLIDS (MG/L)	TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC COND. (µMHOS/CM)	TURBIDITY (FTU)	CARBONATE ALK. CO_3 (MG/L)	BI-CARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIO-ACTIVITY (pCi/L)	BETA RADIO-ACTIVITY (pCi/L)
4-25-89	11:00		Inaccessible																																			
5-23-89	11:50		Inaccessible																																			
6-21-89	11:57	0.007	10	6	7.5																	61.8					256			367		0	246		202	<10		
7-19-89	11:05	0.004	25	8	7.5																	27.7					251			463		0	279					
9-25-89	16:50	0.001		5	7.7																	29.2					308			405		0	294		274			
4-16-90	09:30		Inaccessible																																			
5-22-90	13:20		Inaccessible																																			
6-19-90	15:10	0.0098	17	5	7.3																	18.6					234			338		0	236		203			
7-23-90	16:45	0.0033	18	8	7.6																	24.2					262			470		0	278		244			
8-10-90	11:35	0.0003	18	8	7.5																	32					285			475		0	298					
10-11-90	12:12	0.0012	8	8	7.6										<0.1	0.60	<0.01			<0.01		29.8					309			498		17.2	292		282			

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEX as CR (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	[illegible] TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)	LEAD TOTAL (MG/L)	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89																																			Road Impassible-Snow
5-23-89																																			Road Impassible-Snow
6-21-89								52.8	7.2							<0.01		<0.01	34.2					0.7				1.3				5.52	5.52	0.02	
7-19-89								55.7	5.3										28.4					2.8				2.4				5.29	5.30	0.06	
9-25-89								59.4	4.7							<0.01	<0.01		28.1	<0.01				0.9				2.4				5.40	5.56	1.42	
4-16-90																																			Road Impassible-Snow
5-22-90																																			Road Impassible-Snow
6-19-90								63.3	3.0							<0.01			16.3	<0.01				1.3				2.5				4.64	4.34	3.36	
7-23-90								64.1	<0.1										20.1					0.7				1.8				4.95	5.06	1.13	
8-10-90								63.8	0.21										24.2					0.8				1.5				5.26	5.56	2.73	
10-11-90	<0.1		<0.01	<0.01		0.11	<0.01	82.1	1.7	<0.01		<0.01		<0.1		<0.01	0.028	<0.01	23.2	<0.01	<0.0002	<0.01	<0.01	0.9	<0.002			2.5	<0.01		<0.1	6.13	6.04	0.74	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station S 36-17
Location

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR (°C)	TEMPERATURE WATER (°C)	pH	COLIFORM TOTAL (MPN)	COLIFORM FECAL (MPN)	FECAL STREP. (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	DISSOLVED OXYGEN (MG/L)	OIL & GREASE (MG/L)	PHENOL (MG/L)	NITROGEN AMMONIA as NH_3-N (MG/L)	NITROGEN NITRATE as NO_3-N (MG/L)	NITROGEN NITRITE as NO_2-N (MG/L)	NITROGEN TOTAL KJELDAHL (MG/L)	NITROGEN ORGANIC (MG/L)	PHOSPHATE TOTAL as PO_4-P (MG/L)	PHOSPHATE ORTHO as PO_4-P (MG/L)	SULFATE as SO_4 (MG/L)	HYDROXIDE as OH (MG/L)	SURFACTANT as MBAS (MG/L)	SOLIDS TSS (MG/L)	SOLIDS TOTAL SETTLEABLE SOLIDS (ML/L)	SOLIDS T.D.S. (MG/L)	SOLIDS TOTAL SOLIDS (MG/L)	SOLIDS TOTAL VOLATILE SOLIDS (MG/L)	SPECIFIC COND. (µMHOS)	TURBIDITY (FTU)	CARBONATE ALK. CO_3 (MG/L)	BICARBONATE ALK. as HCO_3 (MG/L)	TOTAL ALK. as $CaCO_3$ (MG/L)	TOTAL HARDNESS as $CaCO_3$ (MG/L)	ACIDITY as $CaCO_3$ (MG/L)	ALPHA RADIO-ACTIVITY (pCi/L)	BETA RADIO-ACTIVITY (pCi/L)
4-25-89	11:00		Inaccessible																																			
5-23-89	10:53	0.015	17	11	7.5										<0.2	0.305	<0.005				0.158	51.1					226			367		0	267		204			
6-21-89	11:10	0.012	10	7	7.6																	52.8					205			398		0	248			14.2		
7-19-89	09:40	0.010	19	9	7.5																	5.0					259			432		4.0	288					
9-25-89	13:10	0.004	20	7	7.6																	8.0					239			496		0	280		236			
4-16-90	09:30		Inaccessible																																			
5-22-90	13:00	0.016	16	10	7.1																	1.3					242			375		0	203					
6-19-90	13:55	0.145	15	13	7.4																	16.2					262			410		0	271		224			
7-23-90	12:00	0.0023	16	10	7.4																	11.5					259			444		2.5	293		238			
8-9-90	14:17	0.0026	15	10	7.6																	15					241			406		0	297					
10-11-90	10:25	0.0022	10	5	7.3										<0.1	0.37	<0.01			0.080		16.8					249			400		12.3	275		235			

DATE	ALUMINUM TOTAL (MG/L)	ANTIMONY TOTAL (MG/L)	ARSENIC TOTAL (MG/L)	BARIUM TOTAL (MG/L)	BERYLLIUM TOTAL (MG/L)	BORON TOTAL (MG/L)	CADMIUM TOTAL (MG/L)	CALCIUM TOTAL (MG/L)	CHLORIDE DISS. (MG/L)	CHROMIUM HEXAVALENT (MG/L)	COBALT TOTAL (MG/L)	COPPER TOTAL (MG/L)	CYANIDE as CN (MG/L)	FLUORIDE DISS. (MG/L)	GERMANIUM TOTAL (MG/L)	IRON DISS. (MG/L)	IRON TOTAL (MG/L)	LEAD TOTAL (MG/L)	MAGNESIUM TOTAL (MG/L)	MANGANESE TOTAL (MG/L)	MERCURY TOTAL (MG/L)	MOLYBDENUM TOTAL (MG/L)	NICKEL TOTAL (MG/L)	POTASSIUM TOTAL (MG/L)	SELENIUM TOTAL (MG/L)	SILICA as SiO_2 (MG/L)	SILVER TOTAL (MG/L)	SODIUM TOTAL (MG/L)	ZINC TOTAL (MG/L)	VANADIUM TOTAL (MG/L)	SULFIDE as S (MG/L)	MAJOR CATIONS (MEQ/L)	MAJOR ANIONS (MEQ/L)	$\frac{C-A}{C+A} \times 100$	COMMENTS
4-25-89																																			Road Impassible - Snow
5-23-89	<0.1						<0.01	60.2	3.5			0.012				<0.01		<0.01	29.2	<0.01		<0.01	<0.01	0.5	0.0024			2.8	0.080		<0.1	5.54	5.54	0.02	
6-21-89								70.2	10.0										21.4					0.2				1.4				5.33	5.45	1.08	
7-19-89								45.6	4.2										23.1					2.8				2.5				4.35	5.07	7.63	
9-25-89								65.4	5.3							<0.01	0.120		19.2	<0.01				1.2				3.2				5.01	4.91	1.09	
4-16-90																																			Road Impassible - Snow
5-22-90								44.8	0.6										12.4					0.4				1.9				3.35	3.37	0.33	
6-19-90								69.8	3.2							<0.01			14.2	<0.01				0.8				3.6				4.83	4.87	0.42	
7-23-90								56.3	<0.1										15.3					0.2				22.2				5.04	5.13	0.86	
9-9-90								60.4	<0.1										17.9					0.5				1.8				4.58	5.18	6.18	
10-11-90	<0.1		<0.01	<0.01		0.10	<0.01	74.4	2.0	<0.01		<0.01		0.10		<0.01	1.68	<0.01	15.6	0.068	<0.0002	<0.01	<0.01	0.5	<0.002			2.6	<0.01		<0.1	5.12	5.33	2.01	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station S36-19
Location

Date	Time	Flow (CFS)	Temperature Air (°C)	Temperature Water (°C)	pH	Coliform Total (MPN)	Coliform Fecal (MPN)	Fecal Strep (MPN)	C.O.D. (MG/L)	B.O.D. (MG/L)	T.O.C. (MG/L)	Dissolved Oxygen (MG/L)	Oil & Grease (MG/L)	Phenol (MG/L)	Nitrogen Ammonia as NH_3-N (MG/L)	Nitrate as NO_3-N (MG/L)	Nitrite as NO_2-N (MG/L)	Nitrogen Total Kjeldahl (MG/L)	Nitrogen Organic (MG/L)
4-25-89	11:00		Inaccessible																
5-23-89	11:50	0.035	17	4	7.2										<0.2	0.170	<0.005		
6-27-89	15:45	0.004	10	7	7.5														
7-19-89	11:45	0.003	23	8	7.5														
9-25-89	16:25	0.0008	18	6	7.5														
4-16-90	09:30		Inaccessible																
5-22-90	13:20		Inaccessible																
6-14-90	15:40	0.0104	17	8	7.7														
7-23-90	17:20	0.0023	16	7	7.6														
8-13-90	10:40	0.0024	22	6	7.3														
10-4-90	12:45	0.001	5	7	7.4										<0.1	0.49	<0.01		

