Sustaining the Yukon's Economy over the Long Term: The Role of Mining

by

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ABSTRACT

Sustainable development and sustainability have become widely accepted as principles guiding the effort to balance the desires for: economic growth and development, some form of social equity, and the maintenance of ecosystem integrity. Canada's Yukon Territory is a jurisdiction heavily reliant on mining and also committed to the principles of sustainability. Mining, like the use of other non-renewable resources, can be made to fit the still evolving sustainability criteria. Economically sustainable use of minerals requires the collection and reinvestment of their economic rents in sustainable substitutes. Advances toward economic sustainability also mean improving environmental sustainability as environmental damage equals dissipated rents. The Yukon can improve the economic sustainability of its mining sector by: replacing its free-entry mineral allocation system, collecting rents more efficiently using a resource rent tax, reinvesting those rents in economic diversification, and enforcing the requirements for mine abandonment.

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INTRODUCTION

Since their emergence as integrated concepts in the 1980s, sustainable development and sustainability have become widely accepted as principles guiding the effort to balance the desires for: economic growth and development, some form of social equity, and the maintenance of ecosystem integrity. While the concepts are still being added to and refined, versions of them have been officially adopted in many jurisdictions as the philosophical underpinning of development policies. This has been the case in the Yukon Territory where the territorial government, the First Nations, and the federal Department of Indian Affairs and Northern Development have all done so.

Cynics might suggest that the idea of sustainability is simply a trendy bit of intellectual fluff that governments have seized upon to appease a vocal part of their constituency while continuing to go about the business of economic development largely as before. While this may sometimes be the motivation, if governments adopt the principles of sustainability or sustainable development, they must be held accountable for their commitment. An underlying assumption of this thesis is that implementing the principles of sustainability is both necessary and important, and that governments do take their commitments to sustainable development and sustainability seriously.

When discussing sustainability, it is important to specify what one wishes to sustain. The environment? The economy? The community? All three? Equally important is to be clear on what scale to apply the idea of sustainability. In the long term, the application of sustainability must be on a global scale if it is to be meaningful. A "sustainable" economy in one region that maintains itself by externalizing costs to other areas is not sustainable at all. Similarly, leaving a particular ecosystem intact and claiming that the global environment is therefore sustainable is questionable to say the least. In the shorter term however, it is

practical, and politically necessary, to focus on a scale considerably smaller than global. This thesis will focus on the economy of the Yukon Territory in northern Canada, but recognizes the importance of both the environment and local community.

The central theme of this thesis is an analysis of the role mining can play in the long-term sustainable development of the Yukon Territory's economy and of means to move mining toward sustainability. Emerging from the central theme are two sub-themes: first, the axiomatic necessity of sustaining the natural environment if one is to have a sustainable economy in the long term, and second, the problems of sustaining communities dependent on mining. The necessity of sustaining the environment requires that, at a minimum, mining's level of ecosystem impact be acceptable. A full accounting of the costs of environmental impacts is also required. The issues of sustaining the environment and mining communities are illustrated using the town of Faro in the central Yukon (see Figure 1) as an example.

The use of non-renewable resources has always been a thorny issue for proponents of sustainability because such use is intuitively non-sustainable. Mining can meet most of the generally accepted criteria of sustainability however, given the right conditions. This thesis focuses on the limited goal of having mining meet some of these criteria (and particularly the criterion of weak sustainability) as defined in Chapter 1. Meeting this goal may be seen as a first step in the longer process of having all non-renewable resource development meet much broader and more stringent goals of full or strong sustainability in the longer term. Prescriptions for changes designed to create the conditions to allow mining to meet these limited criteria form a portion of the central theme.

Chapter 1 introduces the ideas of sustainable development and sustainability, including their origins, criteria, and some of the economic theory behind them. Chapters 2 and 3 provide some background on the history of economic

development in the Yukon, the history of Faro, and on the regulatory framework controlling the mining industry in the Yukon. Chapters 4, 5, and 6 follow the stages of the mining process, from exploration through decommissioning and abandonment, examining selected issues in each stage in the context of sustainability. Finally, Chapter 7 will briefly examine differing efforts in three jurisdictions to retain and invest natural resource rents. Figure 2 shows a schematic plan of the structure of this thesis and how its main and sub-themes interact.

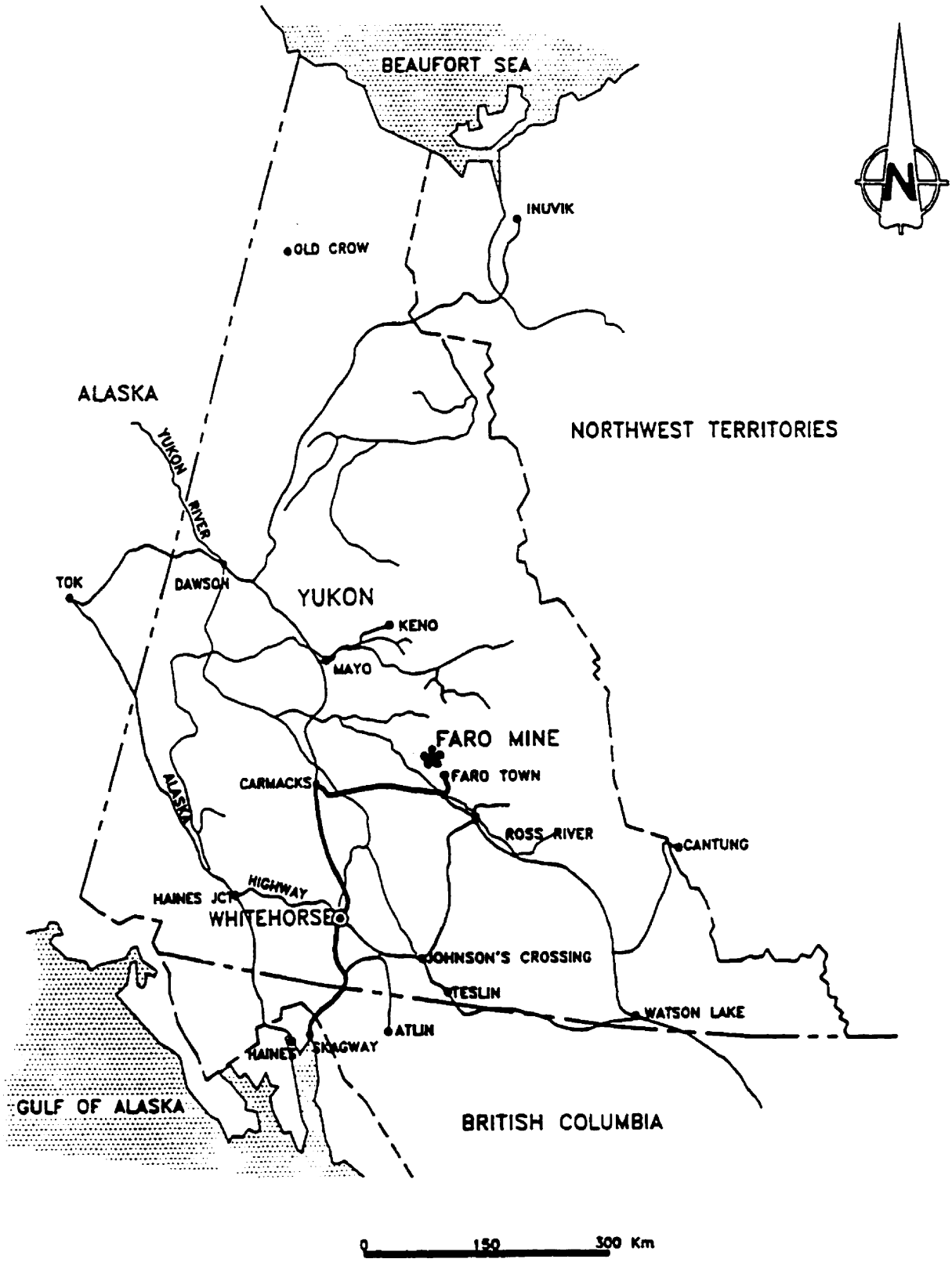

Figure 1: The Yukon Territory

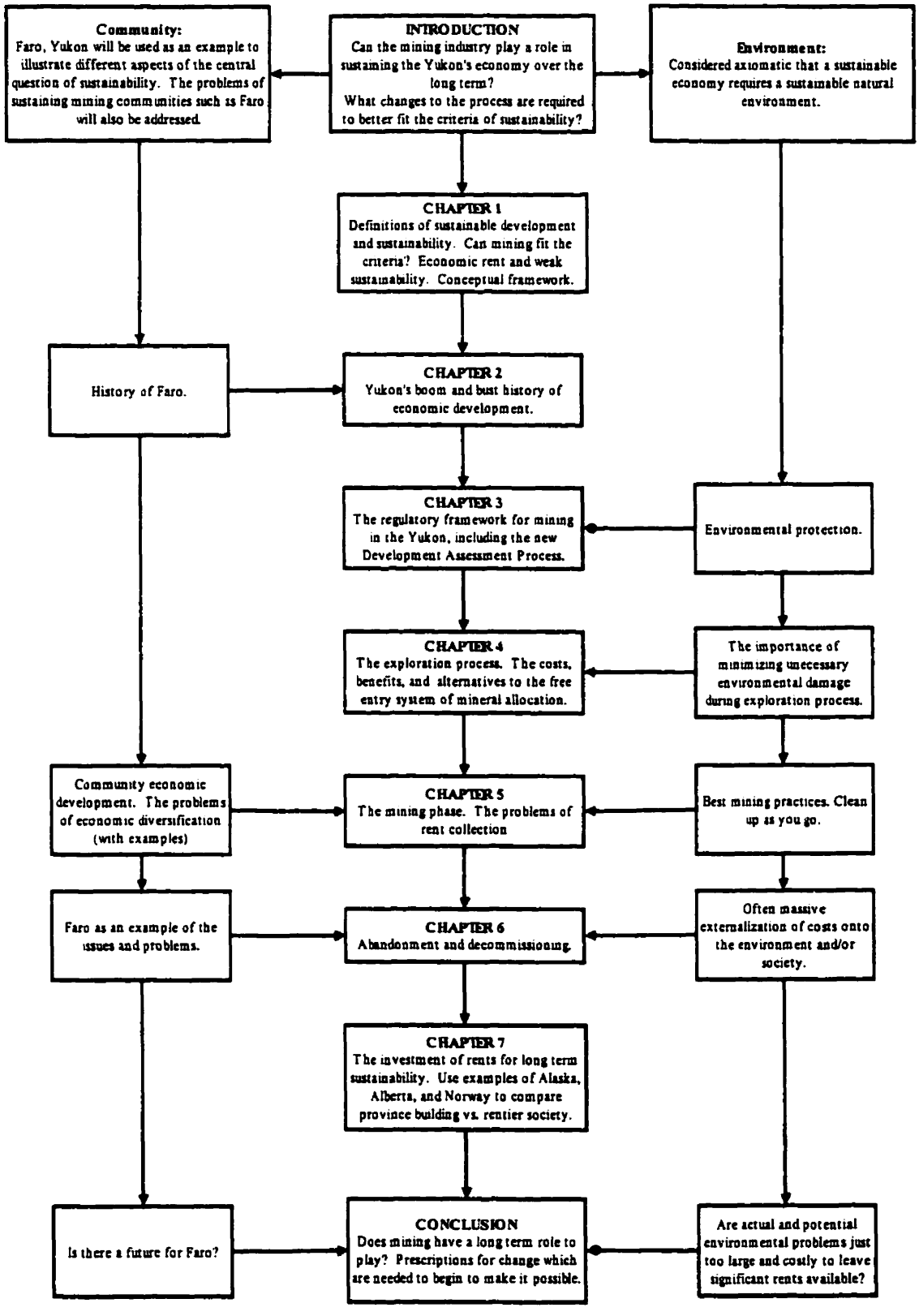

Figure 2: Schematic Outline of Thesis

CHAPTER 1: SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

Sustainable Development and Sustainability

Origins

While it has been argued that the roots of sustainability are embedded in such diverse soils as North American Indian mythology,[5] the earth goddess Gaia of the ancient Greeks,[6] and the biblical injunction to act as stewards of the earth, the beginnings of the modern concept were in the ideas of wise use and conservation in the early twentieth century. These ideas emerged as a reaction to the excesses of laissez-faire development of the last century and proponents meant to ameliorate the worst excesses of such development without slowing development itself. Proponents argued for the sustainable exploitation of renewable resources, not necessarily for the protection or preservation of the landscape.[7] In the economics discipline, the 1920s saw the development by Pigou of the idea of externalities and his differentiation between private and social costs laid the groundwork for some of the economic rationale behind the concept of sustainability.[8]

The emergence of the modern environmental movement in the 1960s and the Club of Rome Report of 1972 (which argued that the limits to natural resource use and to economic growth were fast being approached) pushed forward thinking on the issues of long term sustainability of environmental, economic,

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[5] Dorcey, A.H.J. 1991. Perspectives on Sustainable Development in Water Management. p.3.
[6] Hughes, D. 1983. "Gaia: An Ancient View of Our Planet." p.55.
[7] Taylor, Duncan M. 1994. Off Course: Restoring Balance Between Canadian Society and the Environment. p.27.
[8] Dasgupta, Partha. 1991. "The Environment as a Commodity." p.26.

and social systems.[9] There were calls for a "conserver society,"[10] much questioning of the basic assumptions of economics, and a general sense that full speed ahead on the economic front would mean a spectacular crash sooner rather than later.[11]

Sustainable Development: The Brundtland Commission

Sustainable development emerged as an integrated approach to economic development and conservation with the publication of the World Conservation Strategy in 1980.[12] But it was not until the publication of Our Common Future (also known as the Brundtland Report) in 1987 that the concept became widely known.[13] The Brundtland Report unleashed a ground swell of support for sustainable development from virtually every point on the ideological spectrum. It managed to do so by offering something to everyone. It defined sustainable development as, "...development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[14] This masterfully innocuous definition, coupled with the insistence that all development must be within the bounds of the ecologically possible, and a call for accelerated economic growth to meet the present needs of the world's poor, insured widespread support for the concept. It also created a fundamental split in that support however, as various proponents could not agree on what they were agreeing to.

The debate over sustainable development quickly polarized between two camps, each with its assumptions and view of humankind's role on earth. As William Rees writes:

> "Environmentalists of all stripes and groups on the political left emphasize the 'sustainable' part. They see a need to put Earth first, limit material growth, return to community values, and devise ways to share the world's

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[9] Meadows, D.H. et al. 1972. The Limits to Growth.
[10] Solomon, L. 1978. The Conserver Solution. p.2.
[11] See for example: Schumacher, E.F. 1973. Small is Beautiful.
[12] International Union for Conservation of Nature et al. 1980. World Conservation Strategy.
[13] World Commission on Environment and Development. 1987. Our Common Future.
[14] Ibid. p.8.

> wealth more equitably. Economic planners, the political center, and all those to the right warm more to the 'development' component. From this perspective, there are no limits, growth comes first, the present system works, and the global expansion of market economies will create all the wealth needed for world ecological and social security."[15]

Most of those emphasizing the development component narrowly interpret sustainable development as sustained economic growth. Such growth raises the living standards of all (the rising tide will lift all boats argument) and helps pay for a degree of environmental protection. Environmental protection is itself a narrow concept based on seeing humanity as quite distinct from nature.

As with other noble objectives (e.g., democracy or justice) everyone can agree on the ideal of sustainable development, but not on what that ideal entails. Nonetheless, sustainable development has a core meaning, despite differing interpretations. Jacobs summed up that core by arguing that sustainable development must have three elements:

1. Environmental considerations must be entrenched in economic policy-making.
2. Sustainable development incorporates an inescapable commitment to social and intergenerational equity.
3. Development does not simply mean economic growth as it is currently measured; it can mean a qualitative as well as, or instead of, a quantitative improvement.[16]

Even with these elements broadening the understanding of and debate over economic growth and development, there remained many who saw the debate as too narrow. It continued to focus almost exclusively on human needs and wants, and even environmental considerations tended to be based on human health, enjoyment, and well being. A broader approach was seen as essential, and the concept of sustainability began to emerge.

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[15] Rees, William E. 1991. "Understanding Sustainable Development." p.2.

[16] Adapted from: Jacobs, M. 1993. The Green Economy: Environment, Sustainable Development, and the Politics of the Future.

The Evolution from Sustainable Development to Sustainability

The shift in thinking from sustainable development, with its focus on meeting human economic needs, to sustainability is a shift toward a systems approach to the issues of economics, development, environment, and social and intergenerational equity. The systems approach is clear in Costanza et al.'s definition of sustainability as:

> "...a relationship between dynamic human economic systems and the larger dynamic, but normally slower-changing ecological systems, in which (1) human life can continue indefinitely, (2) human individuals can flourish, and (3) human cultures can develop; but in which effects of human activities remain within bounds, so as not to destroy the diversity, complexity, and function of the ecological support system."[17]

Robinson et al. state that sustainability is, "...the persistence over an apparently indefinite future of certain necessary and desired characteristics of the socio-political system and its natural environment" and identify its seven characteristics:

1. What is most important is preserving capacity to change. Persistence of a system itself in perpetuity is not required.
2. Increasing the sustainability of a system is not necessarily equivalent to preserving the system in its current form. Increasing resilience (capacity to recover from disturbance) is the appropriate goal rather than increased reliability (resistance to breakdown).
3. Both necessary and desirable characteristics should be considered.
4. The value-laden nature of this definition makes essential consideration of who is to decide what the necessary and desirable characteristics are and on what basis such decisions are made. Thus, social/political dimensions of sustainability are equally as important as environmental/ecological dimensions.
5. Because the definition is value laden, there will be no single precise definition of sustainability.
6. It is not meaningful to measure the absolute sustainability of a society at any one point in time. Sustainability will change as values change.
7. Applying this concept of sustainability, it is more meaningful to pursue a goal of "sustainable society" rather than "sustainable development".[18]

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[17] Costanza, Robert et al. 1991. "Goals, agenda, and policy recommendations for ecological economics." p.8.

[18] Robinson, J.G. et al. 1990. "Defining a Sustainable Society: Values, Principles, and Definitions." pp.26-36.

Explicit in Robinson and implicit in Constanza is the normative, value-laden nature of the idea of sustainability. Differing value systems and the worldviews from which they spring lie at the heart of the debates over sustainability.

