RECLAMATION RESEARCH IN NORTH DAKOTA

PART A

RESEARCH PROJECTS AND NEEDS

III. CURRENT AND FUTURE RECLAMATION RESEARCH NEEDS

The information contained in this section is based on the responses obtained from various research groups, government agencies, and the lignite industry. These entities were periodically (1983, 1986, 1995) surveyed to obtain their opinions regarding reclamation research needs. The results of these surveys have been summarized into two lists, presented in Subsection I and Subsection II, respectively.

Subsection I includes information based on the most recent survey and, therefore, provides a glimpse of some of the outstanding research needs as perceived today. The agency or entity that identified the research need is shown by acronym in parenthesis at the end of the stated need. The entities surveyed include North Dakota Public Service Commission (PSC), State Water Commission (SWC) State Department of Health (SDH), Bureau of Reclamation (BOR), UND-Energy and Environmental Research Center (EERC), Lignite Energy Council (LEC), Natural Resources Conservation Service (NRCS), and Fish and Wildlife Service (FWS). Suggestions and opinions of the NDSU-Land Reclamation Research Center and USDA-ARS Northern Great Plains Research Center Scientists are also included in this list.

Subsection II summarizes information on research needs that were identified about 12 years back and presented in the 1984 edition of this report. This information is included to provide, by comparison with the recent list, some general idea of the progress that has been made in the last decade, and the old or new concerns that still remain to be addressed. The list of research needs presented in Subsection B does not include the name of the agency/entity that identified the need, but identifies the priority a specific research need was assigned at that time. The high (H), Medium (M) and Low (L) priorities are shown at the end of each stated need.

A perusal of both lists will readily reveal that although the number of research needs has significantly decreased over the past 12 years, there are many reclamation questions and concerns for which no complete answers have been found as yet. Also, the reader will note that some new research needs have surfaced that need to be addressed. Concerns regarding supply and quality of groundwater following reclamation, waste disposal in mined areas, soil handling and evaluation of productivity in prime farmland areas, and alleviation of compaction in reclaimed lands, require immediate attention. Compaction in reclaimed lands is a serious problem. Engineering and/or agronomic solutions for alleviation of compaction need to be invented; otherwise realizing the required productivity goals from reclaimed lands may be in serious jeopardy. Development of scientifically appropriate and practical methods of evaluating the success of tree and shrub communities, and use of microbial techniques for establishing these and other plant communities on reclaimed lands, are also some of the outstanding research needs that need to be addressed as soon as possible.

SUBSECTION A

RECLAMATION RESEARCH NEEDS PERCEIVED IN 1996

GEOLOGY AND HYDROLOGY

- Develop appropriate methods for assessment and mitigation of mining effects on groundwater quality and supply. (PSC)
- Determine aquifer properties of spoils, and reassess the role of spoils saturated zone in groundwater movement and quality. (SWC)
- Determine suitability of surface mined lands as solid waste disposal facilities. (SDH)
- Compare the hydrologic functions and effectiveness of reclaimed wetlands to natural, undisturbed basins in relation to groundwater recharge. (BOR, EERC)
- Evaluate the hydrologic impacts of sedimentation ponds retained as permanent impoundments in the post-mining environment. (SDH)

SOIL MANAGEMENT

- Determine if the rule regarding soil respread thicknesses based on graded spoil properties should be continued. (PSC)
- Determine if prime farmland soils warrant separate handling. (PSC)
- Assess long term effects of soil compaction on hydrology and productivity of reclaimed lands and develop effective methods of alleviating soil compaction. (PSC, LEC)
- Are reclaimed croplands more susceptible to erosion than unmined croplands? (PSC)
- Study the profile characteristics of reclaimed soils for assessment of soil development process and classification of the reclaimed soils. (NRCS, LEC, PSC)

