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Dug Mine file
Hidden Valley

The CalMat Companies

December 11, 1992

VIA FACSIMILE

Dr. Dianne R. Nielson
Utah Division of Oil, Gas & Mining
3 Triad Center, Suite 350
355 West North Temple
Salt Lake City, Utah 84180

Re: **NOV N91-26-8-2**

Dear Dr. Nielson:

Following our meeting with the Division staff on December 3, 1992, we have modified our Abatement Plan on the above-referenced matter to conform with the comments contained in your letter of November 17, 1992, as clarified during the meeting. The modified Abatement Plan is attached hereto for your review and approval.

Please note that the Revegetation Monitoring Study, dated November 20, 1992, attached as an appendix to the Abatement Plan, is an integral part of the proposed plan, as it provides the basis for a number of conclusions contained in the plan, as well as justification for the methodologies to be employed in the plan's implementation. Also appended to the proposed Abatement Plan by this reference is the discussion and argument regarding the extended liability and bonding period; the so called "bond clock."

The Abatement Plan and bond clock interpretation are integrally linked in this submittal. The nature and extent of the remedial work proposed in the Abatement Plan necessitates that the Division make an interpretation of, or set policy for, what types of activities constitute maintenance and remedial erosion control, based upon experience within a specific reclamation site, and whether or not such proposed activities will restart the bonded liability period.

Hidden Valley Coal Company hereby requests an interpretation of the applicability of restarting the bonded liability period for the mine site if the work proposed in the Abatement Plan is performed. In my opinion, the arguments for erosion control and not restarting the bond clock under the circumstances proposed in the Abatement Plan for the Hidden Valley site, given the results of the Revegetation Monitoring Study, are persuasive. We are hopeful that you will agree once you have carefully considered all of the factors involved in this matter.

If you desire any additional information or clarification regarding this submittal, please do not hesitate to call me.

Sincerely,

HIDDEN VALLEY COAL COMPANY

Lee Edmonson
Assistant Secretary & Manager,
Planning and Regulatory Affairs

LE/cn

Enclosures

92-155

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December 11, 1992

HAND DELIVERED

Dr. Dianne R. Nielson
Utah Division of Oil, Gas & Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180

RE: Revegetation Standards - Hidden Valley Mine

Dear Dr. Nielson:

At the request of Hidden Valley Coal Company ("HVCC"), we have reviewed the application of revegetation standards to the road and stream buffer area at the Hidden Valley Mine ("Mine"). As a result of the settlement discussions on December 3, 1992 between the Division of Oil, Gas & Mining ("Division") and HVCC, the parties are reviewing alternatives for the abatement of NOV 91-21-8-2 which is currently in litigation and resolution of the conditions of the May 2, 1980 stream buffer zone variance. HVCC is anxious to resolve these matters to assure the certainty as to its remaining reclamation obligations at the Mine. HVCC seeks to determine applicable revegetation standards, the specific areas of abatement to which these standards apply and the long-term obligations incurred by undertaking revegetation under the abatement plan. HVCC seeks to achieve a written consent decree or stipulation to avoid the cost and delay of litigation.

I. DO THE REVEGETATION STANDARDS APPLY TO THE AREAS CITED?

A. The Road As An Approved Post-Mining Land Use

The Division approves the road to the Mine as a post-mining land use under HVCC's 1986 reclamation plan. The Division's revegetation requirements provide a clear exception for roads which are approved as a post-mining land use.

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> R645-301-353. Revegetation: General Requirements. The permittee will establish on regraded areas and on all other disturbed areas, except water areas and surface areas of roads that are approved as part of the postmining land use, a vegetative cover that is in accordance with the approved permit and reclamation plan [emphasis added].

Under these regulations, the surface of the Mine road is not subject to revegetation standards.

B. **Road as a Previously Disturbed Area**

The road to the Mine was constructed in 1980, was not reclaimed to the requirements of the permanent program and may have been redisturbed by reclamation operations. Pursuant to the Division's regulations, revegetation standards applicable to the Mine road outslopes may be only those necessary to control erosion. R645-301-356.250 provides:

> For areas previously disturbed by mining that were not reclaimed to the requirements of R645-200 to R645-203 and R645-301 to R645-302 and are remined or otherwise redisturbed by coal mining and reclamation operations, at a minimum, the vegetative ground cover will be not less than the ground cover existing before redisturbance and will be adequate to control erosion.

C. **Vegetation and Erosion Control Standards**

The erosion control standards applicable to roads specifically include "vegetating or otherwise stabilizing all exposed surface in accordance with current, prudent engineering practices." R645-301-752.210. In addition, cut and fill slopes of roads not approved as a post-mining land use must be reshaped to complement the drainage pattern of surrounding terrain. R645-301-762. However, this requirement is not applicable to the Mine road which has been approved as a post-mining land use. Id.

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D. The Road as an Exception to a Disturbed Area

The Division's revegetation standards apply to "disturbed areas." R645-301-353. The term "disturbed area" is defined at R645-100-200 to exclude "roads that are designed, constructed and maintained in accordance with R645-301 and R645-302." Although the Mine road was designed and constructed in 1980 prior to adoption of the permanent standards, it may still qualify as an "existing structure." Under the definitions at R645-100-200, an "existing structure" is defined to include those built prior to January 21, 1981. The variance which was granted to HVCC's road under the terms of the 1986 permit may constitute an "existing structure exemption" under R645-100-420. If the Mine road is an "existing structure," it only needs to meet performance standards, not design standards. As indicated above, the surface of roads approved as a post-mining land use are specifically excluded from revegetation performance standards. In addition, cut and fill slopes may not be "disturbed areas" if the road otherwise meets the requirements of R645-301. Under R645-301, the only applicable standards appear to be use of revegetation or other engineering practices as erosion control.

In sum, this circular argument leads HVCC back to erosion control of outslopes by revegetation or other engineering practices. The reference area of the outslopes would appear to be the vegetation growing on the outslopes prior to redisturbance or that needed to control erosion. It seems unlikely that vegetation adequate to control erosion will succeed. Therefore, alternate engineering practices may be required.

II. APPLICATION OF REVEGETATION STANDARDS TO STREAM BUFFER ZONE

On May 2, 1980, the Division granted a variance to the stream buffer zone requirements at the Mine with the stipulation that the outslope of the fill of a pad area be stabilized and that runoff from the outslope meet the effluent limitations. HVCC believed that the terms of this variance were met long ago, however, the Division further required that the operator treat the outslope of the "A" seam. August 5, 1992 Division Memorandum. HVCC initially agreed to revegetate a small area on the outslope of the A-seam pad. However, the Division concluded that revegetation of this small area would restart the ten-year bond clock for reclamation liability. Therefore, by letter dated September 25, 1992, HVCC withdrew the seeding from its plan of

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compliance. Under the terms of the settlement proposal, the Division has asked that this seeding take place.

A. A-Seam Pad as a Previously Disturbed Area.

The standard of revegetation applicable to the A-Seam pad as an area previously disturbed by mining is set forth at R645-301-356.250. Under this provision:

> the vegetative ground cover will be not less than the ground cover existing before redisturbance and will be adequate to control erosion.

The pad was constructed prior to adoption of permanent program standards and would appear to be a previously disturbed area.

B. The A-Seam Pad as an "Existing Structure."

Under the definitions of R645-100-200 an "existing structure" is defined to include structures built prior to January 21, 1981. The A-Seam Pad was built prior to this date and a variance was granted to the structure in 1980. Therefore, the pad would appear to be an "existing structure exemption" under R645-100-420 which only must meet performance standards, not design standards.

III. DOES REVEGETATION RESTART THE BOND CLOCK?

The Division requires a period of ten years of extended responsibility for successful vegetation. R645-301-357.220. Pursuant to R645-301-357.100, this ten year period commences:

> after the last year of augmented seeding, fertilization, irrigation or other work, excluding husbandry practices that are approved by the Division in accordance with R645-301-357.300.

Under this regulation, if seeding of the stream buffer zone and or the road outslopes is considered to be revegetation, this work would appear to restart the bond clock.

Certain exceptions to extending this period of liability appear to be available. If seeding is not undertaken for the

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purpose of revegetation but for erosion control, the Division may have discretion not to restart the bond clock. In addition, the "husbandry practices" exception may be available if the activities do not constitute "augmented seeding." R645-301-357.300. The Division must determine what constitutes "husbandry practices" and adopt these practices into the Utah Coal Program. Id. Conservation practices including seeding may be approved as a "husbandry practice." Id.

