STATEMENTS OF BASIS, SPECIFIC STATUTORY AUTHORITY, AND PURPOSE

1. Rule 1.04(71)(f) is amended to include developed, intensive use recreational facilities under the definition of "Industrial or Commercial." Such facilities are more similar in nature to commercial service facilities than to undeveloped recreational uses such as hiking, canoeing, and other leisure activities that do not depend on specialized man-made structures and facilities. The amended rule differs from but is no less effective than the corresponding land use definitions of 30 CFR 701.5.

2. Rule 1.04(71)(g) is amended to limit the definition of "recreation" to non-intensive leisure activities and other undeveloped recreational uses, to be consistent with amended 1.04(71)(f). The amended rule differs from but is no less effective than the corresponding land use definitions of 30 CFR 701.5.

3. Rule 2.04.13(1)(e) is being amended to require the seedmix and seed tag, invoice or other comparable documentation to be included be submitted in the Annual Reclamation Report. This additional information will document compliance with Rule 4.15 at the time of bond release.

4. Rule 2.06.6(2) is amended to be no less effective than 30 CFR 785.17 (c)(1) by updating the reference to the National Soils Handbook and to recognize the name change from the U.S.D.A. Soil Conservation Service to Natural Resources Conservation Service.

5. Rule 2.06.8(4)(a)(i) is amended to be consistent with 30 CFR 785.19(d)(2)(I). This amended rule requires the applicant to identify all potentially affected essential hydrologic functions of an alluvial valley floor (rather than the characteristics necessary to preserve these functions as in the previous rule) and evaluate the factors contributing to their functions.

6. Rule 2.06.8(5)(b)(i) is amended to correct a typographical error. This rule is no less effective than 30 CFR 822.12(b)(3).

7. Rule 2.07.6(1)(a)(ii) is amended to correct a typographical error.

8. Rule 2.07.6(2)(n) is amended to correct a typographical error and an erroneous statutory reference.

9. Rule 2.08.4(6)(c)(iii) is amended to correct a typographical error.

10. Rule 3.03.2(1)(e) is added to be no less effective than 30 CFR 800.40(a)(3).

11. Rule 3.03.2(5)(a) is amended to correct a typographical error.

12. Rule 4.03.1(4)(e) is amended to correct a typographical error.

13. Rule 4.05.2(2) is amended to correct a typographical error.

14. Rule 4.06.1(2) was amended to be no less effective than 30 CFR 816/817.22(c). Alternative topsoil storage practices were deleted from the rule.

15. Rule 4.15.1(5) is being added to comply with the requirements of the "Colorado Noxious Weed Act" §35-5.5-115, C.R.S., and Rules established pursuant thereto [8 CCR 1203-15]. This law requires State agencies to manage noxious weeds on properties under their jurisdiction. The noxious weeds are to be managed using the methods prescribed by the local governing body. A copy of the Colorado Noxious Weed Act and the rules that enforce it are attached in Exhibit A.

16. Rule 4.15.7(1) is being amended to be no less effective than 30 CFR 816/817.116(a)(1). The Federal rules require the state regulatory authority to submit both its selected revegetation success standards and its selected statistically valid sampling techniques to OSMRE for review as a program amendment. The specific techniques are added in new Rule 4.15.11.

17. Rule 4.15.7(2) is amended to be consistent with the proposed changes to 4.15.8 and 4.15.11.

18. Rule 4.15.7(2)(d) is amended to be no less effective than 30 CFR 816/817.116(a)(1), by specifically limiting methods of revegetation success comparison to those listed in 4.15.7(2)(d).

19. Rule 4.15.7(3)(b) is reorganized and amended to specify exceptions to the requirement that reference areas be demonstrated to be statistically comparable to equivalent pre-mine vegetation types in terms of vegetation cover and herbaceous production. 4.15.7(3)(b)(i) is merely a recodification identifying cropland post-mine land use as one exception to this requirement. The content of the rest of the existing rule is not changed by the recodification.
Rule 4.15.7(3)(b)(ii) is added, to identify situations in which the post-mining land use will be different than pre-mining land use, as a second exception to the pre-mine equivalency requirement. This amendment is in recognition of the fact that when there is a change in land use, such as from forestry or wildlife habitat to pasture land or cropland, assumptions upon which the traditional reference area concept are based may no longer be valid or applicable. Selection of a reference area which reflects the alternative post-mining land use and planned vegetation community structure may be a more practical approach in such cases, when suitable areas occur in the vicinity of the mine.

