MINE RECLAMATION RESEARCH PRIORITIES

IN

BRITISH COLUMBIA

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Introduction

The Ministry of Energy, Mines and Petroleum Resources has long recognized the importance and necessity of research in developing long-term solutions to problems associated with environmental protection and reclamation in British Columbia. In 1975 the Ministry, realizing that it did not have the expertise to carry out reclamation research, formed a Technical Assessment and Research Sub-Committee. This Subcommittee was asked among other things to:

1. Coordinate research efforts in reclamation and establish research programs in conjunction with government, universities or other research agencies, and

2. Recommend research programs that should be developed in order of priority.

This subcommittee which survives today as the Technical and Research Committee on Reclamation has continued with this task.

The Technical and Research Committee is presently supported by four sectors:

Government Agencies - M.E.M.P.R., or M.O.E. & A.
Industry Associations - M.A.B.C., Coal Association
Educational Institutes - U.B.C., U.Vic. Mining
Companies.

At a meeting which was held last year, the members of the Technical and Research Committee agreed that we should publicize our research priority list as an initial attempt to perhaps instill more effort into accomplishing what we feel are the current research needs in British Columbia.

History of Research Activity

Government funding for reclamation research was available between 1975 and 1977 and research was concentrated into two priority areas.

Tailings research carried out by the Dept, of Soil Science at the University of British Columbia, under the direction of Dr. Les. Lavhulich produced two published documents describing the physical and chemical conditions of the major tailings waste in British Columbia, This work is now out of print but remains a valuable source of information.

The second area of research produced a report in 1977 entitled "Reclamation of Land disturbed by Mining in Mountainous and Northern Areas", by Hubbard and Bell of the University of Victoria which gave us an excellent state-of-the-art, and was used extensively to develop reclamation programs in high elevation areas. Test plots were also established by the Ministry as part of the North East Coal Study.
With Provincial government research funding essentially drying up, research lagged for several years. The Technical and Research Committee on Reclamation continued to sponsor and support the annual symposia. The proceedings of these annual symposia continue to be the major vehicle for dissemination of reclamation research and technology in British Columbia.

In 1982, with the prospect of research funds still very low, the Technical and Research Committee decided that there would still be some value in maintaining a prioritized list of research topics.

In 1982, there were ten topics:


This problem has never been addressed on a Province wide basis but individual companies have evaluated their own materials. This high priority for such basic work reflects the infancy of our knowledge in 1982.

2. Nature and ecological characterization of reclaimed ecosystems. At what level does the revegetated ecosystem become self-sustaining?

This topic addresses the concern by many of us that by establishing a grass/legume stand we do not necessarily achieve long-term reclamation. The concern originated primarily in high elevation areas but also remains a concern in dry interior areas where we have had considerable difficulty in establishing legume dominated stands.

Work in the East Kootenays particularly by Westar Mining has provided considerable information to show that many of these plant communities are permanent although species are changing continuously over time.

3. The effect of waste material and waste dump configuration on productivity of reclaimed land.

This topic was suggested to provide information on the effects of slope angle, aspect, recontouring, slope length and waste material type on productivity of reclaimed lands. The results could be used to address the issue of recontouring waste rock dumps.

4. An assessment of potential metal uptake on plants grown on mine waste materials in British Columbia. What levels occur and what levels are hazardous?
Metal uptake in vegetation near mineral deposits is a fact of life and the uptake of metal on vegetation established on reclaimed land has the potential to severely restrict land use options. Forage containing high levels of metal would be unacceptable, whereas forest produced on the same land would be acceptable.

The monitoring of metal levels has been undertaken by many companies and data has continued to be gathered.

5. Native species use in reclamation of alpine and northern regions in British Columbia.

In northern and alpine areas the choice of readily available plant material is severely restricted. This is particularly critical for nitrogen fixing legumes which do not generally survive on difficult sites.

Research, supported by individual mining companies, has been conducted and native trees and shrubs are now widely used throughout British Columbia in operational reclamation.

6. The use of nitrogen fixing species in reclamation programs. Identify, propagate, determine the quantities of nitrogen that are fixed and evaluate the effects of substrata on nitrogen fixation.