In considering these alternatives, it should be noted that the recent vegetation survey at Hidden Valley Mine showed excellent revegetation of this area. The Mine as a whole is well on its way to meeting the Division's revegetation standards. If revegetation is considered over the entire area of the Mine as opposed to isolating the road and pad outslopes, revegetation standards could be met during the initial ten-year period. Because revegetation at the Mine has progressed to this point, the additional seeding activities requested by the Division may be viewed as erosion control activities which exceed the vegetation cover requirements of R645-301-353.

In conclusion, it appears that abatement of NOV N91-26-8-2 and satisfaction of the stream buffer zone variance may be achieved through erosion control. Revegetation is one form of erosion control but reseeding activities may restart the ten-year revegetation bond clock. If possible, erosion control, should be achieved through alternate engineering methods which cause minimum surface disturbance. If areas are seeded to prevent erosion control, an interpretation should be sought by the Division that these activities do not restart the bonding clock.

Very truly yours,

Denise A. Dragoo

Denise A. Dragoo

CC: Lee Edmunson
Joe Jarvis
Karla Knoop

DAD:121092b

HIDDEN VALLEY COAL COMPANY

PLAN FOR ABATEMENT OF NOTICE OF VIOLATION NO. N91-26-8-2

December 8, 1992

Submitted by

Hidden Valley Coal Company
1801 University Drive
Phoenix, Arizona 85034

Prepared by

JBR Consultants Group
8160 South Highland Drive, A-4
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19 pages

HIDDEN VALLEY COAL COMPANY
NOV ABATEMENT PLAN

Introduction

The proposed plan is intended to satisfy two violations that were issued for the reclaimed Hidden Valley Mine under NOV N-91-26-8-2 on November 20, 1991. The Hidden Valley site is owned and operated by Hidden Valley Coal Company. It is considered a difficult site to reclaim due to the inherent instability of the landscape and soils, and due to the erratic, scattered precipitation events that include intense convection storms. Significant plant growth can be short-lived, and erosion events from convection storms are characteristic of this terrain.

Following several heavy precipitation events that caused erosion in the reclaimed areas, repairs were made to the site, using modifications of original reclamation techniques in some areas. This has provided some stability to the site considering the natural erosion rate in the area. The seeded vegetation responded well to spring moisture in 1991 and 1992. Perennial plants have become established on the roadbed and the A- and B-seam fill slopes, in spite of six years of drought in the region. In particular, species seeded only in 1986 during the initial revegetation efforts have now appeared five growing seasons later as immature plants. A recently completed vegetation survey (attached as an appendix to this report) provides evidence of vegetation success.

The establishment of any seeded plant species in the roadbed has been difficult even with repeated seeding, fertilizing, mulching and covering with netting. Now that some desirable vegetation is becoming established, we will avoid further mechanical disturbances on the roadbed, either to alter water bar outfalls or to aid in revegetation.

The following sections describe plans to abate the two violations within the constraints given above. The first addresses the violation for erosion of road slopes and the second addresses seeding of disturbed areas associated with the road. Some of the procedures and methods proposed below differ from those described in the approved Hidden Valley Mine Reclamation Plan; a plan amendment has also been prepared.

Erosion Control

Hidden Valley Coal Company plans to abate the first violation by performing repair work on the water bars and the outfall locations using non-mechanical, hand labor. Use of equipment would not significantly increase the chances for success of the repairs. Even if equipment usage was considered acceptable from a re-disturbance standpoint, the same type of structures would be proposed as are proposed below; equipment would simply allow more dirt and rock to be moved faster. However, given the nature of the slope to be worked, equipment would only be able to access the upper third of the outfalls in most instances; hand work would be required for the majority of the outfall lengths. The detriment to vegetation by bringing in equipment is not acceptable for the benefits gained.

The proposed work will begin no later than April 1, 1993, and as soon as practical after approval has been obtained, materials have been received, and environmental conditions are acceptable. Conditions necessary for work to proceed are (1) no snow cover (for safety reasons it is not possible to work on the steep, unstable slope when snow is present), (2) ground not frozen such that digging is possible, and (3) moisture content such that fill slope materials are workable without forming clods. It is planned that a two-person labor crew will be supervised by a designated professional in accomplishing the proposed work. Level of effort is anticipated to be approximately one month for the crew to

accomplish the repairs. Given the non-uniform conditions within and among water bars, and given the non-standard materials and techniques proposed, close technical supervision of the crew will be necessary. In addition, is it anticipated that a product representative of the proposed material will be onsite during the initial stages of the repair work to provide guidance.

It is important to note that each of the water bar outfalls has eroded to a different level and configuration. At a given outfall, condition varies along the outfall length as well. In addition, particle size of the outfalls ranges from very fine textured clays up to large boulders and bedrock. Given the above, field fitting of the proposed structures will be essential to insure the greatest chance of success. The information provided below provides as much specificity as possible regarding dimensions and methods proposed. It is expected that the height, width, and thickness of structure will vary, as well as the distance between structures.

Next, it is important to note that the proposed techniques are thought to provide the best possible chance of success given the inherent constraints of site topography, substrate and climate. The natural, undisturbed watersheds above the roadway contribute sediment-laden runoff to the disturbed area, as evidenced by deposition in the water bars. Consequently, some erosion and sediment contribution to the ephemeral channel at the base of the slope is a natural phenomenon. The proposed treatments are not expected to eliminate all erosion from the disturbed area, nor are they expected to prevent all sediment contribution to the ephemeral drainage. Instead, they are expected to provide a measure of stability such that erosion will be minimized to the extent possible. Every effort will be made to insure that structures are installed properly and maintained after installation.

A description of the repair work follows.

First, the outfalls will be groomed or shaped within the confines of the existing gullies by rearranging loose rock and slump features. The side slopes of gullies - where steep, undercut or unstable - will be laid back to a gentler angle. Smaller boulders will be strategically placed within the gully, or will be removed. Larger boulders will be pried loose and rolled downhill where possible and desirable. Due to the nature of the unengineered fill in which these gullies occur, the reshaping will not result in a uniform channel down the steep slope, but will provide the best possible "foundation" for further repairs.

Next, small, porous check dams will be installed at frequent intervals along the outfall channels. These dams will be constructed of a fiber barrier using a product equivalent to the fiberdam material constructed by Synthetic Industries. Manufacturer's recommendations (attached at the end of this report) for material installation will be followed. The material is a flexible, moldable mass of fibers that, although irregular in shape, can be molded to fit within a non-uniform cross sectional area. It will be shaped to about a one-foot thickness, with maximum height approximately two feet. The center of the dams will be lower than the edges and will function as a spillway. The dams will be held in place with 18- 24-inch long metal rebar stakes. A schematic cross section showing the check dam treatment follows this report.

These dams will be spaced closely down the outfall; distance between dams will not be uniform, but is expected to range between approximately 5 - 15 feet. Generally, they will be spaced such that the downstream toe of a given dam will be at approximately the same elevation as the maximum potential elevation of sediments deposited behind the next dam downstream. The level to which sediments can be deposited above a dam is dependant upon the

spillway elevation, the gradient above the dam, and particle size of the sediments. This level will not be known exactly; instead, visual estimation of dam location will be done using professional judgement. Presence of bedrock or large boulders will further affect spacing.

Where feasible, a synthetic fiber erosion matting will be laid in the channel between the check dams to provide additional protection. In areas where large rock may preclude placement of matting, the rock itself will serve as protection.

The function of these porous dams will be to reduce velocity of runoff in the outfall, causing deposition of sediments behind and within the fiber dams. Water will pass through the dams, as well as over the spillways; the porous nature of the dams will not block flow or set up conditions whereby forces against the dams are excessive. Allowing water to pass through the dams also reduces the chance of erosion around the edges of the dams, causing failure. Over time, sediments will eventually clog the dams. This, in combination with deposition behind the dams, will in effect, build back up the gully floor to some reasonable elevation. The retention of the fine sediments will, in turn, allow greater moisture retention and these areas will have a greater opportunity for plant colonization. The result will be a series of steps down the outfall, with the flat sections vegetated and the steep sections stabilized.