Date	Phosphate Total as PO_4-P (MG/L)	Ortho as PO_4-P (MG/L)	Sulfate as SO_4 (MG/L)	Hydroxide as OH (MG/L)	Surfactant as MBAS (MG/L)	Solids TSS (MG/L)	Total Settleable Solids (ML/L)	T.D.S. (MG/L)	Total Solids (MG/L)	Total Volatile Solids (MG/L)	Specific Cond (µMHOS)	Turbidity (FTU)	Carbonate Alk. CO_3 (MG/L)	Bi-Carbonate Alk. as HCO_3 (MG/L)	Total Alk. as $CaCO_3$ (MG/L)	Total Hardness as $CaCO_3$ (MG/L)	Acidity as $CaCO_3$ (MG/L)	Alpha Radio-Activity (pCi/L)	Beta Radio-Activity (pCi/L)
4-25-89																			
5-23-89		0.040	48.8					81			112		0	67.2		34.1			
6-27-89			24.8					138			185		0	125			<10		
7-19-89			10.2					145			262		0	174					
9-25-89			5.6					655			314		0	176		150			
4-16-90																			
5-22-90																			
6-14-90			12.5					158			156		0	103		83			
7-23-90			5.7					126			250		0	144		121			
8-13-90			1.6					111			300		0	159					
10-4-90	0.067		10.5					154			281		0	190		143			

Date	Aluminum Total (MG/L)	Antimony Total (MG/L)	Arsenic Total (MG/L)	Barium Total (MG/L)	Beryllium Total (MG/L)	Boron Total (MG/L)	Cadmium Total (MG/L)	Calcium Total (MG/L)	Chloride Diss. (MG/L)	Chromium Hexa-Cr (MG/L)	Cobalt Total (MG/L)	Copper Total (MG/L)	Cyanide as CN (MG/L)	Fluoride Diss. (MG/L)	Germanium Total (MG/L)	Iron Diss. (MG/L)	Iron Total (MG/L)	Lead Total (MG/L)
4-25-89																		
5-23-89	<0.1						<0.01	20.8	3.1			0.015				<0.01		<0.01
6-27-89								33.8	6.4									
7-19-89								38.7	8.6									
9-25-89								56.8	8.5							<0.01	0.135	
4-16-90																		
5-22-90																		
6-14-90								30.1	2.7							<0.01		
7-23-90								42.6	<0.1									
8-13-90								46.3	<0.5									
10-4-90	<0.1		<0.01	<0.01		0.10	<0.01	54.1	1.6	<0.01		<0.01		<0.1		<0.01	0.255	0.155

Date	Magnesium Total (MG/L)	Manganese Total (MG/L)	Mercury Total (MG/L)	Molybdenum Total (MG/L)	Nickel Total (MG/L)	Potassium Total (MG/L)	Selenium Total (MG/L)	Silica as SiO_2 (MG/L)	Silver Total (MG/L)	Sodium Total (MG/L)	Zinc Total (MG/L)	Vanadium Total (MG/L)	Sulfide as S (MG/L)	Major Cations (MEQ/L)	Major Anions (MEQ/L)	$\frac{C-A}{C+A} \times 100$	Comments
4-25-89																	Road Impassible-Snow
5-23-89	11.8	<0.01		<0.01	<0.01	0.3	<0.002			1.6	0.090		<0.1	2.09	2.20	2.77	
6-27-89	13.3					0.3				1.7				2.86	2.75	2.09	
7-19-89	14.5					2.6				3.1				3.32	3.31	0.28	
9-25-89	6.8	<0.01				1.2				2.6				3.54	3.24	4.38	
4-16-90																	Road Impassible-Snow
5-22-90																	Road Impassible-Snow
6-14-90	4.8	<0.01				0.6				2.7				2.03	2.02	0.13	
7-23-90	5.2					0.2				1.4				2.62	2.48	2.73	
8-13-90	5.4					0.5				1.4				2.83	2.65	3.25	
10-4-90	6.7	<0.01	<0.0002	<0.01	<0.01	0.5	<0.002			1.1	0.023		<0.1	3.31	3.38	1.05	

HANSEN ALLEN & LUCE INC
CONSULTANTS/ENGINEERS
SALT LAKE CITY, UTAH

WATER QUALITY DATA

Station S36-23
Location

DATE	TIME	FLOW (CFS)	TEMPERATURE AIR °C	TEMPERATURE WATER °C	pH	COLIFORM TOTAL MPN	COLIFORM FECAL MPN	FECAL STREP. MPN	C.O.D. MG/L	B.O.D. MG/L	T.O.C. MG/L	DISSOLVED OXYGEN MG/L	OIL & GREASE MG/L	PHENOL MG/L	NITROGEN AMMONIA as NH_3-N MG/L	NITRATE as NO_3-N MG/L	NITRITE as NO_2-N MG/L	NITROGEN TOTAL KJELDAHL MG/L	NITROGEN ORGANIC MG/L
4-25-89	11:00		Inaccessible																
5-23-89	12:30	0.011	13	3	7.5										<0.2	0.433	<.0056		
6-21-89	14:10	0.008	10	3	7.3														
7-19-89	12:10	0.007	18	4	7.4														
9-25-89	15:55	0.0012	21	6	7.6														
4-16-90	09:30		Inaccessible																
5-23-90	13:20		Inaccessible																
6-14-90	16:10	0.0104	15	5	7.6														
7-23-90	17:45	0.008	16	4	7.6														
8-9-90	13:04	0.0074	17	6	7.4														
10-11-90	13:20	0.0048	9	5	7.3										<0.1	0.46	<0.01		

DATE	PHOSPHATE TOTAL as PO_4-P MG/L	ORTHO as PO_4-P MG/L	SULFATE as SO_4 MG/L	CHLORIDE as Cl MG/L	SURFACTANT as MBAS MG/L	SOLIDS TSS MG/L	TOTAL SETTLEABLE SOLIDS ML/L	T.D.S. MG/L	TOTAL SOLIDS MG/L	TOTAL VOLATILE SOLIDS MG/L	SPECIFIC COND. µMHOS/CM	TURBIDITY FTU	CARBONATE ALK. as CO_3 MG/L	BICARBONATE ALK. as HCO_3 MG/L	TOTAL ALK. as $CaCO_3$ MG/L	TOTAL HARDNESS as $CaCO_3$ MG/L	ACIDITY as $CaCO_3$ MG/L	ALPHA RADIOACTIVITY pCi/L	BETA RADIOACTIVITY pCi/L
4-25-89																			
5-23-89		0.076	57.1					184			298		0	200		142			
6-21-89			54.9					241			366		0	249			<10		
7-19-89			71.0					336			398		0	264					
9-25-89			7.6					261			415		0	268		220			
4-16-90																			
5-23-90																			
6-14-90			8.5					246			322		0	221		183			
7-23-90			42					221			398		0	258		209			
8-9-90			<1					226			396		0	271					
10-11-90	0.022		6.6					279			395		6.1	246		215			

DATE	ALUMINUM TOTAL MG/L	ANTIMONY TOTAL MG/L	ARSENIC TOTAL MG/L	BARIUM TOTAL MG/L	BERYLLIUM TOTAL MG/L	BORON TOTAL MG/L	CADMIUM TOTAL MG/L	CALCIUM TOTAL MG/L	CHLORIDE DISS. MG/L	CHROMIUM HEXAV. CR MG/L	COBALT TOTAL MG/L	COPPER TOTAL MG/L	CYANIDE as CN MG/L	FLUORIDE DISS. MG/L	GERMANIUM TOTAL MG/L	IRON DISS. MG/L	IRON TOTAL MG/L
4-25-89																	
5-23-89	<0.1						<0.01	45.5	3.6			0.012				<0.01	
6-21-89								56.8	5.3								
7-19-89								60.2	5.2								
9-25-89								71.1	7.7							<0.01	0.155
4-16-90																	
5-22-90																	
6-14-90								63.8	2.7							<0.01	
7-23-90								72.8	<0.1								
8-9-90								64.9	<0.1								
10-11-90	<0.1		<0.01	<0.01		<0.1	<0.01	76.1	1.6	<0.01		<0.01		<0.1		<0.01	0.123

DATE	LEAD TOTAL MG/L	MAGNESIUM TOTAL MG/L	MANGANESE TOTAL MG/L	MERCURY TOTAL MG/L	MOLYBDENUM TOTAL MG/L	NICKEL TOTAL MG/L	POTASSIUM TOTAL MG/L	SELENIUM TOTAL MG/L	SILICA as SiO_2 MG/L	SILVER TOTAL MG/L	SODIUM TOTAL MG/L	ZINC TOTAL MG/L	VANADIUM TOTAL MG/L	SULFIDE as S MG/L	MAJOR CATIONS MEQ/L	MAJOR ANIONS MEQ/L	$\frac{C-A}{C+A}\times 100$	COMMENTS
4-25-89																		Road Impassible-Snow
5-23-89	<0.01	20.6	<0.01		<0.01	<0.01	0.5	<0.002			2.4	0.068		<0.1	4.08	4.51	5.61	
6-21-89		27.8					0.3				2.6				5.24	5.37	1.23	
7-19-89		19.7					2.63				4.1				5.35	5.95	5.34	
9-25-89		13.1	<0.01				0.9				2.8				4.77	4.77	0.03	
4-16-90																		Road Impassible-Snow
5-22-90																		Road Impassible-Snow
6-14-90		9.1	<0.01				0.8				3.2				4.09	3.88	2.72	
7-23-90		10.6					0.2				1.9				4.59	4.32	3.09	
8-9-90		10.3					0.4				1.9				4.18	4.44	3.05	
10-11-90	<0.01	10.0	<0.01	<0.0002	<0.01	<0.01	0.4	<0.002			2.1	<0.01		<0.1	4.72	4.42	3.28	

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE INC
6771 SOUTH 900 EAST
P.O. BOX 21146
SALT LAKE CITY, UTAH 84121-0146
(801) 566-5599

November 12, 1990

Mr. Steve Tanner
Valley Camp of Utah, Inc.
Scofield Route
Helper, UT 84526

RE: Spring Depletion Analysis.

Dear Steve:

As requested we have plotted spring flow data collected during 1990 for springs S7-11, S24-12, S25-13, S31-13, S36-17, S36-19 and S36-23. Copies of these plots are attached showing all data collected at each spring since 1980. An analysis of the curves indicates that overall local trends are quite consistent between springs monitored for any given year. The matrix identified as Table 1 has been prepared to show local consistency. Trends for any given spring throughout the period of record however do show some interesting correlations as will be discussed later.