Values and World Views

As is clear from Rees' argument above, the debates over sustainable development and sustainability tend to become polarized into two opposing camps. These camps have widely diverging sets of attitudes and values deeply embedded in a way of looking at the world. This world-view is usually so ingrained that individuals or societies are often not conscious of its existence. It has been described as the lens or filter through which an individual or a society views the world.[19] There have been many definitions, descriptions, and explanations offered of these differing sets of values and world-views. This paper will adopt the labels of the expansionist world-view and the ecological world-view.

The expansionist world-view, the dominant view (at least in the West) for the past two centuries, has its roots in the Enlightenment period of the 17th and 18th centuries. From thinkers such as Bacon, Galileo, Descartes, and Newton came the idea of Nature as a machine and the conviction that human duty required the use of science to dominate and control it. A highly dualistic form of thinking emerged, separating God from nature, spirit from matter, and humans from all else.[20] Also during this period, political and economic theorists such as John Locke and Adam Smith argued for the primacy of individual freedom and that the end of scarcity was at hand.[21]

William Catton proposes the following four assumptions as the basis of the expansionist world view:

1. People are masters of their own destiny; they are essentially different from all other creatures, over which they have dominion.

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[19] Hodge, Robert A.L.(Tony). 1995. Assessing Progress Toward Sustainability: Development of a Systemic Framework and Reporting Structure. p.II-3.
[20] Taylor. 1994. p.47.
[21] Ibid. p.22.

2. People can learn to do anything.
3. People can always change when they have to.
4. People can always improve things; the history of mankind is a history of progress; for every problem there is a solution, and progress need never cease.[22]

Under this worldview, nature is seen largely as a storehouse of resources, ever increasing material wealth will satisfy all needs, and human ingenuity will solve all problems. Holders of the expansionist world-view often take pride in their optimistic outlook and scoff at the perceived pessimism and negativity of the ecological world-view.

The still emerging ecological world-view has roots in, and borrows from, a variety of traditions. These include the Counter-Enlightenment or Romantic movement of the late 18th and early 19th centuries,[23] some aspects of North American Indian mythology,[24] and some aspects of Buddhism.[25] Its underlying assumptions, according to Catton, are:

1. Human beings are just one species among many species that are independently involved in biotic communities.
2. Human social life is shaped by intricate linkages of cause and effect (and feedback) in the web of nature, and because of these, purposive human actions have many unintended consequences.
3. The world we live in is finite, so there are potential physical and biological limits constraining economic growth, social progress, and other aspects of human living.
4. However much the inventiveness of Homo sapiens or the power of Homo colossus may seem for a while to transcend carrying capacity limits, nature has the last word.[26]

There is a danger in the drawing up of opposing lists of the features and assumptions of the opposing world-views, however. The most obvious is that these lists create two sharply defined and totally separate camps when there is, in reality, much overlap. Individuals will often subscribe to some aspects of one

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[22] Catton, William. 1980. Overshoot: The Ecological Basis for Revolutionary Change. p.238.
[23] Taylor. 1994. p.47.
[24] Dorcey. 1991. p.3.
[25] Schumacher. 1973. p.53.
[26] Catton. 1980. p.239.

view and some aspects of its opposite. This is to be expected during any shift of worldviews as an instant and complete shift would be impossible. It is also important (particularly for those who wish to escape the dualistic thinking typical of the expansionist worldview) to recognize that such neat, opposing mirror images are themselves a fine example of dualistic thinking.[27]

Sustainability and the Canadian North

The ideas of sustainability and sustainable development have had a special resonance in the Canadian north and in the Yukon in particular. While the North has had a long history of boom and bust development, there has also been a growing view over several decades that here was a chance to "get it right"; to have long-term, stable economic development without the environmental and social problems that have usually accompanied development. The North's enormous area, tiny population, and its relative lack of development (particularly industrial development) were seen as allowing for a new approach and the concepts of sustainability were welcomed by many with considerable enthusiasm.

Adopting Sustainable Development in the Yukon

The early 1980s saw a prolonged nation-wide economic slump, worse in the Yukon than in most of Canada. It was bust time again on a large scale as mines closed, jobs vanished, and people moved south. It was during this bust that a series of interlinked initiatives began to change the approach to development in the territory. These initiatives included the Yukon 2000 planning process, the beginnings of the Yukon Conservation Strategy, increasing efforts to diversify the economy (particularly into environmentally sensitive use of renewable resources), increased efforts to settle First Nation land claims, and increased efforts to assert local community control over resources and their use.

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[27] Taylor. 1994. pp.51-53.

The Yukon 2000 process was a wide-ranging consultation with Yukon residents over the economic and social future of the territory begun in the fall of 1986 and culminating in the spring of 1988 with the issuing of the Yukon Economic Strategy.[28] Although not explicitly centered on issues of sustainability, many of the issues did arise during the process including calls for sustainable development in the Yukon.[29] Four broad goals were articulated and became the foundation for the Yukon Economic Strategy:

1. The option to stay in the Yukon.
2. Greater control over the economic future of the Yukon.
3. An acceptable quality of life.
4. Equality of economic opportunity.[30]

From these goals came a strong emphasis on the need to: diversify the economy, decrease dependence on imported goods, and increase local community control, particularly control by First Nations. The need for economic diversification has become a motherhood issue nearly everywhere but it is particularly strong in the Yukon. It is seen as the obvious solution to the perpetual problem of boom and bust associated with a natural resource based economy. Diversification is not easy to achieve however, whether for a region or for a community. The issues of economic diversification are discussed in more detail in Chapter 5.

Yukon Conservation Strategy

Emerging from the same Yukon 2000 process was the planning and adoption of a conservation strategy designed to provide the framework and rationale for an integrated approach to resource management, economic development, and the environment. The Yukon Conservation Strategy, adopted in 1990, laid out its fundamental objective as:

> "The people of the Yukon, native and non-native, have called for balanced and sustainable development of our natural resources. To be sustainable,

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[28] Yukon. 1988. The Yukon Economic Strategy.
[29] M'Gonigle, Michael. 1987. Sustainable Development in the Yukon.
[30] Adapted from: Yukon. 1987. The Things That Matter: A Report of Yukoners' Views on the Future of Their Economy and Their Society.

development must be environmentally and economically sound. It must meet the needs of the present generation, but not compromise the needs of future generations."[31]

At the core of the strategy are four goals designed to achieve that objective:

1. To provide for the wise management of our resources through:
   - sustainable use of our renewable resources,
   - development of a range of renewable resource uses,
   - a stable, healthy non-renewable resources sector, and
   - active integrated management of our natural resources.
2. To provide for the wise management of our environment through:
   - protection of a quality environment, and
   - protection of our natural and human heritage.
3. To support our needs and values as Yukoners through:
   - benefits and opportunities for Yukoners from the development and conservation of our natural resources,
   - community involvement in decision-making about resources management, and
   - understanding of aboriginal resource management practices and knowledge.
4. To help us recognize our responsibilities for the conservation of resources through:
   - public awareness and understanding of conservation principles, and
   - public involvement and participation in conservation efforts.[32]

The Yukon Territorial government has incorporated the overall goal of sustainable development (and hence the four goals above) into both the *Environment Act* and the *Economic Development Act*. The environmental protection commitments and integrated resource management objectives are incorporated in the 1991 *Environment Act*, which also calls for annual reviews of the government's performance in implementing the conservation strategy.[33] The 1992 *Economic Development Act* explicitly establishes sustainable development as one of the goals of the Department of Economic Development.

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[31] Yukon. 1990. Yukon Conservation Strategy. p.63.
[32] Yukon. August 1996. Staying on Track: Revisions to the Yukon Conservation Strategy. pp.7-8.
[33] Yukon Council on the Economy and the Environment. December 1995. Making Progress: Yukon Government Implementation of the Yukon Conservation Strategy 1990-1995. pp.4-6.

The territorial government in the Yukon has clearly adopted sustainable development as central to its approach to economic development and environmental protection issues in the territory. It is written into the relevant legislation, and regular progress reviews are a requirement. It only remains to be seen how successive governments interpret the requirements of sustainable development and for them to be held accountable for the results of their decisions.

The Federal Government's Sustainable Development Strategies

Until the 1970s, the natural resource development in the North followed a fairly simple process. The private sector was the instigator and prime player, with the federal government acting as cheerleader while also controlling the resources and regulating very lightly. Ottawa directly controlled the territorial government, and First Nations were not considered to have relevant concerns. The federal government remains the single most important player in natural resource decision making in the North through the federal Department of Indian Affairs and Northern Development. DIAND retains jurisdiction over water, Crown lands (i.e. almost all land), minerals, offshore oil and gas, and forest resources in the Yukon. All of these are typically areas of provincial jurisdiction in the south.[34] Two other departments also play a significant role in natural resource decision making: the Department of the Environment (DOE) and the Department of Fisheries and Oceans (DFO).

DIAND has two very distinct programs through which it discharges its wide-ranging responsibilities in the North. The Northern Affairs Program has responsibility for the administration of land, water, forests, minerals, and applies the environmental assessment process to major development proposals. The Indian and Inuit Affairs Program is responsible for funding First Nations, and for the negotiation of land claims agreements. These two programs result in the

[34] Canada. 1997(c). Towards Sustainable Development Volume I: A Strategy for the Department of Indian Affairs and Northern Development. p.12.

department having a split personality, each with its own (sometimes conflicting) goals, and often different approaches and philosophies.

The Department of Indian Affairs and Northern Development has made extensive commitments to sustainability and sustainable development through a strategy paper published in 1997.[35] The department accepted as a starting point the Brundtland Commission's famous definition of sustainable development: "...development that meets the needs of the preset without compromising the ability of future generations to meet their own needs."[36] To this starting point the document adds two Aboriginal definitions of sustainable development: "...keeping it the right way that which gives us life"[37] and, "[b]eneficial socio-economic change that does not undermine the ecological and social systems upon which communities and societies are dependent."[38] Planned actions specific to mining development included the implementation of mining land use regulations in the Yukon, develop regulations governing mine reclamation, review the impact of the royalty regime on sustainable development, and to prepare a strategy for environmental sensitivity mapping of Crown lands.[39]

The broad mandate of the Department of the Environment is to preserve and enhance the quality of the environment for the benefit of present and future generations of Canadians. The department outlines its major goal as: "...to help make sustainable development a reality in Canada and, by doing so, make our country an example to the world."[40] The Environmental Conservation Service of the department has a focus on the sustainable development of environmental resources, which in practice means a responsibility for wildlife management, wildlife inventory, and regulatory change. In the Yukon, the Environmental Protection Branch of DOE is responsible for the enforcement of environmental

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[35] Canada. 1997(c). p.12.
[36] World Commission on Environment and Development. 1987.
[37] Mi'kmaq expression quoted in: Canada. 1997(c). p.10.
[38] Council of Yukon First Nations. Quoted in: Canada. 1997(c). p.10.
[39] Canada. 1997(c). p.51.
[40] Canada. 1998. Environment Canada.

protection legislation, pollution abatement, and for the administration of Section 36 of the *Fisheries Act* that prohibits the release of deleterious substances in fish habitat.[41]

DFO exerts considerable influence over the scope and nature of natural resource development through the wide-ranging provisions of the *Fisheries Act.* These provisions prohibit the harmful alteration, disruption, or destruction of fish habitat except as authorized by the Minister. Thus any proposed development that might affect fish habitat might in theory be blocked by DFO. Project proponents must submit plans to the department that outline how fish habitat will be protected if the project receives approval. Fisheries and Oceans, like DIAND and DOE, has committed itself to the concept of sustainable development. It does so in the most direct way, by quoting the Brundtland definition and then writing: "The main business of the Department of Fisheries and Oceans (DFO) is sustainable development."[42]

The role of DIAND in the Yukon will likely diminish greatly as the process of devolution of powers from the federal government to the territorial and First Nation governments continues. The roles of the various levels of government and how they are changing are discussed in more detail in Chapter 3.

First Nations and Sustainability

The desirability of community control of its economy and its natural resources tends to be an article of faith among proponents of sustainability. Local control, with its social constraints and collective community interests, is seen as the best means of averting the tragedy of the commons.[43] This is seen as particularly applicable for First Nation communities with their strong sense of place, cultural

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[41] Hargrave, A. August 1998. Handbook of Yukon Land and Resource Legislation. p.80.
[42] Canada. 1997(d). Sustainable Development: A Framework for Action. p.1.
[43] See for example: Usher, Peter J. 1987. "Indigenous Management Systems and the Conservation of Wildlife in the Canadian North." p.4.

ties to the land, and long tradition of sustainable use of natural resources.[44] Nonetheless, there is some controversy over the assumption that indigenous peoples will inevitably manage resources on a sustainable basis.[45] There is the fear that local people, even indigenous people with strong ties to the land, might choose short-term economic gains over long-term sustainability. Nonetheless, First Nations are in the forefront of the adoption of sustainability in the Yukon. The Yukon Umbrella Final Agreement (or UFA) sets out the approach to development that the First Nations wish to follow.

The Yukon Umbrella Final Agreement

The UFA, signed in May of 1993, is the product of 20 years of negotiations between the Council for Yukon Indians (now called the Council of Yukon First Nations), and the federal and territorial governments. The UFA sets out, in considerable detail, the framework for final settlements with each of the fourteen Yukon First Nations. All the terms agreed to in the UFA are required to be included in each settlement. To date, 7 of the 14 have been finalized, and several others are very close.

In the Umbrella Final Agreement, one of the objectives is:

> "...to ensure that social, cultural, economic and environmental policies are applied to the management, protection and use of land, water and resources in an integrated and coordinated manner so as to ensure Sustainable Development."[46]

Sustainable development is defined as "...beneficial socio-economic change that does not undermine the ecological and social systems upon which communities and societies are dependent."[47]

The explicit acceptance of sustainable development by First Nations as the

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[44] Kassi, Norma. 1987. "This Land Has Sustained Us." and Usher, Peter J. 1987.
[45] Duerden, Frank. 1992. "A Critical Look at Sustainable Development in the Canadian North." p.221.
[46] Canada. 1993. Umbrella Final Agreement. p.93.
[47] Canada. 1993. Umbrella Final Agreement. p.7.

criterion governing economic development has far-reaching effects for the Yukon. If that criterion is applied, it will not only affect settlement lands (covering approximately 41,440 km^2 or 8.5% of the Yukon's area), but also development throughout the territory. First Nations exert influence over all Yukon development through the right, under the terms of the UFA, to appoint members of boards and committees that form part of the natural resource decision-making process. The boards that have particular influence on mining in the Yukon are discussed in more detail in Chapter 3.

Sustainability and Economics

For the discipline of economics, the concept of sustainability has revolved around the idea of substitutability between different forms of capital (or factors of production). In classical and neo-classical economic theory capital is one of the three factors of production; the others are land and labour. The standard definition of capital was plant and equipment, i.e. manufactured goods designed to help in the production of goods and services. All economic activity consists of combining the three factors in various ways to produce desired outputs. And it has been a standard assumption in neoclassical economic theory that the three factors of production can be readily substituted for one another. Thus if labour is cheap then more workers are hired and less equipment is used.

Until very recently land and labour were, like capital, defined very narrowly in the standard economic texts. In 1988 Samuelson et al. wrote:

> "Land consists of the ground used for farming or under buildings or roads; natural resources include fuels like coal or oil as well as minerals like sand or copper and trees for lumber or paper. Labour consists of the human time spent in production — working in car factories, labouring on farms, or teaching in schools."[48]

[48] Samuelson, Paul A. et al. 1988. Economics: Sixth Canadian Edition. p.22.

The narrow definitions and the assumption of easy substitutability between the factors of production have resulted in a narrow approach to economic development that has long been irksome to many within the economics profession. It has been even more irksome to many more outside of it. The past decade has seen increasing efforts to broaden the outlook of the economics discipline as a whole and particularly to broaden the concept of factors of production. The emergence of ecological economics and of the idea of natural capital has played an important role in this broadening.

Natural Capital and Ecological Economics

In some of the discourse of economics (and even in some of the basic texts) the new triumvirate of natural, human, and manufactured capital has replaced the original three factors of production. Of the three new forms of capital, only manufactured capital retains the narrow definition of its original equivalent. Human capital now includes not just the time spent in the process of production like the labour of old but also broader concepts such as the education level of the population, tacit knowledge and experience. The much broader understanding of what constitutes labour makes the economic payoff from a society's investment in education much clearer. Increases in productivity, and therefore the wealth of society, can stem not just from more investment in manufactured capital, but from a better-educated work force.

Natural Capital

The change of label from land to natural capital has had even wider reaching effects for economic theory than the similar change from labour to human capital. Natural capital includes not just the stocks of potential agricultural land and natural resources, but also the "stock" of complex ecological systems. These systems provide a flow of ecological services valuable both in themselves and for the benefits they provide for humans. Using Samuelson et al.'s definition of land, a forest is simply a collection of potential two by fours waiting to be taken to the sawmill. Looking at the same forest through the natural capital lens, one

sees not just potential lumber, but also a valuable recreation area, a stabilizer of soil, a carbon sink, a provider of genetic diversity, and so on.

One effect of this change of perception is to highlight the always existing complementary (rather than substitutable) relationship between natural resources and manufactured capital. Much manufactured capital is dependent on a supply of natural capital rather than a substitute for it. Obvious examples include a sawmill only having value if there are trees to mill and a smelter being valuable only if a supply of ore is available. As Costanza et al. point out, natural resources and human-made capital have never been good substitutes, but their highly complementary nature was masked during the period when resource supply seemed limitless.

> "The productivity of human-made capital is more and more limited by the decreasing supply of complementary natural capital. Of course, in the past when the scale of the human presence in the biosphere was low, human-made capital played the limiting role. The switch from human-made to natural capital as the limiting factor is thus a function of the increasing scale of human presence."[49]

And because advances in technology, manufactured capital often allowed for the extraction and use of resources that were previously unavailable. This fed the idea that manufactured capital was a ready substitute for natural capital. The substitutability problem is discussed further in the section on weak sustainability below.

