OGMCOAL DNR <ogmcoal@utah.gov>

Fwd: Vegetation Guidelines

Lisa Reinhart <lreinhart@utah.gov> Mon, May 18, 2015 at 9:24 AM
To: OGMCOAL DNR <ogmcoal@utah.gov>

This information was sent in relation to Horizons potential land use change application.

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---------- Forwarded message ----------
From: **Lisa Reinhart** <lreinhart@utah.gov>
Date: Thu, May 14, 2015 at 9:56 AM
Subject: Vegetation Guidelines
To: lbrereton@swlaw.com
Cc: Steve Alder <stevealder@utah.gov>, Daron Haddock <daronhaddock@utah.gov>

Liz,

I have attached the Vegetation Information Guidelines as referenced in R645-301-356.231 per your request. Please note that these are guidelines and some aspects are a little out of date. The document itself has not been updated since 1992 and technology has advanced in data collection methods and mapping techniques. There are references to the Soil Conservation Service Guidelines, which is now the Natural Resources Conservation Service but the standards of NRCS should still apply.

Also-If you need to identify what fish and wildlife habitats should be considered in your reclamation plan, I reference you to the U.S. Fish and Wildlife Service IPaC planning tool. Here is their website: http://ecos.fws.gov/ipac/gettingStarted/index. This tool allows you to draw the project area on a map and then provides you with a current list of species managed or regulated by the U.S. Fish and Wildlife Service, specifically any Threatened or Endangered species that should be on the reclamation radar. This is a very handy tool that not too many people know about.

Let me know if you need anything else.

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Vegetation Information Guidelines 1992.pdf
780K

VEGETATION INFORMATION GUIDELINES

UTAH DIVISION OF OIL, GAS AND MINING
3 Triad Center, Suite 350
Salt Lake City, Utah 84180
(801) 538-5340

Revised, February, 1992
(As approved by 57FR, 41693 on 9/11/92)

INTRODUCTION:

Please read these guidelines carefully and completely before initiating any vegetation studies.

These guidelines are intended to provide a suggested format for the submittal of vegetation information to be included in the mining and reclamation plans for coal mining operations. The purpose of submitting such information is as follows:

1. To approximate and describe the vegetative resources prior to mining;

2. To identify and describe important wildlife habitat areas;

3. To identify and provide protection for any listed or proposed threatened and/or endangered plant species;

4. To aid in the prediction of revegetation potential for the site; and

5. To identify the standards or methodology by which the success of revegetation will be measured for the purpose of bond release.

Should problems or questions arise concerning these guidelines, contact the Division of Oil, Gas and Mining.

DEFINITIONS:

Adjacent Areas: Areas outside the permit area that are within 1/2 mile of areas that will be affected by mining operations.

Baseline Data: Data collected to describe the "original" (pre-disturbed) condition of a vegetation type or range site.

Cover by Species: The percent of ground covered by a species or life form (cover by species may and often does add up to more than 100% and is used to establish plant diversity).

Density: The number of plants per unit of area.

Ground Cover: The percent of ground covered by vegetation, regardless of species. Ground cover cannot exceed 100% when added to the percent of aerial projection of rock, litter, and bare ground.

Normal Precipitation Year: A year where the effective precipitation is 90% of the 10-year average and within 90% of the 10-year monthly average for the month prior to sampling. Effective precipitation is that which falls from October 1 of the previous year to the end of the month prior to sampling.

Productivity (Production): The average yield of food, fiber, forage and/or wood products per unit of area per year.

Random Sample: A sample taken such that any point in the sample area has an equal chance of being sampled at any time during the sampling sequence.

Range Site: The concept of a site as an ecological entity based on climax plant communities; a distinctive kind of rangeland that has a certain potential for producing range plants.

Reference Area: An area that is similar to the community to be disturbed with respect to vegetation (cover, density, composition), soils, aspect, climate, and elevation that will be maintained and used as the standard for comparisons with the reclaimed "disturbed" area.

Species Composition: The species found within a given area.

Vegetation Type: A plant community that is distinguished by its visually dominant species and should be described by two or more dominant species.