AGRICULTURAL PRODUCTION / MANAGEMENT

- Determine long term stability and sustainability of reclaimed grasslands and their best management requirements. (LEC, NRCS, PSC)
- What is the minimum density of warm and cool season grasses needed for reclaimed native grasslands to ensure adequate cover under different grazing pressures? (PSC)
- Develop appropriate methods for determining crop yields of reclaimed lands. Compare hand sampling, strip harvest, and whole field harvest methods of determining crop yields. (PSC)

- Establish scientifically valid methods for meeting sample adequacy requirements under different conditions of population distributions. (PSC)

ECOLOGY AND ECOSYSTEMS

- Develop management and evaluation techniques for tree and shrub communities on reclaimed lands. (PSC, LEC, FWS)

- Determine grading and soil replacement for the construction and establishment of wetlands. How long can wetland soils be stockpiled without losing seed viability. (PSC)

- What are the ecological implications in making a large wetland to replace several small ones. How is wetland recovery affected after functioning as a sediment pond. (PSC)

- Data on mining impacts on wildlife need publishing. (PSC)

- Continued development and selection of plant cultivars and ecotypes suitable for revegetation of mined lands. (LEC, PSC)

- Determine the role of mycorrhizae and other microorganisms in the development of reclaimed soils and in the establishment of self sustaining plant communities on mined lands. (PSC)

SUBSECTION B

RECLAMATION RESEARCH AND DEVELOPMENT NEEDS PERCEIVED IN 1984

GEOLOGY AND HYDROLOGY

- Develop methods of assessing, predicting, and achieving post-mining landscape stability. **(M)**

- Evaluate the effects of disposing fly ash and FGD wastes in mine spoils on surface stability and groundwater quality. **(H)**

- Create a composite computer data base of overburden chemical properties for the eventual development of hydrogeochemical model(s) for predicting the impacts of mining and reclamation on groundwater quality. **(H)**

- Determine and quantify the mechanisms and rates of water and salt movement through vadose zone in reclaimed and abandoned mine lands for eventual modeling of factors affecting groundwater recharge and aquifer reestablishment. **(H)**

- Refine the existing methodologies and develop appropriate model(s) for determining cumulative hydrological impacts of mining and reclamation. **(H)**

- Determine the hydraulic properties of lignite. **(M)**

- Determine the effects of organic compounds present in lignite on the quality of ground water. **(M)**

- Determine the effects of buried water impoundments on final reclamation. **(M)**

MINE SOILS AND AGRICULTURAL PRODUCTION

Soil Requirements

- Determine the optimum topsoil and subsoil thickness requirements as related to soil and spoil characteristics, topography, and post-mining land use. **(H)**

- Reevaluate soil handling requirements for the reclamation of prime farmlands. Determine if the differences in productivity between prime and nonprime soils are essentially moisture and topography related. **(H)**

- Determine the effect of compaction of respread soil on productivity. Devise methods to reduce compaction. **(M)**

- Evaluate the effects of removal, stockpiling and direct respreading processes on the volume changes in topsoil and subsoil. **(H)**

- Quantify the effects of soil type and soil horizon mixing on productivity. **(H)**

- Long term monitoring of erosion, productivity, and cover of reclaimed landscapes as an aid in evaluating adequate soil respread thickness requirements and erosion control methods. **(H)**

- Develop effective techniques for preventing recurrent sodification and salinization in the root zone of respread soils. **(M)**

Mine Soil Properties

- Reassess the adequacy of current regulatory program parameters and critical limits for soil and spoils. **(H)**

- Determine the extent of spatial variability in the physical and chemical properties of graded spoils and respread soils, and its influence on productivity and cover. **(H)**

- Develop and standardize methods for assessing the fertility status and fertilizer requirements of reclaimed lands; determine appropriate methods of fertilizer application. **(M)**

- Quantify moisture retention and release characteristics of reclaimed mine soils and identify best method of moisture conservation. **(H)**

- Quantify and develop predictive models for assessing the vertical and lateral flow of water and salts in reclaimed landscapes. **(H)**

