

July 14, 1988

Mr. Barry J. Barnum  
Valley Camp of Utah, Inc.  
Scofield Route  
Helper, UT 84526

RE: Valley Camp Subsidence Monitoring

Dear Mr. Barnum:

On June 28 and 29, 1988, personnel of Hansen, Allen and Luce performed a subsidence survey of the land surface above Valley Camp Belina No. 1 Mine. All land surface areas above both pillared areas and areas of full seam extraction were included in the survey. Weather conditions were excellent, except for thundershowers during the late afternoon and evening of June 28.

The results of the survey are indicated on the updated Subsidence Base Map. The mine extensions as of July 1, 1987 are also included on the map, it is our understanding that no further extensions in the Belina No. 1 Mine have occurred since the July 1, 1987 update.

The land surface above pillared and full seam extraction areas of the mine was surveyed by walking with up to three men abreast and by noting on maps the extent of surface subsidence features such as sink holes and surface cracks. Only two new surface subsidence features and an old feature with increased expression were found this year. The new features are located over First South off the West Mains and over Second Left off the Third East Mains. The old feature which appears to have enlarged is located over Third Right off the First East Mains. These features are discussed following.

**West Mains.** A new surface crack was found over the north end of First South off the West Mains. The crack is about 60 feet long and up to two feet in depth.

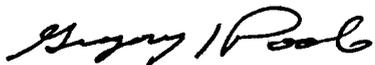
**Third East Mains.** A new sink hole was found west of monitoring spring S36-17 over Second Left off the Third East Mains. The new sink hole is about 20 feet in diameter and about 25 feet deep with vertical to overhanging sides. It is expected that with weathering the sides will slough and tend towards a more stable slope inside the sink hole.

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**First East Mains.** The depression just north of the previously identified (1985) crack over Third Right off the First East Mains appears to have deepened and a definite crack has formed on the north side of the depression.

If we may be of further assistance in any way or if there are questions please call.

Sincerely,



Gregory J. Poole, P.E.  
Project Engineer

RESULTS OF VEGETATION SAMPLING AND  
TEST PLOT MONITORING: 1988

Prepared by

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Prepared for

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Scofield Route  
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Report by

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Fieldwork: Patrick D. Collins  
P. Dean Collins

October 1988

RESULTS OF VEGETATION SAMPLING AND TEST PLOT MONITORING  
for  
VALLEY CAMP OF UTAH

by  
Patrick D. Collins  
October 1988

## INTRODUCTION

Vegetation 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 (DOG M) 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. An additional site that had been previously implemented by a different contractor was also sampled for comparison at the same time. Results of the quantitative sampling are summarized in this report.

## 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, plus the one site that was implemented by another contractor. Therefore, a total of five 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
- 5) Coonrod Plot, east & adj. to NEBO SW plot.

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 formulas from Snedocor and Cochran (1980), insuring that 80% of the samples were within 10% of the true mean of the test plots. Sample number of the Belina Site was determined by L. Kunzler (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 1988 are shown on the summary tables (Tables 1 - 12). 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)
<b>Shrubs</b>	
<i>Amelanchier alnifolia</i>	<i>Amelanchier alnifolia</i>
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	<i>Artemisia tridentata vaseyana</i>
<i>Chrysothamnus nauseosus albicaulis</i>	<i>C. nauseosus albicaulis</i>
<i>Rosa woodsii</i>	<i>Rosa woodsii</i>
<i>Sambucus coerulea</i>	<i>Sambucus coerulea</i>
<i>Symphoricarpos oreophilus</i>	<i>Symphoricarpos oreophilus</i>
<b>Forbs</b>	
<i>Achillea millefolium</i>	<i>Achillea millefolium</i>
<i>Artemisia ludoviciana</i>	<i>Artemisia ludoviciana</i>
<i>Linum lewisii</i>	<i>Linum perenne</i> ssp. <i>lewisii</i>
<i>Hedysarum boreale</i>	<i>Hedysarum boreale</i>
<i>Medicago sativa</i>	<i>Medicago sativa</i>
<i>Melilotus officinalis</i>	<i>Melilotus officinalis</i>
<i>Penstemon strictus</i>	<i>Penstemon strictus</i>
<b>Grasses</b>	
<i>Agropyron dasystachyum</i>	<i>Elymus lanceolatus</i>
<i>Agropyron smithii</i>	<i>Elymus smithii</i>
<i>Bromus marginatus</i>	<i>Bromus carinatus</i>
<i>Poa canbyi</i>	<i>Poa canbyi</i>
<i>Poa pratensis</i>	<i>Poa pratensis</i>

