NORTH DAKOTA
PUBLIC SERVICE COMMISSION

RECLAMATION DIVISION

STANDARDS FOR EVALUATION OF REVEGETATION SUCCESS AND RECOMMENDED PROCEDURES FOR PRE- AND POSTMINING VEGETATION ASSESSMENTS

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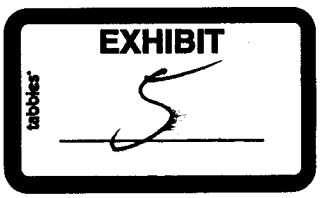

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GENERAL NOTATIONS

Abbreviations

PSC	ND Public Service Commission
OSM	US Dept. of Interior (USDI), Office of Surface Mining and Regulation
NRCS	US Dept. of Agriculture (USDA), Natural Resources Conservation Service [formerly known as the Soil Conservation Service (SCS)]
FR	Federal Register
USFWS	US Fish and Wildlife Service
ARS	USDA, Agricultural Research Service
NDCC	ND Century Code
SMCRA	Federal Surface Mining Control and Reclamation Act
NDASS	ND Agricultural Statistic Service
NDAC	ND Administrative Code
LRA	Land Resource Area as defined by the NRCS
GPS	Global Positioning System

Mathematical Symbols

CF	Climatic correction factor
PI	NRCS Productivity Index for a soil series based on a rating of 1 to 100
X_{AD}	Adjusted yield standard (bu/ac, t/ac, lbs/ac, etc)
X_{UA}	Unadjusted yield standard developed using NRCS PI values
X_C	Annual county small grain yield as reported by NDASS
X_{CLT}	Long term average (minimum 15 years) NDASS hayland yield
X_{PI}	NRCS PI average county yield for cropland or a minimum of an average of the last 15 years of the NDASS-reported hayland yields
X_{est}	Estimated annual county yield using NDASS-reported X_C and correcting for the prior year's management of either fallow or continuous cropping
X_{ca}	Control area yield
X_{cw}	Unadjusted control area standard yield developed using NRCS PI values
PR	Productivity ratio found by dividing X_{UA} by X_{PI}
s	Sample standard deviation [various subscripts denote weighting (w), sampling strata (h), etc.]
s^2	Sample variance (subscripts denote the same indicator as for standard deviations)
$\lvert\ \rvert$	Indicates the absolute value (always positive) should be used
$\sqrt{}$	Indicates a square root should be calculated
t_{calc}	Calculated Student's t value
d.f.	Degrees of freedom
n	Number of samples used to calculate a mean, etc.
t	Student's t distribution value for a given level of confidence

d	Arbitrary level of accuracy desired (i.e. 10% of a sample mean)
p	Percent surface cover
q	Percent bare ground or 100-p
SEM	Standard error of the mean
x_i	Individual sample value
$\bar{x}$	Sample mean [subscripts denote sampling grouping (i.e. 1, 2), strata (h), weighting (w), etc.]
h	Levels of strata in a stratified sampling system
N_h	Number of sampling units (i.e. acres) in the h^{th} stratum where N equals the total number of sampling units
W_h	Proportion of sampling units in the h^{th} stratum
Σ	Indicates a summation of values

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C. CROPLAND

Definition

Cropland, as defined in NDAC 69-05.2-01-02, means land which is used for the production of adapted crops for harvest, alone or in rotation with grasses and legumes, and includes row crops, small grain crops, hay crops, nursery crops, orchard crops and other specialty crops. Land used for facilities in support of cropland farming operations is also considered as cropland. Cropland also includes hayland, which was considered as a separate sub-category prior to June 1,1983.

Requirements for Successful Revegetation

For third-stage bond release on reclaimed croplands, "vegetation shall be considered established after the successful seeding of the crop being grown or a precropland mixture of grasses and legumes" [NDAC 69-05.2-22-07(3)(b)]. For prime farmland, productivity on the permit area must be equal to or greater than that of the approved reference area or standard with 90% statistical confidence for a minimum of three crop years [NDAC 69-05.2-22-07(3)(c)]. For fourth-stage bond release on cropland, productivity (crop yield) is the only vegetation parameter that must be assessed. According to NDAC 69-05.2-22-07(4)(c) and (l), "crop production from the permit area shall be equal to or greater than that of the approved reference area or standard with ninety percent statistical confidence for the last two consecutive growing seasons, or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period." For prime farmlands, North Dakota rules require that third stage bond release standards have been met and that the ten-year responsibility period has elapsed [NDAC 69-05.2-22-07(4)(d)].

Reclaimed tracts that remain in precropland vegetation following bond release must be assessed using annual small grain or row crops if the area had been annually cropped prior to mining. However, only representative portions of these tracts need be cropped for bond release assessment as described in Section III (D), Methods for Measuring Productivity, Cover, and Density. On cropland areas where the land after mining will be managed for perennial hay, yields of hay crops may be used to determine revegetation success during the years that yield measurements are taken for final bond release purposes. The productivity standards for tame pastureland, Section II (E) must be used for these areas. However, this will apply only to areas specifically approved in the reclamation plan as perennial hayland, or to areas where the premine land was perennial hayland.

Premining Assessment

The following information is required as a part of the permit application in accordance with NDAC 69-05.2-08:

1. Delineate and identify on a map or aerial photograph of 1:4800 scale [NDAC 69-05.2-08-08(l)(a)(1)]:

a. All cropland tracts within the proposed permit area; and,

b. Each soil-mapping unit for each tract of cropland.

2. Tabulate total acreage of each soil mapping unit for each surface owner within the proposed permit area [NDAC 69-05.2-08-08(l)(c)(1)].

3. Provide an assessment of the production of the principal crop(s) grown on the cropland within the permit area. [NDAC 69-05.2-08-08(l)(c)(2)]. Evaluation of premining production of cropland may be based on:

a. NRCS yield estimates for the various soil mapping units;

b. Historical yield averages for the area, if available; or,

c. The most recent actual yields from the area.

4. If a cropland reference area or control area will be used to determine revegetation success, provide a map showing the location, size, and the soil mapping units of the proposed reference or control area. Also include a discussion that demonstrates that the proposed area adequately represents the conditions in the permit area [NDAC 69-05.2-08-08(2)].

Postmining Assessment

Third-Stage Bond Release

The following information should be submitted for each reclaimed cropland tract with third-stage bond release requests:

1. An aerial photo of adequate scale that delineates the reclaimed cropland tract(s) proposed for bond release.

2. A narrative that includes methods used for seedbed preparation and seeding and describes all management practices used prior to the bond release request [NDAC 69-05.2-12-12(10)].

3. A demonstration of adequate establishment of vegetation under NDAC 69-05.2-22-07(3)(b), or NDAC 69-05.2-22-07(3)(c) for prime farmland, using the approved standard for third-stage bond release.

4. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards for Third-Stage Bond Release

Precropland or hayland seed mix:

The vegetation will be considered successfully established when the stand consists primarily of grass and legume species. This evaluation will be conducted by PSC field inspection no sooner than the end of the first growing season.

Annual Crops:

The vegetation will be considered successfully established when the stand appears similar to those normally found on undisturbed lands and a harvestable crop is produced. The evaluation will be conducted by PSC field inspection near the end of the growing season, when the crop is mature.

Prime Farmland:

The vegetation will be considered successfully established when the annual production of the reclaimed tract is equal to or greater than the reference area, or standard (as described for fourth-stage bond release success standards for other cropland), with 90% statistical confidence for a minimum of three years, not necessarily consecutive. A separate success standard must be calculated for prime farmland tracts unless a single yield standard has been approved as allowed by NDAC 69-05.2-22-07(4)(l). Spring wheat must be used for this demonstration for at least 2 of the 3 years that productivity measurements are taken. Barley or oats may be used for the other year.

Fourth-Stage Bond Release

The following information should be submitted for each reclaimed cropland tract with fourth-stage bond release requests:

1. An aerial photo of adequate scale that delineates the reclaimed cropland tract(s) proposed for bond release. The aerial photo must depict ownership boundaries if separate landowners are involved, and, within each land ownership, any site type units if a stratified sampling procedure was used. Provide in tabular form the acreages of site type units for each landowner within the reclaimed tract.

2. An aerial photo of adequate scale that delineates the area and soil mapping units that were used to develop the standard.

3. An aerial photo of adequate scale that delineates any corresponding reference or control areas and their soil mapping units, if used to develop the standard.

4. A narrative that includes soil replacement thicknesses and a complete management history of the reclaimed cropland tract(s) and reference or control areas. The narrative should include seed mix and rate, fertilizer program, pesticide control, tillage practices, and any other management techniques used during the liability period [NDAC 69-05.2-12-12(08)].