Ecological Economics

The strongest proponents of the view that manufactured capital is a complement rather than a potential substitute for natural capital (and for including ecosystem services in the definition of natural capital) are the ecological economists. Ecological economics is an interdisciplinary field of study that has evolved largely over the past three decades. Advocates from the economics side tend to find the

[49] Costanza, Robert et al. 1997. p.102.

traditional boundaries of their discipline far too constricting. Certainly economics does give every appearance of being largely devoted to theoretical models that seem to leave little room for such externalities as the global ecosystem.

Because of its interdisciplinary nature, the work done in the field of ecological economics has been broad. There are, however, some points of consensus. Costanza et al. write:

"The basic points of consensus in the ecological economics vision are:

1. the vision of the earth as a thermodynamically closed and nonmaterially growing system, with the human economy as a subsystem of the global ecosystem. This implies that there are limits to biophysical throughput of resources from the ecosystem, through the economic subsystem, and back to the ecosystem as wastes;
2. the future vision of a sustainable planet with a high quality of life for all its citizens (both humans and other species) within the material constraints imposed by 1;
3. the recognition that in the analysis of complex systems like the earth at all space and time scales, fundamental uncertainty is large and irreducible and certain processes are irreversible, requiring a fundamentally precautionary stance; and
4. that institutions and management should be proactive rather than reactive and should result in simple, adaptive, and implementable policies based on a sophisticated understanding of the underlying systems which fully acknowledges the underlying uncertainties. This forms the basis for policy implementation which is itself sustainable."[50]

These fundamentals of ecological economics are both closely linked to, and heavily influence the ideas of sustainability.

Strong versus Weak Sustainability

Pearce et al. distinguish between two forms of sustainabilty. Weak sustainability is the maintenance of the total stock of capital intact regardless of its composition. Implicit in this approach is the belief that human-made capital can be readily substituted (albeit at increasing cost) for natural capital. Strong

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[50] Costanza, Robert et al. 1997. pp.79-80

sustainability is defined as maintaining the stock of natural capital intact. Thus the receipts from the exploitation of natural energy capital (oil, for example) must be invested in renewable energy production and not in simply any asset. Implicit in strong sustainability is the assumption that human-made capital can not be readily substituted for natural capital.[51] The World Bank has adopted a blended view of the two (giving it the rather loaded label of sensible sustainability), which recognizes that there are good substitutes for some forms of natural capital (e.g. tin) while for others there are no conceivable substitutes (e.g. a functioning ozone layer).[52]

Non-renewable resources have always presented a thorny problem to proponents of strong sustainability. Taken to the extreme, strong sustainability would require that no non-renewables at all may be consumed by the present generation as that would result in decreasing the stock — the oil example above being a possible exception. Of course, the same would also hold true for all future generations, and no use of non-renewables could ever take place. Thus, to justify using non-renewable resources, one must accept (as the World Bank has done) that some substitution between forms of capital is necessary for many of those resources.

Sustainability and Non-Renewable Resources: Different Approaches

Herman Daly outlines one of the simplest conceptual approaches to fitting the use of non-renewable resources into the idea of sustainability:

> "Non-renewable resources should be exploited, but at a rate equal to the creation of renewable substitutes. Receipts from the exploitation of a non-renewable resource should be divided into an income component and a capital component. The division is made such that by the end of the life expectancy of the non-renewable a new renewable asset will have been built up by the annual investment of the capital component."[53]

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[51] Pearce, David W. et al. 1989. Blueprint for a Green Economy and 1990. Sustainable Development: Economics and Environment in the Third World.

[52] Serageldin, Ismail. 1996. Sustainability and the Wealth of Nations. p. 8.

[53] Daly, Herman. 1991. "Elements of Environmental Macroeconomics." p.45.

Daly's approach is based on work done by Salah El Serafy who originally argued for dividing receipts from non-renewables into income and capital components with the capital component invested to produce future flows of income.[54] To make such a division is theoretically simple: all one need know is the appropriate discount rate (which is related to the rate of growth of renewable resources and the rate of growth of factor productivity)[55] and the life expectancy of the resource. In practice however, both of these figures are highly elusive, making the division between components open to much dispute.

Efforts to find a practical (though perhaps rough and ready) means of achieving the collection of at least some of the capital component of non-renewables have led to the adoption of the idea that the economic rent of the resource be captured and invested in some other form of capital. Preferably the investment would be in a renewable substitute for that resource. Indeed, it appears that the capture of rents for re-investment has been adopted (more or less by default) as the criterion of economically sustainable use of non-renewable resources.[56] This criterion is a direct adaptation of work done in the 1970s by John Hartwick and Robert Solow on substitution among exhaustible resources and intergenerational equity.[57] Hartwick's models showed that if all the rents of exhaustible resources were invested in reproducible capital such as machines, then future generations would enjoy exactly the same level of per capita consumption as the present one assuming constant population and no technological change.[58] This became known as Hartwick's Rule, summed up by Solow as:

> "... a society that invests in reproducible capital the competitive rents on its current extraction of exhaustible resources, will enjoy a consumption stream constant in time [and therefore achieve intergenerational

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[54] El Serafy, Salah. 1988. "The proper calculation of income from depletable natural resources."
[55] Costanza et al. 1997. An Introduction to Ecological Economics, p. 124.
[56] See for example, Young, M.D. 1992. Sustainable Investment and Resource Use: Equity, Environmental Integrity and Economic Efficiency. Young outlines UNESCO's policies and prescriptions for sustainable development which include the capture and reinvestment of mineral rents.
[57] See: Solow, Robert M. 1974. "Intergenerational Equity and Exhaustible Resources." and Hartwick, John M. 1977. "Intergenerational Equity and the Investing of Rents from Exhaustible Resources." and Hartwick, John M. 1978. "Substitution Among Exhaustible Resources and Intergenerational Equity."
[58] Hartwick, John M. 1978.

> equity]...this result can be interpreted as saying that an appropriately defined stock of capital — including the initial endowment of resources — is being maintained intact, and that consumption can be interpreted as the interest on that patrimony. This seems like a useful rule of thumb for policy." [59]

Hartwick and Solow's emphasis on the investment of rents in reproducible capital (i.e. any form of productive human-made capital) meets the criterion of weak sustainability. Strong sustainability would require investment aimed directly toward replacing the resource with some renewable substitute for it. While the latter is easy to visualize in the case of solar energy as substitute for oil, it is far more difficult when there is no obvious renewable substitute for the resource. Thus the criterion is not clear-cut, but , as Solow points out, it seems useful rule of thumb for policy.

Applying Hartwick's Rule only to the extent of meeting the criterion of weak sustainability has been dismissed as inadequate by many.[60] Too much of manufactured capital is itself dependent on a continual inflow of natural capital to produce income. Thus the somewhat ridiculous notion of seeing pulp and saw mills as a substitute for depleted forests. Even the generally more acceptable idea of investing rents in the building of roads or the education and training of the population in order to provide benefits for future generations comes in for sharp criticism. Thomas Green writes:

> "...if the investments themselves add to the need for non-renewable resources (e.g. we build more highways or enable higher levels of consumption), or if training is irrelevant to or impedes sustainability (we train more advertisers who encourage consumption), then future generations are not likely to benefit; indeed, they may be worse off as a result."[61]

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[59] Solow, Robert M. 1986. "On the Intergenerational Allocation of Natural Resources." p. 141.

[60] See for example, Dasgupta, Partha. 1989. "Exhaustible resources." Dasgupta argues that the possibilities of substitution of human made fixed capital for natural capital are so limited that they do not deserve serious consideration.

[61] Green, Thomas L. October 1998. Lasting Benefits from Beneath the Earth. p.4.

Applying Hartwick's Rule

Defining Mineral Rents

In theory, defining rent is simple. Rent can be viewed as either the return imputed to land, or the surplus above the return required to motivate production. In other words, rent is the difference between unit extraction costs and final selling price. For non-renewable resources however, there can be two views taken of how the rent of that resource behaves: one over the relatively short term and one over the very long term.

Over the very long term, here defined as the total life of the non-renewable resource — from when it first began to be used by humans till its complete exhaustion — the economic rent of that resource must continuously increase. This is the Hotelling Rule and is explained by Dasgupta:

> "The fundamental point about an exhaustible resource deposit lying untapped is that the only way it can earn a return for its owner is by appreciating in value....the expected capital gains on the resource deposit must equal the expected rate of return on other capital assets in the same risk class. This is a fundamental principle of the economics of exhaustible resources and is today referred to by economists as the Hotelling Rule... Now the capital gains I have been talking about...are...the rate of appreciation of the *ground rent*, or *royalty*, on the mine... The final sales price of the extracted, refined, and transported resource must be approximately the sum of its ground rent—or royalty—and its extraction, refinement and transportation cost."[62]

Thus the rent of a resource rises inexorably and most likely becomes a larger and larger proportion of the (also rising) final sales price of the resource, particularly if technological advances reduce the unit extraction cost of that resource.

For the practical purposes of rent collection however, the very long-term behaviors of rent, price, and extraction cost mean very little. In practice, it is the

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[62] Dasgupta, Partha. 1989. pp.114-115.

simple concept of rent as the difference between unit extraction costs — including both normal profit and a risk premium as well if the industry is considered an especially risky investment — and the final selling price *at the present point in time* which is important.

In Canada the vast majority of non-renewable resources are publicly owned but privately extracted. In return for the right to extract the resource, companies pay to governments the rent of that resource. Because extraction costs vary widely from deposit to deposit for minerals or oil, the rent available for collection will also vary widely. A simplified diagram of available rent for a non-renewable resource is shown in Figure 3 below.

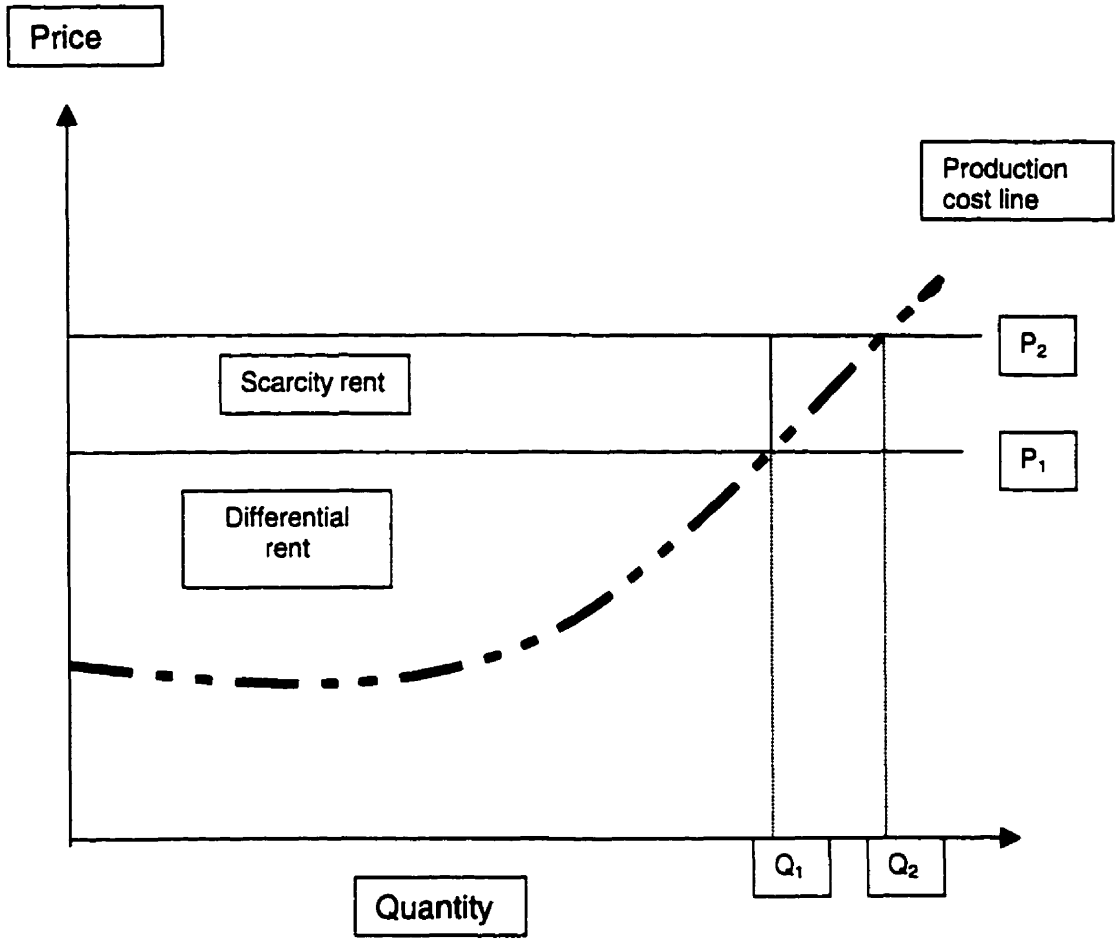

Figure 3: Available Rent

The available rent is also known as the differential rent of a resource as it represents the difference between the unit extraction costs of all the current operations that together supply the total quantity demanded. Unit extraction costs (shown as the production cost line in Figure 3) include all costs of production including a normal profit for the industry. At the margin (e.g. where P_1 meets Q_1) there is no rent available as the last of the ore is produced where the cost matches the price. Under normal circumstances, differential rent is the only available rent as any increase in price leads to the production of the resource from hitherto un-economic deposits. If the price rises but no further production is

possible (at least for a period), then the total rent available will be increased by what is known as scarcity rent, represented by the area between the old price (P_1) and the new price (P_2).

It should be noted, however, that there is some debate over the existence of differential rent. There is the argument that the obvious presence of differentials in deposit qualities does not necessarily imply the existence of differential rents. Mineral deposits must first be discovered and it is very difficult to assign exploration costs to a particular deposit. Producers must be able to earn the excess revenue over costs in high quality deposits to compensate them for exploration costs that result in finding low quality deposits or no deposits at all. Under this scenario, governments collect mineral rents at a pre-set fixed rate, which becomes part of the final price, and so all rents are scarcity rents.[63]

Collecting Mineral Rents

There are many possible mechanisms available to governments for the collection of non-renewable resource rents. These fall into two basic categories: *ex ante* (i.e. rents collected before production), or *ex post* (rents collected after production). *Ex ante* mechanisms include fixed fees and cash bonus bidding. *Ex post* options include royalties and various forms of profit or income taxes. There is an extensive body of literature on the mechanisms of rent collection and a detailed examination of the issues involved is beyond the scope of this thesis.[64] In general however, cash bonus bidding —where private companies bid for the rights to a particular deposit — and the resource rent tax —which taxes only the positive net present value of the cash flow of a particular operation — are considered to be the best, least distortionary means of rent collection. Under ideal conditions, with near perfect information as to the productive power of the asset shared by enough bidders, the cash bonus bidding system would be the perfect means of rent collection. It would be completely non-distortionary with the

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[63] Anderson, F.J. 1985. Natural Resources in Canada: Economic Theory and Policy. pp.141-145.

[64] An excellent overview of the topic is provided by: Garnaut, Ross and Anthony Clunies Ross. 1983. Taxation of Mineral Rents.

most efficient operator paying the entire differential rent for that asset through their bid. Under imperfect conditions cash bonus bidding will still capture some of the rent and a resource rent tax would capture the remainder.[65] The collection of rents is dealt with in more detail in Chapter 5.

The Re-Investment of Rents

The final step in applying Hartwick's Rule — and so making mining meet the criterion of weak sustainability — is the re-investment of the economic rents collected.

Efforts to re-invest natural resource rents have thus far been confined to a number of oil-producing jurisdictions around the world. Alaska has created a fund from oil royalties, the income from which it distributes directly to all residents of the state annually. Alberta created a similar fund, but used much of it to invest in other areas of the economy, apparently with mixed results. Finally, Norway has invested much of its oil royalties in bond and equity markets to provide sufficient income to cover long-term social commitments (e.g. pensions). The experience of these three jurisdictions will be briefly examined in Chapter 7.

Going Beyond Hartwick: A Sustainability Test for Mining

As has been pointed out by Green above, even a careful application of Hartwick's Rule with investment of mineral rents in human capital and infrastructure designed to benefit future generations will not necessarily result in furthering the goal of long-term sustainability. Unfortunately, work on how to apply the concepts of sustainability to the extraction of non-renewable resources in a practical way and on a project basis is still in its infancy. Much of the theoretical framework is there, but practical and meaningful guidelines are not. In

[65] Garnaut, Ross and Anthony Clunies Ross. 1983. pp. 87-125.

an effort to begin filling that gap, Green has proposed a nine-point sustainability test that all mine projects should meet. Green's nine-point test is:[66]

1. Present Need:
The requirement that a need for the mineral exists that cannot be met by reducing use, improving efficiency of use, improving recycling rates, or by extracting virgin ore from existing operations, without causing a mineral shortage that would lead to considerable social hardship and deprivation.

2. Future Need:
The requirement that exploiting the deposit now will be unlikely to deprive future generations of access to deposits of sufficient quantity and quality so they will be able to extract minerals to meet their needs. Effort should be made to take into account the likelihood of future scarcities of fossil fuels, the likelihood of severe restrictions on future fossil fuel use, and the likelihood of technological change in the extraction and processing of ores.

3. Acceptable Legacy:
The mine must be developed so there is high certainty that future generations will not be burdened by the need to undertake ecological restoration, to provide ongoing treatment and decontamination of site discharges, or by the significant loss of ecological productivity or ecosystem services.

4. Encouraging Efficiency Incentives:
Ensure that proceeding with a new mine will not significantly weaken incentives to use minerals more efficiently, to recycle, or to efficiently deplete deposits where extraction has already occurred.

5. Full-Cost:
The mineral must be extracted, refined, and processed in such a way that the producer is responsible for mitigating, compensating, or offsetting the mine's social costs and the known and likely environmental costs.

6. Equity:
Benefits from proceeding with the mine must be equitably shared between those who develop the deposit, those who work at the mine, and those whose landscape and community are affected. Furthermore, through controlling the rate of depletion, implementing a heritage fund, and/or by remediating past mining damage, benefits are shared by several generations.

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[66]Adapted from: Green, Thomas L. October 1998.

7. Consent:
The informed and voluntary consent of those who are most affected by the burdens and costs imposed by the proposed mine must be secured before the mine proceeds.

8. Landscape:
The mine may not significantly interfere with the maintenance of landscape-level ecological function or structure, nor significantly reduce habitat, species, or genetic diversity. In particular, the mine and associated infrastructure should not impede the protection of representative habitats (of sufficient size to contain viable natural populations), along with the connections between such habitats, nor should habitat be significantly fragmented.