Rule 4.15.7(3)(b)(iii) is added, to identify situations in which the planned post-mining community structure will differ significantly from the pre-mining community structure, as a third exception to the pre-mining equivalency requirement. Reclamation which is not directed toward replacement of the original community structure occurs when poor condition rangeland is dominated by undesirable vegetation such as cheatgrass or noxious weeds. Woody vegetation may not be restored to pre-mining densities due to post-mining land use objectives or technological limitations. Again, in such situations,

selections of a reference area which reflects the planned vegetation community structure may be more appropriate and practical than the traditional reference area approach, when suitable areas are identified in the vicinity of the mine.

The amendments to 4.15.7(3)(b) are no less effective than 30 CFR 816/817.116(a)(1) and (2), and (b)(1) and (2).

20. Rule 4.15.7(3) (f) was amended to be consistent with the proposed amendment to Rule 4.15.7(5) which will allow vegetation sampling in two out of any four consecutive years, beginning in year nine of the liability period.

21. Rule 4.15.7(4) is amended to address reference area comparison approaches applicable to each of the reference area types identified in 4.15.7(3).

22. Rule 4.15.7(5) is amended to be no less effective than 30 CFR 816/817.116(c)(3) and (4).

Additional detail has been incorporated regarding management practices that can be conducted on reclaimed lands without re-starting the liability period. References to "extended liability period", and "period of responsibility" have been amended to "liability period" for consistency.

The requirement to sample the last two consecutive years of the liability period has been amended. The proposed rule allows sampling in non-consecutive years. Commencement of sampling will continue to be year nine or later and sampling for revegetation success must be demonstrated for two of the last four years of the liability period. This rule is proposed to allow the Colorado operators greater flexibility in final revegetation sampling and to compensate for unusually dry years that could prevent revegetation success.

The Federal Rules allow areas with greater than 26 inches of precipitation more flexibility for revegetation success sampling. For grazing land, pasture land or cropland sampling is allowed in any two years of the five-year liability period, except year 1. For all other land uses, sampling must be done for only the last year of the liability period. The proposed Colorado rule would allow more flexibility similar to flexibility given the mines in higher precipitation regions.

New Mexico presented a similar request to the OSM which has already been approved, Federal Register: November 2, 2000 (Volume 65, Number 213), pages 65770-65779. Colorado has used the same type of analysis. The coefficient of variation represents a relative measure of the variability of the data to compare the precipitation between locations. As seen on the above table, the coefficient of variation for the Colorado locations is greater than the Henderson, Kentucky location which is representative of conditions in the east. Given the Colorado variability in precipitation a dry year may present an obstacle to the second year of revegetation success sampling. Flexibility in sampling is needed to skip the drought year(s), and allow the operator to sample in one of the two following non-consecutive years. A demonstration of successful revegetation

following a drought would clearly indicate the revegetation could withstand drought and the variable climatic conditions. If revegetation success were not demonstrated the second year of sampling, the operator would be required to take the necessary actions to achieve revegetation success. The liability period would then be reinitiated.

The Colorado mines are located in areas that represent variable precipitation ranges as shown on the table below. The data is from the monthly climate data, Colorado Climate Center at Colorado State University (http://ccc.atmos.colostate.edu), the Trapper Mine Annual Reclamation Report and the Federal Register: November 2, 2000 (Volume 65, Number 213), pages 65776-65777.