5. Data and calculations which demonstrate that productivity of each landowner's non-prime reclaimed tract is equal to or greater than the approved standard (with 90% statistical confidence) in each of the last two consecutive growing seasons or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period.

   For reclaimed prime farmland, a separate yield standard must be calculated for each tract and three years (not necessarily consecutive) of data must be submitted that demonstrates that the productivity is equal to or greater than the approved standard with 90% statistical confidence. Alternatively, if a single standard has been approved and calculated for a reclaimed tract containing a mixture of prime and non-prime farmlands as allowed by NDAC 69-05.2-22-07(4)(l), data must be submitted which demonstrates that productivity is equal to or greater than the approved standard (with 90% statistical confidence) in any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period. Spring wheat must be used for this demonstration for at least two of the three years when productivity measurements are taken for final bond release. Barley or oats may be used for the other year.

   Sampling locations must also be shown on an appropriate map.

6. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards for Fourth-Stage Bond Release

For assessment of revegetation success on surface mined lands reclaimed to cropland use, the permittee may use either a reference area standard, or a technical standard based on NRCS data. Each of these standards provides a procedure for climatic correction of yields. If a tract is owned by more than one landowner, production on each landowner's property must be assessed separately. A separate yield must be obtained, and a separate standard developed, for each landowner's property.

Crops most commonly grown prior to mining must be used to measure productivity to determine reclamation success on areas being returned to cropland. Normally spring wheat (hard red spring wheat or durum wheat) must be grown for at least one of the years that measurements are taken on cropland for final bond release assessments. Other crops that may be grown during the other year on non-prime cropland are oats, barley, flax, rye and sunflowers. Use of the other crops for the years that measurements must be taken will be allowed only for extenuating circumstances that receive prior written approval based on site specific situations.

For fourth-stage release on prime farmlands, the ten-year responsibility period must have elapsed and productivity standards for third-stage bond release must have been met.

Method 1: Cropland Reference Area Standard

This standard combines a reference area with NRCS productivity indices for soil mapping units. It is particularly recommended for reclaimed prime farmland and reclaimed cropland tracts which subtend only a few soil series.

A cropland reference area is established for soil mapping units which were predominant in the reclaimed tract prior to mining. The reference area must include one or two reference soils which singly or together occupy more than 50% of the reclaimed tract. The reference area must be topographically similar to the reclaimed tract and must be established in the vicinity of the mine area. The proposed location of the reference area must be identified in the permit application, and must be inspected and approved by PSC staff.

The reference area must be established at least two years before the first year in which the reclaimed tract will be evaluated for bond release. Beginning at this time, the reference area must be managed using practices which may be site-specific, but equal in effect to those used on the reclaimed tract. The reference area and the reclaimed tract must be planted at the same time and with the same crop species and variety in the years when yields will be compared. An exemption from this two-year requirement may be granted if documentation is submitted to the Reclamation Division that demonstrates that the management of the reference area for the previous two years has been equivalent in effect to that of the reclaimed area.

In each of the two final growing seasons (or three years starting no sooner than the sixth year with one year being the last year of the responsibility period for non-prime lands, or any three years for prime farmlands), the yield from each soil mapping unit in the reference area must be separately harvested or sampled. The crop yield of one of the reference soils must be used, along with NRCS soil productivity indices from Cropland Table 1 (NRCS 2000), to calculate the expected yields for the other premining soil mapping units not represented in the reference area. The expected yields are derived by dividing the index value for each soil series by the index value of the reference soil and multiplying by the current year's yield for the reference soil. The actual yields of the reference soils and the expected yields of the other soils are weighted by the acreage each soil mapping unit occupied in the tract prior to mining. The weighted yields are summed and divided by the total acreage of the reclaimed tract to derive the current year's yield standard for the tract. The current year's actual yield from the reclaimed tract is then compared to the derived standard. The yield standard must be derived for each year that the reclaimed tract is evaluated for bond release.

Since the yield standard is calculated by sampling and obtaining an average, there is a variance associated with the value. Therefore, when the reclaimed tract and reference area are sampled to obtain yields, appropriate statistical tests must be applied as necessary to determine if the yields are significantly different. If the yield of the reclaimed tract is obtained by a random or stratified (site type) sampling procedure, a standard deviation can be calculated which will enable statistical comparison with the yield standard. However, if the entire reclaimed tract is harvested to obtain a yield, a standard deviation cannot be calculated. In this case, special formulas must be used to enable statistical comparison with the standard. Further discussion of sampling and statistical procedures is given in Chapter III.

Example

Assume there is a 50 acre reclaimed cropland tract in Mercer County which, according to the premining soils inventory, contained 30 acres of Bowbells soil, 15 acres of Arnegard soil and

5 acres of Williams soil. Since Bowbells constituted more than 50% of the reclaimed tract, a reference area was established on a Bowbells unit in the vicinity of the mine area. In each of the years that yield comparisons are made for final bond release purposes, the following steps should be taken:

Step 1:

Determine the yield of the reference soil. Assume that the Bowbells reference soil yielded 28 bu/ac in the given year of comparison.

Step 2:

Determine the productivity index for all soil mapping units which were present in the reclaimed tract prior to mining, from Cropland Table 1 (NRCS 2000). The index values for these soils are:

Map Unit Component	**Slope Group**	**Productivity Index Value**
Arnegard	A	100%
Bowbells	B	95%
Williams	A	90%

Step 3:

The Bowbells is used as a reference soil, and has a productivity index (PI) of 95. A correction factor (CF) is calculated by dividing the index value for each mapping unit by the index value of the Bowbells soil. The CF is multiplied by 28 bu/ac (produced by the Bowbells soil in the given year) to derive the expected yields of the other soils for that year. The weighted yield is then calculated for the reclaimed tract by multiplying the expected yield of a soil by the acres of that soil. Finally, an average yield for the tract can be calculated by dividing by total acres.

Soil	Soil PI		Bowbells PI		CF		Bowbells Production		Expected Yield		Acres		Total Bushels
Arnegard	100	÷	95	=	1.05	x	28 bu/ac	=	29 bu/ac	x	15 ac	=	435 bu
Bowbells	95	÷	95	=	1.00	x	28 bu/ac	=	28 bu/ac	x	30 ac	=	840 bu
Williams	90	÷	95	=	0.95	x	28 bu/ac	=	27 bu/ac	x	5 ac	=	135 bu
Total:											50 ac		1410 bu

Weighted average yield = 1410 / 50 ac = 28.2 bu/ac

After rounding, the weighted average yield of 28 bu/ac is the current year's adjusted standard yield for the reclaimed tract.

Step 4:

Compare the current year's actual yield from the reclaimed tract with the adjusted yield standard using the appropriate statistical procedures.

Method 2: NRCS Cropland Technical Standard

NRCS productivity indices may be used to calculate an unadjusted yield standard. The standard must be adjusted for annual climatic variation using any one of four methods discussed later in this section.

Productivity index values for all premining soil mapping units which existed in the reclaimed cropland tract are obtained from Cropland Table 1 (NRCS 2000). As of February 2000, the NRCS has assigned productivity index values to nearly all soil series. However, in the event of a non-rated soil (such as a channeled mapping unit), the soil must be assigned a productivity index of 20%. Index values are converted to yields using the assigned county yield for the Productivity Index of 100% (Cropland Table 2). A yield value is determined for each soil mapping unit in the tract and multiplied by the acreage each mapping unit occupied in the tract. These weighted yields are summed and divided by the total acreage of the tract to obtain a weighted average yield per acre. This value is the unadjusted yield standard (X_{UA}) for the reclaimed cropland tract.

This method is not applicable to hayland because productivity indices are based on spring wheat yields which respond differently to various soils as compared to perennial crops such as grass-legume hay. Therefore, the productivity standard for tame pastureland (Section E) must be used to evaluate hayland.

NRCS yield ratings for productivity indices are based on long-term average data which do not account for annual climatic effects. Therefore, the unadjusted yield standard must be adjusted using one of the following four methods:

Climatic Correction Factors for NRCS Technical Standard:

Correction Method 1:

Annual county yield data (X_C) , reported by NDASS, can be used to calculate an annual climatic correction factor (CF). The unadjusted yield standard (X_{UA}) is multiplied by the correction factor to derive an adjusted yield standard (X_{AD}) for a given year:

$$X_{AD} = X_{UA} \times CF \qquad (1)$$

The correction factor is derived by dividing the NDASS county average yield (corrected for cropping management i. e., fallow or continuous cropping) for the current year (X_C) by the NRCS average yield for the county (X_{PI}) listed in Cropland Table 2:

$$CF = X_C / X_{PI} \quad (2)$$

The NRCS average yield for the county (X_{PI}) was derived by weighting the expected NRCS soil survey yields for all cropland soil mapping units in the county by the acreages of those soil mapping units in the county (refer to Section II-B). Calculated county average yields are shown in Cropland Table 2.

