

COMPARISON OF RECLAMATION OF COAL MINES UNDER THE SURFACE MINING CONTROL AND RECLAMATION ACT OF 1977 AND OIL AND GAS SITES IN WYOMING¹

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Abstract. The current art of reclamation and the science surrounding it generally had its beginnings in the environmental movement of the late 1960's and early 1970's and culminated in the Surface Mining Control and Reclamation Act (SMCRA) of 1977 and subsequent advancement in knowledge since that time. Within current energy industries in the western United States, much can be learned from almost 30 years of coal mine reclamation practices and research. Reclamation regulations vary significantly between coal mines and all other mining (such as uranium), as well as oil and gas (O&G) operations. However, knowledge obtained from one industry may promote land stabilization in a time effective manner within another industry's disturbance and bonding requirements.

Land disturbances due to O&G are different in that the majority of the disturbance is linear rather than large blocks. The proximity to native areas in O&G development is generally a positive factor, in that significant edge effect (reinvansion of plant species) may come into play during reclamation. The depth and volume of material movement in a coal mining operation are much greater than in traditional O&G or coalbed natural gas (CBNG) operations when an equal sized area is compared. However, total surface disturbance in O&G or CBNG has the potential to be much greater than in a single coal mining operation.

There is not a one-size-fits-all reclamation solution across all industries due to the type of disturbance, varying regulations and site-specific circumstances. Within a given O&G development, the contact between various landscape features makes a one-size-fits-all approach particularly problematic. Each development area for O&G should be evaluated individually to determine what techniques might be appropriate. However, well pads, facilities, and pipelines with similar topography, soil, and precipitation patterns should be treated in the same way, wherever possible, to reduce the complexity of reclamation operations.

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Introduction

Reclamation History

Although land disturbance has been common throughout human history, early activities generally did not have a significant impact on the landscape based on size of the population and lack of modern tools and equipment (Box, 1978). “Drastically disturbed lands”, according to Box, 1978, are described as “if the native vegetation and animal communities have been removed and most of the topsoil is lost, altered, or buried”. This definition could apply to both large-scale mining and major oil and gas (O&G) activity. Some discussion particularly for O&G, however, could center on the “removal of animal communities” on a spatial and temporal scale such as the potential interruption of migration corridors.

Land disturbance practices conducive to erosion in conjunction with drought in the 1930’s resulted in the formation of the Soil Erosion Service (later called the Soil Conservation Service and subsequently the Natural Resource Conservation Service) (Box, 1978). Rehabilitation of these lands was likely the first formalized attempt to address large-scale disturbance issues in the United States (US).

In the late 1930’s and early 1940’s, several Eastern and Midwestern states, where surface coal mining was prevalent, began to recognize the need to address reclamation and environmental concerns associated with mining. Several research projects were devised to address the issues of reforestation or tree reestablishment (Plass, 2000).

Regulatory History

Also in the late 1930’s and 1940’s, some states enacted legislation in response to concerns about environmental effects of surface coal mining (Bowling, 1978). Increasing widespread public awareness and concerns eventually led to enactment of the federal Surface Mining Control and Reclamation Act (SMCRA) of 1977 and establishment of the Office of Surface Mining Reclamation and Enforcement (OSMRE) within the US Department of the Interior. Within individual states, however, agencies such as the Wyoming Department of Environmental Quality, Land Quality Division (WDEQ-LQD) is often given primacy over the federal agency in the implementation of their program.

SMCRA contains five principal regulatory provisions (US Congress, 1977; OSM, 2009):

- a. Performance standards for mining and reclamation
- b. Permitting requirements

- c. Establishment of performance bonds to pay for reclamation
- d. Inspection and enforcement
- e. Establish lands unsuitable for mining

In response to potential and eventual federal legislation, the Wyoming Legislature passed the Wyoming Environmental Quality Act in 1973. The WDEQ-LQD currently has primacy in the implementation of the OSMRE-approved WDEQ-LQD program, which must be equivalent to or more stringent than SMCRA. Lands affected by mining operations should generally be reclaimed to, in part:

- the highest previous use of the affected lands
- a state similar to surrounding terrain and natural vegetation
- reestablish wildlife and aquatic habitat and resources (Wyoming Legislature, 1973)

In 1975, WDEQ-LQD published a set of Rules and Regulations which required permittees to restore the land to a condition equal to or greater than its highest previous use and required permittees to restore wildlife habitat commensurate with or superior to premining habitat (WDEQ, 1975). These coal mining rules and regulations were promulgated to meet the requirements as set forth in the 1973 Wyoming Environmental Quality Act and SMCRA. In addition to coal mines, WDEQ-LQD also regulates other forms of mining disturbance under the Non-Coal program.