In addition, a continuation of ongoing work on the water bars themselves will be done. Level of effort will be greater than in the past, in an attempt to maintain retention potential for sediments and runoff water. This work will entail removal of sediments deposited in the bars and construction or enlargement of substantial check dams perpendicular to the bars to serve as retention structures.

Monitoring and Maintenance. In order to insure that erosion is minimized, each structure will be inspected periodically to insure proper functioning. During the regular inspection period of April through October, structures will be examined a minimum of once per month during the regular monthly site visit. In addition, they will be inspected after weather patterns indicate that substantial runoff may have occurred at the site. Any needed maintenance or repairs to the structures will be done within one calendar month following the identification of a problem. In addition, a photographic record will be kept to track outfall condition and to identify trends toward stabilization.

Revegetation

The revegetation techniques to answer the second violation will be limited to hand distribution methods only. The history of revegetation at Hidden Valley has shown that seedings only respond when sufficient moisture is available during the spring growing season. The use of mulching, netting and erosion blankets has not significantly altered the local environment conditions to foster plant growth. Thus, the revegetation attempts will utilize hand methods to increase moisture retention without severely damaging the surface of the steep slopes.

The areas to be seeded are: the access road which has previously been seeded three times; road fill slopes; and stream buffer zone slopes. The road upslopes will not be seeded. All seeding will be done using hand broadcast methods with the included seed mixture. On the access road - where total vegetation cover has recently been measured at 29 percent, and total perennial cover at 6 percent - the surface crust will be disturbed and seed will be broadcast in selected bare areas. Where substrate conditions allow on the remaining areas (road fill and buffer zone), pitting with a pulaski hand tool at the rate of one pit per square yard will be done prior to broadcast seeding.

The revegetation work will be accomplished when soil conditions permit. Those acceptable soil conditions are defined as less than 10 percent snow cover, frost free in the upper six inches, and sufficiently dry in the upper six inches to not clod when worked. If conditions do not permit seeding by February 1, 1993, an alternative seed mix to that listed below will be submitted for Division approval.

The following seed mixture and rates will be used:

Common Name	Scientific Name	PLS lbs/acre
Indian ricegrass	Oryzopsis hymenoides	3
Russian wildrye	Elymus junceus	3*
Ephraim crested wheat	Agropyron cristatum	3**
squirreltail	Sitanion hystrix	1
yellow sweetclover	Melilotus officinalis	3
fourwing saltbush	Atriplex canescens	3
shadscale	Atriplex confertifolia	2
winterfat	Ceratoides lanata	3
Palmer's penstemon	Penstemon palmeri	2
Castle Valley saltbush	Atriplex gardneri var cuneata	2
buckwheat	Eriogonum corymbosum	0.5
	Total	25.5

* exotic used in first mixture in 1986

** exotic but an excellent soil binder and better suited for this site than other native seeds available

This mixture varies from that listed in the Interim Plan. The species selection is based on what has grown and survived at Hidden Valley in the last five years.

Monoammonium phosphate fertilizer will be spread at a rate of 242 lbs/acre on all of the areas to be reseeded.

INSTALLATION

ESTIMATE THE MINIMUM THICKNESS RECOMMENDED FOR THE FIBERDAM AND THE SPACING BETWEEN FIBERDAMS USING THE FOLLOWING CHART:

CHANNEL DEPTH (INCHES)	MINIMUM RECOMMENDED FIBERDAM THICKNESS (INCHES)	RECOMMENDED SPACING BETWEEN FIBERDAMS (INCHES)
LESS THAN 6	4	15
12	7	30
18	10	45
24	12	70
36	16	90
48	20	120

STEP 1

- ☐ PLACE FIBER INTO THE CHANNEL AT THE RECOMMENDED THICKNESS UNTIL CHANNEL DEPTH IS 90% FILLED.
- ☐ PLACE FIBER AT EACH EDGE OF THE FIBERDAM UNTIL A "U" SHAPE IS FORMED AT THE TOP OF THE CHANNEL.
- ☐ ANCHOR THE FIBER TO THE SIDES OF THE CHANNEL USING STAKES OR STAPLES. THE MIDDLE OF THE DAM SHOULD BE LOWER THAN THE EDGES.
- ☐ PLACE STAKES AT THE BACK OF THE FIBERDAM AWAY FROM THE WATER FLOW.
- ☐ STAKES MAY PENETRATE THE FIBERDAM TO HOLD IT IN PLACE.
- ☐ STAKES SHOULD NOT BE PLACED GREATER THAN 6 INCHES APART. (SEE FIGURE 1)

STEP 2

- ☐ INSTALL THE NEXT FIBERDAM USING THE PROCEDURE OUTLINED IN STEP 1.
- ☐ REPEAT STEPS 1 AND 2 IN SEQUENCE UNTIL THE TOP OF THE CHANNEL IS REACHED.
- ☐ ON SOME INSTALLATIONS, IT IS RECOMMENDED THAT LANDSTRAND, COATED WITH ASPHALT EMULSION, BE USED BETWEEN FIBERDAMS TO AID IN COLLECTING SEDIMENT AND ENHANCING VEGETATION GROWTH.

FIBERDAM

BARRIER FOR EROSION CONTROL AND SEDIMENT COLLECTION

FIBERDAM IS A BARRIER FOR REDUCING THE VELOCITY OF WATER IN A CHANNEL AND CAUSING THE DEPOSIT OF SEDIMENT. PLACED IN RILLS AND GULLYS, FIBERDAM WILL ALLOW THE CHANNEL TO HEAL ITSELF BY CAUSING SEDIMENT DEPOSIT FOR GROWTH OF VEGETATION.

UNLIKE STRAW OR HAY BALES, FIBERDAM DOES NOT BLOCK THE FLOW OF WATER. FIBERDAM IS A FIBER BARRIER WHICH ALLOWS WATER TO PASS AT A REDUCED VELOCITY. FIBERDAM WILL NOT DECAY LIKE STRAW OR HAY BALES. IT FILLS WITH SEDIMENT AND BECOMES A PERMANENT REINFORCEMENT IN THE CHANNEL.

FEATURES

☐ LIGHTWEIGHT	EASY TO TRANSPORT AND INSTALL.
☐ EASY INSTALLATION	ANCHOR WITH WOODEN STAKES OR METAL STAPLES.
☐ FLEXIBLE	WILL CONFORM TO ANY SHAPED CHANNEL.
☐ CUSTOM FIT	THE AMOUNT OF FIBER USED IS DETERMINED BY THE EXPECTED WATER FLOW AND THE SIZE OF THE CHANNEL.

PRODUCT DATA

MATERIAL COMPOSITION-	POLYPROPYLENE
SPECIFIC GRAVITY-	0.91
IGNITION TEMPERATURE-	1,100 F (593 C)
WATER ABSORPTION-	NIL
FIBER DENIER-	400 NOMINAL
FIBER DIAMETER-	10 MILS NOMINAL
FIBER LENGTH-	6 INCHES NOMINAL

As a result of NOV N91-26-8-2, additional treatment to water bar outfalls has been done. The treatment consists of reshaping gullies formed in the outfalls, placement of porous check dams, and placement of erosion matting. Details on the design, functioning and maintenance of the outfall treatments are contained in the NOV Abatement Plan which is attached at the end of Appendix III of the Reclamation Plan.

Also as a result of the NOV cited above, reseeding of the road surface has been done in selected bare areas, and seeding has been done on the road fill slopes. Additional descriptions on surface preparation, seed mix and amendments are contained in other pages of this Plan Amendment.

water-barring of the road and filling of the small roadside ditch the discharge into this culvert will be eliminated.

UMC 817.103 Backfilling and Grading: Covering Coal and Acid- and Toxic-Forming Materials

Coal or other associated materials are not readily evident on the site. Should any of these materials be discovered during excavation and backfilling they will be placed against the coal seams and covered with other non-toxic materials. There is no water drainage from the coal seams or adits. Therefore, acid mine drainage and related toxic elements would not be discharged from the site. See letter in Appendix Ia.

UMC 817.106 Regrading or Stabilising Rills and Gullies

The existing rills in the road surface will be eliminated with water-barring and ripping of the road surface. The rills ~~or gullies~~ that may appear during post-reclamation monitoring will be stabilised by filling with soil and rocks. Chronic sites [redacted] will be stabilised with small gabions [redacted] or ~~rock~~ check dams.

