

**DEPARTMENT OF ENVIRONMENTAL QUALITY
LAND QUALITY DIVISION**



GUIDELINE NO. 14

**RECOMMENDED PROCEDURES FOR DEVELOPING
A MONITORING PROGRAM ON PERMANENTLY
RECLAIMED AREAS**

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This Guideline is intended to promote consistency in the design and implementation of monitoring programs on reclaimed areas. If an operator feels that this guideline is receiving improper use by the Department or wishes to pursue other alternatives, that operator is encouraged to contact the Administrator. This document applies only to coal operators and is a guideline only.

INTRODUCTION

Revegetation success will consist of both subjective and quantitative evaluation. Such evaluations should be made through the cooperative efforts of industry and regulatory personnel with surface owner participation. Information assessing the development of revegetation throughout the bonding period will be useful for partial release of the incremental bond and final bond release evaluation.

The following requirements for revegetation monitoring were promulgated on June 17, 1991.

Chapter II, Section 2.(b)(vii)(C)

A plan for monitoring permanent revegetation on reclaimed areas, specifically including quantitative sampling, as required by Chapter IV, Section 2.(d)(xi);

Chapter IV, Section 2.(d)(xi)

Monitoring of permanent revegetation on reclaimed areas before and after grazing shall be conducted at intervals throughout the period prior to bond release in accordance with the plan required by Chapter II, Section 2.(b)(vii)(C). Monitoring results shall be presented in the annual report.

For additional information relating to revegetation, postmining land use, partial bond release and final bond release see the following requirements from the Wyoming Environmental Quality Act and WDEQ/LQD Rules and Regulations:

W.S. § 35-11-402 (a)(i) and (iv)
Chapter II, Section 2.(a)(vi)(A) and (B)
Chapter II, Section 2.(b)(vii) and (xiv)
Chapter IV, Section 2.(a) and (d)
Chapter IV, Section 2.(f)(vi)
Chapter XV
Appendix A

The operator should review all these standards and consider them in developing the revegetation monitoring and grazing land use programs discussed in this guideline.

The three phases of vegetation sampling which occur throughout the life of a mining operation include baseline inventory, revegetation monitoring and bond release evaluation. This guideline emphasizes the interrelationship between these phases and the importance of developing sampling plans compatible with all three. Information regarding the monitoring of grazing effects on reclaimed land is also an integral part of this guideline.

This guideline provides recommendations regarding the implementation of a monitoring program including the delineation of areas to be monitored, sampling parameters, sampling intensity and frequency. A concise plan documenting all aspects of the revegetation monitoring program as well as the grazing land use program should be incorporated into all approved coal permits.

I. RELATIONSHIP BETWEEN BASELINE INVENTORY, REVEGETATION MONITORING AND BOND RELEASE EVALUATION.

Baseline inventory should define the condition of vegetation on the permit area prior to mining. Revegetation monitoring should:

- * document the trend of reclaimed area development,
- * assess a reclaimed area's readiness for grazing, if grazing is the postmining land use,
- * assess effects of grazing on a reclaimed area, and
- * document land uses.

Bond release evaluation should assess the attainment of performance standards given in Chapter IV Section 2.(d)(ix) and (x) of the WDEQ/LQD Rules and Regulations.

The goals of baseline inventory, revegetation monitoring, and bond release evaluation programs, while separate, are related. Therefore, similar sampling methods should be used making the results from the programs comparable. This will then allow information from all three programs to be used as part of the overall evaluation of permanent revegetation for bond release. The elements of the revegetation monitoring program should be compatible with those approved, and used, for baseline inventory and bond release evaluation.

A revegetation monitoring plan that clearly documents all sampling methodology to be used and presentation of sampling results should be incorporated into all approved coal permits. This plan should specify the type of data and data analyses that will be presented in each Annual Report.

II. RELATIONSHIP BETWEEN REVEGETATION MONITORING AND THE GRAZING LAND USE PROGRAM

Two of the goals of the revegetation monitoring program are to assess the readiness for and effects of postmining grazing. Since the revegetation monitoring program and the grazing land use program share these same goals as well as compatible sampling procedures and data analyses, both programs should be implemented over the entire bonding period.