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

**TABLE 1: 1988 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	30.25	5.63	8.00
Mulch & Litter	28.13	8.27	8.00
Bareground	6.88	2.42	8.00
Rock	34.75	9.31	8.00

COMPOSITION			
	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	0.39	1.03	8.00
Forbs	1.95	1.53	8.00
Grasses	97.66	2.08	8.00

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

**TABLE 2: 1988 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				
<u>Picea pungens</u>	0.13	0.13	8.0	12.50
FORBS				
<u>Epilobium helleanum</u>	0.38	0.48	8.0	37.50
<u>Hedysarum boreale</u>	0.13	0.33	8.0	12.50
<u>Melilotus officinalis</u>	0.13	0.33	8.0	12.50
GRASSES				
<u>Agropyron cristatum</u>	2.75	2.82	8.0	50.00
<u>Elymus lanceolatus</u>	0.63	1.65	8.0	12.50
<u>Elymus smithii</u>	12.88	6.90	8.0	87.50
<u>Elymus spicatus</u>	4.00	5.32	8.0	50.00
<u>Poa pratensis</u>	9.25	10.02	8.0	62.50

**TABLE 3: 1988 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	20.75	5.93	8.00
Mulch & Litter	17.50	13.92	8.00
Bareground	8.75	4.84	8.00
Rock	53.00	16.48	8.00

COMPOSITION			
	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	--
Forbs	15.53	17.46	8.00
Grasses	84.47	17.46	8.00

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

**TABLE 4: 1988 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

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SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	--	--	--	--
FORBS				
<u>Epilobium halleanum</u>	1.75	1.98	8.0	62.50
<u>Linum perenne ssp. lewisii</u>	0.13	0.33	8.0	12.50
<u>Melilotus officinalis</u>	0.25	0.43	8.0	12.50
<u>Saxifraga sp.</u>	0.13	0.33	8.0	12.50
<u>Urtica dioica</u>	0.75	1.98	8.0	12.50
GRASSES				
<u>Agropyron cristatum</u>	0.25	0.66	8.0	12.50
<u>Bromus carinatus</u>	1.13	1.69	8.0	25.00
<u>Elymus cinereus</u>	0.63	1.65	8.0	12.50
<u>Elymus lanceolatus</u>	2.88	4.99	8.0	25.00
<u>Elymus smithii</u>	7.50	6.48	8.0	75.00
<u>Elymus spicatus</u>	4.63	7.61	8.0	50.00
<u>Hordeum jubatum</u>	0.13	0.33	8.0	12.50
<u>Poa pratensis</u>	0.63	1.65	8.0	12.50

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**TABLE 5: 1988 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	26.00	7.91	8.00
Mulch & Litter	31.15	11.27	8.00
Bareground	14.63	9.80	8.00
Rock	28.13	7.06	8.00

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE #
Shrubs	--	--	--
Forbs	11.02	11.24	8.00
Grasses	88.98	11.24	8.00

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

**TABLE 6: 1988 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

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SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	--	--	--	--
FORBS				
<u>Epilobium halleianum</u>	1.25	1.48	8.0	75.00
<u>Hedysarum boreale</u>	0.13	0.33	8.0	12.50
<u>Iva axillaris</u>	0.13	0.33	8.0	12.50
<u>Lappula squarrosa</u>	0.13	0.33	8.0	12.50
<u>Linum perenne ssp. lewisii</u>	0.13	0.33	8.0	12.50
<u>Melilotus officinalis</u>	0.13	0.33	8.0	12.50
<u>Penstemon strictus</u>	0.13	0.33	8.0	12.50
GRASSES				
<u>Bromus carinatus</u>	4.00	3.24	8.0	62.50
<u>Elymus lanceolatus</u>	1.25	3.31	8.0	12.50
<u>Elymus smithii</u>	11.13	6.23	8.0	87.50
<u>Elymus spicatus</u>	4.00	6.95	8.0	25.00
<u>Poa pratensis</u>	3.38	4.72	8.0	37.50