By combining equations (1) and (2), we get:

$$X_{AD} = X_{UA} \times (X_C/X_{PI}) \quad (3)$$

Where: X_{AD} = adjusted yield standard

X_{UA} = unadjusted yield standard, obtained using NRCS productivity indices

X_C = NDASS county yield for the current year corrected for management*

X_{PI} = NRCS county average yield (Cropland Table 2)

* For data collection years of 1995 or earlier, the annual average county yields (X_C) of spring wheat and durum are listed in the NDASS publication and are obtained for that year from either the column designated Summer Fallow or Continuous Cropping depending upon the previous year's cropping management of the reclaimed field.

The adjusted yield standard (X_{AD}) must be calculated each year in which actual yield for the reclaimed tract will be compared to the standard.

For spring wheat and durum data collection years of 1996 and later, the NDASS no longer reports individual yield values for Summer Fallow or Continuous cropping. The reported annual county yield (X_C) consists of a combined value for those two cropping management practices. Therefore, the reported county yield must be corrected for the previous year's cropping management prior to the calculation of the climatic correction factor. The PSC has developed updated regression/correlation equations based on long term county data to estimate the yearly yields (expected to occur under conditions of Summer Fallow or Continuous Cropping in the prior year) for use in calculating the CF. The following equations should be used for the appropriate county by inputting the reported NDASS annual county yield (X_C) to estimate Summer Fallow or Continuous Cropping Yields (X_{est}). This value of X_{est} will then be used in place of X_C in Equations 2 and 3.

Adams County:

For Spring Wheat

Summer Fallow Yield Estimate: $X_{est} = 1.03X_C + 0.92$

Continuous Cropping Yield Estimate: $X_{est} = 1.03X_C - 4.89$

For Durum Wheat

Summer Fallow Yield Estimate: $X_{est} = 1.05X_C - 0.24$

Continuous Cropping Yield Estimate: $X_{est} = 0.72X_C + 2.14$

Bowman County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.02X_C + 0.46$

Continuous Cropping Yield Estimate: $X_{est} = 0.99X_C - 4.13$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 0.68X_C + 12.12$

Continuous Cropping Yield Estimate: $X_{est} = 0.76X_C + 9.66$

Burke County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 0.98X_C + 0.91$

Continuous Cropping Yield Estimate $X_{est} = 1.23X_C - 8.55$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = X_C + 0.84$

Continuous Cropping Yield Estimate: $X_{est} = 1.11X_C - 7.22$

McLean County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 0.97X_C + 2.48$

Continuous Cropping Yield Estimate $X_{est} = 1.14X_C - 6.43$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 0.97X_C + 1.63$

Continuous Cropping Yield Estimate: $X_{est} = 1.06X_C - 5.61$

Mercer County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.04X_C + 0.20$

Continuous Cropping Yield Estimate $X_{est} = 0.94X_C - 3.12$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.02X_C + 0.58$

Continuous Cropping Yield Estimate: $X_{est} = 0.95X_C - 2.71$

Oliver County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.03X_C + 2.31$

Continuous Cropping Yield Estimate: $X_{est} = 1.09X_C - 5.44$

Oliver County (cont.):

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.11X_C + 0.07$

Continuous Cropping Yield Estimate: $X_{est} = 0.80X_C + 0.85$

Stark County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.04X_C + 0.47$

Continuous Cropping Yield Estimate: $X_{est} = 1.05X_C - 4.38$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.04X_C + 0.10$

Continuous Cropping Yield Estimate: $X_{est} = 1.02X_C - 4.81$

Example Using Correction Method 1:

Assume there is a 50-acre tract of land in Mercer County that will be reclaimed to cropland following mining disturbance. Let us further assume that the premining soils inventory has indicated that this area contains 15 acres of Bowbells soil, 25 acres of Williams soil and 10 acres of Zahl soil.

Step 1:

Based on the NRCS productivity indices and calculated yields for these soils, calculate the unadjusted yield standard for the tract by the following procedure:

Soil	Slope Group	Productivity Index Value	Yield (bu/ac)[1]	x	Premine Acres	= Weighted Yield (bu)
Bowbells	A	100%	37.0		15	555.0
Williams	A	90%	33.3		25	832.5
Zahl	B	57%	21.1		10	211.0
			Total		50	1598.5

[1] Taken from Cropland Table 2, where: 37 bu/ac x %PI = bu/ac
and where: 37 bu/ac = PI of 100% for Mercer County

Unadjusted standard (X_{UA}) = 1598.5 bu / 50 ac = 32 bu/ac

Step 2:

If the year is 1996 or later, adjust the current year's yield as reported by NDASS for the county for the management, either fallow or continuous cropping, used on the reclaimed field. Assume that the annual yield (X_C) reported by the NDASS for Mercer County in 1996 was 28.5 bu/acre and the reclaimed field was continuously cropped. The annual county yield adjusted for management would then be calculated as follows:

Estimated annual county yield (X_{est}) $= 0.94(X_C) - 3.12$
(regression equation shown above)

$= 0.94(28.5) - 3.12 = 23.7$ bu/ac

Step 3:

Derive the climatic correction factor using the estimated annual county yield as calculated above in Step 2 (or the actual reported county yield if the year is 1995 or earlier). For this example, the estimated annual yield (X_{est}) for Mercer County would be 23.7 bu/acre. The weighted average yield (X_{PI}) for all cropped land in Mercer County on the basis of NRCS yield estimates for each soil type and their respective acreages is 27 bu/ac (Cropland Table 2). Divide the NDASS estimated annual county yield value by the weighted county average yield to determine the correction factor (CF):

$$CF = 23.7 \text{ bu/ac} / 27 \text{ bu/ac} = 0.88$$

This indicates that the current year's yield under continuous cropping management in Mercer County was 0.88 that of the weighted county average yield.

Step 4:

Multiply the unadjusted yield standard for the reclaimed tract calculated in Step 1 by the correction factor to obtain the adjusted yield standard for the current year:

$$\text{Adjusted standard } (X_{AD}) = 32 \text{ bu/ac} \times 0.88 = 28.2 \text{ bu/ac}$$

Step 5:

Compare the current year's adjusted yield standard (28.2 bu/ac) to the actual yield from the reclaimed tract using the appropriate statistical procedures (repeat Steps 2 through 4 for each year).

Correction Method 2:

A control area, which contains some of the predominant premining soil series, or similar soil series (including similar productivity), which existed in the reclaimed tract, can be used to calculate a climatic correction factor. A weighted average yield is calculated for the control area using the same method that was used to calculate the unadjusted yield standard for the reclaimed tract (i.e., using soil mapping units from a professional soil classifiers survey, and NRCS productivity indices). The control area is harvested in the same years that the reclaimed tract is harvested for comparison with the standard. The actual yield from the control area is divided by its weighted average yield to obtain the climatic correction factor for the current year:

$$CF = X_{ca} / X_{cw} \quad (4)$$

This method assumes that the deviation of actual yield from the weighted average yield of the control area is a function of climate. The adjusted standard for the reclaimed tract is derived by combining equations (1) and (4):

$$X_{AD} = X_{UA} \times (X_{ca} / X_{cw}) \quad (5)$$

Where: X_{AD} = adjusted yield standard;

X_{UA} = unadjusted yield standard, obtained using NRCS productivity indices;

X_{ca} = actual yield from the control area for the current year; and,

X_{cw} = weighted average yield for the control area (derived using same method as for X_{UA}).

The proposed location of the control area must be identified in the permit application. Establishment of the control area must occur at least two years prior to the first year that the reclaimed tract is harvested for comparison with the standard. An exemption from this two-year requirement may be granted if documentation is submitted to the Reclamation Division that demonstrates that the management of the control area for the previous two years has been equivalent in effect to that of the reclaimed area. Prior to establishment, the permittee must provide the PSC with information on the control area, including soils descriptions, fertility levels, and management history. The PSC will review this information and inspect the control area prior to approval. Management of the control area and the reclaimed tract may be site specific, but must be equal in effect during the years in which comparisons with the standard will be made.

Example using Correction Method 2:

Step 1:

Assume the same acreages and methodologies used in the previous example to calculate the unadjusted yield standard of 32 bu/ac (refer to Step 1, page 10).