Historical Precipitation

Geographical Area	Years of Record	Precipitation Range (Inches)	Mean	Standard Deviation	Coefficient of Variation
Trapper Mine	1980-2000		16.56	3.54	0.21
Craig	1937-1974	7.42 – 20.83	13.29	3.26	0.25
Hayden	1932-1999	10.89 – 26.40	16.38	3.39	0.21
Trinidad	1938-1999	5.42 – 22.24	13.42	3.36	0.25
Grand Junction	1963-1999	5.69 – 15.02	8.89	3.39	0.29
Henderson, KY	1978-1998	30.94 – 63.27	45.64	8.89	0.19

Several management practices are also addressed in this proposed rule. In 4.15.7(5)(a), repair of minor erosion (including revegetation) is allowed under certain conditions, to reflect the fact that minor erosion affecting limited areas is common during the early stages of reclamation, even when appropriate reclamation and stabilization measures are applied. The provision specifying that the operator's liability period for a reclaimed parcel subject to erosion repair extend for a minimum of five years after completion of such repair is necessary for the Division to be able to determine that the repair has been successful in stabilizing the area, prior to final bond release. Documentation of the repair work in the annual reclamation report will ensure accurate tracking for bond release purposes.

Repair of rills and gullies is a normal husbandry practice in Colorado. A letter from State Resource Conservationist describing the typical conservation practices is attached in Exhibit C.

Control of noxious weeds is required by state law and Division policy, and is recognized in (b) as a normal husbandry on rangelands and agricultural lands. A copy of the "Colorado Noxious Weed Act" [§ 35-5.5-115, C.R.S.(2000 Supp.)], and Rules established pursuant thereto is enclosed as Exhibit A, and a copy of the Division's "Guideline for the Management of Noxious Weeds on Coal Mine Permit Areas" is enclosed as Exhibit D.

(c), (d), and (e) identify specific practices recognized as normal husbandry practices for annual crop production, perennial cropland, and pasture land forage production, respectively. These land uses are characterized by more intensive management than typical of rangeland or wildlife habitat. The Federal regulations require that all normal husbandry practices be identified in the approved state program. Applicable publications include the Colorado State University Cooperative Extension Service "Guide to Fertilizer Recommendations in Colorado" and the USDA Soil Conservation Service "Colorado Irrigation Guide," enclosed as Exhibits E and F, respectively.

The four-year "window" and the limitation on the number of trees or shrubs transplanted to 20 percent of the approved standard in (f) will insure that transplanting during the liability period is of a limited nature to replace initial mortality loss, and that artificially seeded or transplanted woody plants will have been in place for a minimum of six years prior to final bond release. Such limited transplanting is a normal husbandry practice associated with intensive woody plant establishment efforts such as wildlife plantings, windbreaks, etc. The USDA Soil Conservation Service, the Colorado Soil Conservation Board, and the Colorado Division of Wildlife submitted comments supporting this approach. These documents are in Exhibit G.

Interseeding on rangelands and wildlife habitat is a normal husbandry practice recommended by biologists and land managers to enhance established vegetation.

In Rule 4.15.7(f) the Division is proposing the use of interseeding. A. Perry Plummer, in *Restoring Big Game Range in Utah* (1968) states “interseeding (seeding directly into established vegetation usually with only partial reduction in competition) is a widely successful means of improving vegetal cover for game and livestock”. He indicates that interseeding can be an effective means to establish shrubs and forbs in perennial grass stands and notes that the approach is especially useful on steep slopes where it is desirable to establish shrubs in predominantly herbaceous cover.

Many of the Conservation Reserve Program Lands in northwestern Colorado lack spatial, structural and vegetative diversity. To enhance the suitability of some grass dominated CRP lands for sharp-tailed grouse habitat, the DOW recommended, “adding legumes and bunchgrasses and reducing sod-forming grasses within these fields to enhance the suitability for sharp-tailed grouse.” Some reclaimed lands resemble CRP fields and interseeding is one of the tools DOW recommends to improve habitat diversity as documented in the DOW letter in Exhibit H. To further implement this recommendation, the DOW assisted with the formation of the Habitat Partnership Program.