TABLE 1
VARIATION IN SPRING FLOW FROM PREVIOUS YEAR

SPRING NUMBER	YEAR									
	81	82	83	84	85	86	87	88	89	90
S7-11	DN	UP	UP	DN	DN	UP	DN	UP	DN	UP
S24-12	DN	UP	UP	DN	DN	UP	DN	UP	DN	DN
S25-13	DN	UP	UP	DN	DN	-	DN	UP	DN	-
S31-13	DN	UP	-	-	DN	UP	DN	UP	DN	-
S36-17	DN	UP	UP	DN	DN	UP	DN	DN	UP	DN
S36-19	DN	UP	UP	-	DN	UP	DN	UP	DN	UP
S36-23	DN	UP	UP	UP	DN	UP	DN	UP	DN	UP

The shading in the table indicates those years in which general consistency was noted in spring flow for all springs monitored. Identical responses in all springs were noted for the years

1981, 1982, 1985 and 1987. Years 1983 and 1986 showed consistent increases in flow over the previous year except for one spring each year when little or no change was noted in the data. Data for 1984, 1988 and 1989 show that all but one spring each year showed consistent responses with other local springs. 1990 data showed the most variation of all data recorded throughout the period of record. Generally speaking, flow variations in monitored springs were mixed during 1990. Flows from three of the springs increased while two springs showed little variation and two showed decreased flows.

A review of yearly data for each identified spring shows little if any consistent trend toward either increased or decreased flows except perhaps at spring S24-12. Spring S24-12 is the only spring which showed consistent declines over the last two years of record. For the other springs monitored over time, no more than two years at a time could be identified wherein 1) the flow continued on either an uphill or downhill trend and 2) where the associated spring depletion curve showed a marked change in flow condition. To illustrate the absence of trends, Table 1 has been reproduced again as Table 2 with consecutive years being shading. Note from the matrix shown that no trend continues for more than a two year period, even during the last three or four year period of drought. It should also be noted that in spite of current drought conditions, three of the seven springs monitored during 1990 recorded higher flows than those recorded in 1989. A brief review and analysis of each spring follows Table 2.

TABLE 2
SPRING FLOW TRENDS

SPRING NUMBER	YEAR									
	81	82	83	84	85	86	87	88	89	90
S7-11	DN	UP	UP	DN	DN	UP	DN	UP	DN	UP
S24-12	DN	UP	UP	DN	DN	UP	DN	UP	DN	DN
S25-13	DN	UP	UP	DN	DN	-	DN	UP	DN	-
S31-13	DN	UP	-	-	DN	UP	DN	UP	DN	-
S36-17	DN	UP	UP	DN	DN	UP	DN	DN	UP	DN
S36-19	DN	UP	UP	-	DN	UP	DN	UP	DN	UP
S36-23	DN	UP	UP	UP	DN	UP	DN	UP	DN	UP

S7-11

Spring Depletion Figure 1 shows monthly and annual fluctuations in flow from spring S7-11 which is located at the far south edge of the mine permit boundary near Monument Peak. Data collected indicates that flow recorded at the spring during June have been as high as approximately 0.077 cfs (35 gpm) and as low as approximately 0.001 cfs (0.45 gpm). An extrapolation of 1990 data into June may indicate however that 1990 June flows were even less than the previously recorded low. Although flows have varied greatly throughout the period of record, no indications are evident that would conclude that mining impacts have been felt within the spring recharge area. Because of its location, it is felt that this spring is outside the potential mine impact area for the foreseeable future.

S24-12

Flow rates within this spring (located within the South Fork of Eccles Creek along the western mine permit boundary) have been remarkably consistent (with the exception of 1989 and 1990 data) throughout the period of monitoring as shown in Figure 2. With the exception of 1989 and 1990 data, all recorded flows have been within a 0.0008 to 0.007 cfs (0.36 to 3.14 gpm) range. As shown on Figure 2, monthly fluctuations have been moderate indicating a relatively consistent source of recharge water or a relatively large recharge zone. Water levels however within the last two years show a decline in flow rate. In 1989 early spring flows dropped from approximately 0.002 cfs (0.9 gpm) to 0.00065 cfs (0.29 gpm), and in 1990 they dropped again in June to a low of 0.00015 cfs (0.07 gpm).

The fact that the spring has noted a decline is of concern to this particular spring because of its record of consistency prior to 1989. The cause of the declines over the last two years may be the result of 1) climatic trends, or 2) mining impact. Climatic trends throughout the area would indicate that a decrease in flow rate would be expected to occur, however, the decreases noted on the figure are larger than would normally be expected based on past history. Whether or not the impacts at this spring are the result of local mining activities is uncertain because of the timing of the impact. It is possible that either (or both) Valley Camp or Coastal States Energy (located immediately west of Valley Camp) mines have impacted recharge water. In order to determine the causes of the impact additional geohydrologic information related to both mines would have to be analyzed. An additional year of data will also help to confirm impact. The probability of impact increases should flow rates not increase following a relatively good winter snowpack.

S25-13

Flow variations shown on Figure 3 for spring S25-13 have remained relatively consistent throughout the years in spite of recent drought conditions. Although annual fluctuations have been relatively minor, seasonal variations are seen to be large, perhaps indicating a small recharge area. This is logical since the spring is located at a relatively high elevation west of the Belina Mine portals. Based upon available data, seasonal variations ranging from 0.08 to 0.0002 cfs (36 to 0.09 gpm) appear to be possible. No trends appear to be evident at this spring at the current time.

S31-13

Spring S31-13 is located along the eastern mine permit boundary in Finn Canyon near the Old Black Diamond Mine. This spring has characteristics similar to those noted above for Spring S24-12 in that only moderate annual or seasonal fluctuations in flow have been noted (see Figure 4). A slight decrease in flow is noted over the last three years (believed to be the result of local climatic conditions), however, no continued trend is visible, and it is believed that flows will increase upon increased winter snowfall.

S36-17

Flows recorded from this spring located within the mid sections of the mine permit area in Boardinghouse Canyon show a fair amount of variation in flow in terms of both seasonal and annual fluctuation (see Figure 5). It appears that early spring flows are generally found to be within the range of 0.01 to 0.1 cfs (4.5 to 45 gpm). Fall flows are more widely varied with recorded flows ranging from 0.0004 to 0.018 cfs (0.18 to 8.1 gpm). Since no trend toward decreased flows is evident, it appears that mining impacts have not been felt at this spring.

S36-19

Spring S36-19 is found near a southern permit boundary within Coal Canyon. Mining within the area of spring S36-19 is scheduled for the 10 year mine plan as shown on permit Map R614-301-722.100a. At this time it is not believed that this spring would be impacted by mining activities being conducted by Valley Camp. This is certainly the case for the current period as can be seen from Figure 6 where spring flows recorded during 1990 are higher than 1989 flows even in spite of drought conditions. If the spring were lower than upgradient mine workings it may have been possible to account for increased flows as a result of the diversion of in-mine waters into the recharge zone supplying spring S36-19, however this is not the case. Additional data collected over the next few years will help in obtaining a better understanding of conditions.

S36-23

Spring S36-23, located near the western permit boundary in the Middle Fork of Burnout Canyon has perhaps the most consistent flow record of all springs monitored in this monitoring program (see Figure 7). With a total seasonal and annual flow variation throughout the period of record of 0.0048 to 0.018 cfs (2.15 to 8.1 gpm), this spring has shown remarkable consistency.

Although the last three years have seen some of the lowest flows recorded for the spring, the spring has been able to maintain what appears to be a minimum of over 60 percent of its average flow rate. No long term flow trends are evident from the data collected and it is believed that flows will increase at the spring subsequent to increased winter snowpacks.

In summary it is believed that springs monitored as part of the ongoing water monitoring program required under the coal mining regulations have not been impacted as a direct result of mining activities within the area of the Belina Mines except for perhaps Spring S24-12. Flows from Spring S24-12 have been noted to have decreased consistently over the last two years. The cause of the decrease may be due to 1) climatologic conditions or 2) mining impacts. A determination of the cause requires additional information related to local mining activities and an analysis of available data.

Should you have any questions related to the material contained within this letter, please call.