Step 2:

Following the same procedure, calculate the expected yield of the control area. Assume there is a 29-acre control area in Mercer County. Let us further assume that a detailed soil survey, prepared by a professional soil classifier, has indicated that this area contains 8 acres of Sen soil, 18 acres of Williams soil and 3 acres of Zahl soil.

Control Area:

Soil	Slope Group	Productivity Index Value	Yield (bu/ac)[1]	X	Acres	=	Weighted Yield (bu)
Sen	A	80%	29.6		8		236.8
Williams	A	90%	33.3		18		599.4
Zahl	B	57%	21.1		3		63.3
			Total		29		899.5

[1] Derived from NRCS (2000) where: 37 bu/ac x %PI = bu/ac
where: 37 bu/ac = PI of 100% for Mercer County

Control Area unadjusted yield (X_{cw}) = 899.5 bu / 29 ac = 31.0 bu/ac

Step 3:

The current year's actual yield from the control area (X_{ca}, assumed to be 24.5 bu/ac) is divided by the weighted average yield of the control area (X_{cw}) to obtain a climatic correction factor:

$$CF = 24.5 \text{ bu/ac} / 31.0 \text{ bu/ac} = 0.79$$

Step 4:

The unadjusted yield standard for the reclaimed tract (X_{UA}) is multiplied by the correction factor to obtain an adjusted standard:

$$\text{Adjusted standard } (X_{AD}) = 32 \text{ bu/ac} \times 0.79 = 25.3 \text{ bu/ac}$$

Step 5:

Compare the current year's actual yield from the reclaimed tract to the adjusted yield standard (25.3 bu/ac) using the appropriate statistical procedures (repeat Steps 3 and 4 for each year).

NOTE: In the event no PI=100 yield data is available for the crop being grown on both the reclaimed and control areas, the ratio of the weighted productivity indices values from the reclaimed and control areas may be substituted for the CF value and the actual control area yield would be used in Step 4 in order to calculate the adjusted yield for the reclaimed area. For the areas described above, this ratio would be $86.4/83.8 = 1.03$ and this value would be multiplied times the actual control area yield. For example, if both the reclaimed and control areas were planted to canola and the control area yielded 1300 lbs/ac then the reclaimed area would have to yield 1339 lbs/ac (1300 x 1.03) to meet the required production standard for final bond release.

Correction Method 3:

NDASS data may be used in conjunction with precipitation, temperature and other pertinent data to calculate a correction factor. The PSC may develop a regression equation or other formula which accurately predicts a deviation from the long-term average yield based on deviation of the current year's effective precipitation, growing season temperature, the long-term average precipitation and temperature.

The correction factor (+ or -) is added to the unadjusted yield standard (derived from NRCS data) for the reclaimed tract to derive the current year's adjusted yield standard. If an acceptable regression equation or other formula is developed, the correction factor will have to be calculated for each year that the reclaimed tract will be compared to the standard.

Any acceptable regression equation or other formula which will be used in this method will be developed and updated by the PSC using all available NDASS, precipitation, temperature and other pertinent data. The PSC will provide permittees with acceptable regression equations or other formulas.

Correction Method 4:

County-Wide Average Correction

When the entire reclaimed field is harvested or when representative strips are entirely harvested to obtain the yield for the reclaimed area, this reclaimed yield may be compared to the annual county yield reported by the North Dakota Agricultural Statistical Service (NDASS). If this method is used, the annual county yield, standard deviation, and sample size for each year that yield comparisons are made must be obtained from NDASS. The standard deviation and sample size from NDASS will be used to establish a 90% statistical confidence interval.

Under this method, an unadjusted yield standard for the reclaimed area must be calculated according to the example provided in Method 1 described earlier. A productivity ratio of the unadjusted yield standard to the average county yield is determined using the average for the county from Cropland Table 2 on Page II-C-20 of this document. The following steps must be completed for each year that comparisons are made for demonstrating reclamation success:

Step 1:

The ratio of the unadjusted yield standard to the average county yield (from Cropland Table 2 on page II-C-20) is calculated as follows:

$$\text{Productivity Ratio (PR)} = \frac{\text{Unadjusted yield standard}}{\text{Average county yield}}$$

Step 2:

An adjusted yield standard for the reclaimed area for the particular year is then calculated by multiplying the PR (obtained in Step 1) by the annual county yield obtained from NDASS corrected for management (as outlined in Correction Method 1) if the data is from year 1996 or later. This multiplication procedure is then also done on the annual (or estimated) county yield's standard deviation (also obtained from NDASS) in order to reflect the adjustment in the annual county yield.

Step 3:

Using the appropriate statistical procedures, the annual reclaimed yield will be compared with the adjusted yield standard obtained in Step 2 by using the annual county yield sample size and adjusted annual county standard deviation value.

Example using Correction Method 4

Assume that the reclaimed tract is in Mercer County, hard red spring wheat is grown, and the following factors apply in a particular year:

Unadjusted yield standard for the reclaimed tract = 19.8 bu/ac
Average yield for Mercer County from Cropland Table 2 = 27 bu/ac
Annual (or estimated if 1996 or after) county yield = 28.0 bu/ac
Annual county yield standard deviation = 7.56
Number of samples for the annual county yield = 60

Annual yield for the reclaimed tract = 20.0 bu/ac

Step 1:

Calculate the Productivity Ratio (PR):

PR = 19.8 / 27 = 0.73

Step 2:

Calculate the adjusted yield standard and adjusted standard deviation for the reclaimed area based on the current year's annual county yield and annual county standard deviation using the PR obtained in Step 1:

Adjusted yield standard =

X_{AD} = Annual (or estimated if 1996 or after) county yield x PR
= 28.0 bu/ac x 0.73
= 20.44 bu/ac

Adjusted standard deviation =

s_{AD} = Annual county standard deviation x PR
= 7.56 x 0.73
= 5.52

Step 3:

Apply the appropriate statistics (t-test, confidence interval) using the adjusted yield standard and adjusted standard deviation calculated in Step 2 and the annual yield from the reclaimed tract for that year:

t-test

(The following t-test formula is added for user convenience)

$$\text{calculated } t = \frac{\left| X_{AD} - \bar{x}_1 \right|}{\frac{s_{AD}}{\sqrt{n_1}}}$$

where:

X_{AD} = adjusted production standard based on NDASS data

$\bar{x}_1$ = production for reclaimed tract based on total field harvest

s_{AD} = adjusted standard deviation of NDASS county yield data

n_1 = number of samples for NDASS county yield data

t_{calc} = (20.44-20.0) / (5.52/$\sqrt{60}$) = 0.44 / 0.71 = 0.692

$t_{0.10,59df}$ = 1.29

Since t_{calc} is less than $t_{0.10, 59df}$ value, there is no significant difference between the yield values.

90% confidence Interval (one-tail test)

90% Confidence interval = adjusted yield standard - [$t_{O.10,59df}$ x $\sqrt{(5.52^2/60)}$]
= 20.44 bu/ac - 0.92
= 19.52 bu/ac

The actual reclaimed yield of 20.0 bu/ac is greater than 19.52 bu/ac (lower level of the 90% confidence interval). Thus, there is no statistical difference between the adjusted yield standard and the actual reclaimed yield for that year.

Cropland Table 1. Spring wheat productivity indexes (NRCS Soils Interpretive Guide, January, 2000.)

This table lists the percent spring wheat productivity indexes for soil series and phases. The list was prepared by assigning a productivity index for spring wheat to map units in soil surveys and technical guides. Where two values are given for one series (e.g., Tonka, 40-85), the first value refers to an undrained soil, the second value refers to a drained soil. If no surface textural phases are listed, assume that the PI's listed are for all textural phases associated with that soil series. If a surface textural phase is listed (e.g., Amor l, cl), the PI's listed are only for that surface textural phase. Usually, the most common or likely surface textural phases are provided on Table 1. In addition, some stony and saline phases are provided for those soils likely to have stony or saline phases. The PI's provided for the stony and saline phases represent very stony and moderately saline phases, respectively. For textural, salinity, or stony phases or soil series not listed on the table, please consult with Reclamation Division staff. Productivity indexes are provided for E (15-25%) and F (>25%) slope groups. If the map unit has a 15 to 25% slope, then the PI for the E slope phase should be used. However, it is common practice to group the E and F slopes together into a single map unit (e.g., Cabba loam, 15-35% slopes). In this case the midpoint between the E and F slope groups should be used. For example, a map unit of Cabba loam, 15 to 35% slopes would have a PI of 13.5, the midpoint between PI for E slope (16) and F slope(11). Percent PI's are converted to spring wheat yields by multiplying the bu/ac for the county (shown in Cropland Table 2), by a given PI. Conversion factors to convert spring wheat yields to other crops are shown in Cropland Table 3.