The Habitat Partnership Program is designed to protect and enhance the condition of public and private rangeland through the use of inter-seeding technology to modify species composition. Working cooperatively together in this program are representatives of the Rio Blanco Cooperative Extension Service, Douglas Creek Soil Conservation District, the White River Soil Conservation District, the Colorado Division of Wildlife (DOW) and the Natural Resource Conservation Service. Through funding made available by the DOW, an inter-seeding drill was purchased. The drill is available to

landowners based on the priority list in the attached Habitat Partnership Program Proposal in Exhibit H. Of highest priority are wildlife forage improvement projects to improve wildlife habitat. The DMG believes that the use of interseeding on reclaimed lands can enhance the established vegetation similar to CRP lands and native rangelands to improve wildlife habitat.

Additional applicable references include Yoakum et. al. (1980), Monsen and Shaw (1983), Frischknecht (1983), and Soil Conservation Service Range Seeding Standards and Specifications for Colorado (1987). In this later reference, SCS limits the practice to the eastern plains. Two coal mines in the Eastern plains have successfully applied this practice to increase the warm season grass cover. Specifically, at the Bacon Mine and at the CCMC mine, warm season grasses were interseeded after it became apparent that the presence of those grasses was not as high as desired. Interseeding was a very effective technique for increasing the warm season grass component in the reclaimed community. Both of these mines have successfully achieved Phase III bond release criteria. There are other mines in the Denver Region and Raton Creek Basin coal fields where this practice would apply.

For regulatory purposes, interseeding will be defined as a tool to enhance the diversity of established vegetation. Forb, shrub, and grass species native to the area will be considered acceptable. The exact species to be used will depend upon the post mining land use. Interseeding will only apply to lands where vegetation is established and no other management tools are necessary. In contrast, augmented seeding is reseeding with fertilizer or irrigation, or in response to an unsuccessful reclaimed parcel. If a reclaimed parcel were deficient in vegetative cover due to insufficient moisture, poor germination or improper planting methodologies, augmented seeding would be necessary.

Based on these references and practices, it is clear that in certain cases, interseeding is desirable to increase the structural and vegetative diversity of the reclaimed lands for wildlife habitat and for rangeland improvement.

References documenting interseeding as a normal husbandry practice on rangeland and wildlife habitat are listed below:

Monsen, Steven B., and Nancy Shaw, Compilers. 1983. Managing Intermountain Rangelands, Proceedings of Symposia. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah. 193 p.

Frischknecht. 1983. Plants Adapted to Summer Rangelands. In Managing Intermountain Rangelands, Proceedings of Symposia. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah. 193 p.

New Mexico State University Cooperative Extension Service (1992). Seeding New Mexico Rangeland. Circular 525. 10p.

Plummer, A. Perry. 1968. Restoring Big-Game Range in Utah. Utah Division of Fish

and Game Publication No. 68-3. 183 p.

Soil Conservation Service Range Seeding Standards and Specifications for Colorado. 1987. In Office of Surface Mining Reclamation and Enforcement Plant Materials Handbook. Soil Conservation Service Plant Materials Centers.

Yoakum, Jim, William P. Dasmann, H. Reed Sanderson, Charles M. Nixon, and Hewlette S. Crawford. 1980. Habitat Improvement Techniques. In Sanford D. Schemnitzs [editor] Wildlife Management Techniques Manual. The Wildlife Society. Washington, D.C. 686 p.

23. Rule 4.15.8(3)(a) is amended to correspond to proposed Rule 4.15.11. The amended rule is no less effective than 30 CFR 816/817.116(a)(1) and (2). Reference to a specific confidence level is deleted, as detailed statistical requirements including confidence levels are addressed in 4.15.11. Reference to demonstration that "cover exceeds 90 percent…" is added to allow for use of the "reverse null" approach to success demonstration, an option detailed in 4.15.11.

24. Rule 4.15.8(4) is amended to correspond to proposed Rule 4.15.11. In addition, language has been added to clarify that for non-forage crops, it is the production of the primary harvestable product which is to be measured, rather than total herbaceous production. The amended rule is no less effective than 30 CFR 816/817.116(a)(1) and (2). Reference to a specific confidence level is deleted, as detailed statistical requirements including confidence levels are addressed in 4.15.11. Reference to demonstration that "production exceeds 90 percent…" is added to allow for use of the "reverse null" approach to success demonstration, an option detailed in 4.15.11.