As a result of NOV N91-26-8-2, a fourth reseeding effort has been made on the road surface. The effort consisted of disturbing the soil surface in selected bare areas to prepare the seed bed, followed by hand broadcasting with an approved seed mix and fertilizer.

In addition, the road fill outslopes were seeded for the first time as a result of the NOV. Surface treatment consisted of hand pitting at a rate of one pit per square yard where substrate conditions allows. The entire road fill outslope was then seeded and fertilized by hand broadcasting.

The seed mix and fertilizer used in these efforts is given elsewhere in this Plan Amendment.

As a result of NOV N91-26-8-2, additional treatment to water bar outfalls has been done. The treatment consists of reshaping gullies formed in the outfalls, placement of porous check dams, and placement of erosion matting. Details on the design, functioning, and maintenance of the outfall treatments are contained in the NOV Abatement Plan which is attached at the end of Appendix III of the Reclamation Plan.

Amendments added to the soil in areas which were reseeded as a result of NOV N91-26-8-2 consisted of 242 lbs/acre of monoammonium phosphate fertilizer. This fertilizer is preferable to the diammonium phosphate which was previously permitted, especially where alkaline soils occur.

As a result of MOV M91-26-8-2, additional reseeding of the road surface has been done in selected bare areas, and seeding has been done on the road fill slopes. On the roadway itself, the effort consisted of disturbing the soil surface in selected bare areas to prepare the seedbed, followed by hand broadcasting with an approved seed mix and fertiliser. On the road fill outslopes, surface treatment consisted of hand pitting at a rate of one pit per square yard where substrate conditions allows. The entire road fill outslope was then seeded and fertilized by hand broadcasting.

Seeding that occurred in accordance with the abatement of NOV N91-26-8-2 was done using the following seed mix:

Common Name	Scientific Name	PLS lbs/Acre
Indian ricegrass	Orysopsis hymenoides	3
Russian wildrye	Elymus junceus	3*
Ephraim crested wheat	Agropyron cristatum	3**
squirreltail	Sitanion hystrix	1
yellow sweetclover	Melilotus officinalis	3
fourwing saltbush	Atriplex canescens	3
shadscale	Atriplex confertifolia	2
winterfat	Ceratoides lanata	3
Palmer's penstemon	Penstemon palmeri	2
Castle Valley saltbush	Atriplex gardneri var. cuneata	2
buckwheat	Eriogonum corymbosum	0.5
	Total	25.5

* exotic used in first mixture in 1986

** exotic but an excellent soil binder and better suited for this site than other native seeds available

This mixture is based on what has grown and survived at Hidden Valley in the five years since revegetation efforts began.

Revegetation that was done in accordance with the abatement of NOV M91-26-8-2 did not include the use of any mulch or netting.

As a result of MOV M91-26-8-2, seeding and fertilising of the pad outslopes within the buffer zone has been done using non-mechanical methods.

HIDDEN VALLEY MINE

Revegetation Monitoring Study
Fall, 1992

November 20, 1992

submitted to:

Calmat Company
1801 University Drive
Phoenix, Arizona 85034

submitted by:

JBR Consultants Group
8160 South Highland Drive, A-4
Sandy, Utah 84093

HIDDEN VALLEY MINE

Revegetation Monitoring Study
Fall, 1992

1.0 Introduction

A vegetation study was conducted by JBR Consultants at the Hidden Valley Reclamation Site in September and October, 1992. The purpose of the study was to quantitatively monitor the success of revegetation of the disturbed areas with respect to species cover and composition. In addition, the vegetation reference area used to determine revegetation success standards, which was established and surveyed originally in 1986, was re-surveyed to provide comparative data.

Vegetation sampling methods were designed in accordance with the methods stated in the approved Reclamation Plan for the site, and stated in the Division's Vegetation Information Guidelines, revised December, 1991 version. The methods are described below. Results of the study are presented as well.

2.0 Precipitation Information

Precipitation information for the site was obtained from monthly records for the closest weather station at Castledale, elevation 5604 feet. The average annual precipitation since 1986, when revegetation efforts began, is as follows:

Year	Precipitation (inches)
1986	6.25 inches
1987	11.49
1988	7.90
1989	5.46
1990	6.49
1991	8.06
6-Yr. Average	7.61 inches

As of August 1, 1992 total precipitation was 5.29 inches.

This National Oceanographic Atmospheric Administration (NOAA) station does not precisely represent weather encountered at Hidden Valley. The station is located approximately 30 miles north of the revegetation site, and is at the base of the Wasatch Plateau, which

probably influences the readings. Elevation of the two sites are similar, but the Hidden Valley reclamation site is most likely more xeric, benefitting from infrequent, widely scattered and unquantified rainstorms. (The Emery station which was originally used to monitor site precipitation was discontinued in 1978.)

3.0 Sample Site Location

Transects were located randomly throughout the 6.7-acre reclamation area. The disturbed area at the site was divided into two sections for survey purposes: the roadway and the main area. Separate surveys were conducted on each section, with statistical adequacy being assessed separately. This was done as a means to evaluate success on the roadway separately since it was in question by the Division. Data sets were also combined to provide a single encompassing survey result summary as well. Tables providing data and statistical summaries are at the end of this report.

The number of transects in each of the two sections was dependant upon the sample adequacy calculations as described in the Division Guidelines. Testing of total vegetation cover was done to meet a 90 percent confidence level with a 10 percent change in the mean using a 1-tailed t-test. At the onset of the study, it was anticipated that a large number of transects would be needed due to the apparent variability in vegetated cover at the site. Therefore, permanent marking of the transects was not done.

3.1 Roadway

The roadway was marked off in 10-foot intervals, giving the researchers 280 points along its length. An additional 20 points were identified on a grid within the topsoil stockpile site at the top of the road, providing a total of 300 potential starting points for this part of the survey. A random number generator on a hand calculator was used to select the sample site starting location. A second random number was generated to identified the (0-360) directional aspect of the transect. This number dictated whether the transect started on the left or right hand side of the road, as the directional aspect generated lent itself to containment within the disturbed site. If length of the transect exceeded the width of the disturbed area, a second random direction was generated and the transect angled to accommodated the 100-foot transect length.

Sample sites were located by compass and a measured pace of the researcher from the bottom of the road, ending with (280) at the top of the road, near the topsoil stockpile site.

3.2 Main Area

A closely spaced grid was placed on the 1-inch = 100-foot Final Reclamation Map from the Reclamation Plan. Points at grid intersections were numbered sequentially from 1 to 193. Site location and direction were identified randomly as discussed for the roadway.

4.0 Sample Types

For each sample, a 100-foot survey tape was laid out along the randomly determined transect. Two types of cover determinations were done along the line, (cover by species may and often does add up to more than 100%). First a line-intercept method was used, reading the continuous transect length, where percent cover of each species, litter, bare ground and rock were obtained by adding the distances along the transect that each occurred. Even though present year's growth of annual plants was now dead, it was all considered vegetation, rather than litter. Dead, mostly decayed organic matter was counted as litter. Some of the transects within the main area had relatively large amounts of litter due to the persistence of the original erosion-control mat placed on the site. Grass species were easily identified as seed heads were present.

Next, an ocular method was used to mimic the original survey of the vegetation reference area. Along the 100-foot transect line, 10 randomly spaced, 1-yard square quadrants were placed. (Random samples were identified at one-foot intervals between 1 and 100, as potential points.) The percent ground cover by species, litter, rock and bare ground were ocularly estimated.

Both sampling methods were used in order to (1) duplicate the original ocular 1-yard square quadrat sampling technique used in 1986 on the reference site, (2) comply with the methodology stated in the Reclamation Plan, and (3) use a technique more acceptable to the Division for determination of revegetation success. If the two methods proved close in results, it was hoped that the ocular 1-yard square quadrat method could be dropped as a sampling method in subsequent years.

5.0 Data Analysis and Results

All data obtained from cover and density sampling were checked for completeness, and statistical information was generated. For each transect sampled, percent cover was recorded separately for each vegetative species, and the ground cover components of litter, rock and bare ground. Each line transect represented one sample for the line intercept method. Each 1-yard square quadrant was considered one sample for the ocular quadrat sampling technique. The data for each method was averaged separately for

both areas described and provided two separate, but supporting, mean cover values for the roadway and the main area. Further, data sets were combined to provide a single encompassing survey.