SERIES MODIFIERS

Drainage	
ed	excessively drained
wd	well drained
mwd	moderately well drained
spd	somewhat poorly drained
pd	poorly drained
vpd	very poorly drained

Slope Group	
A	0-3%
B	3-6%
C	6-9%
D	9-15%
E	15-25%
F	>25%

Stoniness	
st	stony
stv	very stony
stx	extremely stony

Texture					
cos	coarse sand	lvfs	loamy very fine sand	si	silt
s	sand	cosl	coarse sandy loam	scl	sandy clay loam
fs	fine sand	sl	sandy loam	cl	clay loam
vfs	very fine sand	fsl	fine sandy loam	sicl	silty clay loam
lcos	loamy coarse sand	vfsl	very fine sandy loam	sc	sandy clay
ls	loamy sand	l	loam	sic	silty clay
lfs	loamy fine sand	sil	silt loam	c	clay

PRODUCTIVITY INDICES (%)

Soil Series	Slope Group				
	A	B	C	D	E-F
Absher	30	28	22	17	12/8
Amor l, cl	80	76	61	46	32/22
Amor fsl	70	67	54	41	28/20
Amor, very stony	40	38	30	23	16/11
Arnegard	100	95	76	57	40/28
Arnegard, saline	50	48	-	-	-
Arveson sl, fsl - pd	30-55	-	-	-	-
Banks fsl, vfsl	45	43	-	-	-/-
Banks lfs, ls	35	33	-	-	-/-
Bearpaw	90	85	68	51	36/25
Beisigl ls, lfs	35	33	26	20	14/10
Beisigl sl, fsl	45	43	34	26	18/12
Beisigl, very stony	18	17	13	10	7/5
Belfield l, sil	75	71	57	43	30/21
Belfield, saline	38	36	-	-	-/-
Benz	25	24	19	0	0/0
Bowbells	100	95	76	-	-/-
Bowbells, saline	50	47	38	-	-/-
Bowdle	60	57	46	-	-/-
Boxwell	80	76	61	-	-/-
Boxwell, extremely stony	12	11	9	-	-/-
Brandenburg l, ch-l	30	28	22	17	12/8
Breien fsl	40	38	-	-	-/-
Brisbane l, cl	85	80	64	48	34/24
Bryant	90	85	68	51	30/25
Cabba l, sil, cl, sicl	40	38	30	23	16/11
Cabba, very stony	20	19	15	11	8/6
Cabbart, l, sil, cl	40	38	30	23	16/11
Cabbart, very stony	20	19	15	11	8/6
Chama	70	67	54	41	28/20
Chanta	60	57	46	35	24/17
Cherry sil, l, sicl, cl	75	71	57	43	30/21
Chinook	65	63	50	33	26/18
Cohagen	30	28	22	17	12/8
Colvin sil, sicl, vpd	10-60	-	-	-	-/-
Colvin, sil, sicl, pd	40-70	-	-	-	-/-
Colvin, channeled	NR	-	-	-	-/-
Colvin, saline, pd	35	-	-	-	-/-
Daglum cl, sil, l, sil	45	43	34	26	18/12
Daglum l, sil, cl--mod. deep	40	38	30	23	16/11
Daglum, saline	23	22	17	13	9/6
Daglum, very stony	20	18	15	11	8/6
Desart fsl, sl, vfsl	55	52	42	32	22/15
Dilts	30	28	22	17	12/8
Dimmick c, sic	30-70	-	-	-	-/-
Divide l. sil, cl, scl	65	63	-	-	-/-
Divide, saline	33	32	-	-	-/-
Dogtooth	25	24	19	14	11/7
Ekalaka fsl, vfsl, sl	40	38	30	23	16/11
Falkirk	90	85	68	51	36/25
Falkirk, saline	45	42	34	25	18/12
Fargo, saline	45	43	-	-	-/-
Farland	90	85	68	51	36/25
Farnuf	90	85	68	51	36/25
Felor fsl, sl	80	76	61	46	32/22
Flasher ls, lfs	25	24	19	14	11/7
Flasher sl, fsl	35	33	26	20	14/10
Flasher, very stony	13	12	10	7	5/4

Soil Series	Slope Group				
	A	B	C	D	E-F
Flaxton fsl	70	67	54	41	28/20
Flaxton lfs	55	52	42	32	22/15
Flaxton l	75	71	57	43	30/21
Fleak fsl, sl	35	33	26	20	14/10
Golva	90	85	68	51	36/25
Grail	100	95	76	57	40/28
Grail, saline	50	48	38	-	-/-
Grassna	100	95	76	57	40/28
Grassna, saline	50	48	38	-	-/-
Hamerly	85	80	-	-	-/-
Hamerly, saline	43	40	-	-	-/-
Hamerly, very stony	43	40	-	-	-/-
Hanly fsl, sl	45	43	-	-	-/-
Harriet	25	-	-	-	-/-
Havre	85	80	-	-	-/-
Havre, channeled	NR	NR	-	-	-/-
Havrelon, l, sil, sicl	85	80	-	-	-/-
Havrelon, channeled	NR	NR	-	-	-/-
Havrelon, fsl, vfsl	75	71	-	-	-/-
Heil sicl, sil	35	-	-	-	-/-
Janesburg l, sil, sicl, cl	40	38	30	23	16/11
Korchea fsl, sl, vfsl	80	76	-	-	-/-
Korchea cl, sicl, l ,sil	90	85	-	-	-/-
Korchea, channeled	NR	NR	-	-	-/-
Krem fs	35	33	26	20	14/10
Krem ls, lfs	50	48	38	29	20/14
Kremlin	85	80	64	48	34/24
LaMoure	40-70	-	-	-	-/-
Lawther sicl	85	80	64	48	34/24
Lawther c, sic	80	76	61	46	32/22
Lefor	60	57	46	35	24/17
Lehr l, sl	45	43	34	26	18/12
Lihen fsl, sl	55	52	42	32	22/15
Lihen lfs, ls	45	43	34	26	18/12
Linton	85	80	64	48	34/24
Lisam	30	28	22	17	12/8
Livona fsl, sl	70	67	54	41	28/20
Livona lfs, ls	50	48	38	29	20/14
Lohler sic, c	80	76	-	-	-/-
Magnus sicl	85	80	-	-	-/-
Makoti	95	90	72	54	38/26
Mandan	95	90	72	54	38/26
Manning fsl, sl	40	38	30	23	16/11
Marysland	30-60	-	-	-	-/-
Max	85	80	64	48	34/24
Max, very stony	45	43	34	26	18/12
McKenzie, pd	25-45	-	-	-	-/-
Moreau sic	65	63	50	38	26/18
Moreau sicl, cl	70	67	54	41	28/20
Moreau, saline	32	32	25	19	13/9
Morton	85	80	64	48	34/24
Morton, very stony	45	43	34	26	18/12
Mott	60	57	46	35	24/17
Niobell	75	71	57	43	30/21
Noonan l, sil	45	43	34	26	18/12
Nutley sic, c	90	85	68	51	36/25
Oburn	30	28	22	17	12/8
Omio	85	80	64	48	34/24

PRODUCTIVITY INDICES (cont.)

Soil Series	Slope Group				
	A	B	C	D	E-F
Parnell sic, sil, sicl	20-75	-	-	-	-/-
Parshall	70	67	54	41	28/20
Parshall, saline	35	33	27	-	-/-
Parshall, wet	80	76	61	-	-/-
Patent l, sil, cl, sicl	50	48	38	29	20/14
Reeder	85	80	64	48	34/24
Reeder, very stony	45	43	34	26	18/12
Regan, pd	35-65	-	-	-	-/-
Regan, vpd	20-55	-	-	-	-/-
Regan, saline	33	-	-	-	-/-
Regent sicl, cl, sil	85	80	64	48	34/24
Rhame	60	57	46	35	24/17
Rhoades	30	28	22	17	12/8
Rhoades, saline	13	12	10	-	-/-
Ringling l, ch-l	35	33	26	20	14/10
Ringling chv-l	20	19	15	11	8/6
Roseglen	100	95	76	57	40/28
Ruso	40	38	30	23	16/11
Sakakawea	60	57	48	35	24/17
Savage	90	85	68	51	36/25
Savage, saline	45	43	34	25	18/13
Schaller fsl, sl	40	38	30	23	16/11
Searing	65	63	50	38	26/18
Sen	80	76	61	46	32/22
Seroco lfs, ls	35	33	26	20	14/10
Sham l	45	43	34	26	-/-
Shambo	85	80	64	48	34/24
Sinai sicl	95	90	72	54	38/26
Sinnigam	30	28	22	17	12/8
Sinnigam, very stony	15	14	11	8	6/4
Southam	0-50	-	-	-	-/-
Stady	60	57	46	35	24/17
Stirum sl, fsl	20	-	-	-	-/-
Stirum, ponded	10	-	-	-	-/-
Straw	95	90	72	54	38/26
Straw, channeled	NR	NR	-	-	-/-
Sutley sil	60	57	46	35	24/17
Tally fsl, sl	65	63	50	38	26/18