Sincerely,

David E. Hansen, Ph.D., P.E.
Vice President

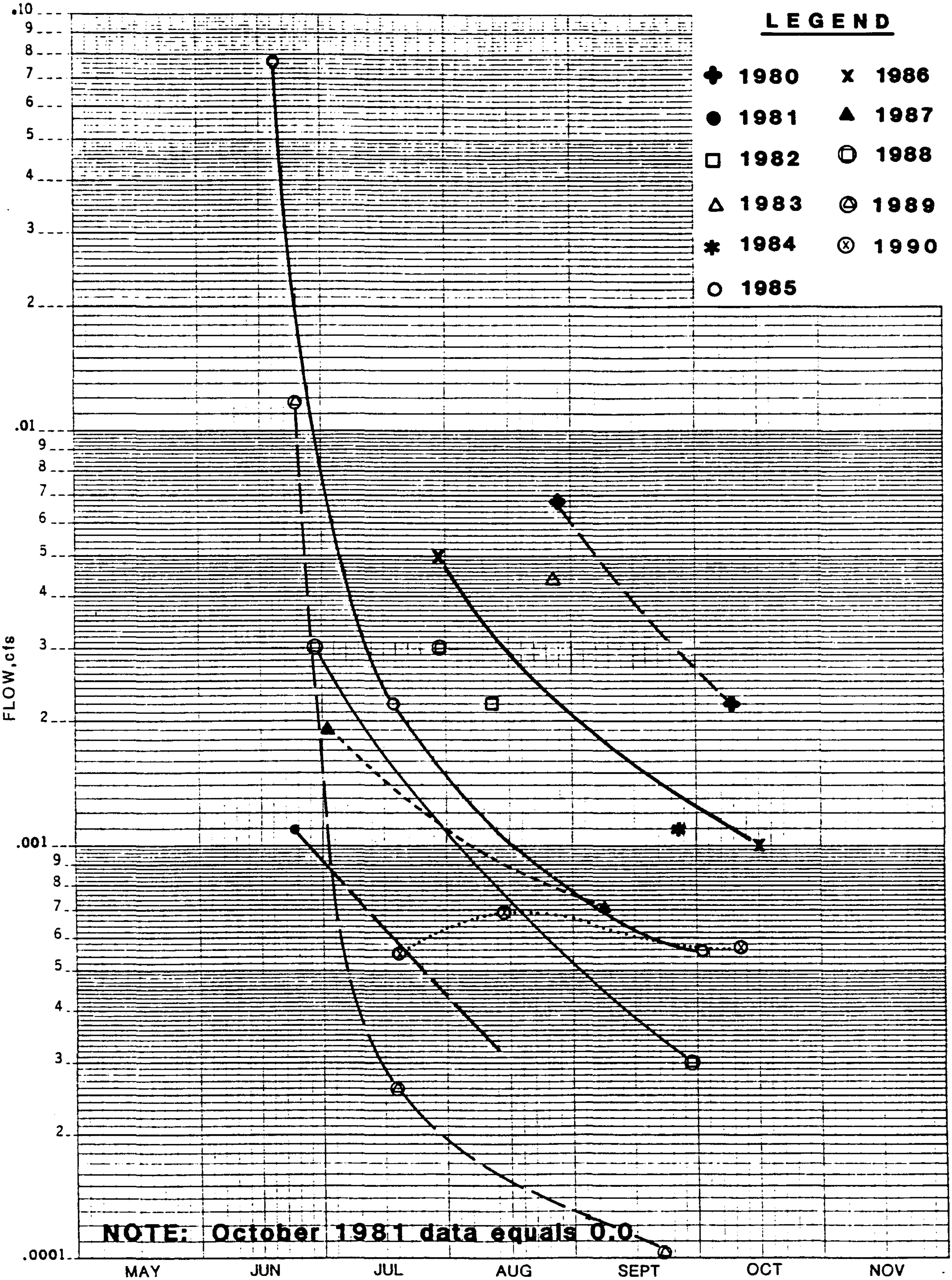

Figure 1. Spring S7-11 Depletion Curve

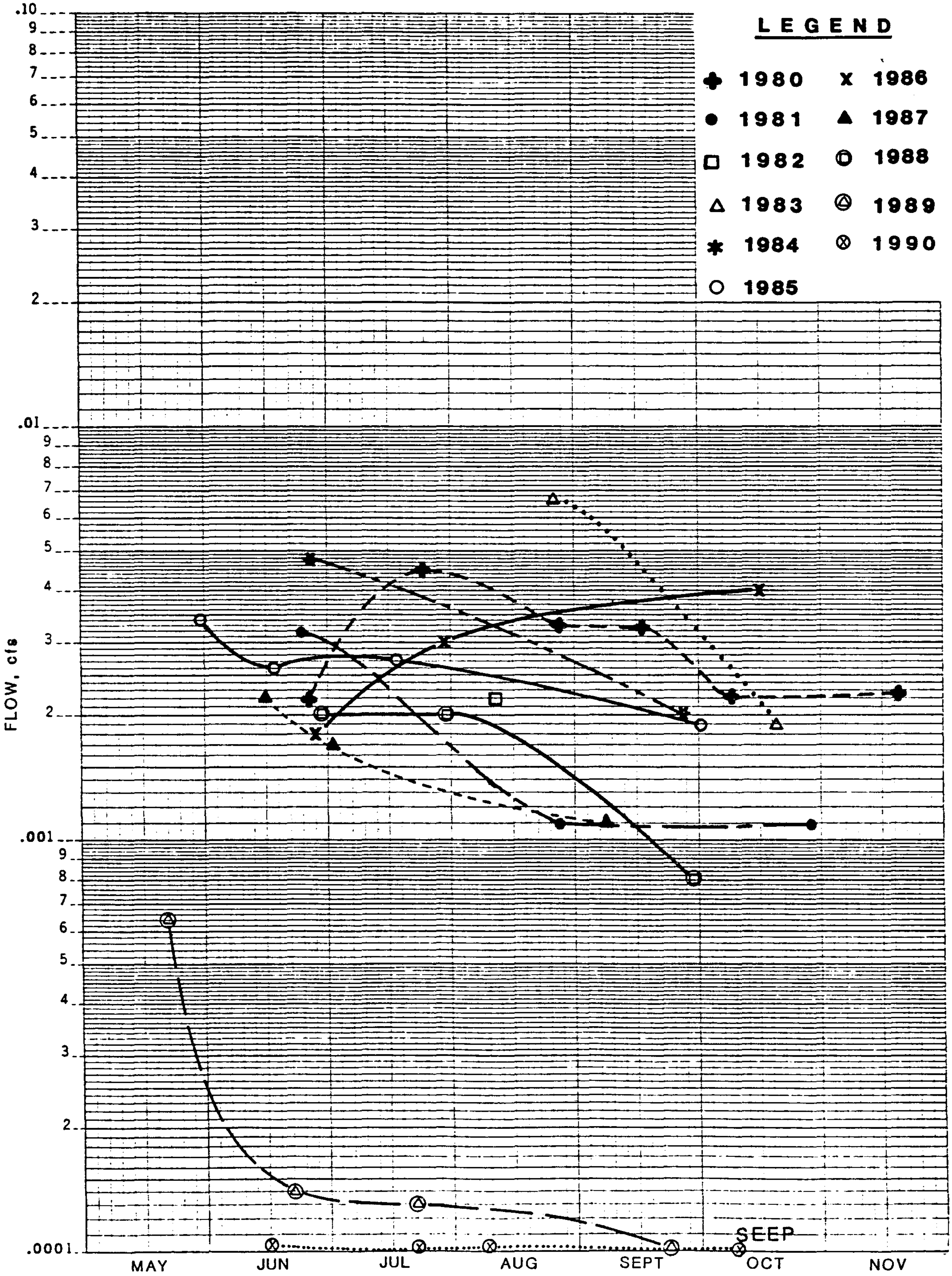

Figure 2. Spring S24-12 Depletion Curve

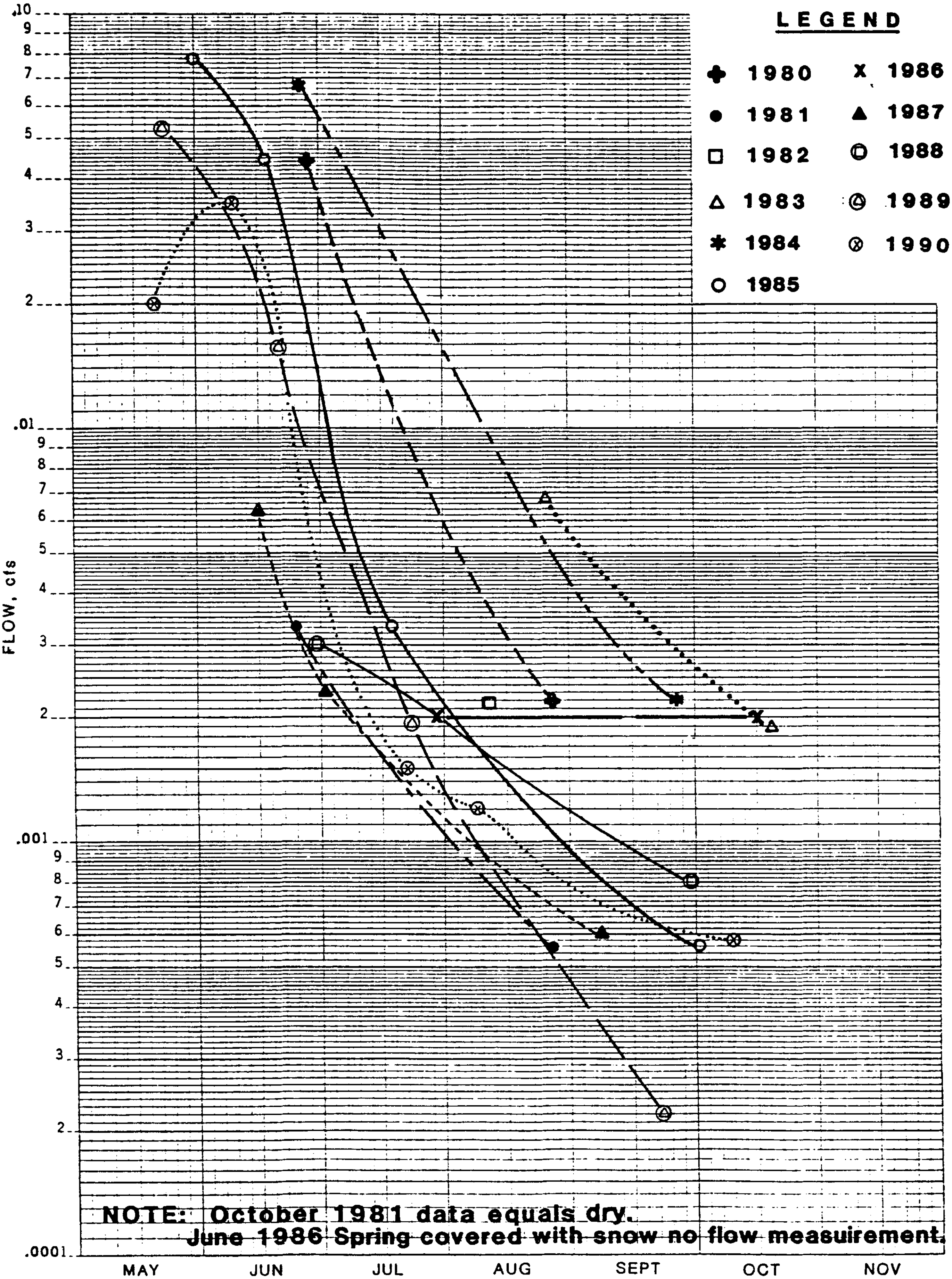

Figure 3. Spring S25-13 Depletion Curve

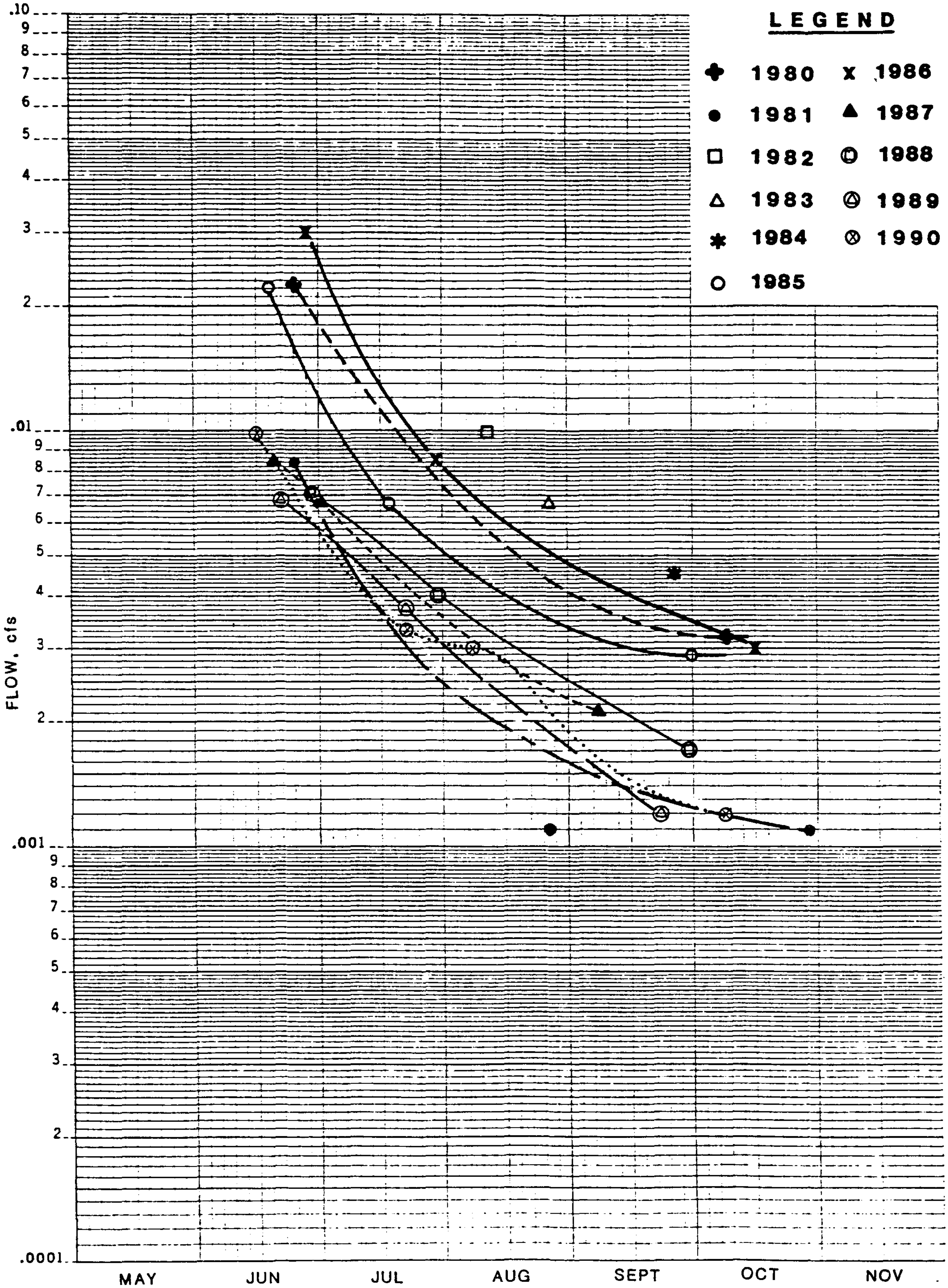

Figure 4. Spring S31-13 Depletion Curve

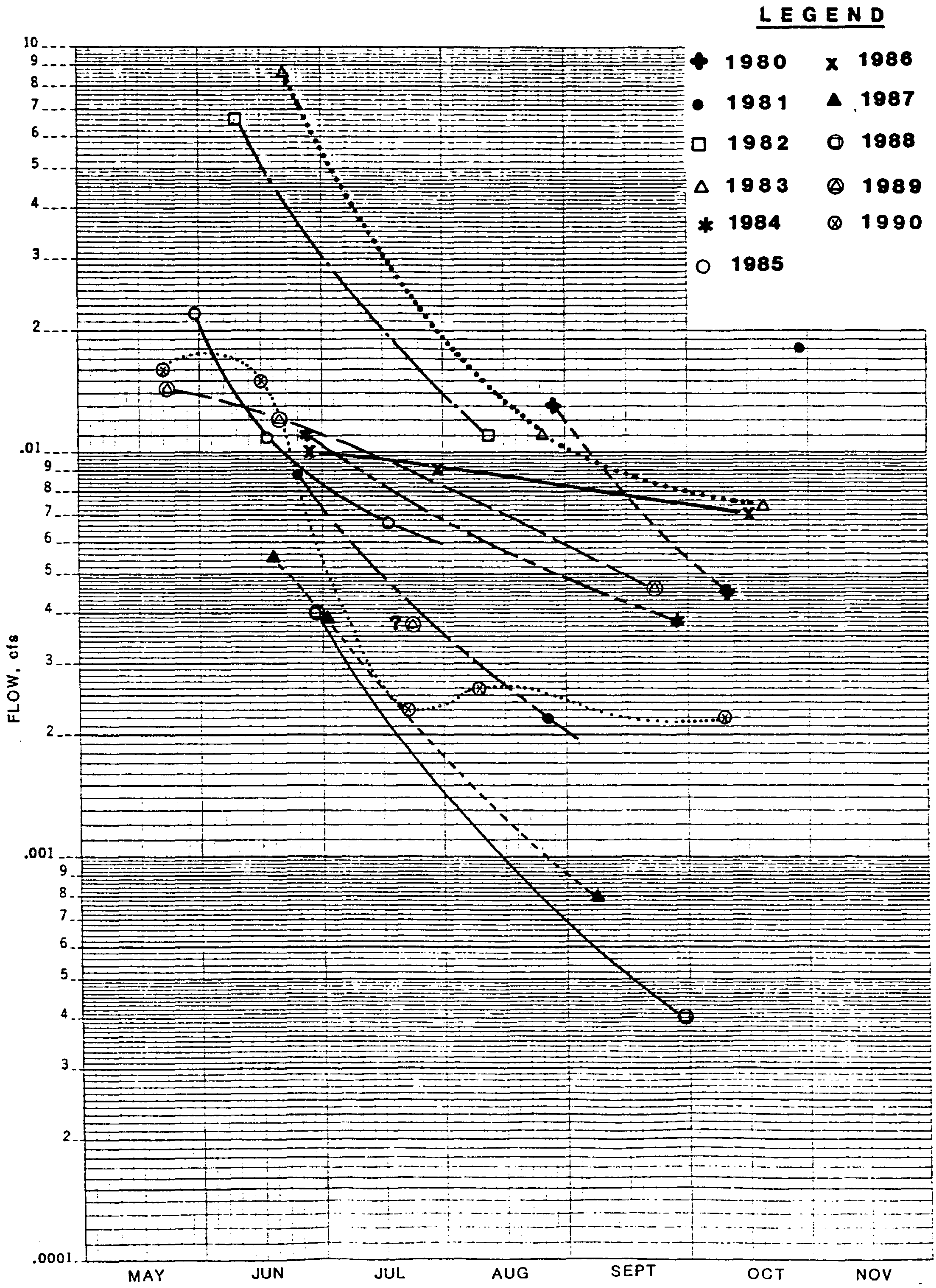

Figure 5. Spring S36-17 Depletion Curve

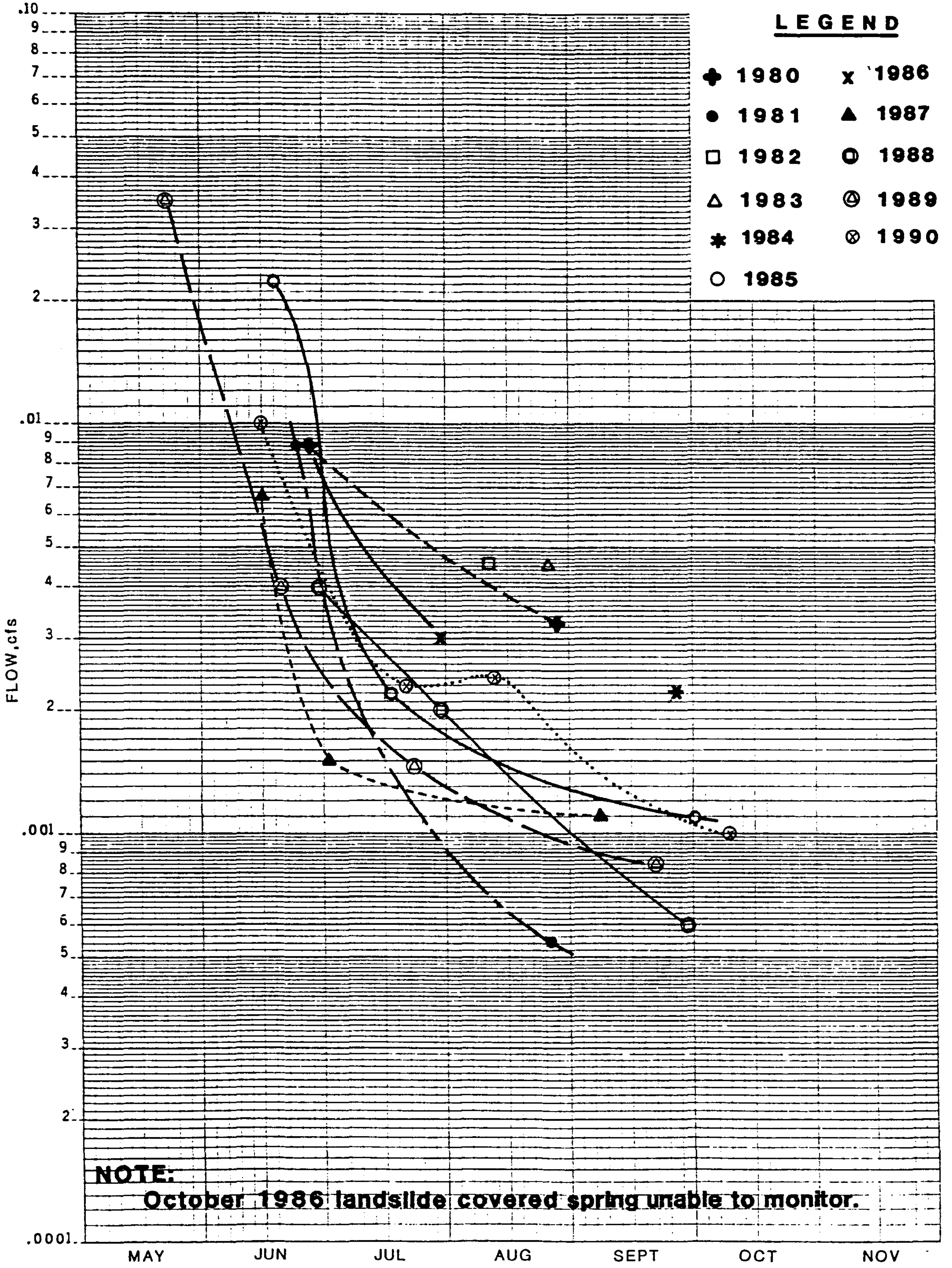

Figure 6. Spring S36-19 Depletion Curve

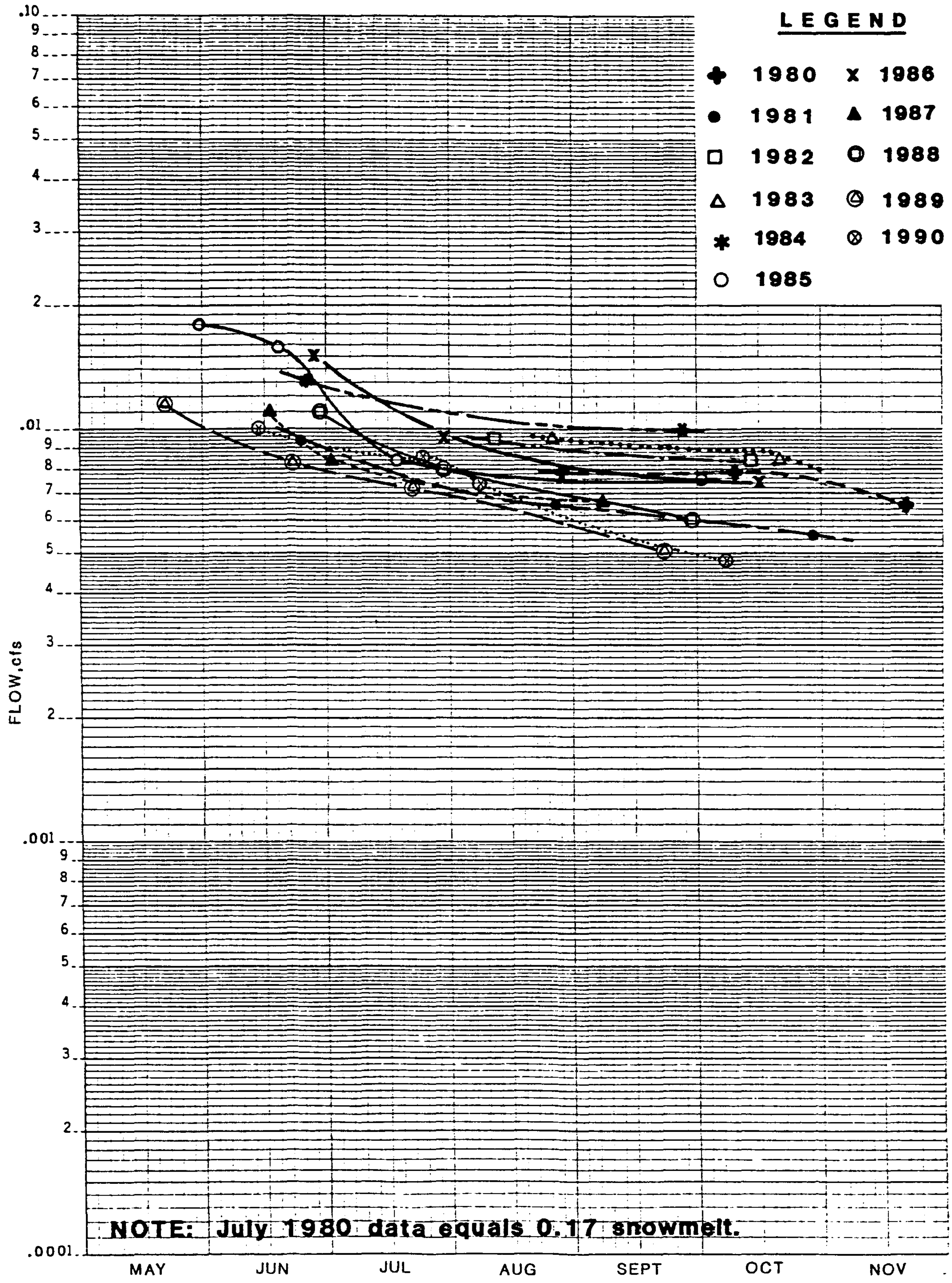

Figure 7. Spring S36-23 Depletion Curve

APPENDIX R614-301-724.600

Subsidence Control Plan

DRAFT

Valley Camp of Utah, Inc.

Subsidence Control Plan

January 1991

SUBSIDENCE CONTROL PLAN

This subsidence control plan is intended to be a compilation of facts and conditions related to subsidence as discussed throughout the mine permit renewal application submitted by Valley Camp of Utah Inc. to the Utah Division of Oil, Gas & Mining during the 1990 calendar year. Also included is information related to transit surveys of either existing or proposed survey lines within the permit area. Information contained herein is intended to meet the requirements of R614-301-521, 525, 623, 625, 632, 642, and 724.

Historical Surveys

The surface effects of subsidence have been monitored annually since 1982 through the use of pedestrian surveys. These ground pedestrian surveys have typically been conducted during the summer or late summer period of the year when ground cover is a minimum. During these surveys, a three or four man field crew traverses hillslopes above mine workings at an average spacing of 50 to 100 feet. Notes related to irregularity of the land surface are made based upon visual observations when they were thought to be the result of mine subsidence. Irregularities noted throughout the period of record include surface cracking, depressions, and sinkholes.

