Casey and Julie Voigt v. Coyote Creek Mining Company, LLC

Case No. RC-23-348

Soil Salvage Requirements Based on Overburden Quality – Applying the Research

Voigt Exhibit 44

SOIL SALVAGE REQUIREMENTS BASED ON OVERBURDEN QUALITY - APPLYING THE RESEARCH[1]

Michael W. Pole[2]

Abstract. -- North Dakota State regulations governing the reclamation of surface mined lands have recently been changed as a result of cooperative efforts by the regulatory agency, the research community, and the regulated industry. Since 1975, operators had been required to salvage and respread all available suitable plant growth material, up to 5 ft thick, over regraded overburden because overburden materials in some areas were not suitable for plant growth. However, in the many areas of the state where regraded overburden is suitable for plant growth, presumably less soil needs to be respread. Research directed toward determining respread soil thickness requirements culminated in 1986 in an effort to change soil salvage and respread regulations through the administrative process established by the Surface Mining Control and Reclamation Act of 1977 (SMCRA) and the North Dakota State program. The rule-making process was difficult, time-consuming, and frustrating, but the resulting regulatory changes should improve both the quality and cost-effectiveness of reclamation operations in North Dakota. Factors which contributed to this successful application of research results to regulatory changes in North Dakota include participation by independent research organizations, long-term financial support for reclamation research, frequent and effective communications among technical staffs, and active participation by all parties in the rule-making process.

[1]Paper presented at the 1988 Mine Drainage and Surface Mine Reclamation Conference sponsored by the American Society for Surface Mining and Reclamation and the U. S. Department of the Interior (Bureau of Mines and Office of Surface Mining Reclamation Enforcement), April 17-22, 1988, Pittsburgh, PA.

[2]Michael W. Pole is Manager of Environmental Affairs, The North American Coal Corporation - Western Division, Bismarck, ND.

INTRODUCTION

Regulatory agencies, coal mining companies, and environmental organizations have all argued that laws and regulations affecting coal mining and reclamation operations should be based on the best available scientific research. Both State and Federal reclamation laws include provisions which encourage reclamation research. Since the enactment of The Surface Mining Control and Reclamation Act

Proceedings America Society of Mining and Reclamation, 1988 pp 299-304
DOI: 10.21000/JASMR88020299

of 1977 (SMCRA), numerous reclamation research experiments have been completed. This research has resulted in a tremendous increase in our knowledge of the science and technology of reclamation. Application of improved reclamation techniques, based on more than 10 years of research since the enactment of SMCRA, should improve the quality and the cost-effectiveness of reclamation. However, the application of these research results is often impeded by the considerable efforts required to change State and Federal laws, regulations, and guidelines. Regulatory agencies, the mining industry, and environmental organizations are understandably hesitant to change an environmental design or performance standard which may be imperfect but is acceptable to all three groups and has survived the arduous tests of the courts. Nevertheless, innovation is inextricably related to change, and innovation is absolutely necessary to ensure that reclamation is as successful and as economical as possible. Despite the obstacles, research results can be used to improve reclamation, even if regulatory changes are necessary, as evidenced by the recent changes to soil salvaging regulations in North Dakota.

The lignite coal mining region of North Dakota includes many areas which are blessed with an abundance of topsoil and subsoil, referred to as suitable plant growth material (SPGM) in the North Dakota regulations governing the reclamation of surface-mined lands. In some areas, however, SPGM is quite limited. Similarly, the quality of the regraded overburden near the reclaimed surface is quite variable. Regraded overburden in some areas is virtually identical to subsoil and is an excellent substitute for subsoil. However, in other areas regraded overburden is high in sodium and other salts or has a coarse texture limiting its plant-available water-holding capacity. North Dakota's reclamation regulations were initially developed on the basis of the "worst case scenario", that is, the assumption that the overburden placed in the reclaimed plant root zone would be deleterious to plant growth and that all available SPGM should, therefore, be salvaged and respread to bury the overburden below the plant root zone.