Developing a monitoring plan to be coordinated with grazing increases the importance of determining when an area is ready for grazing. WDEQ/LQD Rules and Regulations Chapter IV, Section 2.(d)(xiii) require that the Administrator, operator and the landowner or land managing agency cooperatively determine when a revegetated area is ready for livestock grazing.

The postmining grazing program can be differentiated into two components, husbandry practices and grazing land use demonstration. The LQD considers grazing husbandry practices as short duration management tools. Grazing over long periods of time will be considered a component of the grazing land use program discussed below.

A. Husbandry practices

A description of how grazing will be used as husbandry should be given in the permit under revegetation practices. When employed, actual husbandry practices, and the effect of employing these husbandry practices, should be described in the appropriate Annual Report. The operator should notify the LQD of any changes to the approved husbandry plan provided in the permit prior to implementing the change.

B. Grazing land use

Monitoring reclaimed areas before and after grazing at intervals throughout the period prior to bond release is important. **However, monitoring of reclaimed vegetation should not be confined only to those areas being grazed.**

The grazing land use program presented in the permit should outline the procedures to meet the intent of WDEQ/LQD Rules and Regulations, Chapter IV, Section 2.(d)(ix), (x) and (xiii) including:

- * decision elements used to initiate the grazing land use,
- * decision elements for stocking rates, % utilization, types of animals and duration of grazing, and
- * qualitative and quantitative vegetation monitoring procedures to be used before and after grazing to document that the reclaimed area is capable of withstanding the grazing pressure exerted by the grazing land use program.

Sampling need not occur every season that grazing occurs. However, sampling should be planned at frequent enough intervals that accurate measures of cover and production can be obtained.

III. IMPLEMENTATION OF A MONITORING PROGRAM

A. Delineation of Areas to be Monitored

This guideline uses the term "unit" to describe permanently reclaimed land seeded with a specific seed mix in a single (fall or spring) seeding period. The operator should compile an accurate and complete reclamation history of each unit.

Units of reclaimed land may be combined into one or more monitoring areas for the sake of sampling vegetation parameters and for application of the grazing land use program. Each monitoring area should be defined according to logical parameters such as time of seeding, seed mixture applied, topography, etc. The monitoring areas should remain the same throughout the entire monitoring program unless strong and obvious biological or physical differences develop within the area.

If, during the bonding period, a portion of a designated monitoring area should receive management that can not be considered a normal husbandry practice, the area may need to be divided and sampled accordingly. Such nonstandard husbandry practices should be recorded in the reclamation history of the particular unit. Proposals for dividing an established monitoring area should be presented to LQD prior to implementation and recorded in the subsequent Annual Report.

Areas that are being grazed under the grazing land use program should be monitored at intervals throughout the bonding period before and after grazing.

Where differentiation of vegetation communities is apparent in monitoring areas, these areas may require stratification by community types. Differentiation of vegetation communities should be based on the potential for comparison with control, reference or extended reference areas.

B. Monitoring Plan Parameters

Each area should be sampled for the following parameters (as defined in Appendix A of the WDEQ/LQD Rules and Regulations). All methods used during the revegetation monitoring program to estimate the prescribed parameters should be the same as those used in the baseline inventory. If this is not possible or is undesirable, the operator should use the methods discussed in Appendix A of the WDEQ/LQD Rules and Regulations. **For the sake of consistency and data comparability among data sets, the operator should use the same methodology throughout the duration of the revegetation monitoring program.**

All sampling procedures to be used during the revegetation monitoring program should be presented to, and discussed with, WDEQ/LQD for approval and incorporation into the permit document.

These sample parameters should be addressed:

1. % vegetation cover by species
2. % total vegetation cover (= sum of all species)
3. % total ground cover (= vegetation + litter + rock)
4. % bare ground

* **NOTE:** All % cover values should be reported as absolute % cover

5. annual production of perennial vegetation by dominant species (and minor species by life form) in each area; if shrubs and/or subshrubs are a dominant life form, recording their annual production is desirable
6. shrub density
7. list of plant species observed during sampling
8. supplemental data as desired by the operator

C. Sampling Methodology

1. Cover Sampling

Sampling for % vegetation cover and % total ground cover should occur at approximately the same phenological development stage each sampling period. The % cover sampling period should coincide with peak herbaceous production whenever possible.