We all recognize the importance of nitrogen fixing species in order to achieve stable maintenance-free productive land. This topic addresses that issue and some research has been carried out by individual companies.

7. Strategies for incorporating environmental and reclamation concerns into operational practice.

This topic is not really a research issue. It appeared in this list as a result of the very real concern that reclamation and environmental problems were not reaching the operations personnel at mines.

8. The characterization and re-establishment of critical wildlife habitat in Northeast and Southeast British Columbia.

Although many companies have stated wildlife use as their objective, no-one had ever described what that in fact meant.
Since 1982, there have been a number of studies in the south-east at Westar, Line Creek and Fording Coal which have gone a long way to understand wildlife use on reclaimed sites. Much work remains to be done elsewhere.

9. Re-establishment of forest and grazing land on mine wastes.

This topic has been addressed by individual companies but has not been addressed on a Province wide basis.

10. Methods of water management in and around mine waste materials.

This topic arose in 1982 when it was realized that there were potential problems with water management which were crucial to the long-term reclamation and abandonment of mining areas.

This briefly describes the research priorities as they stood in 1982.

The review was repeated in 1984 (Table 1) and there were some significant alterations in research priorities.

Resloping and productivity of waste dumps became the highest priority and resulted in commissioning of two studies, one by Norecol and one by Golder and Associates. Both studies addressed the technical issues related to waste dump resloping and copies of these reports are still available.

Water management aspects rose from a very low priority in 1982 to the third priority. This topic was expanded to include rock drains and addressed their costs and benefits and limitations.

This increased priority gave rise to the Rock Drain Symposium held in September 1986 in Cranbrook.

Waste materials as a plant growth medium moved from the highest priority in 1982 to the eighth priority in 1984. This clearly indicates that information accumulated by individual mining companies has been sufficient to provide a degree of confidence regarding simple revegetation of mine waste materials and indicates an increasing degree of sophistication in research priorities.

The ninth priority is a new topic and addresses Reclamation of difficult sites including acidic materials, arid areas, gullies and high elevations. This is the first reference to acidic materials.

In 1987 research priorities were again evaluated and there were some significant changes (Table 2), Resloping and productivity of waste rock dumps continues as the highest priority.
TABLE 1

TECHNICAL AND RESEARCH COMMITTEE ON RECLAMATION

RESEARCH PRIORITIES (in decreasing order)

November 28th, 1984

1. The effect of waste materials and waste dump configuration on productivity of reclaimed land including the costs and benefits of resloping. (3)

2. Nature and ecological characterization of reclaimed ecosystems. At what level does the revegetated ecosystem become self-sustaining? (2)

   (a) including rock drains, waste dumps across valleys, costs benefits and limiting factors
   (b) water quality (10)

4. The use of Nitrogen fixing species in reclamation programs. Identify, propagate, determine the quantities of nitrogen that are fixed. Substrate effects on nitrogen fixation. (6)

5. An assessment of potential metal uptake on plants grown on mine waste materials in British Columbia. What levels occur and what levels are hazardous? (4)

6. Native species use in reclamation of alpine and northern regions in British Columbia. (5)

7. The characterization and re-establishment of critical wildlife habitat in N.E. and S.E. British Columbia. (8)


9. Reclamation of difficult sites including; acidic materials, arid areas, gullies and high elevations. (N)

10. Re-establishment of forest and grazing land on mine waste materials. (9)

( ) Order of priority in 1982 is shown in brackets.
TABLE 2

TECHNICAL AND RESEARCH COMMITTEE ON RECLAMATION

RESEARCH PRIORITIES

January, 1988

1. The effect of waste materials and waste dump configuration on productivity of reclaimed land including the costs and benefits of resloping. (1)

2. The prediction, prevention, treatment, control and monitoring of acid mine drainage. (3,9)

3. Nature and ecological characterization of reclaimed ecosystems. At what level does the revegetated ecosystem become self-sustaining. (2)

4. Methods of water management in and around mine waste materials, (a) including rock drains, waste dumps across valleys, cost benefits and limiting factors (b) water quality (3)

5. An assessment of potential metal uptake on plants grown on mine waste materials in British Columbia. What levels occur and what levels are hazardous? (5)