9. Offsetting Restoration:
The mine operators will go beyond ensuring that the new mine site will be reclaimed and restored to the highest standards. Even if best restoration efforts are made, closed mines normally leave a landscape of lower ecological value than the original. The mine operators will ensure that there is no net loss in the ecological value and services provided by regional ecosystems due to the new mine, by using part of the wealth generated by the mine to undertake offsetting restoration at previously abandoned mine sites.

As Green points out, no current mine is able to meet all nine of the above criteria, but he argues, quite rightly, that a clear goal is required if sustainability is to be achieved for mining.

Of the nine criteria, numbers 1, 2, and 4 all concern the basic decision of whether a proposed mine is needed at all. Broad acceptance of such criteria, which run completely contrary to the currently accepted market and profit-driven approach, is unlikely in the foreseeable future. There is an argument to be made that if any economic activity (including related activities such as the necessary transportation) pays the full social and environmental costs of the activity (number 5) then the market will function perfectly. Such a perfectly functioning market would make a separate assessment of present or future needs unnecessary. Others would argue that even with full cost accounting, the market is unlikely to take into account likely future needs for example when making

production decisions. Doubtless the argument over these points will continue for many years, perhaps decades. Point 9, the requirement for offsetting restoration, is another criterion that is unlikely to be adopted in the near future. It is an intriguing idea and a necessary one if one accepts the premise that abandoned mine sites cannot be restored to their original (or equivalent) ecological value. But while it may well be decades before all these criteria are accepted and implemented, progress on some of them has been considerable and the groundwork is there to make considerably more progress.

An example of this groundwork is the 180-degree shift in the perception of who is responsible for minesite restoration and for any environmental damage caused by mining. As late as the 1960s, it was commonly accepted that it was the landowner (usually the government) who was responsible. Now it is clearly seen to be the responsibility of the mining company — a large step toward allocating the full cost of mining to the miner. While the industry's efforts in this direction are not always laudable, progress toward having mining operators take better care of the mine's environment and eventually restoring some of its ecological value means progress toward a more acceptable legacy, a less fragmented and better functioning ecological landscape, and also less dissipation of mineral rents via hidden environmental costs. Thus progress on any one of the nine test criteria tends to mean progress on several others as well.

Conceptual Framework

As laid out in the introduction, a fundamental assumption of this thesis is that a sustainable economy absolutely requires a sustainable environment and, in the best of all worlds, would also mean sustainable communities within that economy. A further assumption is that it is both necessary and important that the ideas and criterion of sustainability be applied to the mining industry within the larger context of building an economy that will be sustainable over the very long term. If mining is to be a part of a sustainable economy, each proposed project

must eventually pass a sustainability test such as Green's. While it may be decades before each new mine does meet all the criteria of such a test, making progress toward meeting any one of the criteria tends to result in simultaneous progress being make in one or more of the others, in a self-reinforcing process. Because of this (limited) positive feedback loop, pursuing what initially appears to be somewhat narrow and limited goals can have much broader consequences.

One such seemingly narrow goal forms a part of the central theme of this thesis: how to apply the criteria of weak sustainability to the mining industry in the Yukon. Weak sustainability requires that the economic rents of minerals be collected (usually in a fund of some kind) and re-invested in sustainable forms of economic activity or in other forms of capital in order to benefit future generations. Rent collection and re-investment forms only a part of the equity requirement in the sustainability test but properly implementing it would have broader effects. For example, meeting the goal of weak sustainability requires first that the dissipation of rents must be avoided through the entire mining process. This will require the elimination of unnecessary environmental disruption during exploration, and a full accounting of the costs of mine abandonment and restoration. Thus progress will also be made toward meeting the goals of requiring full cost accounting, reducing harm on a landscape level, and leaving an acceptable legacy.

Ensuring that mineral resource extraction meets the criteria of weak sustainability requires a three-stage process. First, institutional and market structures must be configured in such a way as to minimize the dissipation of rent, that is, to leave the maximum possible amount of rent available for collection. Second, the mechanism of rent collection should be such as to allow for the collection of the maximum possible amount of that available rent. And third, a mechanism is required to prevent those rents from being treated as general revenue but instead allows them to be invested appropriately.

Suggestions for means of accomplishing the first stage are offered in Chapters 4 (for the exploration phase) and 6 (for the mine abandonment phase). The issues and problems of rent collection itself are discussed in Chapter 5. Finally, Chapter 7 touches on possible means of holding and re-investing such rents using three oil-producing jurisdictions as examples.

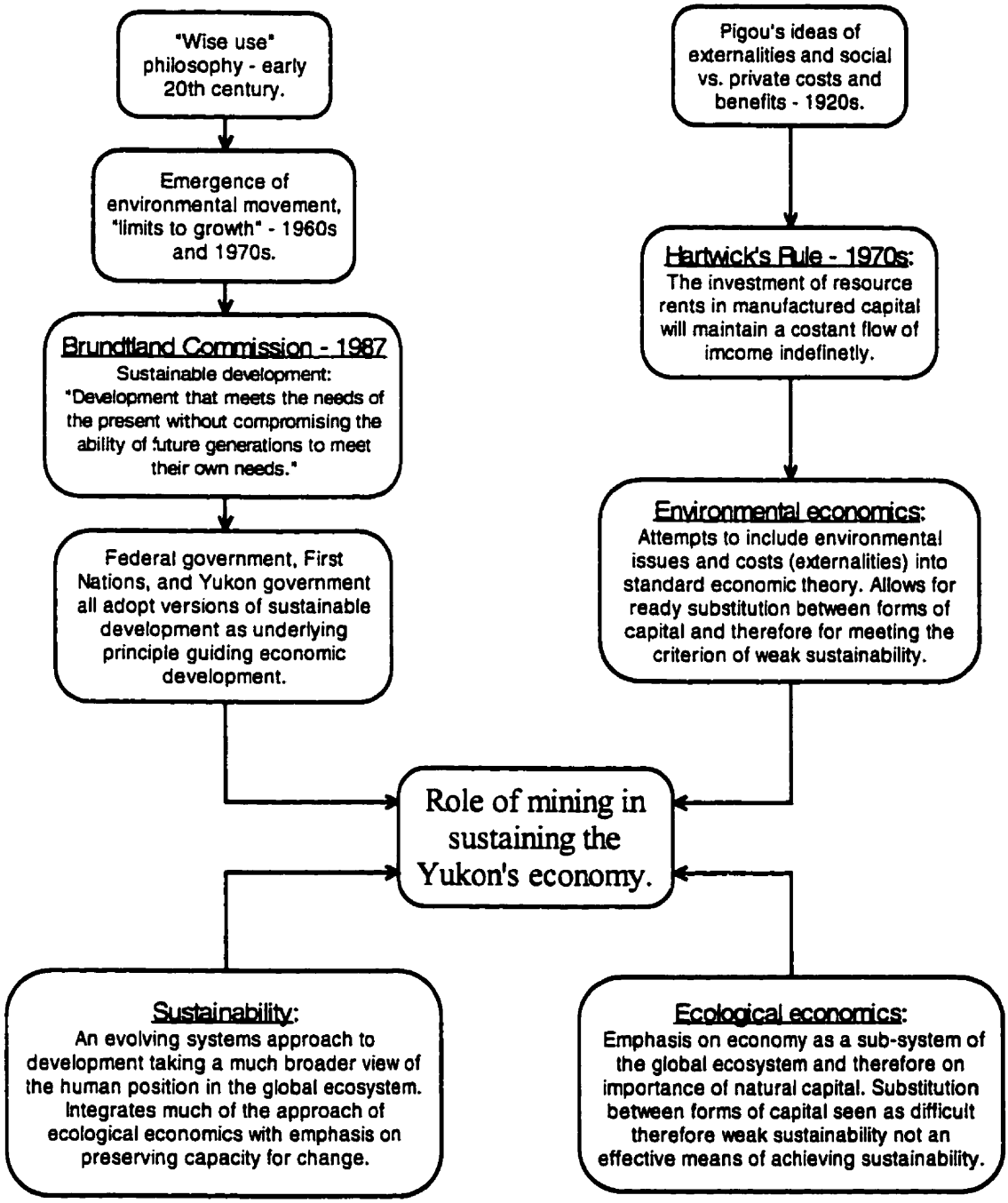

Figure 4: Summary of Major Concepts

CHAPTER 2: ECONOMIC DEVELOPMENT IN THE YUKON

A Brief History

The Pre-Contact Economy

The pre-contact subsistence economies of the Yukon's original inhabitants clearly illustrate the links between societal world view and sustainability. The relationship between hunter-gatherer societies and their physical environment was one in which the environment was viewed not as a threat but as a partner in life.[67] Coupled with social institutions and values that emphasized the sharing of resources and the collective good,[68] this relationship formed a world view that accorded these societies a high degree of resilience and hence stability over a very long period. It is a common mistake to view hunter-gatherers as eking out a miserable existence on the very edge of survival. It is true that First Nations people could — and did — face starvation if their environment turned against them, but that is equally true of agricultural societies who faced famine if their crops failed. The nomadic hunter-gatherers also enjoyed more mobility, flexibility, and leisure than their agricultural cousins did. Indeed, Marshall Sahlin has described hunter-gatherer peoples as "the original affluent society."[69]

This relative affluence showed itself not just in time for leisure, but also in an economic surplus that was the norm in pre-contact Yukon societies. These surpluses resulted in a flourishing trade network. Catherine McClellan writes:

> "Long before the arrival of white men, the Coast Indians were bringing candlefish (or oolichan) grease, dried seaweed, dried clams, clamshells, plant medicines, cedar boxes and seashells into the southern Yukon. Seashells were said to be like jewels to Yukon Indians, and in return for

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[67] Coates, Ken S. 1991. Best Left as Indians. p. xx.
[68] Asch, Michael. I. 1979. "The Ecological-Evolutionary Model and the Concept of the Mode of Production." p.85.
[69] Sahlin, Marshal. 1972. Stone Age Economics. p.1.

> these shells they offered copper, furs, tanned hides, and the lichen dyes and mountain goat hair used in making Chilkat blankets."[70]

Long accustomed to trade, and with adaptability as one of their defining characteristics,[71] the North's original peoples were well positioned to adapt to the first major shift in the Yukon's economy, the introduction of the European fur trade.

The Fur Trade

Although European explorers had begun to enter the North in the late 1700s (Alexander Mackenzie had descended the Mackenzie River to the Arctic Ocean in 1789), European fur traders were slow to follow. Trading posts were established on the Mackenzie and Liard Rivers early in the nineteenth century but these were quickly abandoned.[72] It was not until the middle of the century that the Hudson's Bay Company had firmly established a string of posts from Great Slave Lake through the Liard and Mackenzie Basins all the way to Fort Youcon on the Yukon River, well within Russian territory. The HBC suffered a set back in the central Yukon in 1852 when a group of coastal Chilkats, annoyed at having their trade monopoly broken, eliminated the competition by burning down Fort Selkirk.[73]

Although the trading posts were new to the interior First Nations of the Yukon, the trading process and European trade goods were not — the latter had been reaching them for decades via middle-men. Ken Coates writes:

> "...they [Yukon First Nations] took from the trade only what they wanted; the trade was a supplement to their way of life and did not control it. Conversely, the natives exerted considerable influence over the pace and direction of the trade."[74]

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[70] McClellan, Catherine. 1987. Part of the Land, Part of the Water. p.235.
[71] Cruikshank, Julie. 1975. Their Own Yukon. p.1.
[72] Coates, Ken S. and William R. Morrison. 1988. Land of the Midnight Sun. p.15.
[73] Ibid. p.25.
[74] Ibid. p.29.

First Nations were creating a mixed or dual economy in which people continued their subsistence way of life while trapping to satisfy new needs. Adrian Tanner writes, "...the dual economy can be seen as an attempt to embrace the two poles of sustainability and development within a single society."[75] Although this dual economy of subsistence and furs continued successfully in the Yukon for nearly a century, the volatile nature of the fur market with its changing fashions and fluctuating demands probably made its eventual demise inevitable. In the mean time there was a new dimension taking shape in the economic development of the Yukon.

The Beginning Of Boom And Bust

Two discoveries in the last decade of the nineteenth century brought on the spectacular beginnings of the boom and bust economy that has marked the development of the Yukon. The first was the discovery — or more accurately, the realization — in 1890 that the Beaufort Sea teemed with bowhead whales. The second was the discovery of large quantities of easily mined placer gold in the creeks of the Klondike in 1896.

Although far less famous than the Klondike Gold Rush and having a much more localized impact, the "whale rush" to the Beaufort is perhaps an even better example of boom and bust. The first two American whaling ships sailed into the Beaufort and wintered on Herschel Island, Yukon in the fall of 1890. Both made fortunes during the next summer's whaling season. The *Mary D. Hume* returned to San Francisco late in 1892 with $400,000 worth of whale oil and baleen aboard. It was one of the most profitable whaling voyages in history. The rush was on and by 1894-95 15 ships were wintering at Herschel.[76] In this most extreme example of "get in, get rich quick, and get out" resource exploitation in the North, not even the Canadian government received any benefits from the resource. No royalties were paid on whales taken or on goods traded with the

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[75] Tanner, Adrian. 1990. "Northern Indigenous Cultures in the Face of Development." p.262.
[76] Coates and Morrison. 1988. p.124.

Inuit that together amounted to about $14.5 million in total value by the time whaling ended.[77] Any benefit the Inuit received through working for the whalers and through trade was dwarfed by the costs of close contact with the whalers. Coates writes:

> "By the mid 1890s the local population had shrunk to such an extent that the whalers had to import Inuit from Alaska to work for them...[it is] estimated that by 1930 only a dozen of the original two thousand to twenty five hundred Inuit population of the western Arctic remained, the rest having succumbed to imported diseases."[78]

The Beaufort whaling industry was already in steep decline within twelve years of its beginnings due to extreme overharvesting, and was totally finished by 1914.[79]

The Klondike gold rush had its start in 1896 but did not reach its peak until 1898-99 when tens of thousands poured into the Yukon and, almost as quickly, poured back out again. The exploitation of the Klondike gold fields lasted much longer than that of Beaufort whaling grounds (mining continues at a much reduced level a century after the first big strike), but it too was seen as an opportunity to get rich quick and get out by the vast majority. Coates writes:

> "The preoccupation with quick returns provided the psychological foundation for a boom-and-bust economy, and for a lack of concern with the environment and the aboriginal inhabitants. Most whites came north determined to leave soon and rich. An overwhelming majority achieved the first goal; only a few accomplished the second."[80]

Like the Beaufort whaling, virtually all the wealth generated by the exploitation of the northern resource flowed south as quickly as it could be moved. And, although to a somewhat lesser degree, the aboriginal peoples of the area paid the steep costs of loss of health, and social and economic disruption. Unlike the whaling in the Beaufort, the Canadian government did collect royalties on the

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[77] Coates and Morrison. 1988. p.133.
[78] Ibid. p.128.
[79] Ibid. pp.135-136.
[80] Coates. 1991. p. xxii.

gold mined (and declared) in the Klondike but largely chose not to invest in Northern development.

The Attitude Of Government

Prior to the gold rush, the government of Canada had displayed little interest in the North. That changed for a time in the Yukon during the rush as police and some bureaucrats were sent to keep order and maintain sovereignty. But the official presence declined almost as rapidly as the goldseekers'. The Yukon was seen as a cruel and forbidding land with no prospect of permanent and sustained development.[81] The government therefore made no effort to encourage settlement or to build the transportation infrastructure necessary for permanent development. Another result of this view was the marked reluctance to sign treaties with the First Nations of the North. To sign treaties meant to take responsibility for and the responsibility would lead to the spending of too much money. Federal authorities tended to follow a "best left as Indians" policy to promote economic self-sufficiency among the First Nations[82] while simultaneously encouraging assimilation through the use of residential schools.

Stop And Go: Development From 1900 To The 1950s

While the first half of the twentieth did see some economic development in the Yukon, the pattern was one of stop and go. Hopes for long-term and stable development were often raised only to be dashed. The fur industry went through several boom and bust cycles during this time but the overall increase in fur prices brought a degree of prosperity to many First Nations trappers.[83] Gold mining continued around Dawson, and a large mine opened at Keno in the central Yukon in the 1920s. None of these projects (nor the myriad of smaller mining operations that came and went) brought economic or social stability to the

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[81] Coates. 1991. pp. xvi and 163.
[82] Ibid. 1991. pp.164-169.
[83] Cruikshank. 1975. pp.40-41.

Yukon. Through most of this period the non-native population and the level of economic activity declined.[84]

The exception to this general decline occurred during the Second World War when thousands of American troops poured in to build: the Alaska Highway, the short lived Canol pipeline linking Norman Wells to Whitehorse, and a large number of airstrips. All were designed to safeguard Alaska from Japanese attack. The Alaska Highway was the first direct ground transportation link between the Yukon and the southern parts of the country and the first link of any kind built with public funds, albeit American. It was also the North's first mega-project.[85] Like preceding booms however, the surge of construction included social and environmental costs along with economic benefits.

Optimism And Expansion: 1958 To 1975

The federal government's general policy of benign neglect of the North began to change after WW II but the big shift came in 1958. That year saw Prime Minister Diefenbaker launch an election campaign with the proclamation that his Northern Vision would be a major goal of his administration.[86] Diefenbaker won the election and the development of the North became a national duty. At the core of the Vision was to be the building of "Roads to Resources," designed to open up access to the storehouse of wealth the North was now seen to be. Although Lester Pearson, then in opposition, mocked the program as building roads "from igloo to igloo," the Liberal government that succeeded Diefenbaker's regime in 1963 carried on many of the development programs.[87]

This period did see a boom in the economic development of both the Yukon and the Northwest Territories. With government money pouring in to build infrastructure and subsidize resource exploration and extraction, mining and oil

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[84] Statistics Canada. Various publications.
[85] Coates and Morrison. 1988. p.225.
[86] Zaslow, Morris. 1988. The Northward Expansion of Canada: 1914-1967. p.332.
[87] Ibid. p.338.

companies moved in as well. Oil exploration began in the High Arctic with the drilling of three exploratory wells on the Archipelago in 1961.[88] There was the construction of the Great Slave Railway into the NWT allowing the enormous lead zinc mine at Pine Point to go into production in 1964. Construction of the Dempster Highway into the northern Yukon was begun to facilitate oil exploration. The Mackenzie Highway to Yellowknife was completed. The Yukon saw the opening of three large hardrock mines in the late 1960s, including the very large Cyprus-Anvil lead zinc operation at Faro that was to become the cornerstone of the territorial economy. The population climbed, the economies boomed and the North appeared to be fulfilling its potential.