A total of 17 line-intercept transects and 170 1-yard square quadrants were sampled along the roadway. Further, 21 line-intercept transects and 209 1-yard square quadrants were sampled within the main area. Data tables follow at the end of this report.

5.1 Roadway

5.1.1 Line-Intercept Data

The average vegetated cover is 29.0%. The vegetated cover data met the statistical adequacy of a 1-tailed t-test, at the 90% confidence level with a 10% change in the mean, with the 17 samples taken. Of this total vegetation cover, 79.4% is annual forb, 17.2% is subshrub/shrub and 3.4% is perennial grass cover. (Vegetated cover included all species of cover including undesirable invader annual species such as Halogeton glomeratus and Kochia (spp.)

Of the total cover, the average perennial desirable plant species cover is 6.0%. However, due to the great variability in the data, statistical adequacy was not met for perennial cover. To meet statistical adequacy of the 1-tailed t-test at the 90% confidence level with a 10% change in the mean would have required 97 samples.

5.1.2 Ocular Quadrat Data

The average vegetated cover is 25.2%, which met the statistical adequacy with 170 samples. Of this total vegetation cover, 81.3% is annual forb, 16.3 is subshrub/shrub and 2.4% is perennial grass cover.

Of the total cover, the average perennial desirable plant cover is 4.8%; statistical adequacy was not met. To meet statistical adequacy, 659 samples would be required.

5.2 Main Area

5.2.1 Line-Intercept Data

The average vegetative cover is 11.0%, which met the statistical adequacy with 21 samples. Of this vegetation cover, 70.7% is annual forb, 19.5% is shrub/subshrub and 9.8% is perennial grass cover.

Of the total cover, the average perennial desirable plant cover is 12.6%. Again, statistical adequacy for perennial cover was not met. To meet statistical adequacy 167 samples would be required.

5.2.2 Ocular Quadrat Data

The average vegetated cover is 34.0%, which met the statistical adequacy with 209 samples. Of this vegetation cover, 70.3% is annual forb, 18.5% is shrub/subshrub, and 11.2% is perennial grass cover.

Of the total cover, the average perennial desirable plant cover is 10.1%. To meet statistical adequacy 467 samples would be required.

5.3 Combined Data Set

5.3.1 Line-Intercept Data

The average vegetated cover is 35.6%, which met the statistical adequacy. Of this vegetation cover, 72.7% is annual forb, 19.4% is subshrub/shrub, and 7.9% is perennial grass cover.

Of the total cover, the average perennial desirable plant cover is 9.7%, statistical adequacy was not met. To meet statistical adequacy 22 samples would be required.

5.4 Reference Area

Reference area data gathered in 1986 by ocular estimation on 40, one-yard square quadrats showed the following:

Vegetation	6.5 percent
Litter	1.7 percent
Rock	21.1 percent
Pavement/Bare Ground	70.7 percent

A repeat survey of the reference area in October, 1992, using the same observer and the same methodology showed the following:

Vegetation	5.6 percent
Litter	2.4 percent
Rock	30.0 percent
Pavement/Bare Ground	62.0 percent

A comparison of the two sets of results shows that little change has occurred in the reference area over the past six years. It should be noted that statistical adequacy was not met with the

40 samples for either of the two reference area surveys. Due to the low percent vegetation cover, a very large number of samples would likely be required in order for adequacy calculations to be satisified.

A comparison of the ocular data gathered on the reclaimed site with those gathered on the reference area shows that litter and vegetative cover are greater on the reclaimed site. Rock and bare ground are less on the reclaimed site than on the reference area.

The average vegetated cover of all considered perennial desirable species was 6.5% and 5.8% for the reference area in 1986 and 1992, respectively. Of these amounts, in 1986, 27% were grasses and 73% were shrubs; in 1992, 38% were grasses and 62 were shrubs. For comparison, the average perennial cover for the main area and the roadway as indicated by ocular estimation was 10.1 and 4.8%, respectively. For the roadway, 86 percent of the perennial vegetation were shrubs and 14 percent were grasses. For the main area, 66 percent of the perennial vegetation were shrubs and 34 percent were grasses.

6.0 Observations and Discussion

Plant vigor of the desirable perennial cover was good to excellent. The mature grass and shrubs produced seed this year, however without germination tests, the viability of that seed is unknown. There is no reason to suspect that the viability would not fall within the norm.

There was evidence of recruitment of young fourwing saltbush in the roadway, where additional water had accumulated behind water bars and small waterways. There were also young indian ricegrass plants noted in the main area, these were identified by the characteristic rolled leaves of the species.

In the best of conditions, revegetation within the moisture regime of this site, semi-desert, 8-11 inches of average annual precipitation, is difficult. Further, is it generally felt that this area is in its sixth year of drought, which further affects any revegetation success. Vegetal changes in semi-desert areas are slow, a minimum of 10-20 years under revegetation conditions. "Desired established plants during a drought on these soils, in this area (Hidden Valley) has been very successful. Many example can be given of seedings elsewhere in the county which have been less successful." (Personal Communication, Bureau of Land Management)

There has been a great deal of discussion surrounding the ubiquitous invader "pioneer" species of halogeton and kochia, particularly the halogeton, due to its poisonous properties at certain times of its life cycle to domestic livestock. The area of

concern is above the gate, on the road, where livestock grazing has not been excluded.

Historical observations indicate that following the reseeding of the roadway, it was mulched with hay to retain additional moisture on the site and facilitate success of the revegetation. However, following the treatment, cattle congregated on the roadway where it was not protected from grazing livestock within this BLM grazing allotment. This factor alone, is the treatment difference on the roadway above the gate, where revegetation success is in question.

Halogeton is a poor competitor when competing against perennial species. It also not considered a particularly palatable plant for domestic livestock. Halogeton represents early succession on disturbed sites, with 4-20 inches of annual rainfall on alkaline soils.

Finally, the site differs greatly from the reference area on the amount and size of rock cover. The revegetation site lacks large rock cover that influences the native vegetation, as rocks act to retain winter moisture on site as drifting snow typically accumulates around them. Pitting and shading caused by large rocks all influence the spatial occurrence and productivity of the individual plants and the overall site.

Hiden Valley Mine - Main Area
Percent Cover Data - Line Transects
Fall, 1992

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
Shrubs and Subshrubs								
Artemisia tridentata	1							
Atriplex canescens	2	3	5		22	11	2	2
Atriplex confertifolia								
Atriplex corrugata	11			<1	<1	1	3	4
Ceratoides lanata				1			1	
Sarcobatus vermiculatus			1					
Unknown shrub						1		
Total Shrubs/Subshrubs Cover	14	3	6	1	22	13	6	6
Forbs								
Descurainia spp.	<1	1		1		<1		
Halogeton glomeratus	15	3		7	1	3	8	4
Kochia spp.	16	34	60	22	16	9	18	19
Salsola kali	6	1	1	2	5	9	10	3
Total Forb Cover	37	39	61	32	22	21	36	26
Graminoids								
Agropyron cristatum	5	7	1	3		4	2	5
Elymus junceus			1					
Elymus salinus							<1	
Oryzopsis hymenoides		<1		<1				
Sitanion hystrix								
Sporobolus cryptandrus					1			
Total Graminoid Cover	5	7	2	3	1	4	2	5
Total Vegetation Cover	49	47	63	36	45	37	38	35
Litter	7	14	13	14	6	6	6	26
Rock	4	1	2	2	15	9	15	3
Bare	40	39	22	48	34	49	41	36

Hiden Valley Mine - Main Area
Percent Cover Data - Line Transects
Page 2
Fall, 1992