Although many regulations within SMCRA were derived from issues surrounding abandoned and existing coal mines in the eastern US, there is uniform application to western coal mines. One of the largest challenges between reclamation in the eastern and western US is due to the precipitation difference (total amount and variable timing) between the two regions. This is addressed to some extent, however, by the longer performance/liability period, i.e., 10 years in the western US. versus 5 years in the eastern US.

Physical Differences in Mining and Oil and Gas Development

Mining disturbances are different from O&G, where the majority of the disturbance is linear rather than intensive covering a large continuous land area. The proximity to native areas in O&G disturbances is generally a positive factor, in that significant edge effect (reinvansion of plant species) may come into play during reclamation. The depth and volume of material movement in a mining operation are much greater than in traditional O&G or coalbed natural gas (CBNG) operations when an equal sized area is compared. However, total surface disturbance in

O&G or CBNG, including roads and pipelines, has the potential to be much greater than a mining operation. Refer to Table 1 outlining current disturbance totals and assumptions used to derive those totals.

Table 1. Wyoming total disturbance and reclamation by industry.

Industry	Hectares	Acres	Reference
Coal Mining Total Disturbance	59,299	146,532	WY OSM
Coal Mining Total Reclaimed	27,652	68,330	WY Mining Assoc.
Deep Gas Total Disturbance	40,568*	100,245	WOGCC
CBNG Total Disturbance	6,730**	16,630	WOGCC
Pipeline Total Disturbance	91,945***	227,200	WY Pipeline Authority

* Hectares shown are based on the number of active, plugged, and abandoned wells multiplied by average well pad size (5 ac or 2.02 ha).

** Hectares shown are based on the number of active, plugged, and abandoned wells multiplied by average well pad size (0.5 ac or 0.2 ha).

***Actual disturbance total likely much less due to multiple pipeline use of right of ways. One fourth actual listed disturbance is likely more feasible.

General Reclamation Differences between Mining and Oil and Gas Development

Table 2 summarizes the major differences in coal mine reclamation in Wyoming and that associated with O&G (including CBNG) development.

Table 2. Major differences in coal mine vs. O&G reclamation in Wyoming.

Description	Coal Mine Reclamation	O&G (including CBNG) Reclamation
Federal vs. State Regulations	OSM/WDEQ (SMCRA)	BLM/WOGCC/WDEQ (No overriding regulation)
Bonding Period	A minimum of 10 years (growing seasons); redisturbance of an area (including reclamation activity) will restart the bond clock	Objective based
Extent of Disturbance	Covering a large continuous area or block	Linear
Maximum Slopes	3:1	>3:1 common, depending on area
Topsoil Salvage (Includes identifying soil profiles prior to disturbance. i.e., mapping, to determine soil salvage depth)	Generally no segregation of horizons in WY (segregation of topsoil vs. subsoil may occur in bentonite mining); detailed soil profile mapping required	Topsoil and subsoil should be segregated, wherever possible, and especially if topsoil depth is limiting. Detailed soil mapping is uncommon

Table 2, continued. Major differences in coal mine vs. O&G reclamation in Wyoming.

Description	Coal Mine Reclamation	O&G (including CBNG) Reclamation
Topsoil Stockpiling and Storage	Very large and deep piles, storage can be > 5 years	Small, segregated piles (even in windrows), storage typically short-term
Topsoil Replacement	Overall depth varies between mines; generally uniform replacement but may vary within a mine	Depth varies depending on pre-disturbance ecological site
Amendments (e.g., gypsum and lime)	Generally not used	Should be used on site-specific basis
Backfill Suitability	Four feet prior to topsoil replacement must meet WDEQ standards; 10 feet in drainages	Backfill needed on reserve pits
Recontouring	Approximate original contour given the removal of large seam	Approximate original contour
Timing of Seeding	Fall primarily, although all year for shrub establishment if firm seedbed can be maintained	Early fall, winter after frost when ground not frozen, spring, summer depending on weather and moisture
Seed Mix	Emphasis on high diversity and native plants	Emphasis on native plants. Edge effect and topsoil segregation promote seeding success
Nurse Crop	Mine specific; sometimes used	Should not be used due to competition on droughty sites. Nurse crops restricted on BLM surface
Erosion Control Matting	Sometimes used	Likely on steep terrain
Mulching (Straw or Hay)	Generally not used	Needed in steep terrain, must be anchored
Hydromulch	Sometimes, relatively steep terrain	Very steep terrain
Fertilization	Phosphorus (P) sometimes	Nitrogen (N) should not be used, P is a possibility for root development
Weed Control (Chemical spray)	Spot spray noxious weeds if forbs are included in the seed mix.	Spot spray noxious weeds if forbs are seeded in seed mix. Federal permit may be needed on BLM surface
Weed Control (Mechanical)	Non-noxious annual weeds such as kochia or Russian thistle are mowed before seed-set in first year to minimize competition in the second year	Non-noxious annual weeds such as kochia or Russian thistle are generally not mowed; unmowed areas, however, can still improve seedling establishment
Livestock Grazing	Not grazed for minimum of two growing seasons	Deferment of grazing should be utilized but linear disturbances make deferment challenging
Reinvasion of Non-seeded Plants	Little or no edge effect	High edge effect due to linear disturbance
Mechanical Erosion Control	Sometimes but generally not needed due to lack of steep slopes	Dozer tracking, seldom terraces
Interim Reclamation	Conducted on areas to be redisturbed during mining process, e.g., topsoil stockpiles; large blocks generally reclaimed at a time	Great emphasis placed on avoiding areas difficult to reclaim and on establishing interim reclamation to stabilize soil