This period saw the full flowering of the expansionist world view, an often overweening belief that anything, literally anything, could, and would be accomplished. There were even grandiose plans for a mini-city, completely enclosed in plastic domes, for Frobisher Bay.[89] Business and government leaders saw unlimited potential wealth and had faith that technology, ingenuity, and determination would deliver it into their hands. Among the speeches at the Second National Northern Development Conference in 1961 were the following:

> "Certainly the construction of the Pine Point Railway would appear to constitute a great leap forward towards the eventual conquest of the Canadian North."
>
> "...the progressive and aggressive spirit of our nation is at its best when advancing new frontiers and conquering the forbidding facts of nature."
>
> "...nothing holds more importance for the future of Canada than the fullest development of her vast unoccupied continent to the North...[we must] stalwartly unlock the rich but stubborn treasures there...Modern science and mechanical equipment have conquered climate."
>
> "The trip of the atomic submarine 'Nautilus' last winter, beneath the polar ice cap may turn out to have more than passing significance for our northern development: it may have brought proof that world markets are closer to our northern mineral deposits than we dared even hope a few years ago."

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[88] Zaslow. 1988. p.345.
[89] Ibid. p.343.

> "Attention might also be given to the use of northern areas, perhaps unfrozen zones within permafrost, as potential garbage dumps for atomic wastes."[90]

The subduing of nature, the conquest of climate, the exploitation of the "treasures" of the North are the recurring themes. Protecting the natural environment and promoting sustainability do not appear to have been concerns.

By 1970 the tone, if not the substance, was quite different. The Fifth National Northern Development Conference included speeches on the importance of the environment and of social issues. Jean Chretien, speaking as Minister of Indian Affairs and Northern Development, stated: "...the Seventies are a decade of *balanced* and *controlled* development, a period in which the new economic, political, ecological and social development in the North can go forward in harmony with one another."[91] But it was not until the Berger Commission began four years later that the realization of just what such words might entail became clear.

The Bloom Comes Off The Development Rose: The Berger Inquiry

The discovery of an enormous reservoir of oil at Prudhoe Bay, Alaska in 1968 set off another boom in the North. In Canada, the Mackenzie Delta and the islands of the High Arctic became the focus of an intense search for oil and natural gas. A search paid for in large part by tax subsidies that were as much as 120% of costs.[92] Gas in significant quantities was quickly found in these areas, but not commercial quantities of oil. There remained the issue of getting the gas (and the oil from Prudhoe Bay) to market economically, an issue given greater urgency following the oil embargo of 1973 and the subsequent quadrupling of oil prices. The Americans built an 800 mile long oil pipeline from Prudhoe Bay to

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[90] Wansbrough, V.C., R. Rierson, Cyrus Eaton, and J.C. Reed. 1961. Second National Northern Development Conference. pp.10-181.
[91] Chretien, Jean. 1970. "Northern Development Issues in the Seventies." p.132.
[92] Hamilton, John David. 1994. Arctic Revolution: Social Change in the Northwest Territories, 1935-1994. p.166.

Valdez after hurriedly settling native land claims and doing some environmental assessment. The pipeline was not finished until mid-1977 and at a final cost of about $8.5 billion, almost 10 times the initial estimates.[93] For northern Canada the issue became where — not whether — to build a pipeline to tap into the gas reserves of both the Canadian and Alaskan Arctic.

By 1974 there were two competing proposals for northern gas pipelines. The Arctic Gas consortium wished to build a line from Prudhoe Bay across the Alaskan and Yukon North Slopes to the Mackenzie Delta and then south through the Mackenzie Valley to southern markets. Foothills proposed a line south from Prudhoe Bay to Fairbanks, then south-east along the Alaska Highway to Alberta and beyond. Another pipeline, the Dempster Lateral, was envisioned from the Mackenzie Delta south through the Yukon to hook up to the main line on the Alaska Highway, allowing Canadian gas reserves to be exploited.

In March of 1974 the Trudeau government in Ottawa appointed Justice Thomas Berger to head a commission of inquiry into the proposed pipelines. His wide mandate included the likely regional impacts of the pipelines on the economy, on people, and on the environment.[94] Berger took his mandate seriously and, much to the dismay of pipeline proponents and the government that appointed him, set about giving equal consideration to both the proponents and opponents of the projects. The opponents included: environmentalists, social and church activists, and especially the native peoples of the North.

Berger travelled to just about every community to be affected by the pipelines, and listened to anyone who wished to speak. It was a startling departure from the usual and the process captured the imagination of Canadians. The country heard native people speak feelingly of their ties to the land, their love of it, and of their fears of the future. For the first time, the needs of the aboriginal population

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[93] Page, Robert. 1986. Northern Development: The Canadian Dilemma. p.257.
[94] Hamilton. 1994. p.182.

and of the environment were at the front and centre of a debate over economic development.

The Berger Commission resulted in another Canadian first — a mega-project blocked and ultimately killed by environmental and social concerns. Berger submitted his report in 1977 and his recommendations were that:

1. No pipeline should ever be built across the Yukon's North Slope.
2. No pipeline should be built anywhere in the North until native land claims are settled.
3. No pipeline should be considered for the Mackenzie Valley for at least ten years.
4. The Alaska Highway Pipeline and Dempster Lateral could be built following the settlement of land claims.[95]

Berger had his share of criticism, with his report being dismissed as romantically utopian[96] and being himself accused of promoting a separatist "Northern Marxist Nation."[97] The Berger Report marked a turning point for the North, bringing social and environmental concerns to the forefront and setting the stage for a different approach to the issues of development.

The Emergence Of A Government Based Economy

The Berger Inquiry had effectively killed the proposed Mackenzie Valley Pipeline but had cautiously endorsed the Alaska Highway route. This route received formal approval, but the economics of the project eventually proved untenable. In part because of the soaring cost estimates, which reached nearly $50 billion by 1982, the project was abandoned in the early 1980s.[98]

The early 1980s also saw the beginnings of a deep and prolonged economic slump in the Yukon, worse there than in most other areas of the country. Mineral prices dropped sharply during this period, making higher-cost mines

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[95] Adapted from: Berger, Thomas. 1977. Northern Frontier Northern Homeland.
[96] Peacock, D. 1977. People, Peregrines, and Arctic Pipelines. p.195.
[97] Gray, Earle. 1979. Super Pipe. p.174.
[98] Page, Robert. 1986. p.262.

economically unviable. All the territory's hard rock mines closed, GDP plummeted, unemployment soared, the population dropped, and the Yukon government, with very few financial resources, was helpless. It was a classic example of a resource-based economy going bust.

In 1985 the Yukon's economy underwent a fundamental change. Beginning in that year the federal government substantially increased the transfer of moneys to the territorial government. The transfer began to be set it by a formula rather than requiring year by year negotiation. In 1986 for example, the federal government transferred $222m to the territorial government. The average annual transfer in the early 1980s was $104m.[99] That increased funding continues, with the current annual transfer being in the $300m range. The effect of these increased transfers has been to transform the Yukon from a resource-dependent economy to one dominated by the public sector and services as is shown in Table 1 below.

Table 1: Government Role in the Yukon's Economy: 1998[100]

Direct government employment (all levels)	4,939
Total employment	13,692
Government's share of employment	36.1%
Yukon government expenditures	$497m
GDP	$1,086m
Yukon government's share of GDP	45.8%

If direct federal and municipal government expenditures were also included, governments' spending would directly account for over half of all economic activity in the Yukon.

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[99] Yukon Bureau of Statistics. Various publications.
[100] Ibid.

The Economic Importance Of Mining To The Yukon

The importance of mining in the measured economy (i.e. excluding non-market and subsistence activities) of the Yukon summed up in the tables below.

Table 2: Mining Industry Share of Yukon's GDP

Annual value of mineral production (1992-1998 average) [101]	$219.1m
GDP multiplier (per $1.00 exogenous industry output "shock") [102]	1.077
Mining sector contribution to GDP (direct and indirect)	$236.0m
Total GDP (annual average, 1992-1998) [103]	$1,023m
Mining sector share of GDP	23.1%

Table 3: Mining Industry Share of Yukon's Employment

Annual value of mineral production (1992-1998 average) [104]	$219.1m
Employment multiple (total per $1,000 of output) [105]	0.00317
Mining industry contribution to employment (direct and indirect)	694
Total employment (annual average, 1992-1998) [106]	13,568
Mining industry average share of employment	5.1%

As can be seen in the tables, mining is responsible for much of the Yukon's GDP. (As nearly 100% of mineral production is exported, the full value of mineral production is considered to be exogenous industry output "shock"). The industry, however, produces a much smaller share of the Yukon's employment. The difference is due to the capital-intensive nature of mining, where little labour is

[101] Yukon Bureau of Statistics.
[102] Statistics Canada.
[103] Yukon Bureau of Statistics.
[104] Ibid.
[105] Statistics Canada.
[106] Yukon Bureau of Statistics.

required to produce large amounts of ore. It should be noted that the choice of and use of multipliers is often highly contentious. The multipliers used here are from Statistics Canada's 1990 inter-provincial input-output tables (the latest available) and are a reflection of the actual conditions when the numbers were collected. Both the GDP and the employment figures include the direct and indirect benefits accruing from the actual production of ore but not from exploration work.

Exploration

In the early stages of a mineral exploration project (the first year or two) approximately 30-50% of total expenditures are on wages. In the early stage those employed are predominantly skilled workers (geologists, technical people) who tend to not be Northern residents. In the later stages of exploration 15-20% of the budget is spent on wages and more jobs are available for locals. However, these jobs (drilling, for example) tend to require fewer skills. There is a strong bias toward seasonal employment in northern mineral exploration regardless of the skill level of the jobs.[107] The levels of spending on mineral exploration in the Yukon and the estimated number of jobs resulting are summed up in Table 4 below.

Table 4: Mining Exploration Spending and Jobs: Annual averages 1991-1996

Estimated total exploration expenditures in the Yukon[108]	$21.1m
Estimated wage expenditures for exploration.[109]	$5.3m
Estimated number of full time equivalent jobs generated annually for Yukon residents.[110]	99

[107] Diament, Rick. December 1997. Personal communication.
[108] Taken from Natural Resources Canada statistics. Assumes that 90% of Natural Resources Canada's figures (which include overheads) are actually spent in the North.
[109] Assumes that 25% of exploration expenditures are wages.
[110] Assumes that 75% of wages go to Northern residents at $40,000 per job per year.

The Development Of The Faro Mine

Al Kulan was the first to prospect the Anvil region of the Yukon in the summer of 1953. Kulan was drawn to the area by members of the Ross River Dena First Nation who told him of a rusty creek bank. Kulan staked the lead-zinc outcropping he observed, later to become known as the Vangorda ore body (see Figure 5), and he raised sufficient funds over the next 3 years to continue prospecting the area. He staked the main Faro ore body in 1956.

Lack of funds and low metal prices soon stopped exploration in the area however, and the claims were allowed to lapse. By the mid 1960s, rising metal prices had led to renewed interest in the Anvil region. A number of companies, including Dynasty Explorations, formed specifically to follow up on Kulan's earlier work began exploring the area. By the summer of 1965, intensive exploration was underway, and Dynasty formed a partnership with an American mining company, Cyprus Mines. The two formed Anvil Mining Corporation, later known as Cyprus Anvil. That exploration season made it clear that the makings of a mine were present.[111]

The Anvil Agreement

Feasibility studies began in 1966, and from the beginning it was clear that the mining company expected substantial government assistance to bring the mine into production. The final decision to go into production was made in August of 1967 when financing was arranged, sales contracts signed, and the government's role defined with the signing of the Anvil Agreement. In the preamble the federal Government laid out its motive for entering into the agreement:

> "... Her Majesty wishes to encourage and support the proposed mining development in order to expand the economic activity of the Yukon

[111] MacPherson, Janet. 1978. "The Cyprus Anvil Mine" p.117.

> Territory and to provide employment opportunity for Canadians, particularly those resident in the said Territory..." [112]

The government agreed to provide transportation and energy infrastructure for the project as well as assistance in the construction of the townsite of Faro. In total, government assistance came to approximately $28 million out of a total capital cost of about $114 million, or about one quarter of the project. The company agreed: to open the mine and construct the town, to examine the feasibility of building a smelter to process the lead-zinc concentrates produced at the mill, and to make every effort to employ local residents, particularly First Nations residents. Smelter feasibility studies were completed but the smelter was never built, and the company failed miserably in its efforts to employ First Nations people.[113]

Given the era it was signed in, it is not surprising that there was no reference to the environment in the agreement. No environmental assessment was required, nor were environmental baseline studies conducted. There was also no reference to an abandonment plan for the mine. Instead, simply a requirement that the company, "...dispose of its mill tailings in a good and minerlike fashion, satisfactory to the Minister..."[114]

Faro: 1969-1985

The mine and town of Faro are near the Anvil Range of the Pelly Mountains in the central Yukon, approximately 300 km northeast of Whitehorse (see Figure 1). At the time the isolated area had virtually no transportation infrastructure. The nearest road was the Canol, which ran north from the Alaska Highway through the community of Ross River approximately 80 km from the minesite. The Canol was (and still is) a rough, narrow, twisting gravel road entirely inadequate as a major haul route. In 1968, the Robert Campbell Highway running west from the

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[112] Anvil Agreement, August 21, 1967. In: MacPherson. 1978. p.145.
[113] MacPherson. 1978. p.127.
[114] Anvil Agreement, August 21, 1967. In: MacPherson. 1978. p.145.

Faro/Ross River area to Carmacks on the Klondike Highway was completed. The new road would allow the ore concentrates to be hauled by truck as far as Whitehorse. From Whitehorse, a railway ran to tidewater.

Construction of the townsite began in the fall of 1968. In June of 1969, the first 50 houses were near completion when, on Friday the 13th, a forest fire roared through the area, destroying 48 of them. It was an inauspicious start, but the decision to rebuild on the same site was made immediately. Three months later, the first families moved into the new town of Faro. Waste rock stripping at the Faro No.1 orebody and the construction of the mill that would process the raw ore into concentrates for shipping also proceeded through 1969. The mine shipped its first load of concentrates on December 8, 1969.[115]

Although the company owned nearly all the housing in the community and had built the recreation centre, Faro did not remain a company town for long. The town incorporated in December of 1970.[116] The 1970s were boom times for Faro. The mine was profitable, the wages were high, there were the benefits of heavily subsidized housing, and the town grew. Although there were strikes, notably in 1974 and 1976, most residents recall the early years fondly.

The picture began to lose its rosy hue in the early 1980s. Cyprus Anvil became a subsidiary of Dome Petroleum through a corporate takeover of its former parent company, Hudson's Bay Oil and Gas, in 1981. Dome had neither the expertise nor the interest to run the mine, metal prices dropped, and Cyprus Anvil began losing money and building up debt. A temporary shutdown was announced in June of 1982, and Dome put the operation up for sale. The shutdown continued as metal prices remained very low, and although various companies expressed interest in the mine, none made offers.

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[115] MacPherson. 1978. p.122.

[116] Epec Consulting Western Ltd. May 1977. Volume II: Inventory and Analysis, Town of Faro. p.4.

A waste-rock stripping program costing $50 million began in June of 1983. (Touted as a program funded equally by the government and the company, nearly $20 million of the company's half share came via an interest free loan from the federal government).[117] The goal of the program was to prepare the mine for reopening by exposing the ore. It would also make the mine more attractive to potential buyers by reducing start up costs, and provide employment for approximately 250 of the original 750 employees.[118] The stripping program continued until October of 1984 when the company locked out its remaining workers. Negotiations had been underway between the company and its unions over wage concessions. The concessions were seen as a critical part of the effort to attract a buyer who would reopen the mine. The union had offered to accept a 20% reduction in wages, but the company refused, demanding a 40% cut and no guarantees of job security for the workers.[119]

The population of Faro, which had reached a peak of approximately 2,300 in early 1982, had now dwindled to fewer than 800, and more than 80% of the local businesses had closed. The final blow came in May of 1985 when the company announced that it was going to mothball the mine.

Faro: 1985-1999

With the announcement of permanent closure came severance pay for the locked-out workers, and by July 1985, Faro was a virtual ghost town. Despite there being no apparent reason for anyone to remain, a stubborn few hung on, believing that, contrary to all the evidence, Faro had a future. These few (totaling less than 100)[120] were proven correct. In the spring of 1985 a new government was elected in the Yukon. Simultaneously, there began a large increase in the transfer payments from the federal government to the Yukon government. The new territorial government made finding a buyer for the Faro mine one of its first

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[117] Lourie, Bruce. 1987. Mineral Resource Decision Making. p.44.
[118] Cyprus Anvil Mining Corporation. 1984. Socio-Economic Impact Assessment. pp.1-5.
[119] Struzic, E. March 15, 1985. "From Boom Town to Ghost Town in Three Years."
[120] McLachlan, Jim. June 1997. Personal communication.

priorities and made it clear that it was prepared to offer financial incentives to that buyer. The federal government, with its involvement in the stripping program and its construction of more hydro-power capacity at the Whitehorse dam, was also clearly committed to the reopening of the mine.

In the summer of 1985, Clifford Frame, an independent mining executive approached Dome with a proposal to buy the mine. Frame's company, Curragh Resources Inc., Dome, and both the federal and Yukon governments then entered into negotiations culminating in Curragh's taking over of the mine, mill and housing in Faro in November of 1985. The purchase price of the operation was effectively zero. (Dome had paid $340 million in cash for the mine in 1981).[121] The total of approximately $40 million in up-front financing was all required to bring the mine back into production. Of this total: Curragh provided $20 million of privately raised capital; a $15 million line of credit that was 85% guaranteed by the Yukon government, which in turn was 90% guaranteed by the federal government; the two governments jointly provided an outright grant of $3 million; and the Yukon government purchased 122 properties (largely vacant lots) in Faro for $1.6 million and provided a second mortgage of $3.4 million, which was interest-free for five years, on 162 housing units. In addition, the federal government agreed to write off much of Cyprus Anvil's debt and power was to be supplied to the mine at below cost. As a further sweetener, the two levels of government spent approximately $25 million upgrading the South Klondike Highway to allow the mine's concentrates to be trucked to tidewater. Dome received nothing directly. Instead, the former owner was to receive a share of future net profits.[122] The new owner began to work on the mine's reopening, and by the spring of 1986 the mill and mine were back in production.