PLANT SPECIES	STAND							
	9	10	11	12	13	14	15	16
Shrubs and Subshrubs								
Artemisia tridentata								
Atriplex canescens	4		3	2	4	53	13	2
Atriplex confertifolia			1					
Atriplex corrugata		1	<1	2	<1		<1	<1
Ceratoides lanata			1	1	<1	1	<1	
Sarcobatus vermiculatus								
Unknown shrub								
Total Shrubs/Subshrubs Cover	4	1	5	5	4	54	13	2
Forbs								
Descurainia			<1			<1		
Halogeton glomeratus	10	6	21	24	9			3
Kochia spp.	15	22	<1	3	1	12	58	28
Salsola kali	1	1	1	2	<1	1		1
Total Forb Cover	26	29	22	29	10	13	58	32
Graminoids								
Agropyron cristatum	4	4			<1	3	4	6
Elymus junceus		2	1				1	
Elymus salinus	<1							
Oryzopsis hymenoides			1		<1			
Sitanion hystrix			1	<1				
Sporobolus cryptandrus								
Total Graminoid Cover	4	6	3	0	0	3	5	6
Total Vegetation Cover	34	36	30	30	15	69	67	41
Litter	5	14	4	6	1	11	6	17
Rock	4	1	12	4	3	4	10	1
Bare	57	49	54	61	80	16	17	41

Hiden Valley Mine - Main Area
Percent Cover Data - Line Transects
Page 3
Fall, 1992

PLANT SPECIES	STAND						
	17	18	19	20	21	Mean	Std. Dev.
Shrubs and Subshrubs							
Artemisia tridentata						<1	<1
Atriplex canescens		5			5	7	12
Atriplex confertifolia						<1	<1
Atriplex corrugata		<1	1	1	<1	1	2
Ceratoides lanata		3			2	<1	1
Sarcobatus vermiculatus						<1	<1
Unknown shrub						<1	<1
Total Shrubs/Subshrubs Cover	0	8	1	1	7	8	12
Forbs							
Descurainia						<1	<1
Halogeton glomeratus	12	14		8	24	8	8
Kochia spp.	14	4	39	26	1	20	17
Salsola kali	2	<1	<1	1	11	3	3
Total Forb Cover	28	18	39	35	36	31	12
Graminoids							
Agropyron cristatum		2	6	4	2	3	2
Elymus junceus		16			1	1	4
Elymus salinus						<1	<1
Oryzopsis hymenoides						<1	<1
Sitanion hystrix						<1	<1
Sporobolus cryptandrus						<1	<1
Total Graminoid Cover	0	18	6	4	3	4	4
Total Vegetation Cover	25	41	46	36	38	41	13
Litter	3	10	23	18	7	10	7
Rock	45	4	1	3	15	8	10
Bare	27	46	30	42	39	41	15

Hiden Valley Mine - Road
Percent Cover Data - Line Transects
Fall, 1992

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
Shrubs and Subshrubs								
Aster spp.							2	
Atriplex corrugata		10	1	6		3		5
Chrysothamnus nauseousus						<1	6	<1
Cryptantha spp.							1	
Eriogonum spp.							1	
Gutierrezia sarothrae						2		6
Total Shrubs/Subshrubs Cover	0	10	1	6	0	5	10	11
Forbs								
Halogeton glomeratus	19	23	17	13	26	3	15	22
Kochia spp.	11	2		2		<1		
Salsola kali	<1					<1	<1	
unknown perennial forb								<1
Total Forb Cover	30	25	17	15	26	4	15	22
Graminoids								
Bromus tectorum					<1			
Elymus junceus				<1	2	1		
Oryzopsis hymenoides						<1	1	
Sitanion hystrix						2	1	
Sporobolus cryptandrus							1	
Total Graminoid Cover	0	0	0	0	2	3	3	0
Total Vegetation Cover	30	35	18	20	28	12	28	33
Litter	7	8	2	9	8	4	5	12
Rock	27	42	36	27	51	13	8	12
Bare	36	14	44	44	13	71	59	43

Hiden Valley Mine - Road
Percent Cover Data - Line Transects
Page 2
Fall, 1992

PLANT SPECIES	STAND							
	9	10	11	12	13	14	15	16
Shrubs and Subshrubs								
Atriplex corrugata	5		2	6	12	2		4
Chrysothamnus nauseousus					3		2	
Gutierrezia sarothrae		3		1			3	
Machaeranthera canescens							<1	
Total Shrubs/Subshrubs Cover	5	3	2	7	15	2	5	4
Forbs								
Descurainia							<1	
Halogeton glomeratus	44	32	22	29	11	18	28	12
Kochia spp.				<1		1		9
Salsola kali						1	1	
Total Forb Cover	44	32	22	29	11	20	29	21
Graminoids								
Agropyron cristatum					<1			
Elymus junceus			<1			1	1	
Elymus salinus						<1		
Hilaria jamesii					<1		<1	
Oryzopsis hymenoides				1	1	<1		
Sitanion hystrix		1					2	
Total Graminoid Cover	0	1	0	1	1	1	3	0
Total Vegetation Cover	48	35	25	36	27	23	34	22
Litter	20	17	12	13	5	9	12	10
Rock	12	16	20	31	11	10	25	46
Bare	20	32	43	20	57	58	29	22

Hiden Valley Mine - Road
Percent Cover Data - Line Transects
Page 3
Fall, 1992

PLANT SPECIES	STAND		
	17	Mean	Standard Deviation
Shrubs and Subshrubs			
Atriplex corrugata		3	4
Chrysothamnus nauseousus		1	2
Gutierrezia sarothrae		1	1
Machaeranthera canescens		<1	<1
Total Shrubs/Subshrubs Cover	0	5	4
Forbs			
Descurainia		<1	<1
Halogeton glomeratus	24	21	10
Kochia spp.	13	2	4
Salsola kali	1	<1<1	<1
unknown perennial forb	<1		<1
Total Forb Cover	38	24	10
Graminoids			
Agropyron cristatum		<1	<1
Bromus tectorum		<1	<1
Elymus junceus	3	<1	1
Elymus salinus		<1	<1
Oryzopsis hymenoides		<1	<1
Sitanion hystrix		<1	1
Sporobolus cryptandrus		<1	<1
Total Graminoid Cover	3	1	1
Total Vegetation Cover	41	29	9
Litter	13	10	5
Rock	30	24	13
Bare	16	37	18

HIDDEN VALLEY MINE MAIN AREA - FALL, 1992 Occular Quadrats - Percent Cover Summary		
Parameter	x	std
Shrubs and Subshrubs	6.3	13.9
Forbs	23.9	14.7
Graminoids	3.8	7.0
Total Vegetation	34.0	18.1
Litter	13.9	10.8
Rock	10.0	13.4
Bare Ground	42.1	19.7

HIDDEN VALLEY MINE ROAD - FALL, 1992 Occular Quadrats - Percent Cover Summary		
Parameter	x	std
Shrubs and Subshrubs	4.1	8.4
Forbs	20.5	15.2
Graminoids	0.6	3.2
Total Vegetation	25.2	14.4
Litter	11.9	9.0
Rock	28.6	17.2
Bare Ground	34.4	21.6

SAMPLE ADEQUACY INFORMATION HIDDEN VALLEY MINE AREA, FALL, 1992				
Sample Set	n	x	std	n_{min}
Main Area - Line Transects	21	40.9	13.1	18
Main Area - Occular Quadrats	209	34.0	18.1	49
Road - Line Transects	17	29.1	9.0	17
Road - Occular Quadrats	170	25.2	14.4	56

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats -Road								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
1a	15	50	10	0	0	25	25	0
b	20	20	10	0	25	25	50	25
c	15	40	10	0	0	35	35	0
d	5	35	15	0	0	45	45	0
e	20	25	15	0	0	40	40	0
f	25	40	10	0	0	25	25	0
g	40	15	10	0	5	30	35	5
h	40	15	10	0	5	30	35	5
i	47	30	10	0	0	13	13	0
j	63	35	0	0	0	2	2	0
2a	40	45	5	0	0	10	10	0
b	14	60	10	0	1	15	16	1
c	20	59	5	0	1	15	16	1
d	19	50	15	0	1	15	16	1
e	15	59	10	0	1	15	16	1
f	25	35	10	0	10	20	30	10
g	30	50	10	0	0	10	10	0
h	40	30	10	0	0	20	20	0
i	10	70	0	0	0	20	20	0
j	25	25	15	0	0	35	35	0
3a	45	0	10	0	15	30	45	15
b	35	40	0	0	0	25	25	0
c	30	40	0	0	0	30	30	0
d	40	35	0	0	0	25	25	0
e	50	35	0	0	0	15	15	0
f	35	60	0	0	0	5	5	0
g	45	45	0	0	0	10	10	0
h	45	45	0	0	0	10	10	0