- Determine runoff and erosion potential for variously reclaimed mined lands (spoils and mine soils). **(M)**

- Monitor soil development processes on reclaimed landscapes and determine the types of soils being formed. Also, determine the practices which may aid in hastening the soil development process. **(H)**

Agricultural Production

- Determine the effects of different levels of management on the long term productivity of mined lands. **(H)**

- Determine appropriate methods for assessing revegetation success on reclaimed mined lands. Develop guidelines for assessing the productivity and cover of mined lands. **(H)**

- Verify the USDA published crop yield data in the coal producing counties of the State. **(M)**

- Review, evaluate, and analyze experiment station yield data for use in deriving cropland revegetation success standards. **(M)**

- Obtain baseline data on vegetation in coal mining areas. Investigate the feasibility and utility of implementing ongoing programs for documenting crop and rangeland vegetation data in active and potential surface coal mining areas in the State. **(M)**

- Determine simple and reliable techniques of predicting time of occurrence of peak yield in various rangeland communities. **(M)**

- Investigate alternatives to plant biomass as indicators of success of reclamation on mined lands, such as use of soil development parameters. **(H)**

- Evaluate the effectiveness of reclamation measures employed several years ago on various mine sites. **(L)**

- Determine the amount of total surface ground cover needed to provide adequate soil protection on grasslands. **(H)**

- Develop indexes of potential productivity on disturbed and reclaimed lands. **(M)**

- Develop techniques of water harvesting and conservation; continue research on use of supplemental irrigation. **(M)**

- Continue research on the effects of grazing management on reclaimed lands. **(M)**

ECOLOGY AND ECOSYSTEM DEVELOPMENT

Wildlife and Wetland Habitats

- Determine ecological and management requirements and effective techniques for the reestablishment of woody draw ecosystems on mined lands. **(H)**

- Determine ecological and management requirements and effective techniques for the reestablishment of wetlands on mined lands. **(H)**

- Develop lists of plants suitable for woody draws and wetlands, and determine their cultural requirements. **(H)**

- Study avian and small mammal community responses to reclaimed sites; and evaluate wildlife productivity and population dynamics. **(M)**

- Devise methods to reestablish or entice the animal component to artificially developed association of plants on mined lands. **(H)**

- Evaluate the feasibility and utility of using high resolution remote sensing techniques for pre- and post-mining vegetation and land use inventories. **(M)**

Physiological Ecology

- Identify and develop plant materials adapted to and capable of growing successfully on mined sites. **(H)**

- Determine the tolerance limits of adapted species to sodicity, salinity, acidity, water stress, and nutrient deficiencies/toxicities, and identify physiological or other mechanisms imparting tolerance for specific stresses. **(H)**

- Determine the role of mycorrhizae and other soil microorganisms on the development of mine soils, and in the establishment of self sustaining plant communities on mined lands. **(H)**

- Determine the role of weedy species in the reestablishment and succession of desirable plant communities. **(M)**

- Determine the techniques for enhancing the germination and establishment of seeds and propagules of native plant species on mined lands. Develop methods of propagating and storing large quantities of seeds of important native species which are currently in short supply. **(M)**

- Determine the extent to which plant species and community composition on abandoned mine lands can reflect the site and spoil characteristics of the area in question. **(L)**

- Determine appropriate methods for the reclamation of uraniferous abandoned mine lands. **(H)**

- For use at uraniferous sites, identify and develop listing of plant species which will not translocate radionuclides. **(M)**

DEVELOPMENT NEEDS

- Develop a reclamation research administrative group that includes representatives from industry, government agencies, the public, and the academic research community, and is charged with the responsibility of promoting, monitoring, and coordinating reclamation research, and transmitting important findings and policy recommendations to the legislative branch. **(M)**

- Develop a mechanism for stable, predictable, and secure funding for various reclamation research groups in North Dakota. **(H)**

- Implement policies that end destructive competitive tactics and provide safeguards against duplication in research. **(H)**

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