25. Rule 4.15.8(7) is amended to be no less effective than 30 CFR 816/817.116(b)(3)(i) and (ii) and reorganized to correspond to proposed Rule 4.15.11. Reference to a specific confidence level is deleted, as detailed statistical requirements including confidence levels are addressed in 4.15.11. Reference to demonstration that "woody plant density exceeds 90 percent…" is added to allow for use of the "reverse null" approach to success demonstration, an option further detailed in 4.15.11. The amended rules require DOW consultation and approval for shrub plantings, address statistical approaches appropriate to woody plant density evaluation, and in (b) address the "80/60" requirement of 30 CFR 816/817.116(b)(3)(ii).

The proposed rule also allows for a reverse null success demonstration based on the median for woody plant density, with a success threshold of "70% of the approved technical standard". These changes correspond to provisions of new 4.15.11, and detailed justification for use of the median based reverse null approach is presented within the statement of basis and purpose sections corresponding to pertinent provisions of 4.15.11, supported by data and analyses included in Exhibit I. The current rule states "establishment of woody plants…shall be considered acceptable if the density…is not less than 90% of the approved reference area or standard with 90 % statistical confidence." This language is essentially identical to the federal requirement at 30 CFR

816/817.116(a)(2). The "not less than" language implies use of the standard, or traditional formulation of the null hypothesis, in which the inherent assumption is that reclamation has been successful for the parameter in question, and the assumption of success must be upheld unless demonstrated to be false with statistical certainty. In this formulation, the "burden of proof" could be thought of as falling on the "opponent" of bond release. The current rule does not specify the use of the mean or median, but traditionally the population mean, as estimated by the sample mean with associated confidence interval has been applied.

The amended rule allows for the traditional approach of the current rule, but in addition would allow for an alternative, median based reverse null approach for woody plant density success demonstration (as specified in proposed Rule 4.15.11(3)(a)). The reverse null approach is inherently more stringent than the traditional null formulation, because the assumption is that reclamation has been unsuccessful for the parameter in question. The assumption of failure must be upheld unless demonstrated to be false with statistical certainty. In this formulation, the "burden of proof" falls on the "proponent" of bond release, to demonstrate with statistical certainty that the reclaimed area parameter exceeds the specified success threshold. The median has certain advantages compared to the mean as a measure of central tendency, as the median is more stable or robust than the mean; it is less impacted by extreme data values. As a result, it is generally possible to estimate the population median with relatively high precision based on a relatively small sample size. However, as demonstrated by data included in Exhibit I, the median is a more stringent standard of success than the mean for woody plant density, due to the typically skewed data distributions associated with woody plant density samples on reclaimed lands. Because of the influence of a relatively small percentage of extremely high data values, the woody plant density mean almost always exceeds the woody plant density median by a substantial margin.

For woody plant density, the reverse null approach combined with use of the median as the specified measure of central tendency is more stringent than the federal requirements of 816/817.116(a)(2), which allow for the traditional null formulation, using the mean as the specified measure of central tendency. The increased stringency is due to effects of both the reverse null formulation and use of the median. In order to offset this excess stringency, the proposed rule (in combination with proposed 4.15.11(3)(a)) allows for success demonstration to be based on a threshold of 70% of a technical standard, rather than 90% of the standard. Documentation in Exhibit I supports the reduction of the success threshold when the median is the specified parameter of comparison. The reduced success threshold is further justified by the requirement to employ the more stringent reverse null formulation to demonstrate success.

For these reasons, the allowance in proposed 4.15.8(7) and 4.15.11(3)(a) for success demonstration based on 70% of the standard, is no less effective than the requirement in 30CFR 816/817(a)(2), that "stocking shall be considered equal…when…not less than 90 percent of the success standard".

26. Rule 4.15.8(8) is amended to be no less effective than 30 CFR 816/817.116(b)(3)(I) and (ii).
The amended rule requires approval of minimum stocking levels and planting arrangements by the State Forester for lands reclaimed to a forestry post-mining land use, and requires at least 80 percent of the trees used to determine success to have been in place for at least 60 percent of the liability period.