Curragh carried on mining the Faro ore body and then moved on to the Vangorda deposit in 1990 when the Faro pit was exhausted. Everything

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[121] Financial Post, October 12, 1985.
[122] Lourie. 1987. pp.42-45.

appeared to be running smoothly and the mine was profitable. By 1992 however, the company was mired in difficulties. A horrendous explosion at its Westray coal mine in Nova Scotia and its heavy debt load (caused by its bid to expand through corporate acquisitions) drove the company to bankruptcy. In April of 1993 the Faro mine was shut down for the second time. This time there was no major stripping program to allow some people to continue working, and again the town's population dropped precipitously (though it never fell below approximately 400).[123]

But the mine had been profitable, and there was still ore in the ground. A new company, Anvil Range Mining Corporation, bought the property in 1994 — with no direct government assistance — and after a $75 million stripping program and work at the mill, production began again in August of 1995. Work resumed at the Vangorda deposit and the company began to mine the Grum deposit. Full commercial production was achieved by November 1995.[124] Again, the community got back on its feet, and many hoped for stability as the new company had little debt and owned no other properties.

It appears, however, to be Faro's fate to imitate the cat with nine lives. In November of 1996, Anvil Range suddenly announced that there would be a temporary closure of the mine by the end of the year. The mill would continue to operate until March 1997 using stockpiles of ore. Lower metal prices and a higher Canadian dollar were given as the reasons for the shutdown. The shutdown occurred as announced, but the company appears to have had problems greater than metal prices and exchange rates. Anvil Range declared bankruptcy in April 1998, leaving the property in the hands of a receiver.[125] The mine remains closed, and the community of Faro has shrunk considerably and seems likely to dwindle further as the likelihood of a reopening grows smaller. No

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[123] McLachlan, Jim. June 1997.
[124] Anvil Range Mining Corporation. May 1997. 1996 Annual Report. p.14
[125] Anvil Range Mining Corporation. April 1998. Press release.

buyer has publicly expressed an interest, the creditors are clamouring for any remaining assets (e.g., the mill and related equipment) to be sold, and a large environmental liability remains.

The Importance Of Faro To The Yukon's Economy

Since its opening in 1969, the mine at Faro has played a very large role in the Yukon's economy. In the mid 1970s, the mine's average net addition to the Yukon's GDP was 20%.[126] In the year following the shutdown in 1982, the Yukon's GDP fell by 17%, and after the 1993 shutdown the GDP fell by 18%.[127] In each case, the GDP continued to drift downward in the second year of the shutdown. Of course there were other factors at play in the economy following each shutdown, but it would be safe to assume that the mine had generally accounted for between 15 and 20% of the Yukon's GDP. It appears to be declining in its relative importance, however, as the decline in GDP in 1997 was 7.9% with a further drop of 4.0% in 1998.[128]

Since its inception, the mine at Faro has been the single largest private employer in the Yukon. Between 1974 and 1980, the mine directly employed, on average, 15% of the Yukon's workforce. At its peak in 1981, the mine accounted, directly and indirectly, for 20.1% of total wages and salaries paid in the Yukon.[129] In that year Cyprus Anvil was paying its employees an average of $40,000 per annum.[130] In 1989, under Curragh's tenure, the mine accounted for 11.3% of total employment in the territory.[131] Like its share of GDP, the Faro mine's share of employment appears to have continued to decline in its third incarnation.

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[126] Canada. July 1982. Preliminary Assessment of Cyprus Anvil Mining Corporation and its Impact on the Yukon. p.10.
[127] Yukon. April 1997. Yukon Short-term Economic Outlook 1997. p.3.
[128] Yukon. February 1999. Yukon Short-term Economic Outlook. p.8.
[129] Gunter, Peter E. and S. Green. March 1982. The Impact of Cyprus Anvil on Yukon. p.24.
[130] Ibid. p.14.
[131] Stanley, William E. and Eric C. Vance. May 1990. Curragh's Socio-Economic Contribution to the Yukon. p.17.

Under Anvil Range the mine was estimated to account for a 5% direct share of employment. [132]

The importance of this single mine to the Yukon's economy has reinforced the general attitude of governments and the public in the Yukon that mining continues to be the prime means of economic development in the territory. Indeed, in 1982 during Faro's first shutdown, the Government of Yukon stated:

> "Yukon's economy is on the verge of total collapse. It is an economic region threatened with extinction. The Government of Yukon wishes all parties to clearly understand the magnitude of the problem. Yukon cannot, on its own, recover from the collapse because it has neither the financial capability nor the complete legislative jurisdiction." [133]

Although stated rather dramatically, the Faro shutdown, coupled with the closure of two smaller hardrock mines in the same year, did result in genuine fears of complete economic collapse.

While government itself is the largest single sector of the Yukon's economy — the size of government in the North seems to be related to area rather than to population — and tourism is a growing industry, the economy continues to rise and fall with the ebb and flow of the mining industry. Governments of every stripe, both federal and territorial, have shown varying degrees of willingness to directly subsidize mining projects in general, and the Faro mine in particular. All have agreed however, that the health of the mining industry is crucial to the Yukon's economy. Generally not included in the equation, however, are the environmental costs, both inevitable and potential, that mining causes. In the case of Faro, those costs are now coming home to roost as the mine appears to be largely played out and the profits made, but the environmental clean-up and rehabilitation remains to be done.

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[132] Yukon. February 1999. Yukon Short-term Economic Outlook 1999. p.3.
[133] Yukon. September 1982. Yukon Economy: Strategy for Recovery. p.21.

CHAPTER 3: THE LEGAL FRAMEWORK FOR MINING IN THE YUKON

As discussed in Chapter 1, the federal government retains jurisdiction over water, Crown lands (i.e. almost all land), minerals, offshore oil and gas, and forest resources in the Yukon. All of these are typically areas of provincial jurisdiction in the south. The legal framework governing hardrock mining in the Yukon is currently dominated by the *Yukon Quartz Mining Act* and the *Yukon Waters Act*. Of course other laws (such as the *Fisheries Act*) play roles in the regulation of mining, but they are relatively minor ones.

Changes to the legal framework are underway in the Yukon. The first, while not specifically aimed at regulating mining, will have a very large effect on how mining is carried out in the territory. It is the introduction, likely in 1999, of a made-in-Yukon environmental screening process known as the development assessment process or DAP. The second, less certain change will occur when the federal government transfers responsibility for mining and lands to the territorial government. This devolution of authority will likely mean the replacement of the *Quartz Act* with a piece of territorial legislation that might be quite different.

The Quartz Mining Act

The first laws governing hardrock mining in the Canadian North were the Quartz Mining Regulations made under the *Dominion Lands Act* in 1898. The regulations were copied directly from British Columbia's *Mineral Act* of 1896. The Regulations were re-enacted as the *Yukon Quartz Mining Act* in 1924 to govern

mining in the Yukon Territory. The *Quartz Act*, a piece of federal legislation, was described in 1993 as the least-amended mining legislation in Canada.[134] A number of amendments since then, however, may have taken away that distinction.

At the core of the *Quartz Act*, as in many other similar mining laws, is the 'right to mine' provision. Section 76 of the Act specifies that the process of staking and registering a claim confers on the staker the right to any minerals on that claim and the right to extract those minerals. In the Yukon:

> "The holder of a recorded mineral claim has the exclusive right to all minerals within the claimed area together with the right to enter on and occupy his claim for the efficient and miner-like operation of the mines and minerals contained within the claim. The initial term of the claim is one year with an absolute right of renewal from year to year subject to the performance of work..."[135]

Under the act, there are no restrictions on what a miner can do on his or her claims as just about any work can be justified as being required for an efficient and miner-like operation. This has led to such problems as a company staking a road into a claim block — that is, staking a series of claims end to end and building an access road over them into the claims of interest — to avoid any oversight or environmental assessment of the road work.

The *Quartz Act* was amended in 1996 to allow for the application of land use regulations to activities on mining claims and on mineral exploration. The planned regulations, which came into force in December 1998, are intended to curb perceived sloppy work and unnecessary environmental damage done to the land during both exploration and mining it. The new regulations require the submission of plans — and will hopefully require adherence to them — prior to major work being carried out on mineral claims, and will limit, somewhat, the nature of that work.

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[134] Barton, Barry. 1993. Canadian Law of Mining. p. 147.
[135] Prospectors and Developers Association of Canada. 1996. Yukon Territory. p. 4-7.

The Yukon Waters Act

If the *Quartz Act* was the only law regulating mining activity, there would be very few constraints on mining and certainly no requirements to preserve and protect water quality either during mining or after abandonment. The constraints and requirements are provided by various laws governing water management and use, because water is involved (often in very large quantities) in virtually all mining operations. In the North, as elsewhere in Canada, the *Fisheries Act* provides the Department of Fisheries and Oceans (DFO) with the very broad power to prohibit the destruction of fish habitat or the deposition of deleterious substances into fish bearing waters.[136] The most important legislation for managing water in the North, however, was the *Northern Inland Waters Act*, enacted in 1970. The NIWA created the two territorial water boards, the mandates of which are to:

> "...provide for the conservation, development and utilization of the water resources ... in a manner that will provide optimum benefit therefrom for all Canadians and for the residents of the... territories in particular."[137]

The water boards, made up of Northerners with some experience and interest in water issues, are unique institutions and have a very high profile in the North. They are involved in nearly every major development and have considerable powers to either block or modify development proposals.[138]

In the Yukon, the *Yukon Waters Act* replaced the NIWA in 1993. The new act continues to provide for the conservation, development and use of water in the Yukon, and it maintains the function of the Yukon Territory Water Board. The Water Board's structure and function are now also enshrined in the Yukon First Nations Umbrella Final Agreement, which requires that the Council of Yukon

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[136] Revised Statutes of Canada, 1985.
[137] Pearse, P.H. et al. 1985. Currents of Change. pp.136-137.
[138] Pearse, P.H. et al. 1985. pp.136-137.

First Nations appoint half of the members. The act allows for the enforcement of water licence conditions, for security deposits by developers, and allows the Water Board to deal with the abandonment and closure of mining operations. It also enables the federal government to prohibit all types of land dispositions to protect waters.[139]

The Yukon Water Board

The Yukon Water Board is a quasi-judicial tribunal of nine members, three of whom are recommended by the Council of Yukon First Nations, three by the territorial government, and three by the federal government. Because it wields so much influence over the course of mining developments in particular, the Board has often been the subject of controversy. Somewhat surprisingly however, the mining industry, while sometimes objecting to decisions and complaining about the length of the Board hearings, generally views the Board as being relatively "mining friendly." The Board has often been reluctant to wield its full powers to revoke licences for example, even in cases of serious or repeated breaches of conditions (see Chapter 6 for the Curragh example at Faro). Generally the Board has seen itself as balancing the desire for resource development with the need for environmental protection. As with any effort to strike that balance, it is open to criticism from both sides.

The role of the Water Board in the Faro mine, and particularly the issue of its abandonment will be examined in some detail in Chapter 6.

The Development Assessment Process

The Development Assessment Process (or DAP) is an ambitious effort at creating a made-in-Yukon environmental screening process. The enabling

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[139] Hargrave, A. August 1998. Handbook of Yukon Land and Resource Legislation. p.31.

legislation for DAP is still in draft form. DAP will likely have far-reaching effects on the Yukon's natural resource development. What form those effects will take is the topic of considerable debate. Supporters of concept of DAP see it as a good means of providing an effective means of screening proposed projects, reducing the negative environmental and social effects of development, and effectively widening the natural resource policy network by including many more members of the policy community in the decision-making process. Proponents and developers anticipate that DAP's primary effect will be to add yet more complexity to an already highly complex approval process and generally act as a barrier to their projects.

DAP flows from of the Umbrella Final Agreement. Chapter 12 of the UFA outlines the requirement for the Council of Yukon First Nations, the federal government and the Yukon government to create a development assessment process for all proposed development projects in the Yukon. The process is meant to:

> "...protects and maintains environmental quality and ensures that Projects are undertaken consistent with the principle of Sustainable Development... avoids duplication in the review process for Projects and, to the greatest extent practicable, provides certainty to all affected parties and Project proponents with respect to procedures, information requirements, time requirements and costs; and... requires Project proponents to consider the environmental and socio-economic effects of Projects and Project alternatives and to incorporate appropriate mitigative measures in the design of Projects."[140]

When the process of designing DAP began, many hoped that it would be a true one-window project assessment process. As such, it would bring some much needed streamlining to a very complex approval process. According to project proponents, the current process is approaching paralysis. The major hurdle for a mining project, for example, is acquiring the water licence necessary to operate the mine. The project must pass an environmental assessment process, CEAA (the Canadian Environmental Assessment Act), with its 20-member review

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[140] Canada. 1993. Umbrella Final Agreement. p.101.

committee, and then go the Yukon Water Board, which holds public hearings and can add further requirements. From the Water Board, the proposal then returns to DIAND, which examines it and sends it to Ottawa for consideration by the Minister.

A recent example of the process at work in the Yukon was the water licence for the proposed Minto copper mine. The proponent entered the process with an environmental evaluation in May of 1995, and the final water licence was signed in late April 1998. During those three years the company had to also go through an assessment of its proposed land use, negotiate a benefits package with and receive approvals from the Selkirk First Nation, and receive numerous approvals from DFO, Environment Canada, and various departments of the territorial government. Not surprisingly, mining proponents feel that the process is becoming intolerably long and complex.[141]

Even those with little sympathy for industry grudgingly admit that the approval process could still be effective if it were simplified. The problem has been that while more and more actors wish to be a part of the natural resource decision-making process — or at least to have a direct influence on that process — none of the original players have wished to give up any part of their roles. Indeed, they often look to augment them to maintain their relative importance in the process. This has been the fundamental problem in the negotiations creating DAP. As the draft legislation now reads, virtually the entire assessment system as it is now will remain in place. DAP will simply be added to it. Even the complete replacement of CEAA as it applies to the Yukon has not been achieved. CEAA will still apply under certain circumstances.[142]

DAP will be a federal piece of legislation and will create the Yukon Development Assessment Board (YDAB) and six regional Designated Offices (DOs). The DOs

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[141] Gaffin, Jane. December 7, 1998. "Permitting delays frustrate the Minto."
[142] Canada, Yukon, and CYFN. October 15, 1998. "Development Assessment Process: Fact Sheet 1."

will be the front line of the process. Projects will enter it through the DO nearest to where the project will take place. The DOs have been specifically exempted from acting as a single-window advisor to proponents, however. Proponents will still be responsible for applying for all the required permits and licences. The DOs will screen projects and those deemed to have significant environmental and/or social impacts will be slated for review. The review can be done by the DO, by the YDAB, or by a special panel. During the screening and review process, there is a requirement to consult the public for its views, and technical expertise and traditional knowledge sources from outside the YDAB or DOs will be called upon. Once a review is completed, the DAP body will forward its recommendation — whether the project should proceeded, not proceed, or proceed with conditions — to all the current, relevant regulatory bodies. Those regulatory bodies are in no way bound by the recommendations. They may each in turn accept, reject, modify, or add more conditions to those recommendations.[143]

From the paragraphs above, it is clear that a real opportunity to simplify the project assessment and approval process appears to have been lost. It might be argued, however, that this is not too serious an issue. We live in a complex world, and proponents of natural resource projects with large effects on society and the environment should simply get used to the complexity. But what are the possible advantages or benefits of DAP? There are several, and the most important are: increased meaningful public involvement in the process, specific commitments to the concerns and aspirations of First Nations, and the requirement that traditional knowledge is fully taken into account in the process. Has the opportunity to incorporate these benefits into the assessment process been seized? Not entirely, it seems.

One of the principle commitments in DAP is to allow and encourage open and meaningful public participation and consultation. Among the provisions of the

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[143] Canada, Yukon, and CYFN. October 15, 1998. "Development Assessment Process: Fact Sheet 2."

draft act and its regulations are: minimum time periods for public participation in screenings and reviews, requirements for public hearings, requirements for each DO to provide complete and easily accessible public registries containing proposals submitted, information on environmental and socio-economic effects collected or submitted for screenings and reviews, lists of pending projects, past recommendations, and all relevant legislation, rules, and procedures. In addition, proponents of large projects are required to consult with any community likely to be affected, even before they formally enter into the process. A possible addition to the DAP regulations is a funding mechanism to allow members of the public or public interest groups to participate in the often lengthy and complex assessment process.[144]

Will these ambitious public participation goals be realized? The Canadian Parks and Wilderness Society and the Yukon Conservation Society, two environmental advocacy groups, have strong doubts that they will. These groups point out that DAP calls for a public registry of relevant information to be readily accessible, but there is no requirement for that information to be timely. If crucial information becomes available to the public only after the period of public consultation is past, then it makes a mockery of the idea of meaningful consultation. The groups also point out that, while the importance of public participation is stressed in the purposes section of the draft act, there are no specific provisions or guarantees that this will happen, nor is it clear how public input will be sought. The groups also argue that the current lack of a participant-funding mechanism will drastically curtail the voices of anyone other than the proponent or various levels of government in the process — that is, reduce input from the policy community. Finally, the two groups argue that there is a need for a provision in the legislation allowing the public to request that any specific project be subject to the more rigorous review process rather than a simple screening, and that specific enterprises or activities be declared a project and subject to screening.[145]

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[144] Canada, Yukon, and CYFN. October 15, 1998. "Development Assessment Process: Fact Sheet 7."
[145] Ellis, Jennifer. December 10, 1998. "Key Issues in DAP."