SOIL HANDLING REGULATIONS IN NORTH DAKOTA

North Dakota's first reclamation law was passed in 1969, but it wasn't until the law was amended in 1973 that operators were required to salvage and respread topsoil up to 2 ft thick, where available. In 1973 and 1974 USDA Agricultural Research Service (ARS) scientists at the Northern Great Plains Research Center in Mandan, ND, began to warn that high sodium levels in regraded overburden might frustrate attempts to reclaim mined lands (Power et al. 1974, Sandoval et al. 1973). A 1975 ARS progress report identified the apparent phenomenon of upward sodium migration from the regraded spoil into the respread SPGM (Agricultural Research Service 1975). Consequently, the 1975 amendments to the North Dakota law provided for salvaging of up to 5 ft of SPGM. In 1976 North Dakota State University scientists suggested that 2.5 ft of SPGM was insufficient when underlying spoil materials have high concentrations of sodium and more than 35 percent clay (Bauer et al. 1976). By 1977 scientists were recommending that up to 3 ft or more of SPGM should be salvaged, but that further research was needed to determine soil thickness requirements (Reis et al. 1977, Agricultural Research Service 1977). The 1977 amendments to the North Dakota law required that all inventoried SPGM should be salvaged, which effectively restated the requirement to salvage 5 ft of material, if available.

In 1977 the requirement to salvage up to 5 ft of SPGM for replacement over sodic spoils was hard to dispute, considering the unknowns regarding potential sodium migration from sodic spoils. However, in many areas regraded overburden is neither sodic nor otherwise deleterious to plant growth, and presumably less SPGM is needed in those areas. In February 1977 The Falkirk Mining Company submitted a request to the North Dakota Public Service Commission (PSC) for a variance from the requirement to salvage subsoil on 190 acres at the Falkirk Mine. To support its request, Falkirk provided analytical data from an intensive drilling program which indicated that concentrations of sodium and other salts in the overburden would not be detrimental to plant growth. The state regulatory agency, the North Dakota Public Service Commission (PSC), denied the variance request in April of that year. The PSC did not disagree with Falkirk's contention that chemical characteristics of the overburden were good. However, it was concerned that the texture of some of the overburden was too coarse to be placed within the reclaimed plant root zone. According to a PSC letter of April 5, 1977, it was feared that such coarse material, "...when placed near the surface after backfilling and reshaping, could present a problem of excessive subsoil drainage and a droughty rebuilt soil profile." Nevertheless, the PSC stated that it would consider modifying its position if Falkirk would provide additional data supporting the variance. The PSC suggested regraded overburden sampling and soil moisture retention studies to obtain such data.

SOIL RECLAMATION RESEARCH

The PSC consulted with the ARS staff at the Northern Great Plains Research Center and the Soils Department of North Dakota State University before responding to Falkirk's request. The ARS had begun

investigating soil respread thickness requirements at several surface mining sites in western North Dakota. Its research, however, was aimed primarily at the problem of reclaiming areas where highly sodic spoils are common. The North Dakota State University Reclamation Research Group, now called the Land Reclamation Research Center (LRRC), is also located at the Northern Great Plains Research Center. The LRRC was, at that time, conducting ground water and soil water studies at the Falkirk Mine, where sodic spoils are very uncommon.

In 1978, through a research grant from Falkirk, the LRRC scientists were able to expand their studies to include evaluations of topsoil and subsoil requirements for reclamation, based on regraded overburden properties. The Falkirk Trench Plots, constructed in the fall of 1978 at the Falkirk Mine, were the last in a series of topsoil and subsoil treatment plots constructed at western North Dakota surface mines by the ARS and the LRRC. The lignite industry in North Dakota made substantial investments in this research, including constructing the plots to the researchers' specifications and providing some of the funding. Lignite industry environmental specialists believed that salvaging all suitable plant growth material up to 5 ft was unnecessary, and they knew that the potential cost savings would be substantial. As early as 1976, Falkirk estimated that reclamation costs could be decreased by approximately $2,400/acre if the salvage requirement could be reduced to 2 ft from 5 ft. For a mine that disturbs about 300 acres/year, that could mean an annual savings of $720,000, based on 1976 costs.