The term "forestry" is substituted for "commercial forest" in the amendment, since "commercial forest" is not defined in the Rules.

27. Rule 4.15.9 is amended to clarify that, for cropping systems which entail summer fallow in the cropping cycle, the last two consecutive cropping years of the liability period are the years in which crop production would be measured for demonstrations of revegetation success. The amended rule is no less effective than 30 CFR 816/817.116(c)(3).

28. Rule 4.15.11 is being added to be no less effective than 30 CFR 816/817.116(a)(1) to specify the statistically valid sampling methods and testing techniques which operators must use in demonstrations of revegetation success. Acceptable sampling methods and approaches for estimates of vegetation cover, herbaceous production, and woody plant density are addressed in new 4.15.11(1). Statistical testing and sample adequacy approaches acceptable for vegetation cover, herbaceous production, and woody plant density are addressed in new 4.15.11(2). Additional statistical testing and sample adequacy approaches applicable solely to woody plant density are addressed in new 4.15.11(3). Approaches in 4.15.11(3) are optional methods that may be used in lieu of the approaches in 4.15.11(2) for woody plant density.

The amended rule ensures that tests for success will employ a 90 percent confidence level (alpha error probability = .10) for “standard null” based demonstrations of success and that tests will employ an 80 percent confidence level (alpha error probability = .20) for “reverse null” based demonstrations of success. Data and analyses in Exhibit I demonstrate that reverse null tests at the 80% level of confidence are no less effective (and in fact are more stringent) than standard null tests at the 90 % level of confidence. Selected revegetation success standards are addressed in 4.15.7(2)(d), 4.15.7(3), 4.15.7(4), 4.15.8, 4.15.9, and 4.15.10. Justification for the 70% success threshold of proposed 4.15.11(3)(a) for woody plant density is provided in the discussion under Item 11, above, pursuant to associated amendments to Rule 4.15.8(7). Additional justification is included in Exhibit I.

New 4.15.11(2)(a) incorporates into regulation the standard statistical sample adequacy formula and direct success comparison approach previously specified in Division guidelines. A notable modification is that the rule allows for use of a precision level of 0.15, rather than 0.10, in the standard sample adequacy formula for woody plant density estimation. Larson (1980) used a precision level of 0.10 in example data sets, and that level of precision has subsequently been widely specified in state regulations and guidelines. However, no specific level of statistical precision is required by federal regulations in 30 CFR 816/817.116. In Colorado, we have found the 0 .10 precision

level to be appropriate and practicable in the majority of cases for statistical evaluation of cover and production success. However, due to the high variability and skewed distributions typical of reclaimed area woody plant density data, extremely large sample sizes are typically necessary to demonstrate sample adequacy for woody plant density, at the 0.10 level of statistical precision. The time and expense associated with obtaining estimates of woody plant density that are precise to within 10% of the true mean, are not justified for coal reclamation lands in Colorado.

As noted, the federal rules do not specify a particular level of sampling precision, nor do they specify particular sample adequacy formulas or approaches. The preamble to 30 CFR 816.116 acknowledges that sample adequacy approaches should reflect the variability of plant populations. The preamble section of the September 2, 1983 Federal Register publication Vol. 48, No. 172, contains an extensive discussion of the 816.116(a)(1) requirement for "statistically valid sampling techniques for measuring success…" Of particular pertinence is the following narrative, from page 40150 of the cited publication.

OSM has not stated a level of sampling precision in the final rules but will instead evaluate on a case-by case basis the adequacy of predetermined sample sizes or methods of sample size selection proposed for use in State programs.