Its origins in the Umbrella Final Agreement make it unsurprising that concern for First Nations issues and the strong involvement of the First Nations themselves in the process are crucial components of DAP. The Council of Yukon First Nations will appoint four of the seven members of the central Yukon Development Assessment Board.[146] Both YDAB and the DOs are required to consult with First Nations and to use traditional knowledge in the screening and review process. Among the purposes written into the legislation are the principles that: traditional First Nation economies be recognized and enhanced, heritage resources be protected, and that the general well-being of First Nations people and their communities be protected and promoted.[147]

Will the Development Assessment Process work in the interests of First Nations? The Council of Yukon First Nations was an equal partner with the federal and territorial governments in designing DAP, and it is therefore likely that the First Nations themselves believe it will do so. But in the end this question, as all the other concerns about the how the process will function, will only be answered some time after DAP is up and running.

In many respects the Development Assessment Process is an adventure into the unknown. It will certainly result in some changes to how natural resource development occurs in the Yukon, and particularly to how such developments are assessed. It will result in some changes to the natural resource policy networks (though perhaps not as many as some had hoped for) and likely broaden the involvement of the related policy community. Above all, however, DAP will for a considerable time be a learning experience, a work in progress, for all concerned. Under the terms of the UFA, DAP is required in some form, and the current draft act is the form it has taken, to the dismay of many. But it should

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[146] Canada, Yukon, and CYFN. October 15, 1998. "Development Assessment Process: Fact Sheet 5."
[147] Canada, Yukon, and CYFN. October 15, 1998. "Development Assessment Process: Fact Sheet 8."

also be possible to improve on DAP and its related regulations as experience is gained.

Possible Further Changes to the Regulatory Framework

The devolution of responsibility for lands and minerals from the federal to the territorial government is expected to occur in the Yukon soon, perhaps as early as the year 2000. (Some skepticism might be in order however, devolution has been a long, slow journey.) When this long awaited event does occur, the Yukon will need to pass territorial laws to replace the current federal ones governing mining. Although it is possible that the current *Quartz Act* will be adopted unchanged by the territory, this is somewhat unlikely. Devolution will bring with it a unique opportunity to update the Yukon's mining law. In the best case scenario, the opportunity will be taken to bring the entire legal and regulatory framework into line with the criterion of sustainability.

CHAPTER 4: MINERAL EXPLORATION

If mining is to meet the criterion of weak sustainability, it is important for the industry's exploration process to avoid the unnecessary dissipation of mineral rents. If the rents are dissipated before mining even begins, it is self-evident that there will be no net gain of rents and hence no possibility of re-investment for the long-term. It must be stressed however, that almost any form of mineral exploration will result in some environmental disturbance and hence some rent dissipation. The goal is to avoid unnecessary damage.

Minimizing rent dissipation during the exploration phase of mining is dependent both on the system used to allocate mineral rights and on the exploration techniques employed. The free entry mineral allocation system used in the Yukon (among other jurisdictions) is the focus of this chapter. An analysis of the techniques of exploration including "best practices," is considered beyond the scope of this thesis.

The Exploration Process

Mineral exploration is a very high-risk endeavor. This truism is well-illustrated by the example of an exploration program carried out by the Hollinger interest in Labrador, covering a 14,000 square mile area, from 1953-1963. The results were as follows:

Table 5: The High Risks of Mineral Exploration[148]

Anomalies indicated by aerial surveys	2,000
Anomalies evaluated on the ground	947
Anomalies drilled	182
Mineral occurrences located	69
Mineral occurrences drilled	25
Significant deposits delineated	4
Economically viable discoveries	0

Such disappointing results are not unusual. Indeed, they tend to be the norm in the mineral exploration industry.

It is generally accepted that mineral exploration is a systematic process in the long term. Mackenzie writes that exploration tends "...to detect first those deposits that are largest, highest grade, closest to surface, and closest to market. Consequently, the best deposits will on average be discovered, developed and exhausted first. Lower quality deposits remain for future mineral supply."[149] Gaffney makes an interesting counter-argument by suggesting that the ingrained psychology of "finders keepers" in the mining industry has the opposite effect. Exploration, he argues, is driven out to the margins, to the virgin ground, far earlier than the economics of potential discoveries can justify the increased expenditures. This psychology, according to Gaffney, often results in potentially superior ground being held in reserve (despite the cost of doing so) while marginal ground on the frontier is explored first to stay ahead of competitors in the field.[150]

If mineral exploration is a systematic process — and even if Gaffney's argument is correct it would appear to be in the long term — then the depletion of superior

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[148] Laughlin, W.H. 1980. Non-Fuel Mineral Exploration in Canada to 1985 p.2.
[149] Mackenzie, Brian W. 1980. Looking for the Improbable Needle in a Haystack: The Economics of Base Metal Exploration in Canada p. 3.
[150] Gaffney, Mason. 1977. "Objectives of Government Policy in Leasing Mineral Lands." pp. 12-13.

deposits will cause the cost of minerals to rise over time. There is an offsetting force at work, however, which acts to reduce cost: advances in technology. Improved exploration techniques, revised geological theories, and more efficient mining and processing techniques allow the discovery of new deposits even on well-explored ground and known marginal or uneconomic deposits to become viable. A Yukon example of this process at work is the discovery of the Brewery Creek gold deposit near Dawson City. The combination of better geological understanding, the use of geochemical analysis of stream sediments as an exploration technique, and the use of cyanide heap leaching as a low cost ore processing technique led to the discovery and exploitation of the deposit.[151]

The expected value of exploration drives mineral exploration for the industry as a whole. The expected value is the average value that exploration will yield in the long term given all the successes and failures associated with a very large number of discoveries. The calculation is made from an average time distribution of cash flows for all economic discoveries within an environment of interest. The expected value must be realized in the long term or investment in the industry by rational investors would cease. It is important, however, to recognize that high discovery risk (i.e. the low probability of finding an economic deposit) and the variability of return among economic deposits make the realization of expected value extraordinarily difficult for any particular investment.[152] Also, many investors in mineral exploration ventures are not particularly rational beings. Investing in junior exploration plays often has more in common with playing the lottery than with rational investment for an expected return. Hope tends to triumph over painful experience time after time.

Mineral Occurrences

The fruits of mineral exploration occur in three forms: mineral occurrences, significant deposits, and economic deposits. A mineral occurrence is any

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[151] Yukon. October 1997. Yukon Mineral Property Update and Diament, Rick. December 1997. Personal communication.

[152] Mackenzie, Brian W. 1980. pp. 5-7.

confirmed incidence of a mineral, regardless of its size or grade. In the Yukon, occurrences are registered on the territorial MinFile once they have been confirmed. Currently the Yukon MinFile contains over 2,500 occurrences.

Although occurrences have an obvious importance (every significant and economic deposit must first be recognized as an occurrence), that importance should not be exaggerated. The discovery rate for occurrences is apparently unrelated to the delineation rate of significant deposits (see section below). Unpublished work by Grant Abbot indicates that the annual discovery rate of occurrences has decreased dramatically since 1974. The decrease has occurred despite tremendous surges in exploration spending in the early and the late 1980s. Indeed, there appears to be no direct correlation between the level of exploration (measured either by expenditures or by staking activity) and the rate of discovery of mineral occurrences over the years 1971-1991.[153]

The decline in the discovery rate is almost certainly the result of the law of diminishing returns. The relatively easy and obvious occurrences (given the current level of geological knowledge and exploration technology) have been found, and so the odds against finding new ones lengthen. Up to 1991, only two of the occurrences contained in the Yukon's MinFile had no surface showing but were found by drilling blind — that is, by relying strictly on interpreting the geology of the area. In the longer term, discovering new occurrences will rely increasingly on expensive and risky blind drilling. This is now the case in heavily explored areas of Ontario, for example.[154] This pattern almost certainly bodes ill for the independent prospector and the smaller junior companies in the longer term. Without surface showings to interest investors, raising funds to carry out exploration will become increasingly difficult.

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[153] Abbot, Grant. December 1998. Personal communication.
[154] Ibid.

Significant Deposits

The term significant deposit is often used somewhat loosely but for the purposes of this paper it is defined as "...a mineral deposit sufficiently attractive to have warranted the expenditure necessary to establish its tonnage and grade."[155] The delineation rate for significant deposits tends to vary wildly over quite short periods. An example is Canada's annual delineation rate from 1960 to 1984. Lemieux shows the rate dropping from a peak of 40 in 1968 to a low of 15 in 1972, only to climb erratically to a new high of 42 in 1981 before plunging again to 12 in 1984.[156] It is therefore important to examine the average delineation rates over time to gain a reasonable idea of the likely future viability of the industry.

In the Yukon the average number of significant deposits delineated per year has remained remarkably constant over time. Over the 28 year period from 1955-1981 there were 38 significant deposits delineated in the Yukon, an average of 1.4 per year.[157] From 1982 to 1995 the Yukon rate dropped slightly to 1.3 per year over the 14 year period.

That the rate of delineation of significant deposits has remained relatively constant over many decades in the Yukon bodes very well for the continued long-term viability of the mining industry in the territory. Given the right economic conditions, almost any significant deposit may become economically viable and result in a producing mine. It is also noteworthy that the average delineation rate has remained constant given the marked decline of the discovery rate as outlined above. Thus the discovery rate appears to have little direct impact on the delineation rate.

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[155] Lemieux, Andre et al. 1986. Canadian Mines: Perspective from 1985. p.23.
[156] Ibid. p.30.
[157] Abbot, Grant. 1982. "Mineral Exploration in Yukon and Western District of Mackenzie: Deposit Discovery Rate and Exploration Potential." p.18.

Economic Deposits

The definition of an economic mineral deposit is also slippery. The usefulness of the concept as an analytical tool is also somewhat questionable given the enormously variable nature of what is economic at any given time. The simplest approach is to rate as economic any deposit that has become a producing mine and no others. From the perspective of rent collection, this is the obvious approach as only operating mines can pay economic rent.

To estimate the expected value of mineral exploration however, the cost and return characteristics of all deposits in the area of interest must be brought to a common point. To do so requires that all be examined under a common set of economic and technological outlook conditions regardless of actual production or lack of it. This was done by Mackenzie et al. in a study of the economics of base metal mining in the Canadian North. [158] Given its assumptions about prices, exchange rates, and rates of return, the study gives expected value assessments (in mid-1983 dollars) of base metal discoveries for 1946-1977 in the Canadian North of:[159]

Table 6: Expected Value and Rate of Return for Base Metal Exploration

	Yukon	NWT	North of 60
Total exploration expenditures	$197m	$140m	$337m
Number of economic discoveries	11	18	29
Average exploration expenditures per discovery	$15m	$7m	$12m
Average return	$145m	$258m	$210m
Expected value	$130m	$251m	$200m
Rate of return	23%	38%	32%

[158] Mackenzie, Brian W. et al. 1984. Base Metal Potential North of 60.
[159] Ibid. pp.34, 36, & 48.

The study concludes that the expected value of base metal exploration in the North was approximately twice as high as in southern Canada. Such high expected values, the study states, should lead to increased mineral activity in the North in the long term, recessions and slumps notwithstanding.[160] Mackenzie's study, coupled with the steady rate of delineation of significant deposits, give weight to the argument that the mineral industry in the Yukon is generally healthy and that its long term prospects are good. Notwithstanding the often wild swings in exploration investment endemic to mining, the industry is highly unlikely to lightly abandon the Yukon.

The Free Entry System

A free entry mineral allocation system operates by granting individuals or corporations the exclusive rights to the minerals under a given area of public land on demand. Certain rules must be followed (the staking and registration process) and the claimant must perform a certain amount of work on the area claimed (known as assessment work). The process can be costly for the claimant (and when staking on a large scale the costs can be considerable), but the government, as owner of the resource, receives little or nothing directly for granting mineral rights.

The free entry system consists of three inter-linked rights: the right of entry onto lands containing minerals, the right to acquire a claim on those lands, and the right to go to a lease and produce the minerals.[161] These rights define free entry. The principle law governing hardrock mining in the Yukon, the *Yukon Quartz Mining Act,* is an example of a free entry allocation system. Under this law the state has only one very crude discretionary power in making allocation decisions: the power to withdraw lands from staking. Beyond that blunt instrument, the

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[160] Mackenzie et al. 1984. p.viii & xii.
[161] Barton, Barry. 1997. "The Future of the Free Entry System for Mining in Canada's North." p. 85.

government has no right to refuse a claimant provided that the claimant has followed the procedures called for by the relevant laws and regulations. (One exception, rarely enforced, is the ability to refuse a claimant who has been guilty of staking fraud in the past.)[162] Non-free entry systems (e.g. a leasing or concession system) give the state far more discretionary power in the process of deciding who will develop mineral resources and where.

A Brief History Of Free Entry

The free entry system of mineral allocation originates in the mining laws that prevailed as customary law in the tin producing areas of England and in the coal fields of Germany in medieval times. Under these laws, miners had the right to enter onto land and to mine it irrespective of who owned the surface rights. The free entry system spread to the New World (likely carried abroad by emigrating miners from England's stanneries) and it fitted perfectly with the expansionist mentality of the 19th century in North America and Australia. Miners were seen as part of the leading edge of the wave of settlement. The perception of the land was that of an unpopulated wasteland (a perception doubtless not shared by the aboriginal peoples), and its exploitation and settlement were high priorities. A fundamental premise of the free entry system is that mining is the best (and often only) possible use for large areas of land.

In North America mining laws have long reflected this premise. In the United States under the 1872 Mining Law, lands subject to the law were declared open for exploration and occupation, and could be bought for very small sums.[163] In Canada, the free entry laws — beginning in British Columbia in 1859 — did not allow for the easy acquisition of the surface rights of mineral claims. The laws allow for the full use of the surface of the claim to extract minerals, however.[164]

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[162] Van Kalsbeek, Leo. December 1997. Personal communication.
[163] Barton, Barry. 1997. pp. 104.
[164] Barton, Barry. 1993. Canadian Law of Mining. p. 119.

The Functioning Of Free Entry In The Yukon

In the Yukon, anyone over the age of 18 years has the right to enter, prospect, and claim minerals on unoccupied crown lands. No licence or permission of any kind is required. The process of staking and registering a claim confers on the staker a set of exclusive rights to any minerals on that claim. In the Yukon:

> "The holder of a recorded mineral claim has the exclusive right to all minerals within the claimed area together with the right to enter on and occupy his claim for the efficient and miner-like operation of the mines and minerals contained within the claim. The initial term of the claim is one year with an absolute right of renewal from year to year subject to the performance of work..."[165]

The Yukon uses the two-post field staking system that requires that a claim be delineated by a location line anchored by two posts placed in the ground. The claim must be a four-sided plot, with no side being longer than 1,500 feet. As a single location line may delineate two claims (with the line as the border between them), most quartz claims are staked as two claim "units" to reduce the cost of staking.

The up-front fees or charges for acquiring mineral rights are nominal. The major expenses to the prospective miner consist of the staking process itself and the ongoing assessment work requirements. The Yukon requires that $100.00 worth of work be done per quartz claim per year or that the same amount be paid in lieu of work to maintain the claim in good standing. A quartz claim covers an area of 51 acres. The work requirement therefore amounts to approximately $2.00 per acre. The types of work allowed as assessment work are not specified under the *Yukon Quartz Act*, but in the Northwest Territories expenditures for the following activities are credited as assessment work:

1. stripping, drilling, trenching, sinking shafts and driving adits or drifts;
2. geological, geochemical, and geophysical surveys;
3. any other exploratory work approved by the engineer of mines;
4. a survey of the claim approved by the Surveyor General;

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[165] Prospectors and Developers Association of Canada. 1996. Yukon Territory. p. 4-7.

5. construction of roads or airstrips to provide access to the claim.[166]

These activities are also generally accepted as assessment work in the Yukon.

The Costs And Benefits Of Free Entry

The costs estimated and discussed in this section are those costs specifically associated with the free entry system and do not include those costs endemic to mining or mineral exploration as a whole. Either the reform of the free entry system or its replacement could eliminate in large part or in whole all the costs discussed. Some of the costs are direct and easily measured while others are indirect and therefore the estimates given are open to debate. Environmental costs, while real, are not included due to difficulties in estimation, and in determining how many of the costs are linked to the free entry system. The costs of free entry are summed up in Table 7 below. The sources of the figures are discussed in detail in the sections below.

Table 7: Costs of Free Entry: Yukon Annual Averages 1992-1996

Field staking	$1,450,000
Subsidization of prospectors	$640,000
Administration costs	$50,000
Dispute costs	$50,000
Total	$2,190,000

Direct costs of free-entry

The direct costs of the free entry system as it functions in the Yukon are the staking costs borne by the industry, and the direct subsidization of prospectors by both territorial governments.

[166] Prospectors and Developers Association of Canada. 1996. Northwest Territories. p. 4-16.

The process of staking claims in the field is an expensive one, and, from an economic perspective, is grossly inefficient. It is inefficient because the same lands can be allocated at nearly no cost by the paper staking process, avoiding the dissipation of moneys on non-productive field staking. Because the costs of field staking are borne up front by industry, in the end these expenditures take the form of lost rent as the industry must still receive its required return after costs before mineral development will occur.

In the Yukon, accurately estimating the total cost of hardrock mineral staking is possible due to the standard size of claims. Staking contractors currently charge $130 per "unit" or pair of claims set on either side of a 1,500-foot long location line. This average cost includes all expenses in the field but not the registration fee of $10 per claim.[167] A total of 55, 795 claims were staked in the Yukon from 1992-1996, at a cost of approximately $7.25 million over those 5 years. The estimated annual average cost was therefore $1.45m.

The subsidization of mineral prospecting by governments is another direct cost of the free entry system as it is currently practiced in the Yukon. Prospector subsidization programs have been in place in the Yukon since 1986. The rationale being that granting small amounts of funds (the maximum grant for exploration is $10,000/year while the maximum for target evaluation is $20,000/year) will act as seed money, encouraging further exploration activity and expenditures. The average annual disbursement over the fiscal years 1992/3 to 1994/5 has been approximately $640,000.[168] Although highly popular among the independent prospectors who are its primary clients, this program appears to be of somewhat dubious value in increasing the likelihood of discovering and delineating significant deposits. The subsidy programs appear to act more as a form of regional or community economic development than as a serious effort to increase mineral discovery and development.

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[167] Davidson, Graham and Denis Jacob. November 1997. Personal communication.
[168] Graham & Associates. January 1996. A Review of the Yukon Mining Incentive Program.

Indirect costs of free-entry

The indirect costs of the free entry system include: unnecessary administrative costs borne by governments, and dispute costs over staking and mineral title borne by both government and industry.