Soil Series	Slope Group				
	A	B	C	D	E-F
Tansem	85	80	64	48	-/-
Telfer fsl, sl	50	48	38	29	20/14
Telfer, lfs, ls	40	38	30	23	16/11
Temvik	85	80	64	48	34/24
Tiffany sl, fsl, vfsl	30-75	-	-	-	-/-
Tiffany l, sil	30-85	-	-	-	-/-
Toby	55	43	42	32	
Tonka	40-85	-	-	-	-/-
Trembles fls, sl	65	63	-	-	-/-
Tusler fsl, sl	45	43	36	30	24/20
Ustorthents	40	38	30	23	16/11
Vallers	40-70	-	-	-	-/-
Vallers, saline	35	-	-	-	-/-
Vallers, very stony	35	-	-	-	-/-
Vanda sicl	25	24	19	14	11/7
Vebar fsl, sl	60	57	46	35	24/17
Vebar l	70	67	54	41	28/20
Vebar, stony	33	31	25	19	13/9
Velva fsl, sl, vfsl	70	67	-	-	-/-
Velva l, cl	80	76	-	-	-/-
Velva, saline	35	-	-	-	-/-
Velva, channelled	NR	NR	-	-	-/-
Wabek l	35	33	26	20	14/10
Wabek, very stony	13	12	9	7	6/4
Wanagan	60	57	46	35	24/17
Watrous	65	63	50	38	26/18
Wayden sicl, cl	35	33	26	20	14/10
Wayden, very stony	15	14	11	9	6/4
Werner	45	43	34	26	18/12
Williams	90	85	68	51	36/25
Williams, very stony	45	43	34	26	18/12
Wilton	95	90	72	54	-/-
Wolf Point sicl	85	80	-	-	-/-
Yawdim sicl, cl	35	33	26	20	14/10
Yegen l	85	80	64	48	34/24
Yetull fsl, sl	40	38	30	23	16/11
Zahill	50	48	38	29	20/14
Zahl	60	57	46	35	24/17

Cropland Table 2. County spring wheat yields equivalent to productivity indexes (PI) of 100% and calculated average county yields. Percent PI's are converted to spring wheat yields by multiplying the bu/ac for a county (shown below), by a given PI (from NRCS 2000.) Calculated average county yields are based on yield ratings for soil mapping units and acres of each soil mapping unit rated for cropland in the county (NRCS 2000 and Soil Survey Staff, County soil surveys.)

County	Wheat Yield Equivalent to a PI of 100% (bu/ac)	Calculated Average County Wheat Yield (bu/ac)
Adams	37	25
Bowman	32	21
Burke	41	29
McLean.	41	32
Mercer	37	27
Oliver	37	28
Stark	37	25

Cropland Table 3. Conversion factors to calculate yields of other annual crops, based on spring wheat yields. To convert, multiply the spring wheat yield by the following conversion factors (NRCS 2000).

Crop	Conversion Factor	Unit of Measure
Oats	2.1250	bushel
Barley	1.6250	bushel
Flax	0.5000	bushel
Rye	1.2750	bushel
Sunflowers	50.000	hundred weight
Sugar Beets	0.3625	ton

II-H. FISH AND WILDLIFE HABITAT

CONTENTS Page II-H-

H. FISH AND WILDLIFE HABITAT

Introduction and Definitions

Fish and wildlife habitat as defined in NDAC 69-05.2-01-02 means lands or waters used partially or wholly for the maintenance, production, protection, or management of fish or wildlife species. Fish and wildlife habitat often encompasses several "land uses" or vegetation types, as structural diversity and food source are of utmost importance for wildlife use. For this reason, this document segregates postmine fish and wildlife habitat standards into woodland, shelterbelt, grassland, wetland and annual grain crop vegetation types. This will enable appropriate postmine evaluations to be made of all areas included in fish and wildlife habitat. Vegetation types that occupy 5 percent or more of the total acreage of the fish and wildlife habitat must be evaluated (SCS 1982). However, if a fish and wildlife habitat area occupies less than 40 acres, this determination will be made on a site specific basis.

When an area is primarily used by wildlife prior to mining, the premine assessment must include a breakdown of vegetation types (i.e., woodland, shelterbelt, grassland, wetlands and annual grain crops), and descriptions as required by NDAC 69-05.2-08-08. Wetlands that occur in any land use must be assessed separately as described in this section. In all other cases, premine assessments must be categorized and analyzed as described for the appropriate primary land use.

Woodland: land where the primary vegetation is trees or shrubs, i.e., natural wooded areas.

Shelterbelt: a strip or belt of trees or shrubs planted by man in or adjacent to a field or next to a farmstead, feedlot or road. Shelterbelt is synonymous with windbreak.

Grassland: land where the primary vegetation is perennial grasses. This includes both areas of native species and those planted with introduced grass-legume mixtures.

Wetland: a natural depressional area that is capable of holding shallow, temporary, intermittent, or permanent water. Wetlands, here defined, also refer to reclaimed basins intended to replace natural wetlands.

Annual grain crops: annual grains specifically planted to provide food and cover for wildlife use. Since annual grain crops planted for wildlife use either remain standing or are cut and stacked, performance standards based on agronomic yields are not appropriate.

NDAC 69-05.2-22-02(6) requires that where fish and wildlife habitat is included in the postmining land use, the permittee shall consult with appropriate state wildlife and land management agencies and select those plant species that will fulfill the needs of wildlife for food and cover. Plant groupings and water resources must be appropriately spaced and distributed. For areas reclaimed to fish and wildlife habitat land use, specific requirements and procedures for the assessment of each vegetation type follow.

WOODLAND AND SHELTERBELT

The requirements and guidelines for meeting third-stage and fourth-stage bond releases and the success standards are synonymous with those described in the section entitled Woodlands and Shelterbelts of this document.

GRASSLAND

Requirements for Successful Revegetation

NDAC 69-05.2-22-07(3)(a) requires that for third-stage bond release, ground cover must be equal to or greater than that of the approved reference area or standard with 90% statistical confidence. All species used in determining ground cover must be perennial species not detrimental to the land use. For fourth-stage bond release, ground cover must be equal to or greater than the approved standard with 90% statistical confidence and adequate to control erosion. In addition, species diversity, seasonal variety and regenerative capacity must meet the approved standard. These requirements must be met the last two consecutive years, or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period [NDAC 69-05.2-22-07(4)(h) and (l)].

Postmining Assessment

Third-stage bond release

The following should be submitted for each reclamation tract when making third-stage bond release requests:

1. An aerial photo of adequate scale which delineates the postmining grassland tract(s) proposed for bond release [NDAC 69-05.2-12-12 (4)].

2. A narrative which includes the seed mix and seeding rate and describes methods used for seedbed preparation and seeding. Include information on all management practices prior to, and following, seeding (e.g., fertilization, weed control, burning) [NDAC 69-05.2-12-12 (10)].

3. A demonstration of adequate establishment of vegetation by quantitative measurement of cover [NDAC 69-05.2-12-12 (7)]. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. Data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

4. A map, which identifies the approximate locations of sampling transects, or the sampling areas and number of randomly located sample units per area, whichever method is used.

5. All other information as required by NDAC 69-05.2-12-12.

Success standards for third-stage bond release

Each reclaimed tract must have at least 73% total cover (live + litter), based on basal hits, or 83% total cover (live + litter), based on first-hits, determined by the point frame method. All species used in determining ground cover must be perennial species not detrimental to the land use [NDAC 69-05.2-22-07(3)(a)]. The standard must be achieved with 90% statistical confidence. Methodology is described in Native Grassland, Section II-D. A field inspection will also be required to verify that ground cover is adequate to control erosion.

Fourth-stage bond release

The following should be submitted for each reclamation tract when making fourth-stage bond release requests:

1. An aerial photo of adequate scale which delineates postmining grassland tract(s) proposed for bond release. Provide in tabular form the acreage of each reclaimed tract.

2. A narrative, which includes the seed mix and seeding rate and describes methods used for seedbed preparation and seeding. Include information on all management practices prior to and following seeding (e.g., fertilization, weed control, burning).