The Forest Service attempted to obtain subsidence related data through the use of aerial surveys in late 1970's and early 1980's. These surveys were unsuccessful in obtaining the desired data because of various problems related to flightline control. Efforts to obtain data using this method were abandoned in mid 1980's. Valley Camp of Utah, Inc. also attempted using aerial methods to obtain subsidence data during the late 1980's in order to eliminate the need for the ground pedestrian survey discussed above. It was the intent of these efforts to utilize the subsidence monitoring locations shown on Geologic Cross Section Mapping located within the permit renewal. By identifying these locations, aerial photography was employed to determine the extent of movement of each point, thereby allowing for an identification of the amount of subsidence which is occurring within the permit area. Several problems have occurred over the last few years as attempts have been made to collect useful aerial survey data. After the expenditure of money to collect the data, it was discovered that errors in land surface elevations throughout the subsidence study area as well as interference from heavy forest growth have made the data which has been collected of little value.

Noted Surface Disturbances

Surface effects of subsidence and other pertinent information have been documented throughout the period of record since 1982 and have been compiled onto maps identified as Maps R614-301-728.100a and R614-301-728.100b. Map R614-301-728.100a shows information related to the mine workings, local subsidence features identified through field surveys, cover lines and draw angles. In addition to mine workings, Map R614-301-728.100b shows subsidence lines for local area streams as well as the survey grid for the east main section of the mine. Survey data relative to the lines shown is printed on Map R614-301-728.100b.

Consistent with expectations and as shown on Map R614-301-728.100a, no surface effects of subsidence (including cracking and the development of sinkholes, etc.) have been found above areas where 1) pillars have not been pulled from the mine workings or 2) where the overburden above the mined coal seam is greater than 350 to 400 feet.