6. A physical and chemical evaluation of waste materials as a plant growth medium. Sedimentary strata in the northeast and southeast coal blocks and porphyry copper materials. (8)

7. The use of nitrogen fixing species in reclamation programs. Identify, propagate, determine the quantities of nitrogen that are fixed. Substrate effects on nitrogen fixation. (4)

8. Evaluate the use of monitoring instrumentation technology in assessing the success of reclamation programs. (N)

9. Native species use in reclamation of alpine and northern regions in British Columbia. (6)

10. The characterization and re-establishment of critical wildlife habitat in British Columbia. (7)

( ) indicates order of priority in November, 1984
The most significant change lies in the introduction of a new topic entitled "acid mine drainage" which arose from topics addressing water management and reclamation of acidic sites. Acid Mine Drainage is clearly a major environmental issue in Canada today and British Columbia has more than its share of problems.

In recognition of this problem, the 1987 Mine Reclamation Symposium held in Campbell River was devoted almost entirely to this issue, although we did also have a panel discussion on waste dump resloping.

A new topic entitled "Monitoring Instrumentation Technology" was introduced to review and evaluate some of the more sophisticated technology available such as satellite imagery as a tool for reclamation research and monitoring.

In summary, although these research priorities did not result in any outpouring of government funds, they had proved valuable. They have served to focus the committee's attention and activity on major issues and priorities. They assisted in the generation of Company and University based research.

Priorities are determined on a simple vote system of all members of the Technical and Research Committee on Reclamation and this leads to some interesting results:

- Topics of widespread interest to both government and industry are favoured and consequently resloping has maintained a high priority.

- Topics of high financial cost are rated higher priority.

- Topics that are politically current rate high priority.

There has been a shift from an emphasis on plant growth research into research pertaining to the whole issue of reclamation as it relates to water management. As a consequence, rock drain research went from a very low priority in 1982 to a high priority two years later and acid mine drainage moved from a low priority in 1984 to high priority in 1987.

The mining industry is very competitive and, as a result, co-operative research is difficult to fund. Research such as that on waste rock dumps that affect most members of industry will get support. Studies on heavy metal uptake probably will not be supported on an industry wide basis and very likely will require total government funding.

This paper, until now, has presented the Technical and Research Committee's research priorities and I will now take the opportunity to present some of my own views on research priorities.
Resloping and productivity of waste rock dumps is currently a major issue. Although I believe that there are a number of technical issues which should be researched further, I feel that it is no longer a research issue but is an economic and political one. The mining industry also, I believe, does not regard it as a technical issue.

I believe that the number one reclamation research priority in British Columbia today is acid mine drainage. Unless government and industry can demonstrate clearly that we have the ability to predict, control and manage acid mine drainage, the mining industry will have severe problems in successfully bringing sulphide mines into production.

I believe research on molybdenum effects (alkaline mine drainage) should also be a research priority. I still recall the severe political issues involved in releasing water from the Brenda Mine and feel that this issue needs to be addressed.

Reclaimed sites should be monitored in detail throughout the Province for extended periods to look at species changes, productivity and ecological stability. This would allow us to build up our confidence level.

Rock drain monitoring must continue to ensure that these large valley fills are performing and are not deteriorating over time.

It is important to establish better understanding of effluent quality to provide an early warning system of long term problems with a reclaimed system. Early detection of acid mine drainage or elevated metals would do much to allow proper management of problems.

Metal uptake in plants must continue. We now have a reasonable idea of metal values through company monitoring. We have yet to establish acceptable levels.

The role of nitrogen fixing species must be evaluated in greater detail. Nitrogen fixing species are the key component of any system where fertility (organic matter) is low. If legumes can not be established then it usually becomes necessary to maintain fertilizer applications.

The use of native species has increased greatly in recent years. There is no reason to favour natives over agronomics for philosophical reasons, however, native species will provide the only options where for particular climatic or substrate conditions the choice of species is severely restricted.

Wildlife habitat studies are important. If wildlife use is proposed for a reclaimed site, then much additional research is required to identify the characteristics necessary on a reclaimed area in order to achieve usable wildlife habitat. A grass/legume monoculture will not achieve wildlife habitat in many instances.