There have been a number of soil depth experiments at North Dakota coal mines, but three of them deserve special mention. These have been referred to as the Stanton Wedge, the Zap Double Wedge, both conceived and developed by the ARS, and the LRRC Falkirk Trench Experiments. The details regarding plot construction, data collection and analyses, and experimental results can be found in numerous publications written by the scientists conducting these experiments (Power et al. 1981, Merrill et al. 1982, Halvorson et al. 1986). The Stanton Wedge Plot consists of a wedge of subsoil 175 ft long, varying in depth from 0 to 7 ft, spread over sodic spoil (SAR about 28). Topsoil thickness treatments were 0, 8, and 24 inches. The Zap Double Wedge, 410 ft by 335 ft, consists of a double wedge of three different subsoil materials varying in thickness from 0 to about 42 inches thick. The Double Wedge Plots were covered overall with an average thickness of 10 inches of topsoil. The underlying spoil was sodic and marginally saline. The Falkirk Trench Plots were eight trenches backfilled with three different textures of spoil material. Various amounts of subsoil and topsoil were respread over each trench. Each trench is 191 ft long, 53 ft wide, and 15 ft deep. All of the spoil was nonsodic and nonsaline. The ARS and LRRC conceived and developed these projects independently. Except for partial funding for the Falkirk Trench Plots, both research organizations obtained funding from traditional sources, that is, designated State and Federal research funds. The lignite industry was consulted, and cooperated by providing land, constructing the plots, and providing expertise in reclamation operations. The PSC (the state regulatory agency) was consulted from conception through analyses of results for each project. It was this close coordination, on the technical level, that ultimately resulted in the successful technology transfer from the research community to the State regulations and, ultimately, to the mine sites themselves.

The successful application of this research did not occur without considerable difficulties, and perseverance and tenacity were required of the researchers and environmental scientists in both the lignite industry and the regulatory agency. The lignite industry's environmental staffs found it necessary to justify the lignite industry's investment in and support of this research, with no assurance that the research would result in any savings, although early research results were promising. The PSC was frequently pressured by the lignite industry to modify regulations to reduce reclamation costs and by other special-interest groups to do the opposite. The researchers, of course, had to justify their reluctance to base recommendations on insufficient research. This was especially true for the LRRC, which gradually took the lead in reclamation research in North Dakota, as the ARS reclamation research program was scaled down in the early 1980s.

REVISING RECLAMATION REQUIREMENTS

Finally, in 1982 Falkirk submitted a mining permit revision application to the PSC to request a reduction in the soil salvage requirements from 60 inches to 40 inches. The application included a four-page letter from the LRRC director supporting Falkirk's request. The revision was approved by the PSC in late 1982. Reclamation cost savings resulting from this revision in soil salvage thickness requirements were estimated to be approximately $4.3 million.

In 1984 the LRRC and ARS researchers published North Dakota State University Agricultural Experiment Station Bulletin 514 (Doll et al. 1984), summarizing the results of all soil replacement research conducted in North Dakota to that date and including respread thickness recommendations, in tabular form, based on regraded

overburden characteristics. During 1985, lignite industry and regulatory agency environmental scientists worked together to develop new soil salvage regulations based on the recommendations included in Bulletin 514. Despite the intimate involvement of both groups in the conception and development of this research, there was considerable disagreement regarding the form and substance of new regulations. For example, Bulletin 514 includes ranges of required respread soil thicknesses, and research since 1984 suggests that even the reduced thicknesses in Bulletin 514 may be too conservative. As a result, the lignite industry and the regulatory agency disagreed on the interpretation of Bulletin 514. Both groups were also influenced by non-technical factors. For example, industry environmental specialists would have preferred generalized regulations adaptable to "site-specific" situations, rather than the "design standards" inherent in an abbreviated table of allowed respread thicknesses. However, a fixed set of numbers was written into the proposed regulations to minimize the uncertainty of site-specific interpretations. The regulatory agency environmental scientists, on the other hand, found themselves supporting an apparent relaxation of environmental protection standards, a very difficult position for them to defend.