Enclosed as Exhibit I is a package containing woody plant density data from representative mine reclamation areas in the Yampa Basin and North Park, Colorado. The package includes detailed analyses of the data, and presents justification for use of a precision level of 0.15 in the standard sample adequacy formula for woody plant density estimation. Use of the 0.15 precision level rather than 0.10 will significantly reduce required sample sizes for reclaimed area woody plant density estimates. In our judgment, the increased precision associated with use of 0.10 for woody plant density estimation is not critical, and the relatively small increase in precision comes at too high a price in terms of the time and effort associated with the additional data collection. Use of a 0.15 precision level rather than a 0.10 precision level for demonstrating woody plant density success will negligibly affect the extent to which reclaimed shrublands provide desired wildlife cover and forage on reclaimed landscapes. Woody plant density standards are set based on consultation with Division of Wildlife personnel, and reflect consideration of a wide range of variables, typically involving negotiation among DOW and DMG staff, operators and consultants. It is not an exact science, and necessary or optimum levels of woody plant density to meet applicable habitat requirements are not precisely defined. Application of such a high degree of precision to a standard that is based on professional recommendation and negotiation is unwarranted.

New 4.15.11(2)(b) incorporates into regulation the one-sided t-test success demonstration approach previously specified in Division guidelines. The approach is no less effective than 30 CFR 816.116(a)(2).

New 4.15.11(2)(c) allows for the option of a "reverse null" t-test to demonstrate that the reclaimed area mean **exceeds** the success threshold. Under this formulation, the burden

of proof is shifted to the proponent of bond release; the underlying assumption that must be shown to be false with statistical certainty is that reclamation was not successful for the parameter in question. As a result of this burden shift, the test of success specified is more stringent than that required by relevant federal Rule 30 CFR 816.116(a)(2). In certain instances, this option will allow operators to make statistically valid demonstrations of success based on smaller sample sizes than would be the case under the standard formulation of the t-test. This is because the approach does not require use of a statistical formula to demonstrate sample adequacy. An additional change in (c), is the allowance for use of an alpha error probability of 0.2 rather than 0.1 (confidence level of 80% rather than 90%), when reverse null testing is employed. Documentation in Exhibit I demonstrates that reverse null testing with an alpha error probability of 0.2 is no less effective than standard null testing with an alpha error probability of 0.1.

New 4.15.11(3) allows for additional optional approaches for demonstrations of sample adequacy and revegetation success that are solely applicable to woody plant density. The approaches include median based reverse null confidence limit comparison, mean based pre-determined sample size direct comparison, and an approach based on stabilization of the running sample mean. The range of options presented for woody plant density is warranted, due to the extremely large sample sizes that have frequently been necessary in order for operators to demonstrate success for this parameter using traditional statistical methods. The approaches specified in 4.15.11(3)(a), (b), and (c) are no less effective than applicable federal requirements of 30 CFR 816.116(a)(1) and (a)(2). However, depending on characteristics of the data, the range of options may allow for operators to select a success demonstration approach that requires a less intensive sampling effort than would be required if limited to only one or two approaches. Data and argument in support of the approaches proposed are included in the previously referenced Exhibit I.

References documenting the techniques proposed in Rule 4.15.11 are listed below.

Bonham, Charles D. 1989. Measurements for Terrestrial Vegetation. John Wiley and Sons, Inc. New York, N.Y. 320 p.

Cochran, W. G., 1977. Sampling Techniques. Third Edition. John Wiley & sons, Inc. New York. 413 p.

Cook, C. Wayne and Charles D. Bonham. 1977. Techniques for Vegetation Measurements and Analysis for a Pre- and Post-Mining Inventory. Range Science Series No. 28. Colorado
State University Range Science Department. Fort Collins, CO. 94 p.

Cook, C. Wayne and James Stubbendieck. 1986. Sampling methods with special reference to range management. p. 215-250. In C. Wayne Cook and James Stubbendieck [editors]
Range Research: Basic Problems and Techniques. Society for Range Management. Denver CO. 317 p.

Gilbert, Richard O. 1987. Statistical Methods for Environmental Pollution Monitoring.
Van Nostrand Reinhold. New York, N.Y. 320 p.

Helsel, D.R. and R.M. Hirsch. 1992. Statistical Methods in Water Resources. Elsevier Science Publishing Company, Inc. New York, N.Y. 522 p.

Larson, Larry. 1980. A Statistical Evaluation of Revegetation Success on Coal Lands in the West. Unpublished report prepared for the Office of Surface Mining Reclamation and Enforcement. Denver Colorado. 18 p.

29. Rule 4.25.2(4) is amended to be no less effective than 30 CFR 785.17(e)(5).