Woody Plants: Those plants which are classified as sub-shrubs, shrubs, half-trees or trees.

SUGGESTED STEPS IN PREPARING PREMINING VEGETATION INFORMATION:

1. Map the existing vegetation types (or range sites) found within the permit area and adjacent areas {scale of 1:6,000 (1"=500') or larger}. Show the locations and boundaries of current disturbed areas as well as any areas proposed to be disturbed, the locations of any listed or proposed threatened or endangered plant species, the locations of sample points and the locations and boundaries of any proposed vegetation reference areas. Vegetation type boundaries should overlay the disturbance areas. Map all potentially disturbed areas on contour maps of a scale approved by the Division {1:2,400 (1"=200') scale or larger}. Mark these maps so that referral may be made back to the permit area map. Aerial photographs of sufficient scale would be acceptable for mapping requirements. Map requirements may be altered on a case by case basis by contacting the Division in advance.

2. Determine and list the acreage of each vegetation type (or range site) to be disturbed or that has been disturbed. Note the total acreage of surface disturbance (existing and proposed) within the permit area.

3. In a narrative, describe each vegetation type (or range site) by visually dominant species, and describe the condition and relative stage of maturity of the vegetation type. Note any past perturbations in the area such as fire, chaining, reseeding, previous mining, cultivation, etc. Discuss any present use by wildlife or livestock and correlate each vegetation type with wildlife habitat types or wildlife use areas. Provide a statement of productivity (a letter of assessment from the U.S. Soil Conservation Service would suffice). For forest types, provide an estimate of wood volume.

4. Sample each vegetation type (or range site) which exists within the proposed disturbed areas or was assumed to have existed within existing disturbed areas according to the methodology selected for determining revegetation success (reference area method, range site method or baseline data method). Approved sampling techniques must be used (see Appendix A). Sampling should be done during the height of the growing season (usually late June to late August). It is highly recommended that a site visit be arranged between the Division and the persons responsible for data collection prior to vegetation sampling.

5. List the species present within each vegetation type (or range site) or any proposed reference area by common and botanical name. List the species by plant groupings, i.e., trees, shrubs, forbs, grasses, etc.

6. Identify any listed or proposed threatened or endangered plant species that occur on the permit or adjacent areas. Make a negative declaration if these are not found. A current list of listed or proposed threatened or endangered species can be obtained from the U.S Fish and Wildlife Service.

7. Correlate vegetation reference areas, range sites or vegetation types with revegetation plans and the proposed postmining land use for all affected areas.

8. As per R614-301-356.231, if fish and/or wildlife habitat, recreation, shelterbelts or forest products are to be a primary or secondary use, the Division will provide, in technical memoranda, evidence of consultation and acceptance of proposed woody plant stocking densities with the Utah Division of Wildlife Resources and other appropriate land and wildlife management agencies.

9. All technical data submitted in the application shall be accompanied by:

   a. The names of persons or organizations which collected and analyzed such data;

   b. The dates of data collection and analysis;

   c. Descriptions of methodology used to collect and analyze data (including means, standard deviations, formulae used, etc.); and

   d. The name, address and position of officials of each private or academic agency consulted by the applicant in preparation of the information.

METHODS:

1. Reference Areas:

The use of vegetation reference areas for establishing revegetation success standards are applicable to all mining situations. For mines with new disturbance (either new mines or existing mines with proposed new disturbance), reference areas are selected and compared with the vegetation existing on the area to be disturbed. For areas of existing disturbance, the reference areas are selected on the basis of the vegetation that most likely existed prior to disturbance. Generally, a reference area is needed for each major vegetation type that has been or will be disturbed. All reference areas must be approved by the Division prior to using them for revegetation success standards (this may be done prior to permit approval). Reference areas do not need to be established for types where less than 1 acre will be disturbed or where the community type will be greatly altered by an approved postmining land use. However, a revegetation success standard must still be established for these areas. Reference areas should be at least 1 acre in size unless otherwise approved by the Division in advance.