Reclamation Bond Posting and Release

In terms of reclamation bond posting for and release from disturbance, coal mines are under much greater structured requirements as a result of SMCRA. SMCRA requires performance bonds to ensure applicants meet reclamation requirements. The O&G industry is not under one specific federal regulation outlining reclamation. In many ways, this results in a much more complicated scenario.

Coal Mine Requirements

Although non-coal mines in Wyoming must post a bond as well, coal mines are required to post a bond for disturbance based on requirements defined in SMCRA and the governing authority such as the WDEQ-LQD (OSM, 2009). This is done either through a corporate surety bond, collateral bond, or self bond. In the aftermath of September 11, 2001, many companies were forced to self-bond, if that option was available in the state where the mine was located.

Wyoming recognizes two types of bonds for coal mines, i.e., area and incremental. The area bond generally covers the costs of backfilling and rough grading (WDEQ-LQD Guideline No. 12, 2008). The incremental bond is designed to cover all other costs not addressed in detail by the area bond, including, but not limited to, topsoil or overburden removal from borrow or backslope areas, overburden redistribution, demolition, removal of monitoring structures, scarification or ripping of compacted surfaces, redistribution of topsoil and revegetation and seeding.

According to WDEQ-LQD Guideline No. 20, 2003, Wyoming has five bond release categories based on date of disturbance. “Regulatory categories” means the following time frames that encompass the major regulatory periods from which the different performance standards and reclamation standards for specified lands within the permit area are established:

- (i) “Category 1” means those lands which were affected to conduct and/or support mining operations and were completed or substantially completed prior to May 24, 1969 (the implementation date of the Open Cut Land Reclamation Act).
- (ii) “Category 2” means those lands which were affected on or after May 24, 1969 (the implementation date of the Open Cut Land Reclamation Act) in order to conduct and/or support mining operations and were completed or substantially completed prior to or on June 30, 1973 (day prior to the effective date of the Wyoming Environmental Quality Act).

- (iii) “Category 3” means those affected lands and support facilities if those lands supported operations which were not completed or substantially completed prior to July 1, 1973 (the effective date of the Wyoming Environmental Quality Act) and any affected lands or support facilities taken out of use on or after July 1, 1973 and before May 25, 1975 (the effective date of the Division’s 1975 Rules and Regulations).
- (iv) “Category 4” means those affected lands if coal was removed from those land prior to May 3, 1978 and which do not qualify for any of the previous categories. It also means those affected lands and support facilities if they were taken out of use on or after May 25, 1975 (the effective date of the Division’s 1975 Rules and Regulations) and before May 3, 1978 (the effective date of the Office of Surface Mining’s (OSM) Initial Regulatory Program).
- (v) “Category 5” means those affected lands and support facilities if coal was not removed from those lands prior to May 3, 1978 (the effective date of OSM’s Initial Regulatory Program) or those lands were used on or after May 3, 1978 to facilitate mining (including support facilities and associated lands constructed before May 3, 1978 but still in use on or after May 3, 1978.)

WDEQ-LQD conducts rough backfill verification during the annual report review. Credit is given for backfilling and that amount is rolled over into the next year’s bond. There is public notice announcing the annual report has been received but no notice of area bond release because there is no release of bond (WDEQ-LQD Guideline No. 20, 2003; WDEQ, 1975 – Chapter 15, Sec. 5(a)).

Criteria for incremental bond release in Wyoming depend upon the bond category. Category 5 contains four levels of bond release: Area; Phase 1 Partial Incremental, which involves finishing of grading; Phase 2 Partial Incremental, which addresses species composition of vegetation, sediment control, and soil productivity; and Phase 3 Full Incremental or Final release, which means that reclamation meets the postmining land use and has passed verifications for surface and ground water, wetlands, vegetation, trees, shrubs, wildlife and final surface stability (WDEQ-LQD Guideline No. 20, 2003; WDEQ, 1975 – Chapter 15, Sec. 5(a)).