During the initial survey of 1982, some subsidence cracking was documented on the sidehill east of the South Fork of Eccles Creek. In one location a hole had developed down the hill from a small spring (Spring S25-11). The flow of about 1.5 gallons per minute (gpm) from the spring disappeared into the hole. In the 1983 summer survey, subsidence effects were observed to have increased in the South Fork area, and subsidence had also appeared in Whisky Canyon directly south of the Belina No. 1 portal area. Cracks have appeared and some sink holes have developed. One of these sink holes is in a intermittent side tributary near the head of Whisky Creek south of the Belina Mines.

No surface evidences of subsidence were observed in the August 1983 survey in areas having more than about 350 feet of overburden above the mined coal seam, or where pillars have not been pulled. It is also noted that no new subsidence was noted as a result of the recent August 1990 pedestrian survey. It is anticipated however that additional subsidence will occur during the next few years as mining continues in the area adjacent to Whisky Creek.

Subsidence found to exist within the Blackhawk formation of the Mine Permit Area appears to be more significant than that experienced by other local mines. Two explanations are given for this. First, other mines generally have more overburden than is typical of subsided areas of the Belina Mines. Greater overburden thicknesses generally do not permit the development of cracks, holes, or other noticeable surface effects of subsidence because of the distance through which deformation must travel before being noticed on the surface. The second potential explanation for increased subsidence is that more faults have been found through the mining of local area coal reserves than were originally known to exist. The frequency of faulting in the

Mine Permit Area appears to be higher than that found in other surrounding mines. Faults reduce the ability of a formation to withstand stresses caused by extracting a coal seam, therefore resulting in subsequent subsidence. Consequently, in faulted areas, subsidence effects are likely to transmit further vertically.