As a result, two separate sets of proposed regulations were presented at the public hearing held in March of 1986 and, inevitably, one set was unofficially labeled as the Lignite Council proposal and one as the PSC staff proposal. Many interested North Dakotans were present for the hearing. All who testified were examined and cross-examined by three attorneys and their advisors, as well as the three elected Public Service Commissioners. The three attorneys represented the PSC staff, the North Dakota Lignite Council, and the Dakota Resources Council. Numerous persons testified, but the key witnesses were the three LRRC and ARS research scientists who wrote Bulletin 514. It was not an entirely pleasant experience for the research scientists, but their willingness to discuss and defend their work in that forum made it possible for the lignite industry and the PSC to finally apply more than 10 years of research to the "real world."

The resulting regulations, which were finally approved by the U. S. Office of Surface Mining (OSM) in late 1986, are not perfect in the technical sense, but they represent a very considerable leap forward in our efforts to use research results to improve reclamation and to reduce unnecessary reclamation costs. The gist of these regulations is shown in table 1. In most cases, reclamation costs will be reduced because less soil will have to be salvaged. Reclamation cost savings for each acre-foot of soil which does not have to be salvaged are more than $1,000. Associated costs for reclamation bonds, topsoil and subsoil stockpiles, and water management facilities to control runoff from those stockpiles will also be reduced.

Table 1. -- Suitable plant growth material redistribution thicknesses required by North Dakota State regulations.

Spoil Properties			Total Redistribution Thickness (topsoil plus subsoil)	
Texture	Sodium Adsorption Ratio (SAR)	Saturation % (SP)	Avg. in Inches	Avg. in Centimeters
Medium[1]	<12	NA[2]	24	61
Coarse[3]	<12	NA	36	91
NA	12-20	<95	36	91
NA	12-20	≥95	42	107
NA	>20	NA	48	122

1 Loam or finer
2 Not applicable
3 Sandy loam or coarser

Of course, some reclamation-related costs may increase as a result of the new regulations. For example, unless the overburden were toxic, the amount of suitable plant growth material required for respread under pre-existing regulations was never more than the amount available for salvaging. However, under the new regulations, minimum respread thicknesses are specified, and, if the soil classifier identifies less than the minimum amount, substitute subsoil must be identified, salvaged, and respread. Also, administrative costs have increased substantially under the new regulations. When all suitable plant growth material was salvaged and respread, minimum respread thicknesses and variability in respread thickness were not serious concerns, since more than enough was being respread in most cases. With the new regulations, the mining company must ensure that sufficient soil is salvaged to provide for a minimum thickness of respread soil, taking into account compaction and variability of respread thicknesses. Regraded overburden sampling programs and improved soil inventory techniques are required to ensure that sufficient soil is respread and to avoid the costly salvaging of excess soil. Nevertheless, cost savings resulting from reduced subsoil salvaging requirements should much more than compensate for these additional costs.

RESULTS AND CONCLUSIONS

Years of research and hundreds of thousands of dollars have been expended to

develop better and more cost-effective soil handling regulations in North Dakota. There are surely many other areas where regulations can, and should, be changed to improve reclamation and to decrease unnecessary reclamation costs. Following are several factors which contributed significantly to the successful application of soils research to changes in reclamation regulations in North Dakota.

1. The research was conducted by well established research organizations with widely respected reputations in the field of study. Both organizations (ARS and LRRC) operated independently of the regulatory agency, the lignite industry, or any other special-interest group. The reputations and independence of the LRRC and ARS added immeasurably to the prestige of arguments made to change the regulations.

2. The foresight of the State of North Dakota in being willing to fund reclamation research was a critical, positive factor in ensuring that this research was undertaken and completed. This commitment is necessary to ensure that it is worthwhile to initiate experiments to evaluate the long-term productivity of reclaimed agricultural lands.

3. The research organizations consulted with potential users (the lignite industry and the PSC) at every stage of the research process, through both regularly scheduled meetings and more informal communications. Inputs from industry and the PSC were used to improve the applicability of anticipated research results, but were used only at the researchers' discretion, so that the integrity of their experiments was not adversely affected. Communications among the parties were on the technical staff level, to minimize the influence of institutional constraints on the research. Because of these early and continuing communications with industry and the PSC, all three parties supported the basic objectives of the research, even though there were often disagreements as to how the resulting data should be interpreted.