For each vegetation type that will be disturbed and the corresponding proposed reference area (or any proposed reference areas for existing disturbed areas):

a. Randomly sample for ground cover, cover by species, woody plant density and productivity. Productivity measurements need not include noxious weeds (a list of noxious weeds may be obtained from the County Weed Supervisor, U.S.U. Extension Service or the District Agriculture Inspector).

b. Assess the current range condition of the affected areas as well as all proposed reference areas (range condition should be re-assessed every 5 years, during the field season prior to permit renewal). Reference areas must be in fair or better range condition at the time of bond release sampling. For reference areas not meeting this criteria, describe management practices (i.e., fencing) that will be employed to improve range condition. Range condition should be determined according to Soil Conservation Service guidelines.

c. Demonstrate sample adequacy for ground cover, density (woody plants) and productivity (see Appendix A).

d. Demonstrate by table (see attached summary table example), or other simplified format, the similarity between proposed disturbed sites and the corresponding proposed reference area according to the following parameters:

   1. Species composition (by a similarity index, see Appendix B), similarity should be 70% unless otherwise approved by the Division.

   2. Ground cover and woody plant density (by a t-test).

   3. Productivity, soils, slope, aspect and land use.

e. One reference area may represent more than one disturbance site if the reference area meets the requirements for each site.

f. Mark off the proposed reference areas in the field with permanent, readily visible markers (i.e, t-posts) so that they can be easily located.

g. Upon request, submit to the Division copies of the data sheets from sampling of areas to be disturbed and potential reference areas.

2. **Range Sites:**

In order to use range sites as an alternative to vegetation reference areas for revegetation success standards, the following criteria **must** be met:

a. Range sites must be described in accordance with the Soil Conservation Service, 1976, National Range Handbook, U.S. Department of Agriculture, as amended.

b. Range sites to be sampled must be in fair or better condition and representative of areas to be disturbed.

c. Sampling must be done during a normal precipitation year.

d. The range site area to be sampled must be at least one acre in size.

For each range site that will be or has been disturbed:

a. Randomly sample for ground cover, cover by species, woody plant density and productivity. Productivity measurements need not include noxious weeds.

b. Assess the current range condition (if the condition is not fair or better, the range site method cannot be used). Range condition is determined according to Soil Conservation Service guidelines.

c. Demonstrate sample adequacy for ground cover, density (woody plants) and productivity (see Appendix A).

Since the results of this sampling will be considered the values for the success standard for revegetation success, a legible copy of all data sheets must be submitted to the Division.

3. The baseline data method can only be used for areas of proposed new disturbance. In order to use baseline data as an alternative to vegetation reference areas for revegetation success standards, the following criteria **must** be met:

   a. The data must be collected from the proposed disturbed area(s).

   b. Vegetation types to be sampled must be in fair or better range condition.

   c. Sampling must be done during a normal precipitation year.

   For each vegetation type that will be or has been disturbed:

   a. Randomly sample for ground cover, cover by species, woody plant density and productivity. Productivity measurements need not include noxious weeds.

   b. Assess the current range condition (if the condition is not fair or better, the baseline data method cannot be used). Range condition should be determined according to Soil Conservation Service guidelines.

   c. Demonstrate sample adequacy for ground cover, density (woody plants) and productivity (see Appendix A).

   Since the results of this sampling will be considered the values for the success standard for revegetation success, a legible copy of all data sheets must be submitted to the Division.

SUMMARY OF MAP GUIDELINES:

A vegetation map of the entire permit area and adjacent areas on a scale of 1:6,000 (1"=500') or larger should be submitted if not otherwise exempted by the Division. A contour map {scale of 1:2,400 (1"=200') or larger} should be submitted for all areas of present or potential disturbance.