Subsidence Impacts on the Local Environment

After studying hydrologic impacts of coal mines in the Blackhawk Formation of the Wasatch Plateau, Danielson et al. (1981) concluded:

> *Where subsidence has not been extensive and where water-bearing zones that overlie the Star Point-Blackhawk aquifer are perched, it is unlikely that mine dewatering induces greater recharge to the ground-water system. Neither is it likely under these conditions that the flow of springs that issue from the perched zones or the rate of natural downward leakage into the Star Point-Blackhawk aquifer are affected by mine dewatering. However, natural recharge and discharge relationships can change if hydraulic connection between the perched zones and the Star Point-Blackhawk aquifer is increased by fracturing due to subsidence.*

No noticeable changes in the high-elevation, perched springs are expected within the portions of the Mine Permit Area where the pillars are not pulled or where the overburden is greater than about 350 to 400 feet. However, in the remaining areas, as has been documented, subsidence can and does extend to the surface thereby altering the recharge-runoff characteristics of the area. Perched aquifers in these zones may be partially or wholly drained. This may increase the recharge to the regional aquifer, increase the water made in the mines, and/or change the point of discharge of a spring. It is believed that some evidence that this is occurring has been brought to light as a result of the 1990 seep and spring inventory discussed in the recently submitted mine permit renewal application. Over the period of time between the 1979 and 1990 seep and spring surveys it has been noted that some springs have dried up while others have appeared. Continued seep and spring inventories as well as spring depletion analyses will aid in documenting this phenomenon. It is expected that the shale and clay layers which exist within the Blackhawk formation will have a tendency to seal cracks that develop, thus reducing the long-term hydrologic impacts of subsidence.

Subsidence impacts on perched springs within the Mine Permit Area are not expected to reduce significantly base flows in local perennial streams in the area because of 1) the large number of the springs that are found (all of which are not affected similarly), and 2) because of the relatively small flow rates characteristic of high elevation perched springs.

Springs located within Boardinghouse Canyon provide an ideal example of the relatively low flow rates typical of high elevation perched springs and the relative impact they have on base flow. During the early summer of 1979, 13 springs with a combined flow of approximately 0.09 cfs (39 gpm) were identified within the Boardinghouse Canyon drainage area. These 13 springs did not include those large developed springs located near the canyon mouth. Records for the years 1980 through 1983 show that the average June flow within Boardinghouse Creek (above the large springs near the canyon mouth) was about 6.2 cfs. A comparison of flows from the 13 springs and Boardinghouse Canyon clearly indicates that flow from the high perched springs contribute only a small portion (1.4%) of the total base streamflow. It is anticipated that similar analyses could be performed on other local drainages should it be desired. However, such analyses are not included herein, and if desired, are left to the interested party to perform.

A comparison between high springs and local streamflows for the fall period shows that spring flow contributions are still minor with an estimated flow contribution in the 5% range. The 5% estimate is based upon recorded Boardinghouse Creek flows for the August period of 1.5 cfs and the assumption that high elevation spring flows remain at approximately 0.09 cfs. In reality, spring flows will decrease as the year progresses as will the estimate of contribution. The purpose of this example is to illustrate that even with an unrealistic worst case, drying up small perched springs will not be expected to decrease base flows of the perennial streams significantly.

When subsidence results in the draining of the small perched aquifers into the mines, the drained water will either 1) aid in recharging the regional aquifer and thus eventually result in an increased discharge from the aquifer at some location, or 2) will increase the amount of water that will be discharged from the mines by way of Whisky Creek into Eccles Creek. Surface runoff from small upstream watershed areas will also be captured by subsided areas and contribute to the discharges mentioned.

Subsidence has the potential for increasing the discharge of suspended sediment in adjacent streams due to the disturbance of local geology (by potential denuding or by softening of the soil structure). As a result, subsided areas may tend to erode more than unsubsided areas until they are weathered and revegetated. Subsidence is not anticipated in streambeds or perennial streams, since attempts will be made to protect them from subsidence by limiting adjacent coal mining activities.

Subsidence may also impact water quality in local streams. Snowmelt and surface runoff from rainstorms is typically of very good quality as is spring discharge. For example, average concentrations of total dissolved solids (TDS) for spring discharges noted in Section R614-301-700 of the mine permit are generally in the range of approximately 200 to 400 mg/l. It is anticipated that the portion of runoff that is intercepted by subsidence cracks will develop increased concentrations of some water quality parameters (such as TDS). Because the amount of water being potentially captured by subsided areas will be relatively small in comparison with the overall volume of ground water within the Mine Permit Area, it is believed that the overall impact to surface water quality will be minimal.

An additional effect of subsidence which was just alluded to would be the potential for flow from springs unaffected by subsidence to flow into a subsided area. In such cases the springs will still provide a water supply for wildlife and vegetation above the subsided areas.

Prevention of Subsidence

As stated earlier, subsidence is expected to have hydrologic impacts in areas where pillars are pulled from mine workings and the overburden is less than approximately 350 to 400 feet thick. Perennial streams (i.e. South Fork of Eccles Creek, Whisky Creek, Boardinghouse Creek, Finn Creek, and Long Creek) will be protected from subsidence through the practice of leaving pillars beneath the perennial portions of these streams. Pillars will not be pulled where any perennial stream is located within the area included within the angle of draw of the mines. The currently proposed angle of draw for these buffer zones is 35 degrees from vertical. However, the angle of draw in the Blackhawk Formation is likely considerable less than 35 degrees. When documentation of the actual angle of draw can be obtained, a request will be made to reduce the size of the buffer zones accordingly.

Monitoring Plan

The subsidence monitoring plan for the Belina mine includes the continued annual pedestrian survey for all ground surfaces overlying mined areas as well as the transit survey of critical areas. Each year, the land surface located above, and adjacent to mined areas (where the mining method employed includes pillar and full seam extraction methods) will be thoroughly walked. Coverage of the area will be obtained by inspectors which will traverse the area in horizontal sweeps, keeping a uniform distance between them. When a preselected area is traversed horizontally in one direction, the inspection team will drop perpendicular to the contour to a new area, and then begin a new horizontal sweep in the opposite direction. This back and forth method of inspection will be continued until the area has been traversed. Using this method, new subsidence features, or changes in previous features will be noted annually. As part of this effort, numbered markers have been placed on trees and vegetation adjacent to areas affected by subsidence as shown on Map R614-301-728.100a. Where possible, these numbered markers have been installed so that specific changes in subsidence can more accurately be documented and monitored from year to year.

Two detailed transit surveys have also been conducted of the area overlying the East Mains adjacent to Whisky Creek. Data from these surveys, completed in October of 1983 and in August of 1990 are shown on Map R614-301-728.100b. From the map it is seen that survey lines set up for this area of the mine consists of three north-south trending cross sections with survey data points taken at 50 foot intervals.

Additional survey data will be collected during the summer of 1991 parallel to local area streams and canyon bottoms within the permit area as shown on Map R614-301-728.100b. Note that the areas proposed to be surveyed during 1991 include the northern sections of the mine and that survey stationing will be placed along the hillside out of the channel or canyon bottom. It is important to protect survey stationing from disturbances which might occur through stream or channel flows. Survey stationing will consist of rebar stations located at uneven intervals based upon local topography.

As mining continues within southern sections of the mine, additional stream or canyon survey data will be collected at the proposed locations shown on Map R614-301-728.100b. As with other stream or canyon surveys, these rebar survey stations will be field fit near the canyon bottom to protect them against disturbance from channel runoff. The timing for installation of these southern stations at this point is uncertain, however they are not planned to be installed until future mining progresses into an adjacent region which approaches an angle of draw related to subsidence.

Monitoring Updates

Subsidence Map R614-301-728.100a will be updated annually to document potential subsidence areas above the Belina Mines as found during the pedestrian survey. Updated versions of this map along with a brief letter report describing the observed subsidence effects will be submitted annually to the Utah Division of Oil, Gas, and Mining. At a later date, aerial photogrammetric surveys may also be initiated as an aid in determining and monitoring the effects of subsidence. Before such surveys are attempted however, the problems of accuracy noted historically must be resolved by those capable of providing the service.

Survey updates on cross sections shown on Map R614-301-728.100b will be completed following two criteria. The first criteria will based upon evidence of subsidence found during the annual pedestrian surveys. When new visual evidences are noted in land surface, a transit survey will be taken of the area affected to document the degree of local area disturbance. If no survey is documented within the five year permit term, then a second criteria will be followed in that a transit survey will be made for inclusion in the five year permit term renewal. Map R614-301-728.100b will be updated annually and submitted to the Division along with Map R614-301-728.100a when additional pertinent survey data is obtained subsequent to a previous submission.

RESULTS OF VEGETATION SAMPLING AND MONITORING FOR THE UTAH AND BELINA REVEGETATION TEST PLOTS

1990

Prepared by

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December 1990

INTRODUCTION

Following are third year results from vegetation monitoring of test plots for Valley Camp of Utah. The plots are located near Scofield, Utah. Quantitative data were also submitted in 1988 and 1989 for the test plots.

The test plots were constructed in 1987 to test revegetation potential of available soil material on the mine area. The test plot design was developed by the State of Utah, Division of Oil, Gas & Mining (DOGM) and Valley Camp of Utah, Inc. Plot construction (layout and earthmoving work) was accomplished by (or under the direction of) Valley Camp of Utah. Seed, fertilizer and hydromulch by the specified design was applied by Mt. Nebo Scientific in October of 1987.

Two main areas were used as sites for the vegetation test plots. These areas were called the Utah Site and the Belina Site. The Utah Site is located south of the truck load-out pad and east of the railroad tracks on an old coal storage area. The Belina Site is on the slope south of the sediment pond.