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats -Road								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
i	35	50	0	0	0	15	15	0
j	50	50	0	0	0	0	0	0
4a	25	55	10	0	0	10	10	0
b	50	25	10	0	0	15	15	0
c	30	5	5	0	15	45	60	15
d	60	15	0	0	0	25	25	0
e	55	25	0	0	15	5	20	15
f	75	5	0	0	0	20	20	0
g	50	10	0	0	15	25	40	15
h	20	25	15	0	15	25	40	15
i	55	20	5	0	0	20	20	0
j	50	40	0	0	0	10	10	0
5a	30	35	10	0	0	25	25	0
b	25	35	10	0	0	30	30	0
c	0	80	0	0	0	20	20	0
d	0	100	0	0	0	0	0	0
e	30	50	0	0	0	20	20	0
f	20	55	10	0	0	15	15	0
g	15	55	15	0	0	15	15	0
h	25	40	10	0	0	25	25	0
i	20	35	15	0	0	30	30	0
j	10	60	15	0	0	15	15	0
6a	88	5	0	5	1	1	7	6
b	48	10	10	2	10	20	32	12
c	60	10	5	0	20	5	25	20
d	58	30	2	0	0	10	10	0
e	55	15	5	0	25	0	25	25
f	69	15	5	0	10	1	11	10

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats -Road								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
g	48	15	10	10	2	15	27	12
h	44	20	5	10	16	5	31	26
i	43	20	5	5	25	2	32	30
j	20	30	15	10	20	5	35	30
7a	78	15	2	0	5	0	5	5
b	88	10	2	0	0	0	0	0
c	10	55	10	0	0	25	25	0
d	15	34	10	11	0	30	41	11
e	46	15	10	2	25	2	29	27
f	85	15	0	0	0	0	0	0
g	90	10	0	0	0	0	0	0
h	79	10	0	0	11	0	11	11
i	70	5	5	0	20	0	20	20
j	55	10	5	0	20	10	30	20
8a	40	10	15	0	0	35	35	0
b	55	15	0	0	25	5	30	25
c	25	20	20	0	20	15	35	20
d	60	20	10	0	10	0	10	10
e	20	15	10	0	40	15	55	40
f	25	25	10	0	30	10	40	30
g	40	25	15	0	5	15	20	5
h	20	25	30	0	0	25	25	0
i	10	20	15	0	0	55	55	0
j	10	35	15	0	0	40	40	0
9a	25	20	25	0	0	30	30	0
b	30	20	20	0	0	30	30	0
c	10	15	10	0	0	65	65	0
d	20	25	20	0	0	35	35	0

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats -Road								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
e	40	25	15	0	0	20	20	0
f	25	15	20	0	0	40	40	0
g	15	10	15	0	0	60	60	0
h	25	10	25	0	0	40	40	0
i	30	15	30	0	0	25	25	0
j	25	15	30	0	0	30	30	0
10a	50	40	10	0	0	0	0	0
b	30	35	0	0	0	35	35	0
c	59	0	10	6	15	10	31	21
d	50	0	30	0	5	15	20	5
e	20	40	0	0	0	40	40	0
f	30	30	10	0	0	30	30	0
g	20	10	20	0	0	50	50	0
h	25	20	10	0	0	45	45	0
i	20	20	10	0	0	50	50	0
j	20	25	20	0	0	35	35	0
11a	55	20	15	0	0	10	10	0
b	40	20	15	0	0	25	25	0
c	40	30	10	0	0	20	20	0
d	25	40	15	0	0	20	20	0
e	20	25	25	0	0	30	30	0
f	55	20	10	0	10	5	15	10
g	15	35	20	0	0	30	30	0
h	40	25	15	0	0	20	20	0
i	14	35	25	0	1	25	26	1
j	50	20	15	0	0	15	15	0
12a	25	25	25	0	0	25	25	0
b	0	90	5	0	0	5	5	0

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats -Road								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
c	0	25	25	0	0	50	50	0
d	20	25	30	0	0	25	25	0
e	10	50	20	0	0	20	20	0
f	5	35	35	0	0	25	25	0
g	20	25	25	0	0	30	30	0
h	35	30	15	0	0	20	20	0
i	15	15	20	0	0	50	50	0
j	35	30	20	0	0	15	15	0
13a	60	5	10	0	25	0	25	25
b	60	5	10	0	25	0	25	25
c	50	10	10	0	30	0	30	30
d	33	15	10	0	40	2	42	40
e	10	65	10	0	0	15	15	0
f	70	30	0	0	0	0	0	0
g	15	30	25	0	0	30	30	
h	35	15	35	0	0	15	15	0
i	35	15	35	0	0	15	15	0
j	45	20	10	0	0	25	25	0
14a	100	0	0	0	0	0	0	0
b	100	0	0	0	0	0	0	0
c	93	5	0	0	2	0	2	2
d	56	15	5	3	21	0	24	24
e	30	15	25	0	0	30	30	0
f	25	25	15	0	0	35	35	0
g	50	30	10	0	0	10	10	0
h	25	25	25	0	0	25	25	0
i	35	20	15	0	0	30	30	0
j	43	20	15	0	0	22	22	0

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats -Road								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
15a	65	15	0	5	15	0	20	20
b	25	15	35	0	0	25	25	0
c	45	20	20	0	0	15	15	0
d	35	15	25	0	0	25	25	0
e	10	30	10	0	0	50	50	0
f	20	30	15	5	0	30	35	5
g	10	20	0	0	0	70	70	0
h	5	15	10	0	0	70	70	0
i	0	40	10	0	0	50	50	0
j	5	50	10	0	5	30	35	5
16a	15	50	15	0	5	15	20	5
b	20	50	10	0	0	20	20	0
c	45	25	10	0	0	20	20	0
d	29	50	10	0	0	11	11	0
e	68	20	10	0	0	2	2	0
f	37	50	10	0	2	1	3	2
g	55	35	5	0	0	5	5	0
h	25	45	10	0	15	5	20	15
i	30	40	15	0	5	10	15	5
j	30	35	20	0	5	10	15	5
17a	0	40	30	0	0	30	30	0
b	5	35	30	0	0	30	30	0
c	0	40	30	0	0	30	30	0
d	10	40	25	0	0	25	25	0
e	30	25	20	0	0	25	25	0
f	30	25	15	0	0	30	30	0
g	15	20	25	0	0	40	40	0
h	30	10	15	35	0	10	45	35

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats -Road								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
i	35	35	10	0	0	20	20	0
j	15	45	10	0	0	30	30	0
Mean	34.35	28.57	11.86	0.64	4.06	20.52	25.22	4.73
Std. dev.	21.55	17.25	9.01	3.19	8.38	15.18	14.44	9.22

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats - Main Area								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
1a	45	5	15	10	0	25	35	10
b	35	15	20	5	0	25	30	5
c	34	20	15	0	1	25	26	1
d	17	0	5	0	75	2	77	75
e	5	0	10	0	80	0	80	80
f	39	0	10	5	35	11	51	40
g	48	5	0	5	16	26	47	21
h	79	10	5	1	0	5	6	1
i	34	0	5	5	25	31	61	30
j	40	2	15	0	0	43	43	0
2a	55	5	15	0	0	25	25	0
b	48	2	20	0	5	25	30	5
c	50	0	20	0	10	20	30	10
d	45	5	20	0	0	30	30	0
e	50	0	25	0	0	25	25	0
f	55	5	15	0	0	25	25	0
g	56	5	20	3	0	16	19	3
h	53	2	20	10	5	10	25	15
i	30	0	20	35	0	15	50	35
j	15	0	15	25	35	10	70	60
3a	48	0	15	0	0	37	37	0
b	25	20	35	0	5	15	20	5
c	15	34	25	0	0	26	26	0
d	40	5	20	0	0	35	35	0
e	15	0	35	0	0	50	50	0
f	10	15	20	0	0	55	55	0
g	10	0	15	0	0	75	75	0