The permit area map should show the boundaries and/or locations of:

1. The permit area and give the legal description {i.e. township, range, and section(s)};

2. Any surface areas which are disturbed by mining or any areas proposed to be disturbed;

3. Any proposed vegetation reference areas;

4. Existing vegetation types or range sites;

5. Any listed or proposed threatened or endangered plant species; and

6. Sampling sites.

The disturbed area map(s) should:

1. Provide reference points back to the permit area map, including legal description;

2. Show the vegetation types or range sites which currently exist in areas of proposed disturbance or which are assumed to have existed in current disturbed areas; and

3. Show the locations of sampling sites.

VEGETATION DATA SUMMARY

(- Company -)
(- Mine Name -)
(- Permit Number -)

VEGETATION TYPE:_____ Date Data Collected:_____

% Similarity between Reference and Affected Areas:_____ Index Used:_____

	REFERENCE AREA				CORRESPONDING AREA TO BE AFFECTED				
	$\bar{X}$	S	N	N_{min}	$\bar{X}$	S	N	N_{min}	't'
Ground Cover									
Density									
Productivity									
Soil Type									
% Slope									
Aspect									
Land Use									

$\bar{X}$ = Sample Mean
S = Standard Deviation
N = Sample Size

N_{min} = Minimum Sample Size (for statistical adequacy)
't' = Calculated t - value from t - test

VEGETATION INFORMATION GUIDELINES

APPENDIX A

(February, 1992)

ACCEPTABLE SAMPLING METHODS FOR VEGETATION STUDIES

Pursuant to R614-301-356.110, the following sampling methods, as described below, have been selected and approved by the Utah Division of Oil, Gas and Mining for conducting vegetation studies for permitting purposes and for determining revegetation success of reclaimed areas. One should select the most appropriate sampling method for the community to be sampled. Sampling methods other than those described herein must be submitted through the Division to OSM for review as a state program amendment. Any sampling method used, whether identified in this guideline or approved as an alternative method, must be described in detail and approved as part of the permit application package or as an amendment thereto.

For sampling methods that require the use of quadrats, please note that quadrat size and shape are not fixed. However, common use is made of rectangular or square plots of m^2, $\frac{1}{4}m^2$ or 20 X 50cm in size or a $\frac{1}{4}m^2$ - m^2 circular plot.

I. SAMPLE ADEQUACY

Regardless of sample size requirements determined from the formula below, the minimum sample size listed for each method must be achieved. All other sampling must meet the statistically adequate sample size as determined by the formula:

$$N_{min} = \frac{t^2 s^2}{(dx)^2}$$

where: t = the value from appropriate t-table*, (2-tail test for premine studies, 1-tail test for revegetation success studies),
s = the sample standard deviation,
d = the desired change in the mean,
x = the sample mean of the parameter in question.

* All parameters should be tested at the 90% confidence level with a 10% change in the mean (d=.1)

Reference: Cochran, W.G., 1977. Sampling techniques, 3rd ed. John Wiley and Sons, New York, N.Y. 428pp.

II. COVER

1. Ocular Estimation:

Estimate the percent of ground covered by vegetation (by species, total vegetation, litter, rock, etc.) to the nearest percent. Values should be reported by species (and could potentially exceed 100% due to overlap) and by total vegetation cover. Total vegetation cover, when added to vertical projection of exposed rock, litter and bare ground will equal 100%. Each quadrat is considered one

sampling unit. Since ocular estimation is more subjective than exact measurement methodologies, ideally, sampling would be done by the same individual to promote consistency between monitoring years.

Quadrats should be randomly placed within the study area.

Minimum sample size = 10

Reference: Daubenmire, R., 1959. A Canopy–Cover Method of Vegetational Analysis. Northwest Science 33:43-63.

2. Cover Classes:

Cover classes may be used, provided they are at least as small (in range) as those listed below. Utilizing quadrats as discussed above, estimate the percent of ground covered by vegetation to the nearest class. Values should be reported by species and total vegetation cover. Each quadrat is considered one sampling unit. When analyzing the data, the mid-point of each class is used to calculate the mean and standard deviation.