4. The regulatory agency was flexible in its response to industry's request for variances from the requirement to salvage the full 5 ft of suitable plant growth material. This flexibility didn't necessarily translate into approval of variances, but when the PSC denied such a request, it always "left the door open" by suggesting that it would be willing to reconsider its position if additional data or information were submitted. The PSC was willing to specify exactly what information it would require, such as soil moisture retention studies at the Falkirk Mine, and when data became available, it honored its commitment to change the requirements.

5. The lignite industry's position that something less than 5 ft of suitable plant growth material needs to be salvaged when overburden quality is good was reasonable and supported by research. Industry was willing to make the investment in time and money to obtain the necessary data, despite the fact there was no guarantee that the research would support its position. North Dakota lignite mining companies patiently supported their environmental staffs in their contention that the research would ultimately pay off.

6. The researchers themselves refused to make recommendations based on insufficient data, but once they felt confident in their research conclusions, they were willing to publicize and, if necessary, defend their research in the political arena, the media, and the scientific community. They conditioned their conclusions and recommendations, but not to the extent that the results of their work could not be applied to reclamation in the field.

Regulatory agencies, researchers, and the surface coal mining industry approach reclamation and research from three different points of view. The goals and objectives of the three groups and the forces which drive them often seem incompatible. Nevertheless, applying research to improve reclamation is in the best interests of all three groups, as well as the public. The process can be difficult, time-consuming, and frustrating, but it can also be successful.

LITERATURE CITED

Agricultural Research Service, USDA and North Dakota Agricultural Experiment Station. 1975. Progress report - research on reclamation of strip-mined lands in the Northern Great Plains. Northern Great Plains Research Center, Mandan, ND. 20 pp.

Agricultural Research Service, USDA and North Dakota Agricultural Experiment Station. 1977. North Dakota progress report on research on reclamation of strip-mined lands - Update 1977. Northern Great Plains Research Center, Mandan, ND. 26 pp.

Bauer, A., G. W. Gee, and J. P. Gilley. 1976. Physical, chemical, and biological aspects of reclamation of strip-mined lands in western North Dakota. Final Report. Old West Regional Commission, Billings, MT. 605 pp.

Doll, E. C., S. D. Merrill, and G. A. Halvorson. 1984. Soil replacement for reclamation of strip-mined lands in North Dakota. North Dakota Agricultural Experiment Station Bulletin #514. 24 pp.

Halvorson, G. A., S. W. Melsted, S. A. Schroeder, C. M. Smith, and M. W. Pole. 1986. Topsoil and subsoil thickness requirements for reclamation of nonsodic mined land. Soil Sci. Soc. Am. J. 50:419-422. http://dx.doi.org/10.2136/sssaj1986.03615995005000020033x

Merrill, S. D., R. E. Ries, and J. F. Power. 1982. Effect of subsoil quality and depth upon crop growth and water use on mine soil reclaimed by topsoil and subsoil spreading. Agron. Abst. p. 253. Am. Soc. Agron., Madison, WI.

Power, J. F., F. M. Sandoval, R. E. Ries, and S. D. Merrill. 1981. Effects of topsoil and subsoil thickness on soil water content and crop production on a disturbed soil. Soil Sci. Soc. Am. J. 45:124-129. http://dx.doi.org/10.2136/sssaj1981.03615995004500010027x

Power, J. F., W. O. Willis, F. M. Sandoval, and J. J. Bond. 1974. Can productivity of mined land be restored in North Dakota. North Dakota Agric. Exp. Stn. Farm Res. 31(6):30-32.

Ries, R. E., F. M. Sandoval, and J. F. Power. 1977. Reclamation of disturbed lands in the lignite area of the northern plains. pp. 309-327. In Proc. 1977 Symposium on Technology and Use of Lignite, Grand Forks, North Dakota. May 18-19, 1977. University of North Dakota, Grand Forks, ND.

Sandoval, F. M., J. J. Bond, J. F. Power, and W. O. Willis. 1973. Lignite mine spoils in the Northern Great Plains characteristics and potential for reclamation. pp. 1-24. In M. K. Wali (ed.) Some environmental aspects of strip mining in North Dakota. Educ. Ser. 5, North Dakota Geol. Surv., Grand Forks, ND.