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats - Main Area								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
h	55	5	10	5	0	25	30	5
i	25	0	25	0	0	50	50	0
j	25	0	25	0	0	50	50	0
4a	60	0	15	0	0	25	25	0
b	55	0	0	0	0	45	45	0
c	69	5	0	0	1	25	26	1
d	50	10	10	1	1	28	30	2
e	65	5	5	0	0	25	25	0
f	46	5	10	6	1	32	39	7
g	39	5	15	0	0	41	41	0
h	56	5	20	0	0	19	19	0
i	41	2	25	0	10	22	32	10
j	25	5	30	0	0	40	40	0
5a	38	5	15	2	15	25	42	17
b	54	1	20	3	2	20	25	5
c	55	5	25	0	5	10	15	5
d	15	5	45	0	0	35	35	0
e	30	15	20	0	0	35	35	0
f	61	10	10	5	2	12	19	7
g	50	15	10	0	0	25	25	0
h	60	5	10	0	0	25	25	0
i	24	25	20	0	5	26	31	5
j	18	40	15	0	15	12	27	15
6a	43	30	5	0	0	22	22	0
b	0	5	10	10	75	0	85	85
c	33	10	10	0	31	166	197	31
d	20	15	10	0	30	25	55	30
e	20	30	20	0	5	25	30	5

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats - Main Area								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
f	26	25	10	0	2	37	39	2
g	39	25	10	0	2	2	4	2
h	33	20	15	0	2	30	32	2
i	55	30	5	0	0	10	10	0
j	65	35	0	0	0	0	0	0
7a	37	1	25	2	0	35	37	2
b	30	5	15	0	20	30	50	20
c	41	2	10	0	20	27	47	20
d	36	10	5	10	2	37	49	12
e	43	10	25	5	2	15	22	7
f	43	10	20	0	10	17	27	10
g	33	10	25	20	2	10	32	22
h	54	10	10	5	1	20	26	6
i	49	10	10	15	1	15	31	16
j	35	5	5	5	15	35	55	20
8a	10	5	25	0	10	20	30	10
b	36	5	15	22	15		37	37
c	45	10	15	5	10	15	30	15
d	63	5	15	0	5	12	17	5
e	22	15	2	0	25	36	61	25
f	38	10	10	0	15	27	42	15
g	51	20	10	5	0	14	19	5
h	10	0	50	10	0	30	40	10
i	10	0	65	5	0	20	25	5
j	5	0	64	1	0	30	31	1
9a	45	15	20	0	5	15	20	5
b	55	5	10	0	10	20	30	10
c	75	0	10	0	0	15	15	0

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats - Main Area								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
d	58	2	15	10	0	20	30	10
e	42	5	10	0	2	41	43	2
f	62	5	15	5	1	12	18	6
g	50	5	15	0	0	30	30	0
h	80	10	0	0	0	10	10	0
i	85	15	0	0	0	0	0	0
j	55	5	15	0	0	25	25	0
10a	70	5	10	0	0	15	15	0
b	70	5	5	0	0	20	20	0
c	30	0	25	30	5	50	85	35
d	30	0	35	10	0	25	35	10
e	30	15	20	10	0	25	35	10
f	45	2	10	20	2	21	43	22
g	58	0	20	15	0	17	32	15
h	44	15	20	0	1	20	21	1
i	55	20	5	0	10	10	20	10
j	56	10	10	5	2	17	24	7
11a	70	10	1	0	0	19	19	0
b	62	5	2	1	0	30	31	1
c	52	10	10	0	0	28	28	0
d	55	5	10	0	0	30	30	0
e	17	50	15	4	2	12	18	6
f	15	25	13	7	20	20	47	27
g	50	25	5	10	0	10	20	10
h	53	10	10	0	0	27	27	0
i	55	15	5	0	0	25	25	0
j	48	20	10	0	0	22	22	0
12a	61	10	2	0	5	22	27	5

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats - Main Area								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
b	80	5	0	0	0	15	15	0
c	71	10	0	0	3	16	19	3
d	72	10	0	0	2	16	18	2
e	75	10	0	0	0	15	15	0
f	73	10	5	0	2	10	12	2
g	77	10	0	0	1	12	13	1
h	68	10	0	0	5	17	22	5
i	80	10	0	0	0	10	10	0
j	76	15	10	0	3	6	9	3
13a	64	2	2	2	20	10	32	22
b	74	10	0	0	0	16	16	0
c	79	5	0	0	0	16	16	0
d	78	10	0	0	0	12	12	0
e	80	5	0	0	0	15	15	0
f	78	5	0	0	2	15	17	2
g				0	40	16	56	40
h	54	5	10	0	25	6	31	25
i	64	15	5	0	0	16	16	0
j	56	15	15	0	2	12	14	2
14a	29	1	30	15	5	20	40	20
b	19	1	25	20	5	30	55	25
c	52	2	20	10	1	15	26	11
d	51	2	25	10	1	11	22	11
e	30	0	30	10	15	15	40	25
f	80	20	0	0	80	0	80	80
g	100	0	0	0	100	0	100	100
h	15	0	10	0	60	15	75	60
i	15	0	10	0	75	0	75	75

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats - Main Area								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
j	30	0	10	0	50	10	60	50
15a	38	5	20	0	2	35	37	2
b	15	0	0	10	0	75	85	10
c	50	5	10	10	5	20	35	15
d	33	10	20	10	7	20	37	17
e	5	5	0	0	0	90	90	0
f	5	0	10	5	0	80	85	5
g	53	5	5	0	7	30	37	7
h	5	0	5	5	40	35	80	45
i	25	0	10	0	0	65	65	0
j	10	5	5	0	0	80	80	0
16a	60	5	20	0	0	15	15	0
b	58	5	10	0	0	27	27	0
c	40	0	15	10	0	35	45	10
d	55	0	15	0	0	30	30	0
e	35	0	20	10	0	35	45	10
f	45	0	20	0	0	35	35	0
g	40	5	15	10	0	30	40	10
h	30	5	20	25	0	20	45	25
i	55	0	10	15	0	20	35	15
j	25	10	20	15	0	30	45	15
17a	15	60	0	0	0	25	25	0
b	20	65	0	0	0	15	15	0
c	5	93	0	0	0	2	2	0
d	23	55	0	0	0	22	22	0
e	30	66	0	0	0	4	4	0
f	25	50	0	0	0	25	25	0
g	10	30	15	0	0	45	45	0

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats - Main Area								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren -nial
h	20	45	10	0	0	25	25	0
i	75	10	0	0	0	15	15	0
j	45	10	15	0	0	30	30	0
18a	15	0	5	25	40	15	80	65
b	20	0	15	25	30	10	65	55
c	35	5	0	30	20	10	60	50
d	45	5	10	20	20	0	40	40
e	35	0	20	25	15	5	45	40
f	35	10	0	5	30	20	55	35
g	49	15	5	0	1	30	31	1
h	70	15	15	0	0	0	0	0
i	40	10	15	0	5	30	35	5
j	40	10	15	0	0	35	35	0
19a	35	5	35	0	0	25	25	0
b	20	0	20	0	0	60	60	0
c	30	5	20	0	0	45	45	0
d	35	5	25	0	0	35	35	0
e	25	0	35	0	0	40	40	0
f	40	0	15	0	0	45	45	0
g	25	0	30	0	0	45	45	0
h	40	0	15	0	0	45	45	0
i	40	0	35	0	0	25	25	0
j	20	0	20	20	0	40	60	20
20a	50	20	10	0	0	20	20	0
b	45	10	15	0	0	30	30	0
c	40	0	25	10	0	25	35	10
d	25	0	30	15	0	30	45	15
e	50	10	15	0	0	25	25	0

Hidden Valley Vegetation Survey - Fall, 1992 Ocular Quadrats - Main Area								
Sample ID	Bare	Rock	Litter	Grass	Shrub	Forb	Total Veg	Peren-nial
f	39	10	20	0	1	30	31	1
g	30	10	30	0	0	30	30	0
h	10	5	40	20	15	10	45	35
i	45	15	15	10	0	15	25	10
j	25	15	25	10	0	25	35	10
21a	40	10	15	0	10	25	35	10
b	30	35	10	0	0	25	25	0
c	40	15	10	0	15	20	35	15
d	65	0	10	0	5	20	25	5
e	30	15	15	0	20	20	40	20
f	48	5	15	0	2	30	32	2
g	41	42	5	0	0	12	12	0
h	30	20	15	0	0	35	35	0
i	35	25	15	0	0	25	25	0
j	30	0	20	0	40	10	50	40
Mean	42.02	10.07	13.90	3.71	7.34	24.68	35.61	11.05
Std. Dev.	19.85	13.38	10.83	6.95	16.23	17.78	21.83	18.07