3. Data and calculations, which demonstrate that ground cover is equal to or greater than the approved standard (with 90% statistical confidence) during the last two consecutive years or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period [NDAC 69-05.2-22-07(4)(h)(1)]. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. Data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

4. A map which identifies the approximate locations of sampling transects, or the sampling areas and number of randomly located sample units per area, whichever method is used.

5. Information which is required to evaluate species diversity, seasonal variety and regenerative capacity.

6. All other information as required by NDAC 69-05.2-12-12.

Revegetation success standards for fourth-stage bond release

Cover

1. To ensure adequate cover for erosion control, the same standard used for third-stage bond release must be used to assess cover for fourth-stage bond release.

2. To ensure wildlife cover, vegetation must be sufficient to provide protection to wildlife going into the winter months. (This will be field assessed at the time of final bond release).

Species diversity and seasonal variety

The permittee must demonstrate that a majority of the species specified in the reclamation plan has become established in the tract and that the seeded species comprise at least 60% of the total composition during the years sampling is conducted for the purpose of final bond release. The presence of non-seeded species will be evaluated at the time of the final bond release inspection. Noxious weeds and other highly competitive species that are capable of out competing and displacing seeded species must not be present in quantities that may be considered detrimental to the desired use.

Regenerative capacity

Regenerative capacity will be assessed by an evaluation of live surface cover and will be subjectively evaluated during the bond release field review. Sufficient live cover must be present to ensure regenerative capacity.

WETLANDS

The following sections refer to the immediate wetland basin, and its characteristic vegetation, unless otherwise stated.

Requirements for Successful Vegetation

For fish and wildlife habitat, where the vegetation type is wetland, vegetation zones and dominant species must be equal to those of the approved standard at the time of final bond release. In addition, wetland permanence and water quality must meet approved standards [NDAC 69-05.2-22-07(4)(g)].

Wetland Classification

Wetlands are classified according to the system of Stewart and Kantrud (1971). The use of prairie wetlands by waterfowl is strongly influenced by water characteristics, i.e., permanence, depth, and chemistry, and by land use. The complex interrelationships of these parameters are reflected in vegetation characteristics, including: life form, cover interspersion, species composition and species dominance. Vegetation zones in wetlands are distinguished by a unique community structure or life form, and a unique assemblage of plants. Since these characteristics are readily discernible in the field, they have been used as the principal criteria for classification. Stewart and Kantrud describe seven wetland classes. They are:

Class I	ephemeral ponds; deepest part of the pond basin supports low-prairie vegetation;
Class II	temporary ponds; deepest part of the pond basin supports wet-meadow vegetation;
Class III	seasonal ponds and lakes; deepest part of the pond basin supports shallow-marsh hydrophytes, often with peripheral wet-meadow and low-prairie zones;
Class IV	semi-permanent ponds and lakes; deepest part of the pond basin supports deep-marsh hydrophytes, often with peripheral shallow-marsh, wet-meadow and low-prairie zone;
Class V	permanent ponds and lakes; permanent open-water zone of submergent hydrophytes, often with peripheral deep-marsh, shallow-marsh, wet-meadow and low-prairie zones;
Class VI	alkali ponds and lakes; intermittent shallow saline water alternating with salt flats in the central zone, often with peripheral shallow-marsh, wet-meadow, and low-prairie zones; and
Class VII	fen (alkaline bog) ponds; central zone represented by fen vegetation, often with peripheral wet-meadow and low-prairie zones.

For mining permit applications submitted prior to January 1, 1987, all premine Class III-VI wetlands had to be identified and replaced. Class I and Il wetlands did not have to be identified nor were specific plans for replacement needed. Fen ponds (Class VII wetlands) are

unlikely to occur in the mining regions of North Dakota; however, if fen ponds do occur, they must be treated on a site specific basis.

For mining permit applications submitted after January 1, 1990, the NRCS will be consulted during the wetland inventory and identification process. This is required to ensure compliance with the Wetland Conservation Provisions of the 1985 Food Security Act and the 1990 Food Agricultural, Conservation, and Trade Act. Consultation with the State Game and Fish Department and U.S. Fish and Wildlife Service is also recommended during the wetland inventory and identification process. Required notification must be given to the Army Corps of Engineers.

The success standards that follow apply to all Class III through VI wetlands. The total acreage of postmine wetlands, including Class I and II prior to final bond release, for the mine must equal the total premine acreage.

Premining Assessment

1. Identify and show all Class I-VII wetlands on a map or aerial photograph (scale 1:4800) [NDAC 69-05.2-08-08(l)(a)(5)(b)].

2. For Class III-VII wetlands, tabulate total acreage of each wetland class for each surface owner within the proposed permit area [NDAC 69--05.2-08-08(l)(b)(1)].

3. For Class I and II wetlands provide the total acreage, list land use and extant vegetation. If these wetlands are tilled, indicate the crop normally grown.

4. Identify Class III wetlands, which are sampled. Wetlands sampled must be based on the number present, distribution and variability. Sample numbers, must be approved by the Commission.

5. For sampled Class III wetlands and all Class IV-VI wetlands, provide:

    a. A description of vegetation zones or plant communities, identified by ecological dominant or co-dominant species, through the use of a line drawing of appropriate scale. Where premine wetlands, are disturbed by land use management, a discussion of the succession phase should be included.

    b. A narrative describing the relationship among vegetation, soils and surface and groundwater hydrology in the wetlands as well as observed or historical anthropomorphic use.

    c. A species list for each vegetation zone or plant community, which includes date(s) evaluated.

    d. An assessment of surface water quality. Sampling Class IV-VII wetlands should be conducted two times per year, at high and low water, to reflect seasonal variation [NDAC 69-05.2-08-07(3)(b)]. Class III wetlands should be sampled

once a year, in the early spring. A composite sample of three grabs should be taken from Class III wetlands, whereas a minimum of three randomly located samples should be taken from Class IV-VI wetlands and reported as a mean and range. The number of years, that data is collected, must be approved by the Commission based on distribution and variability of wetlands. Results of this water quality analysis together with a discussion regarding the effects of water quality on extant vegetation should be provided. Water quality data must include:

(1) Total dissolved solids;

(2) Specific conductance in mmhos/cm^3;

(3) Major cations (calcium, magnesium, sodium and potassium);

(4) Major anions (bicarbonate, carbonate, sulfate and chloride);

(5) Total suspended solids;

(6) pH;

(7) Total iron; and

(8) Any additional parameters (e.g., selenium) as determined on a site specific basis.

6. Provide a narrative describing the nature and variability of the vegetation of each wetland class [NDAC 69-05.2-08-08(l)(d)].

Postmining Assessment

Third-Stage Bond Release

The following information must be submitted for each reclaimed wetland when making third-stage bond release requests:

1. An aerial photograph (1:4800) which delineates reclaimed wetland basins and contiguous postmining land uses (if fish and wildlife habitat is the contiguous land use, vegetation types must be delineated).

2. A narrative which describes any plugging, seeding, respread of topsoil containing wetland species propagules, or other practices that were used to establish vegetation of the wetland basin [NDAC 69-05.2-12-12(7)(a)].

3. Evidence of vegetation zone development and adequate establishment of wetland vegetation [NDAC 69-05.2-12-12(7)(a)]. Include the following information:

   a. A low altitude aerial photograph;

b. A detailed map to accompany the aerial photograph which delineates vegetation zone (if identifiable);

c. A descriptive narrative of each vegetation zone or plant community identified; and,

d. A species list for each vegetation zone or plant community identified.

4. A demonstration that erosion is being adequately controlled by the established vegetation in the contiguous vegetation types or land uses [NDAC 69-05.2-12-12(7)(b)]. Data required for the appropriate vegetation types within fish and wildlife habitat or land uses must be submitted.

5. All other information as required by NDAC 69-05.2-12-12.

Success Standards for Third-Stage Bond Release

An on-site inspection by Commission personnel, the Wetlands Advisory Committee and landowner will be conducted following a request for third-stage bond release. [Personnel from the U.S. Fish and Wildlife Service, North Dakota Game and Fish Department, North Dakota State University, and the University of North Dakota will be invited to participate on the Wetlands Advisory Committee.] The wetland basin must exhibit the capacity to hold water. This can be shown by the establishment of wetland vegetation. Ground cover in the contiguous vegetation types or land uses must be adequate to control erosion to avoid sedimentation into the wetland basin. The extent of the contiguous area will be evaluated on a site specific basis to ensure that an adequate buffer zone is provided. Erosion control must be demonstrated as described for third-stage bond release requirements of the appropriate vegetation type(s), or appropriate land uses.