2. Annual Production

Production sampling should occur at approximately peak production during each sampling effort.

If the monitored area is dominated by shrubs or subshrubs, sampling the annual production increment of these species is desirable.

3. Shrub Density

The performance standard specified in WDEQ/LQD Rules and Regulations for the postmining shrub component includes density and distribution (shrub mosaics). Therefore, the revegetation monitoring program should also define how the shrub mosaic boundaries will be defined and mapped for density sampling purposes.

Density sampling should also be designed to provide verification of the longevity of established shrubs as this is one of several criteria for bond release. Operators may use revegetation monitoring to document the trend of shrub development and longevity.

4. Species List

Each sampling effort should include a separate list of the species observed during each annual monitoring effort. The methods and data presentation format should be consistent among all monitoring efforts. This will provide information concerning species diversity and identify non-seeded species occurring on the revegetated areas. The operator may secondarily reorganize the species list into life form categories.

D. Grazing Land Use Program

The grazing land use program should specify decision elements for determining the following during each grazing episode:

- * stocking rate,
- * duration of grazing,
- * % utilization, and
- * documentation of each of the above.

In the reclaimed environment varying levels of utilization may be used to produce a specific effect on community composition.

Livestock grazing a reclaimed area during the bond release evaluation period may compromise the adequacy of cover and production data.

E. Sampling Intensity

The revegetation monitoring plan should clearly specify the intended sampling intensity per monitored area or unit. The LQD prefers that all vegetation parameters be sampled to adequacy using a standard statistical test. The LQD prefers the statistical test listed in Appendix A of the WDEQ/LQD Rules and Regulations.

Sampling to less than statistical adequacy may limit the usefulness of the revegetation monitoring data. If the operator does not sample to statistical adequacy, the revegetation monitoring plan

must specify an alternative sampling intensity. The LQD outlines the following alternative sampling regime in compatibility with Appendix A:

- * ten (10) random samples on reclaimed areas up to 100 acres in size; sample numbers for small areas may be adjusted upon consultation with LQD,
- * add one (1) sampling location for every additional ten (10) acre incremental increase in acreage,
- * the maximum sample size is fifty (50) for each sampling area.

If each reclaimed area or unit is not sampled to statistical adequacy, the operator should present the confidence level achieved with the number of samples taken.

F. Sampling Frequency

The revegetation monitoring program should be conducted at a frequency adequate to document trends in vegetation development. Once sampling is initiated, two additional samples must be taken during the ten years that follow. The third sample may be included as part of the bond release evaluation program. In the event the bond period for specific monitored areas or units exceeds ten years, the operator should discuss as part of the revegetation monitoring program how the monitoring will be carried out over an extended bonding period.

G. Data Analysis

All data should be analyzed using the procedures described in Appendix A of the WDEQ/LQD Rules and Regulations. Tabular representation of data (as described in Appendix V of Appendix A) is recommended. This type of format allows for easy interpretation of sampling results and can be especially useful for comparing results from several sampling years. Graphing results from several years of data collection may also be useful for visually demonstrating trends in plant community development.

The results from the grazing land use and revegetation monitoring programs should be presented in the first available Annual Report.

H. Sampling Control, Reference or Extended Reference Areas

It may be beneficial to sample the Control, Reference or Extended Reference Areas in conjunction with sampling revegetated areas during at least one sampling period. This would provide insight into the occurrence of climatic changes on the Control Area and/or the initial comparability of the revegetated areas to their respective Reference Areas/Extended Reference Area.

In order to obtain data which are comparable to that collected on the Control Areas/Reference Areas/Extended Reference Area during baseline sampling, it is recommended that the minimum and maximum sample sizes listed in Appendix A of the WDEQ/LQD Rules and Regulations or sample adequacy be achieved.

IV. INCORPORATION OF THE GRAZING LAND USE PROGRAM AND THE REVEGETATION MONITORING PROGRAM INTO COAL PERMITS

Development of a concise work plan outlining the sampling procedures to be used for the grazing land use and revegetation monitoring programs should now be provided in the permit document as part of the Reclamation Plan.

Modifications to the sampling program presented in the permit should be presented to and approved by LQD prior to implementation. These modifications should be presented as changes to the permit document in accordance with Chapter XIII of the WDEQ/LQD Rules and Regulations.