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**TABLE 7: 1988 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	20.13	9.56	8.00
Mulch & Litter	25.00	7.50	8.00
Bareground	18.13	9.66	8.00
Rock	36.75	8.30	8.00

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	--
Forbs	7.10	6.62	8.00
Grasses	92.90	6.62	8.00

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

**TABLE 8: 1988 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				
<u>Epilobium halleanum</u>	0.63	0.70	8.0	50.00
<u>Fragaria vesca</u>	0.13	0.33	8.0	12.50
<u>Hedysarum boreale</u>	0.38	0.48	8.0	37.50
<u>Melilotus officinalis</u>	0.13	0.33	8.0	12.50
<u>Penstemon strictus</u>	0.13	0.33	8.0	12.50
GRASSES				
<u>Bromus carinatus</u>	3.88	5.69	8.0	62.50
<u>Elymus smithii</u>	7.38	5.41	8.0	100.00
<u>Elymus spicatus</u>	5.00	8.47	8.0	37.50
<u>Poa pratensis</u>	2.50	2.92	8.0	50.00

**TABLE 9: 1988 SAMPLING RESULTS - BELINA SITE**  
 (Coonrod Plot, east & adjacent to MT. NEBO'S SW subplot)

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	5.50	1.32	8.00
Mulch & Litter	43.13	24.61	8.00
Bareground	26.38	19.87	8.00
Rock	25.00	9.89	8.00

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	2.50	6.61	8.00
Forbs	26.16	27.28	8.00
Grasses	71.34	27.52	8.00

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

**TABLE 10: 1988 SAMPLING RESULTS - BELINA PLOT**  
 (Coonrod Plot, east & adjacent to MT. NEBO'S SW subplot)

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

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SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
<u>Amalanchier utahensis</u>	0.13	0.33	8.0	12.50
FORBS				
<u>Epilobium halleanum</u>	0.25	0.66	8.0	12.50
<u>Hedysarum boreale</u>	0.38	0.48	8.0	37.50
<u>Penstemon strictus</u>	0.38	0.48	8.0	37.50
<u>Polygonum aviculare</u>	0.25	0.66	8.0	12.50
GRASSES				
<u>Bromus carinatus</u>	0.50	1.00	8.0	25.00
<u>Bromus tectorum</u>	0.88	1.62	8.0	37.50
<u>Elymus lanceolatus</u>	0.13	0.33	8.0	12.50
<u>Elymus smithii</u>	2.38	2.34	8.0	87.50
<u>Poa pratensis</u>	0.13	0.33	8.0	12.50

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**TABLE 11: 1988 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	27.90	8.83	20.00
Mulch & Litter	17.85	14.43	20.00
Bareground	44.50	26.06	20.00
Rock	9.75	8.62	20.00

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	0.57	1.40	20.00
Forbs	83.26	11.16	20.00
Grasses	16.17	11.20	20.00

\* Sample size insures 80% accuracy within 10% of the true mean.

**TABLE 12: 1988 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				
<u>Artemisia tridentata</u>	0.15	0.36	20.0	15.00
FORBS				
<u>Artemisia ludoviciana</u>	0.10	0.30	20.0	10.00
<u>Chaenactis douglasii</u>	0.10	0.30	20.0	10.00
<u>Chenopodium fremontii</u>	0.10	0.30	20.0	10.00
<u>Cirsium</u> sp.	0.60	0.66	20.0	50.00
<u>Erigeron</u> sp.	0.15	0.36	20.0	15.00
<u>Eriogonum</u> sp.	0.15	0.36	20.0	15.00
<u>Gayophytum ramosissimum</u>	0.30	0.46	20.0	30.00
<u>Lappula occidentalis</u>	1.15	1.74	20.0	40.00
<u>Linum perenne</u> ssp. <u>lewisii</u>	0.30	0.46	20.0	30.00
<u>Melilotus officinalis</u>	7.15	5.77	20.0	85.00
<u>Polygonum aviculare</u>	1.30	2.10	20.0	35.00
<u>Salsola iberica</u>	11.90	7.76	20.0	100.00
GRASSES				
<u>Bromus carinatus</u>	1.65	2.52	20.0	45.00
<u>Elymus lanceolatus</u>	0.80	1.54	20.0	35.00
<u>Elymus smithii</u>	2.00	1.82	20.0	65.00