Fourth-Stage Bond Release

The following information should be submitted for each reclaimed wetland when making fourth-stage bond release requests:

1. An aerial photograph of adequate scale which delineates reclaimed wetlands and adjacent land uses (or vegetation types within fish and wildlife habitat land use) proposed for bond release. In tabular form, include the acreage of the wetland(s).

2. A narrative which describes any plugging, seeding, or respread of topsoil containing wetland species propagules or other practices that were used to establish vegetation and any management employed thereafter [NDAC 69-05.2-12-12(8)(b)].

3. A brief description of the wetland design including the class (Stewart and Kantrud 1971) the wetland was designed to become.

4. A measure of the surface water quality (using methodology described for the premine assessment) for the last three years of the liability period, including:

a. Total dissolved solids;

b. Specific conductance in mmhos/cm^3;

c. Major cations (calcium, magnesium, sodium and potassium);

d. Major anions (bicarbonate, carbonate, sulfate and chloride);

e. Total suspended solids;

f. pH;

g. Total iron; and,

h. Any additional parameters (e.g., selenium) as determined on a site specific basis.

5. A postmining topography map which delineates the entire watershed of the wetland basin.

6. Data on quality, quantity and dates of any water pumped into the wetland basin.

7. Documentation that the vegetation of the reclaimed wetland exhibits vegetation characteristics of the wetland class it was designed to become. This information must be submitted annually to the Commission or at the time of bond release and include data collected during each of the last three years of the liability period. Each year's data must include:

   a. A low altitude, preferably low oblique, aerial photograph;

   b. A detailed map to accompany each aerial photograph which delineates identifiable vegetation zones;

   c. A plant species list of each vegetative zone which ranks the occurrence of each species (i.e., very rare, occasional, abundant, very abundant, subdominant, dominant); and,

   d. A descriptive narrative which characterizes each vegetation zone.

8. All other information as required by NDAC 69-05.2-12-12.

Success Standards for Fourth-Stage Bond Release

An on-site inspection by Commission personnel, the Wetlands Advisory Committee and landowner will be conducted following a request for final bond release. The wetland basin must exhibit the degree of permanence for the class for which it was designed (based on water supply from normal year precipitation as described by the ND Water Commission or based on basin configuration and the 50% annual water yield from the contributory watershed), to ensure the required acreage replacement. All, or nearly all, of the watershed must have final grade approval

and additional water (e.g., water pumped in) must not be added to the wetland basin for the last five years of the liability period. A natural system must be present in order to evaluate the class size and ensure sufficient potential water supply.

A successfully revegetated wetland basin must exhibit vegetation zones dominated by native, perennial, emergent and submergent hydrophytes appropriate for the abiotic characteristics of the intended class. This will be determined by comparison with species lists for vegetation zones as listed by Stewart and Kantrud (1971), and with premine species lists. Species diversity, seasonal variety and regenerative capacity of species present on the reclaimed wetland must be similar to those in the zones listed by Stewart and Kantrud. Small zones of vegetation from a more permanent wetland class (i.e., deep-marsh emergent and submergent hydrophytes) are acceptable in a portion of a Class III wetland basin. Ground cover in the contiguous area must meet the appropriate ground cover standards for erosion control to avoid sedimentation into the wetland basin. The extent of the contiguous area will be provided on a site specific basis to ensure that an adequate buffer zone is evaluated. Water quality parameters will be evaluated based on recommendations from the Wetlands Advisory Committee.

ANNUAL GRAIN CROPS

Postmining Assessment

Third-Stage Bond Release

The following should be submitted for each reclaimed tract when making third-stage bond release requests:

1. An aerial photograph of adequate scale which delineates annual grain crops within the Fish and Wildlife Habitat.

2. A narrative which includes methods used for seedbed preparation, seeding and all management practices used prior to the bond release request [NDAC 69-05.2-12-12(10)].

3. A demonstration that the tract is capable of supporting crops and that standing crop, stubble or crop residues are adequate to control erosion [NDAC 69-05.2-22-07(3)(d)].

4. All other information as required by NDAC 69-05.2-12-12.

Success Standards for Third-Stage Bond Release

The vegetation will be considered suitable for the postmining land use upon demonstration that an adequate food source and adequate cover are present.

Fourth-Stage Bond Release

The following should be submitted for each reclaimed tract when making fourth-stage bond release requests:

1. An aerial photograph of adequate scale which delineates reclaimed annual grain crops within the fish and wildlife habitat proposed for bond release.

2. A narrative which includes a complete management history of the reclaimed annual grain crops. The narrative should include seed mix and rate, fertilizer program, conservation tillage practices, and any other management techniques used during the liability period [NDAC 69-05.2-12-12(10)].

3. Data showing the height of the standing grain crop or residual cover for the last consecutive two years or any three years starting no sooner than the sixth year and with one-year being the last year of the liability period.

4. Evidence that conservation tillage is practiced on the area and that erosion is adequately controlled to prevent the contribution of suspended solids to runoff.

5. All other information as required by NDAC 69-05.2-12-12.

Success Standards for Fourth-Stage Bond Release

Revegetation success of annual grain crops for fish and wildlife habitat must be evaluated during the last two consecutive years or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period. The ground cover will be deemed successful upon demonstration that an adequate food source and adequate cover are present. Documentation must be provided to indicate that conservation tillage practices have been used and that suspended solids are not detrimental to stream flow.

II-I. OTHER LAND USES

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I. OTHER LAND USES

Introduction

Other land uses that may occur in the permit area are "recreation," "residential" and "industrial and commercial." There are no specific requirements for premining land use assessments for these uses under NDAC 69-05.2-08-08. Only a general description of the premine use is required under NDCC 38-14.1-14(2)(a).

For areas to be developed for recreation, residential, or industrial and commercial following mining, NDAC 69-05.2-22-07(4)(j) requires the vegetative ground cover on these areas not be less than that required to control erosion. This standard must be met at the time of fourth-stage (final) bond release. There is no specific third-stage bond release standard for these land uses under NDAC 69-05.2-07(3). However, vegetation must be established on the areas and documentation provided to show that the areas are not contributing suspended solids to streamflow or runoff outside the permit area as required by NDAC 69-05.2-12-12(7) for third-stage bond release. Therefore, the same standard will be applied for both third- and fourth-stage bond release on areas to be developed for recreation, residential, or industrial and commercial land uses. In addition, if areas developed for recreation use include woodland plantings and/or shelterbelts, the woody plants must meet all applicable fourth-stage bond release standards described under sections II-F and II-G of this document.

Postmining Assessment

For each tract to be developed to recreation, residential, or industrial and commercial land use, the following information should be submitted when making third-stage or fourth-stage bond release requests:

1. An aerial photo of adequate scale, which delineates the tract(s) proposed for bond release [NDAC 69-05.2-12-12(4)].

2. A demonstration of adequate establishment of vegetation by quantitative measurement of cover [NDAC 69-06.2-12-12(7)]. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. Data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

3. A map, which identifies the approximate locations of sampling transects, or the sampling areas and number of randomly located sample units per area, whichever method is used.

4. If a recreation area includes woodland plantings, a demonstration, with supporting data, must be included showing that the applicable standards described under section II-F are met.

5. If a recreation area includes shelterbelts, a demonstration, with supporting data, must be included showing that the applicable standards described under section II-G are met.

6. All other information as required by NDAC 69-05.2-12-12.

Revegetation success standards for third stage and fourth stage bond release

The technical standard for evaluating ground cover is based on ARS research conducted by Hofmann et al. (1983) and Ries and Hofmann (1984) on reclaimed grasslands in North Dakota. According to Ries and Hofmann, erosion from reclaimed grasslands is similar to that of undisturbed native grassland when total cover is 73% or greater, based on basal hits measured with a point frame; or when total cover is 83% or greater, based on first-hits measured with a point frame. Therefore, for third-stage bond release, the reclaimed tract must have at least 73% total cover (live + litter), based on basal hits; or 83% total cover (live + litter), based on first-hits. Live cover included in the standard must be perennial species not detrimental to the land use [NDAC 69-05.2-22-07(3)(a)].

Either standard must be achieved with 90% statistical confidence. In statistical calculations, a standard deviation of +18 for basal cover and a standard deviation of +16 for first-hit cover should be used for ARS data. These values are based on a sample size of 60 10-point frames (Hofmann, personal communications 1987). Calculations of standard deviation for the reclaimed tract must be based on the same methodology, i.e., use of one 10-point frame as the sample unit. A field inspection is required at this time.

For recreation areas that include woodland plantings and/or shelterbelts, the woody plants must meet all applicable standards described in Sections II-F and II-G for fourth-stage bond release.