Cover Class	Range	Mid-Point	Cover Class	Range	Mid-Point
1 =	0-1.0%	.5%	8 =	35.1-45.0%	40.0%
2 =	1.1-3.0%	2.0%	9 =	45.1-55.0%	50.0%
3 =	3.1-5.0%	4.0%	10 =	55.1-65.0%	60.0%
4 =	5.1-10.0%	7.5%	11 =	65.1-75.0%	70.0%
5 =	10.1-15.0%	12.5%	12 =	75.1-85.0%	80.0%
6 =	15.1-25.0%	20.0%	13 =	85.1-95.0%	90.0%
7 =	25.1-35.0%	30.0%	14 =	95.1-100%	97.5%

Minimum Sample Size = 20

Reference: Daubenmire, R., 1959. A Canopy–Cover Method of Vegetational Analysis. Northwest Science 33:43-63.

3. Point Methods:

Vegetation cover is identified at a pre-determined 'point' and recorded as vegetation, litter, rock or bare ground. Points may be located systematically or randomly along a tape, using a pin frame or an ocular devise with cross hairs. Total vegetation cover is determined by the first interception or hit (i.e., vegetation, rock, litter, etc.) Cover by species is determined by subsequent hits of vegetation as the point (pin) is lowered through the vegetation. Transects of 50 point minimum are counted as one sample unit. The location and orientation of the transect within the study site should be randomly placed.

Minimum sample size = 15

Reference: Goodall, D.W., 1943. Point Quadrat Methods for the Analysis of Vegetation. The Treatment of Data for Tussock Grasses. Aust. J. Bot. 1:457-461.

4. Line Interception:

Using the line intercept method, percent cover is obtained by summing the distances of the transect that are covered by vegetation, litter, rock, bare ground. Transects are commonly 10-100m long. Each transect is counted as one sampling unit. Transects should be randomly placed within the study area. (This method is best used in sparse, low vegetation.)

Minimum sample size = 15

Reference: Canfield, R.H., 1941. Application of the Line Interception Method in Sampling Range Vegetation. J. For. 39:388-394.

III. DENSITY (SHRUBS AND/OR TREES)

1. Point-Quarter Method:

Randomly located sample points within the study area. At each point, two lines are made to divide the area into four quarters, with the point being the center. The distance from the point to the base of the nearest plant in each quarter is then measured and recorded. To determine the density, sum the 4 distances measured at each point and divide by 4. This mean distance is then squared to give the mean area per plant (this is done for each sampling point). Sum the mean area per plant of each point and divide by the number of points sampled. Divide 43,560 by this number to obtain plants per acre (formulas summarized below). This is the preferred method for semi-dense to dense stands.

Points may be randomly located in the stand or along randomly located transects.

Minimum sample size = 10

Density Formula

For each point:

$$A_j = \left(\frac{\Sigma Y_i}{4}\right)^2 \quad ; \qquad D = 43{,}560 \div \frac{\Sigma A_j}{n}$$

Where: Y_i = Distance from point to nearest plant in the ith quarter.
A_j = mean area/plant at the jth point.
n = sample size (number of points sampled).
D = plants/acre.

Reference: Cottam, G., and J.T. Curtis, 1956. The Use of Distance Measures in Phytosociological Sampling. Ecology 37(3):451-460.

2. Belt Transects or Plots:

Belt transects or plots are randomly placed in the study area and the number of plants that are rooted in each plot are counted, even if all of the plant canopy is not within the plot. Likewise, plants that overlap the plot but are not rooted within the plot are not counted. The size of the plot is not fixed; however, those sizes commonly used are: M^2, 5ft-10ft x 100ft, .1 acre, or 1-5m x 50m. Each plot is counted as one

sample unit. Select the plot size that is best suited to the community being sampled. This method is better adapted for low to semi-dense stands.

To obtain the number of plants/acre, multiply the number of plants counted in the plot by 43,560 and divide the product by the size of the plot (in square feet).

Minimum sample size = 15

Reference: Chambers, Jeanne C., Ray W. Brown, Methods for Vegetation Sampling and Analysis on Revegetated Mined Lands. Gen. Tech. Rep. INT-151. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Exp. Station; 1983, 57p.

3. Exact Count

For Extremely Small Stands (usually less than 1 acre) or Very Low Density Areas, an exact count may be preferred since the use of an exact count is not subject to statistical tests of sample adequacy.