Monitoring was initiated by sampling the vegetation on the two sites by Mt. Nebo Scientific in August of 1988, 1989 and 1990.

METHODS

Quantitative and qualitative data were taken on each of the two sites. Bi-directional random placement of sampling plots were designed to provide unbiased accuracy of the data compiled. A randomized block design was implemented to insure adequate representation of the entire plot. On the Utah site, three 12.5 meter transects were regularly placed on the plot to adequately cover the entire plot. Twenty sample points were then placed every 1.5 meters along these transects. A one meter buffer strip was placed around the entire plot where sample points were avoided to limit sample bias. There was only one treatment to be monitored on this plot.

The Belina Site, however, had four different treatments to be sampled. Therefore, a total of four areas or "subplots" were sampled. The subplots were labeled on the data summary tables by directional locations and treatments and are listed below:

1) NE Subplot, Light Soil A, Fertilized
2) NW Subplot, Light Soil A, Unfertilized
3) SE Subplot, Gray Soil B, Fertilized
4) SW Subplot, Gray Soil B, Unfertilized

Three transects were also placed on each of the subplots listed above. Eight sample locations were regularly placed on each treatment with a total of 40 samples for all treatments. A one meter buffer strip was also placed around each of the treatments where quadrat placement was avoided.

Cover estimates were made using ocular methods with meter square quadrats. Species cover, total cover, composition and relative frequency were also assessed from the quadrats. Also recorded on data sheets were estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes.

Sampling adequacy for cover on the Utah Site was achieved using formula suggested by DOGM (see Table 9 footnote). Sample number of the Belina Site was determined by L. Kunzler (Biologist, DOGM). All sample means, standard deviations, and sample sizes were included in this report to enable the reviewers to apply further statistical tests if desired.

Plant species nomenclature follows Welsh et al. (A Utah Flora. 1987. Great Basin Naturalist Memoir No. 9). Sample design and methodologies were approved by a representative of the State of Utah, DOGM (L. Kunzler, Reclamation Biologist). Mr. Kunzler was present on site upon initiation of the test plot sampling in 1988.

RESULTS

Summary Tables

All results of the vegetation sampling for 1989 are shown on the summary tables (Tables 1 - 10). Included in these tables are:

1) percent cover and standard deviations (total living cover, mulch & litter, bare ground, & rock),
2) composition (% shrubs, forbs, & grasses),
3) cover and frequency by species,
4) sample sizes.

Nomenclature

Because the author decided to use the most recent nomenclature for plant species for the summary tables, and because some of the species on the original seed mix list have been changed, a list is provided below showing the old and new scientific names.

Old Name (on seed mix lists)	New Name (Welsh 1987)
Shrubs	
Amelanchier alnifolia	Amelanchier alnifolia
Artemisia tridentata var. vaseyana	Artemisia tridentata vaseyana
Chrysothamnus nauseosus albicaulis	C. nauseosus albicaulis
Rosa woodsii	Rosa woodsii
Sambucus coerulea	Sambucus coerulea
Symphoricarpos oreophilus	Symphoricarpos oreophilus
Forbs	
Achillea millefolium	Achillea millefolium
Artemisia ludoviciana	Artemisia ludoviciana
Linum lewisii	Linum perenne ssp. lewisii
Hedysarum boreale	Hedysarum boreale
Medicago sativa	Medicago sativa
Melilotus officinalis	Melilotus officinalis
Penstemon strictus	Penstemon strictus
Grasses	
Agropyron dasystachyum	Elymus lanceolatus
Agropyron smithii	Elymus smithii
Bromus marginatus	Bromus carinatus
Poa canbyi	Poa canbyi
Poa pratensis	Poa pratensis

The test plots will continue to be monitored according to the schedule accepted by the State of Utah, DOGM.

TABLE 1: 1990 SAMPLING RESULTS - BELINA PLOT
(NE Subplot, Light Soil A, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	36.88	4.28	8
Litter	7.50	2.50	8
Bareground	6.88	2.42	8
Rock	48.75	3.31	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	0.00	0.00	8
Forbs	3.49	3.64	8
Grasses	96.51	3.64	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 2: 1990 SAMPLING RESULTS - BELINA PLOT
(NE Subplot, Light Soil A, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
FORBS				
Circium sp.	0.63	1.65	8.0	12.50
Epilobium halleanum	0.75	0.83	8.0	50.00
GRASSES				
Bromus carinatus	8.13	3.48	8.0	87.50
Dactylus glomeratus	7.50	5.59	8.0	87.50
Elymus smithii	5.63	7.58	8.0	75.00
Elymus spicatus	14.25	6.85	8.0	87.50

TABLE 3: 1990 SAMPLING RESULTS - BELINA PLOT
(NW Subplot, Light Soil A, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	36.38	6.82	8.0
Litter	6.25	2.17	8.0
Bareground	8.75	2.17	8.0
Rock	50.63	7.68	8.0

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	0.00	0.00	8.0
Forbs	8.67	8.44	8.0
Grasses	91.33	7.94	8.0

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 4: 1990 SAMPLING RESULTS - BELINA PLOT
(NW Subplot, Light Soil A, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
FORBS				
Circium sp.	0.25	0.66	8.0	12.50
Epilobium halleanum	0.63	0.70	8.0	50.00
Fragaria vesca	0.25	0.66	8.0	12.50
Saxifraga sp.	0.38	0.70	8.0	25.00
Urtica dioica	1.75	2.59	8.0	37.50
GRASSES				
Bromus carinatus	4.00	2.78	8.0	75.00
Dactylis glomerata	4.75	2.05	8.0	87.50
Elymus smithii	3.88	3.02	8.0	75.00
Elymus spicatus	12.88	8.74	8.0	75.00
Poa pratensis	5.63	8.82	8.0	37.50

TABLE 5: 1990 SAMPLING RESULTS - BELINA PLOT
(SE Subplot, Gray Soil B, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	39.38	5.83	8.0
Litter	8.13	3.48	8.0
Bareground	15.00	4.33	8.0
Rock	37.50	10.61	8.0

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	0.00	0.00	8.0
Forbs	19.04	17.26	8.0
Grasses	80.96	17.26	8.0

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 6: 1990 SAMPLING RESULTS - BELINA PLOT
(SE Subplot, Gray Soil B, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
FORBS				
Artemisia ludiviciana	0.25	0.43	8.0	25.00
Epilobium halleanum	4.38	4.47	8.0	75.00
Fragaria vesca	0.25	0.66	8.0	12.50
Hedysarum boreale	1.88	2.42	8.0	37.50
Machaeranthera canescens	0.63	1.65	8.0	12.50
GRASSES				
Bromus carinatus	4.63	3.12	8.0	75.00
Dactylis glomerata	5.63	6.34	8.0	62.50
Elymus smithii	5.00	2.50	8.0	87.50
Elymus spicatus	13.63	10.09	8.0	100.00
Poa pratensis	3.13	4.96	8.0	37.50

TABLE 7: 1990 SAMPLING RESULTS - BELINA PLOT
(SW Subplot, Gray Soil B, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	36.88	5.56	8.0
Litter	6.25	2.17	8.0
Bareground	12.50	4.33	8.0
Rock	44.38	4.64	8.0

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	0.00	0.00	8.0
Forbs	18.93	14.01	8.0
Grasses	81.07	14.01	8.0

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 8: 1990 SAMPLING RESULTS - BELINA PLOT
(SW Subplot, Gray Soil B, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
FORBS				
Epilobium halleanum	5.13	4.20	8.0	87.50
Gayophytum ramosissimum	0.25	0.66	8.0	12.50
Hedysarum boreale	1.25	2.17	8.0	25.00
Urtica dioica	0.25	0.66	8.0	12.50
GRASSES				
Agropyron cristatum	0.63	1.65	8.0	12.50
Bromus carinatus	6.13	11.13	8.0	50.00
Dactylis glomerata	1.88	3.48	8.0	25.00
Elymus smithii	4.50	2.83	8.0	87.50
Elymus spicatus	12.88	6.92	8.0	100.00
Poa pratensis	4.00	4.36	8.0	50.00

TABLE 9: 1990 SAMPLING RESULTS - UTAH PLOT
(Single plot design)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	38.10	13.38	20.0
Litter	8.25	3.63	20.0
Bareground	48.60	18.35	20.0
Rock	5.05	5.10	20.0

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE
Shrubs	5.37	6.10	20.0
Forbs	42.10	13.35	20.0
Grasses	52.53	13.32	20.0

* Sample size insures adequate sample with the following formula:

$$Nmin = \frac{(t\ squared)\ X\ (variance)}{25}$$

TABLE 10: 1990 SAMPLING RESULTS - UTAH PLOT
(Single Plot Design)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
Artemisia tridentata	2.25	2.45	20	50.00
FORBS				
Artemisia ludoviciana	2.45	4.59	20	35.00
Chaenactis douglasii	0.25	1.09	20	5.00
Circium sp.	0.65	1.53	20	20.00
Eriogonum sp.	0.75	1.04	20	40.00
Lappula occidentalis	0.40	1.53	20	10.00
Linum perenne ssp. lewisii	3.95	2.73	20	80.00
Medicago sativa	4.25	4.59	20	60.00
Melilotus officinalis	0.25	1.09	20	5.00
Penstemon strictus	0.20	0.60	20	10.00
Rumex cripus	0.55	1.02	20	25.00
Verbascum thapsus	1.85	2.37	20	50.00
GRASSES				
Bromus carinatus	3.15	3.07	20	60.00
Elymus lanceolatus	11.30	8.18	20	90.00
Elymus smithii	5.60	4.84	20	70.00
Hordeum jubatum	0.25	1.09	20	5.00

VALLEY CAMP OF UTAH, INC.

ANNUAL SEDIMENT AND FILTER POND CERTIFICATION

On March 18, 1991, I hereby certify that to the best of my knowledge, Sediment Ponds 001A thru 004A and Filter Pond 005A have been maintained and are operating as described within the Mine Permit.

Edwin Brookshire Foust P.E.

Date: 4/18/91