Upon completion of each phase of bond release, WDEQ-LQD reviews the reclamation work and either releases a portion of the applicable bond or requires additional work and future review. The reclamation, from the time it has been seeded with the permanent seed mix, must be

10 years old before the operator can apply for full release of the bond. If the reclamation is disturbed during this 10 years, the operator may have to wait another 10 years before applying for full release of the bond. Once the final phase is reached, the company is released from financial responsibility.

Oil and Gas Development Requirements

Within Wyoming, O&G development is governed by three main agencies. The Wyoming Oil and Gas Conservation Commission (WOGCC) regulates wells on private and/or patented lands (under a patented claim from the federal government). The Office of State Lands and Investments is responsible for state lands under development. The Bureau of Land Management (BLM) of the Department of the Interior is responsible for federal lands under development.

Under WOGCC, “blanket bonds” cover all wells for which a bond is posted by a developer, regardless of well depth. The blanket bond requirement is \$75,000. Single well bond requirements are \$10,000 for wells under 2,000 feet (610 meters) in depth and \$20,000 for wells deeper than 2,000 feet (610 meters). As an incentive for operators to plug wells no longer in use (or to use them) on private lands, WOGCC requires a bond in the amount of \$3.00 per foot (30 cm) of depth for idle wells.

Under the Office of State Lands and Investments, Surface Impact Payments are required by land lessees for various activities such as fossil fuels drilling. However, these payments are separate from WOGCC’s reclamation bond requirements. Mineral lessees must demonstrate, through bonding, financial obligation to reclamation after development is completed. The Office of State Lands and Investments sets the amount of each bond, as authorized by Board of Land Commissioners’ Rules and Regulations, Chapter 18, (Office of State Lands and Investments, 2007). The blanket bond for O&G wells on state lands is \$100,000, and individual well bonds are \$10,000 (OSLI, 2007).

Bureau of Land Management, Department of the Interior, holds jurisdiction over reclamation efforts on federal lands. Bonds may be nationwide, statewide or individual. Individual bonds are no less than \$10,000 and apply to individual wells; state bonds are no less than \$25,000 and cover all wells operated by a lessee in a particular state; national bonds are no less than \$150,000 and apply to all wells a lessee holds throughout the country (USDOJ, BLM, 2007).

Overall concern of whether a blanket bond (\$10,000 individual, \$25,000 state and \$150,000) is adequate to cover all disturbances for a company on properties throughout Wyoming is an

issue. While historical examples may exist, recent abandonment of wells to avoid reclamation is currently rare in Wyoming. It is to the company's benefit to conduct reclamation at a given site for the following reasons:

- 1) With current public awareness, it is risky to have a poor track record of reclamation.
- 2) A company would run the risk of not being able to do business within the State of Wyoming or other states, especially on public land.
- 3) A company would run the risk of being a "poor credit risk" and discourage investors or financing institutions.

For bonding on reservoirs, the operator must fill out a Engineer's Cost Estimate for Reclamation (Freise, 2009). The figure is \$2.50/cubic yard if the embankment is less than 10,000 cubic yards. All embankments that are over 10,000 cubic yards will require a minimum of \$25,000 bond and must be estimated by a professional engineer. The bonds are riders attached to the 3104 O&G bond.

Development in the Jonah Field and Anticline of southwestern Wyoming initiated federal and state interagency cooperation in developing monitoring criteria of reclamation success and means of incorporating successful reclamation areas for purposes of "rollover", an important factor in areas with disturbance caps. If an area has met "rollover criteria", that area is eligible to be removed from the total limited disturbance cap outlined for a given area. Reclamation criteria, as outlined in the Jonah Interagency Office Recommendations, are used to assess rollover and final criteria (Reinhart, 2009). Rollover criteria include a measure of erosion control, determination of non-native weed presence including cheatgrass and other weedy bromes, a measure of plant vigor, as well as vegetative criteria for native forbs, shrubs, grasses. Final criteria include a measure of ground cover and ecological function, as well as more advanced vegetative criteria.

In addition, BLM offices such as Rawlins are being used as national pilot test areas for defining reclamation criteria to be used for bond release purposes. The Rawlins Field Office is currently working on a geodatabase format to gather and effectively utilize all future disturbance area data.

Conclusion

Despite the current recession and decreased price of oil per barrel, US and world demand for fossil fuels will remain for some time and, thus, mining and O&G development will continue.

The perception of the public, as well as arguments between mining and O&G of what is too much regulation and what is not sufficient regulation will continue. Are bonding requirements an incentive to reclaim disturbed ground? And, if so, how much is enough? Are the required reclamation differences in mining vs. O&G development a matter of money or regulatory structure? The federal SMCRA regulations provided initial structure for the coal mining industry which has taken over 30 years to work out the specifics of what is reclamation success. Given the fact that physical differences between coal mines and O&G do exist, how can flexibility be provided for landscape and operational differences, while at the same time learning what is required to define “success”. Those questions remain to be answered.

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