IV. PRODUCTIVITY MEASUREMENTS

1. Exclosures:

The use of exclosures for productivity measurements is optional where domestic livestock will not be in the study area prior to sampling. If livestock are to be in the study area prior to sampling, then exclosures should be used.

When used, exclosures should be large enough to prevent animals from reaching through and grazing on the plot to be sampled. Exclosures should be randomly placed and anchored to the ground, before the growing season begins. The number of exclosures established should be based on previously collected production data and field experience. To reduce variability and sample sizes, community types should be separated as much as possible. Exclosures should be numbered in the order of the random numbers generated for their placement. Sampling should follow the number sequence until sample adequacy is met or all exclosures have been sampled.

2. Clipping:

Select the quadrat size that is best suited to the community being sampled. Randomly locate the quadrat and clip plants by life form (e.g., herbaceous or woody). For grasses and forbs, clip all standing biomass; for shrubs, clip only current year's growth. Oven dry samples and weigh to the nearest .1 gram. For sample adequacy, use the combined weight of each life form at each plot. Report productivity as pounds/acre or kilograms/hectare.

Minimum sample size = 10 quadrats

Reference: Boyer, William D., 1059. Harvesting and Weighing Vegetation. Pages 11 through 16. In: Techniques and Methods of Measuring Understory Vegetation. USDA Forest Service Southern Forest Exp. Station and Southeastern Forest Exp. Station.

3. Double Sampling:

Select the quadrat size that is best suited to the community being sampled. 2-4 quadrats are clustered systematically around a central, randomly located quadrat. The amount of biomass in the clustered quadrats is estimated as a percent of the biomass of the center quadrat. The center quadrat is then clipped, dried and weighed. A weight is then calculated for the clustered plots based on the percent recorded. For testing purposes, the mean weight for the cluster is used with each cluster being counted as one sample unit. Report productivity as pounds/acre or kilograms/hectare.

Minimum sample size = 10

Reference: Boyer, William D., 1059. Harvesting and Weighing Vegetation. Pages 11 through 16. In: Techniques and Methods of Measuring Understory Vegetation. USDA Forest Service Southern Forest Exp. Station and Southeastern Forest Exp. Station.

4. Soil Conservation Service Estimation:

For establishing reference areas, it is preferred that the Soil Conservation Service be contacted to estimate productivity and evaluate range condition. Their signed statement will be sufficient for the pre-mining inventory for production on the affected area and reference area.

VEGETATION INFORMATION GUIDELINES

APPENDIX B

(February, 1992)

ACCEPTABLE SIMILARITY / DIVERSITY INDICIES

1. Jaccard's Community Coefficient:

$$SI = \frac{common\ species}{total\ species} \times 100 \qquad \text{or} \qquad SI = \frac{c}{a + b - c} \times 100$$

Where: SI = Similarity index;
a = Total number of species in community a;
b = Total number of species in community b; and
c = Number of species common to both communities.

REFERENCE: Jaccard, P., 1912. The Distribution of the Flora of the Alpine Zone. New Phytologist 11:37-50.

2. Ruzicka's Index of Quantitative Similarity:
{Quantitative data is required for this index (i.e., cover or productivity by species).}

$$SI = \frac{\Sigma min}{\Sigma max} \times 100$$

Where: SI = Similarity index;
Σmin = Sum of minimum values for any species in the two communities (zero is possible); and
Σmax = Sum of maximum values for any species in the two communities.

REFERENCE: Ruzicka, M., 1958. Anuendung Mathematisch - Statisticher Methoden in Der Geobotanik (Synthetische Bearbeitung von Aufnahmen). Biologia, Bratisl. 13:647-661.

3. Sorensen's Similarity Index:

$$SI = \frac{2C}{A + B} \times 100$$

Where: SI = Similarity index;
A = Total number of species in community A;
B = Total number of species in community B; and
C = Number of species common to both communities.

REFERENCE: Sorensen, T., 1948. A Method of Establishing Groups of Equal Amplitude in Plant Sociology Based on Similarity of Species Content. Det Kong. Danske Vidensk. Selsk. Biol. Skr. (Copenhagen) 5:1-34.