Newfoundland is an example of a jurisdiction that, while retaining the free entry system of allocation, has recently moved from ground staking to paper staking on the island portion of the province. (Labrador was already using the paper staking process.) Newfoundland's experience has been that administration costs are roughly the same for the two approaches. Paper staking saves approximately $1,000 per 15,000 claims staked over ground staking. Field inspection costs however, have dropped by $10,000 to $30,000 per year.[169] It seems reasonable to assume that adopting map staking in the Yukon would save approximately $50,000, the equivalent of one full-time inspector.

Disputes over the boundaries of staked claims, over fractions, and over whether the required staking procedures have been followed are commonplace in the North. The great majority of such disputes are settled outside the formal hearing structures of the mining recorders let alone the courts. This is most likely due to the unknown and perhaps ephemeral value of the ground under dispute and the well known and concrete costs of hearings and court cases. But even settling disputes outside the formal channels does have a cost. Negotiations between companies, delays, and general bad feeling all impose costs although these are very difficult to estimate. In addition, the government commonly bears a part of the costs of any staking dispute as the parties often demand that the mining recorder inspects the entire area under dispute in detail. With large areas involved, this can be prohibitively expensive. The mining recorder occasionally refuses such unreasonable demands and orders the parties to settle the dispute

[169] Andrews, Kenneth. January 1998. Personal communication.

among them. A recent example is a dispute in the Finlayson Lake area of the Yukon between Cominco and Westmin concerning overstaking.[170]

In the Yukon between 1981 and 1997 the Mining Recorder filed approximately 125 notices of hearing. Each hearing is an attempt to resolve some issue concerning mining claims. Of the 125, only 4 have dealt with the staking of hardrock claims. The vast majority deal with disputes over placer claims.[171] Each hearing costs the government approximately $1,500.[172] There appear to have been no court cases at all over the same period disputing the staking or boundaries of quartz claims. Total costs associated with a civil court case of this nature can easily reach the $30,000 to $40,000 range.[173]

Taken together, dispute costs are roughly estimated to average $50,000 per year in the Yukon. This is likely quite conservative, especially during staking rushes when the hidden costs to companies are likely much higher.

Environmental costs

The historical right to enter onto lands and the right of miners to do largely as they pleased on their claims has resulted in the industry having a less than stellar environmental record. Of course, the process of mineral exploration must inevitably lead to some environmental disturbance. This cost must be accepted as part of the mining equation under any allocation system.

However, the free entry system appears to impose higher environmental costs than those strictly necessary to locate and delineate mineral deposits. It does so in part by encouraging poorly financed speculative exploration efforts. Most are legitimate efforts to locate minerals but some are little more than stock promotion scams. Because of the lack of financing and the sometimes transitory nature of

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[170] Van Kalsbeek, Leo. December 1997.
[171] Taken from: Notices of Hearing File. Mining Recorder, Whitehorse.
[172] Wiebe, Dave. November 1997. Personal communication.
[173] Radke, Mark. February 1998. Personal communication.

the companies involved, these efforts result in the abandonment of exploration camps and sites, along with assorted garbage and contaminants. In the Yukon, DIAND has approximately 133 abandoned mineral exploration sites on their files, and has cleaned up 79 of them to date. The average cost of clean up is approximately $10,000 per site giving a total direct cost of $1.33 million. [174] These are the direct costs only. Including the costs of identifying the sites and of any environmental costs caused by contaminants would lead to much higher totals.

Due to the difficulties in estimating the total environmental costs of mineral exploration, and the further difficulty in estimating what portion of those costs can be ascribed to the nature of the free entry system, environmental costs have been left out of the totals in Table 7. It must be emphasized however, that these costs are both real and important.

Mineral industry confidence

Proponents claim two general benefits of the free entry system of mineral allocation. Neither is easily quantified. The first is that the existing system gives the mineral industry the necessary level of confidence to operate in the North. The second is that free entry maintains diversity in the industry, allowing the independent prospector and the small junior companies continued existence.

Representatives of the mining industry often assert that industry confidence is a delicate flower and in need of careful nurturing. Security of tenure is usually cited as the number one concern in choosing where to invest exploration dollars — behind promising geology of course. Any suggestion of modifying the allocation system quickly raises concerns about tenure. That concern almost inevitably precedes comment on how badly the government of B.C. damaged its mining industry by short circuiting established processes and expropriating the Windy Craggy deposit in 1993. Indeed, some make the claim that mining in B.C. is

[174] Hartshorne, Bert. December 1997. Personal communication.

effectively finished, that exploration is in such a steep decline that, as existing deposits are exhausted, there will be none in the pipeline to replace them.[175]

Oddly enough, this strong and persistent perception is not supported by the actual pattern of exploration expenditures in B.C. since 1992. Table 8 below shows the percentage share of total Canadian exploration expenditures in selected provinces and the territories from 1992 to 1998.

Table 8: Percentage of Total Mineral Exploration Expenditures[176]

	1992	1993	1994	1995	1996	1997(p)	1998(f)
	%	%	%	%	%	%	%
B.C	18.6	13.8	13.5	11.1	11.7	12.0	13.4
Que.	24.4	22.2	20.7	17.2	15.3	17.4	20.0
Ont.	20.1	15.8	18.0	18.1	21.8	21.6	17.3
Nfld.	2.9	1.9	2.0	9.9	10.3	8.6	6.0
Man.	8.3	5.7	6.5	4.5	4.6	4.9	5.5
NWT	11.1	21.1	23.8	24.0	21.7	19.0	20.4
Y.T.	2.5	4.0	4.1	5.5	5.2	4.6	4.8

While B.C.'s share of total Canadian exploration did drop from a high of 18.6% in 1992 to 11.1% in 1995, it has since begun to climb and the province's share is expected to be 13.4% in 1998. In dollar terms the rebound has been even more marked. During the same period, the NWT's share more than doubled before slipping, Newfoundland's more than tripled, Quebec's share has followed a similar pattern as B.C. (though less marked), and Manitoba's was nearly halved before recovering somewhat. The large increases in the NWT's and

[175] McFaul, Jim. November 1997. Personal communication.
[176] Canada. June 1998. Natural Resources Canada.

Newfoundland's shares had to result in a decreased share for other jurisdictions, and B.C. in no way stands out as having destroyed its mineral industry. B.C. appears to be particularly vulnerable to wide swings in its share of exploration dollars over the longer term. Its lowest recorded point came in 1986 with a share of 10.3% while in 1990 it took in 29.2%.[177]

The one indicator that B.C.'s mineral industry may indeed be in decline is the ratio of grassroots exploration to advanced work. Currently, 58% of B.C. exploration goes to grassroots activity compared with the 70% Canadian average. Newfoundland does even worse, at 52%.[178] How much of this relatively poor showing in grassroots exploration results from lack of industry confidence and how much from very low copper and gold prices (the two major minerals in B.C.) and a relative lack of generous government subsidy is unclear. If industry confidence in B.C. has been shattered since 1993, why is any grassroots exploration taking place at all? The Fraser Institute's survey of mining companies shows that B.C. is ranked below even Wisconsin as a desirable destination for exploration investment.[179] This is more than a little astonishing as Wisconsin has a blanket moratorium on mining. Again, if things are that bad, why is *any* exploration taking place?

Canada as a whole continues to jockey with Australia for honours as top destination in the world for mineral exploration investments. Total mineral exploration expenditures in Canada rose from $385.3m in 1992 to a peak of $894.8m in 1996, an increase of 132%. Expenditures were forecast to decline to $767.4m in 1998, still nearly double the 1992 figure.[180]

Mining industry confidence appears to be a hardier plant than industry people

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[177] Canadian Intergovernmental Working Group. Fall 1998. Overview of Trends in Canadian Mineral Exploration. p.86.
[178] Ibid. p.9.
[179] Fraser Institute. Fall 1998. Survey of Mining Companies Operating in Canada.
[180] Canadian Intergovernmental Working Group. Fall 1998.

would like outsiders to believe. It is commonplace for mineral exploration to go on in countries that are subject to considerable political risk and wide-spread corruption. It is very difficult to believe that a somewhat altered mineral allocation system, for example, that continues to grant security of tenure would drive the industry out of the Yukon.

Industry diversity

It appears to be intuitively obvious that a free entry system allows for, and indeed encourages, a diverse range of companies in the mineral exploration industry. Low entry costs allow independent prospectors and small junior exploration companies to make a go of the exploration business notwithstanding the growing sophistication and expense of exploration. If intuition is correct, then jurisdictions with free entry should be more attractive to junior mining companies than those with non-free entry. A statistical analysis of the ratio of senior to junior exploration expenditures in two non-free entry jurisdictions (Alberta and Nova Scotia) versus the ratio in Canadian free entry jurisdictions shows this to be the case.[181] Too much weight should not be placed on this analysis however, as the amount of exploration in Alberta and Nova Scotia is small in comparison with the rest of the country.

For the senior companies having a free entry system is not a particularly important requirement, indeed it is not a requirement at all. Unless there is an obvious threat to security of tenure (however acquired), the allocation system used is not a weighty issue to seniors compared with the geology of the area of interest. Kennecott Canada for example, would be equally ready to explore for diamonds in Alberta, the NWT, or in Greenland, provided the ground looked equally promising.[182] The senior companies have both the financial resources

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[181] A T-test was performed on the senior/junior ratios of the two groups of jurisdictions over the period 1992-1997. (Data source: Canada. June 1998.) The result was t=0.25 with 12 degrees of freedom, leading to the rejection of the null hypothesis that the ratios were the same.

[182] Finlayson, Eric. November 1997. Personal communication.

and the experience needed to operate under a large variety of regulatory regimes.

Given that free entry allows and encourages small exploration outfits to operate, the question becomes whether this is an economically desirable state of affairs. It has been argued above that poorly financed exploration companies can impose unnecessary environmental costs. It has also been argued elsewhere that free entry results in a mining industry version of the tragedy of the commons. Every prospector will explore and stake the moment he or she perceives the value of the claim to equal his or her outlay. The process is often repeated several times, sometimes over decades, before a deposit is eventually developed. This results in the dissipation of the economic rent of the resource as all the expenditures plus the interest on them must be paid out (in theory at least) of the producing deposit.[183]

Historically the prospector and the smaller juniors have played a strong role in the mineral industry, discovering many deposits and generally adding value before deposits went to production. Is this still the case? Will it continue to be the case?

A twenty-year-old analysis by P.A. Bailly on the optimum size of an exploration budget suggests that, even by the 1970s, the large majority of economic mineral discoveries were made by medium- to large-sized (but not too large) exploration teams.[184] The following table is adapted from the study.

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[183] Gaffney. 1977. pp. 17-18.
[184] Bailly, P.A. 1977. Quoted in: Mackenzie. et al. 1980.

Table 9: Exploration Budgets and Economic Discoveries

Annual Exploration Budget (1974 dollars)	% of Economic Discoveries	% of Exploration Expenditures
> $5 million	15	44
$2-5 million	35	14
$1-2 million	40	13
< $1 million	10	29

Overall, the outlook for the independent prospector and the small junior mining company does not look bright in the long term regardless of the mineral allocation system. The decline of the mineral occurrence discovery rate (discussed above), means that many, if not most, of the readily detectable deposits have already been found and exploration will become increasingly costly. While the nimbleness and entrepreneurial spirit of the small operators will likely carry them on for a considerable time yet, it appears that in the long run their fate will be that of the small farmer on the prairies — a few will hang on but their time will be past.

Reforms Of And Alternatives To Free Entry

There are two areas in the current free entry system that can be reformed to increase economic efficiency and available mineral rents without fundamentally altering the nature of the system: replacing field staking with paper staking, and altering the assessment work process.

Paper staking

To move from field to paper staking is an easy and obvious means of improving the efficiency of the mineral allocation process. The industry would save many millions of dollars in staking costs over the years and be able to put that money to more productive uses. The costs of conflicts over claim boundaries and disputes over correct staking procedure would also be eliminated. Governments

would reduce their costs by eliminating staking inspections. Using the figures given in Table 7, the use of paper staking in the Yukon in the early 1990s would have reduced rent dissipation by approximately $1.5 million per year.

Of course, a change to paper staking would not result in universal joy. Field staking can be viewed as a tradeoff that governments make between future resource rents and current regional economic stimulation. Staking dollars currently end up in the pockets of local staking contractors and their employees, local helicopter pilots, and various other suppliers.

The work assessment process

The requirement to perform a certain amount of exploration work on mineral claims or pay the equivalent sum as rent is known as assessment work. The assessment work requirement attempts to: discourage holding large tracts of land for speculative purposes, encourage the development of mineral deposits into producing mines, and, as a side benefit, create some employment and economic activity in what is usually an economic hinterland. All of these goals could be better achieved by simultaneously expanding the list of eligible work and raising the value of the work requirements.

When the *Yukon Quartz Mining Act* was passed in 1924, the representation (or assessment) work requirement was set at $100.00 per claim or approximately $2.00 per acre.[185] The current assessment work requirement in the Yukon is still $100.00 per claim. Using the consumer price index as measured by Statistics Canada as a deflator, that $2.00 per acre in 1925 (the first year for which inflation figures are available) is equivalent to approximately $20.00 per acre today. (More specifically, $100.00 in 1925 would be worth $993.20 in 1997 dollars.) If $2.00 an acre was sufficient in 1924 to meet the three goals outlined above, it appears obvious that one tenth of that amount (in real terms) is inadequate to meet them today.

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[185] Statutes of Canada, 1924. Chpt. 74 Sect. 54.

That the assessment work requirement is now lower than the optimum is shown by the degree to which companies that are seriously exploring their properties exceed the required minimums. For example, Viceroy Exploration, the owner of the Brewery Creek mine in the central Yukon, spent US$1.4m exploring their claims in 1997, far exceeding the required minimum of C$320,000.[186] Another example is Cominco's spending approximately $11m on the Kudz Ze Kayah property in the Yukon since discovering it in late 1993, again far more than the minimum required.[187] Just what the minimum work requirement should be today to encourage the development of mineral properties without discouraging the necessary degree of initial exploration is open for debate. It may be less than $20.00 per acre, but is certainly greater than the current $2.00 per acre.

Given a rise (perhaps substantial) in the required assessment work, it would make sense to simultaneously revisit the list of types of eligible assessment work. Adding environmental baseline studies, environmental impact assessments, marketing studies, and other work required to bring a mine into production to the list would both recognize the importance of such work and mitigate some of the financial impact felt by the industry. A substantial increase in the minimum assessment work requirement would likely force out some of the smaller and less well-financed of those currently exploring for minerals in the Yukon.

The Greenland model

The system of mineral allocation used in Greenland offers a possible alternative to (rather than simply a reform of) the current free entry system in the Yukon. The Greenland system consists of a staged process for acquiring mineral title. The three stages are: the prospecting licence, the exploration licence, and the exploitation licence. A summary of the system appears in Table 10 below.

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[186] Diament, Rick. December 1997.
[187] Yukon. December 1998. Yukon Mineral Property Update. p.26.

Table 10: Greenland's Mineral Allocation System[188]

Licence type:	**Prospecting**	**Exploration**	**Exploitation**
Time period:	Personal: 1 year Corporate: 5 years	5 year term, renewable for another 5 years.	30 years.
Area covered:	Unlimited within one of three regions	5 km^2 minimum, no maximum.	Approx. 5km^2
Fee: (in Canadian dollars).	Personal: $23 Corporate: $690	$5,750 per term with additional $5,750/year during second term.	$23,000
Work obligations: (in Canadian dollars per year).	None.	Years 1-2: $23,000/year + $230/$km^2$ Years 3-5: $46,000/year + $1,150/$km^2$ Years 6-10: $96,000/year + $2,300/$km^2$	None.

A prospecting licence, which can be either individual or corporate, is valid for five years and grants permission to prospect in one of the three regions of Greenland. The right to prospect is valid only on those lands not already covered by an exclusive exploration licence. The prospecting licence does not grant rights to any minerals found. A corporate prospecting licence requires that the company provides information on its technical and financial capabilities (including annual reports) and the government reserves the right to refuse any applicant. The fee is due on application and is non-refundable even if the application is refused. There are no exploration obligations attached to a prospecting licence.

An exploration licence grants a five year exclusive right to explore a minimum defined area of 5 km^2 (there is no maximum area). The licence is renewable for a further five years, and, under exceptional circumstances may be extended to a total of 16 years. As with the prospecting licence, the company's financial and technical capabilities are examined as is its track record in Greenland —this can include its success in hiring and training local labour. Again the government retains the right to refuse any applicant. In addition to the fee levied on granting of a licence, there is a non-refundable $1,150 application fee. There is a sliding

[188] Mineral Resources Administration for Greenland. 1997.

scale of assessment work obligations based on flat fee plus area rate. Work obligations may be met in part with either environmental or feasibility studies. Both up-front fees and work obligations are linked to inflation by the Danish consumer price index.

The exploration licence does not in itself grant title to any minerals found, but provided the licencee has met the stipulated obligations, he is entitled to an exploitation licence for any minerals found. An exploitation licence is for a 30 year term and is granted to the holder who intends to exploit his deposit. The applicant must have an ore body delineated, a bankable feasibility study, an environmental assessment report, and a closure plan in place before the licence is granted. The area covered by the licence will be the delineated ore body plus one kilometre in every direction, but may be extended on evidence of ore bodies extending beyond the area.

The scale of work obligations is designed to increase sharply toward the end of the exploration licence period to encourage companies to focus their exploration onto a smaller area relatively rapidly. This frees up areas for new companies to move in, perhaps with fresh geological theories. Greenland's experience over the past five years indicates that this indeed is happening as areas let go by some companies have been taken up by others.[189] (The holder of an exploration licence may reduce its size at the end of each year in the licence period.)

Although seemingly restrictive to those accustomed to the free entry system, this approach was instituted in 1991 to make Greenland more attractive to mining investment. In particular, the 1991 revision of Greenland's mining laws eliminated the right of the government to become a partner in any mining venture, taking a stake of up to 50% of a project. In addition, the old laws gave no fixed terms for the granting of exploitation licences. These terms would be

[189] Mineral Resources Administration for Greenland. 1997. p.37.

negotiated on a case by case basis when an exploitation licence was applied for.[190] Under the new laws, there has been no lack of industry interest in the country. Much of the interest is generated by geology similar to both Voisey's Bay in Labrador and the Lac de Gras area in the NWT. (Greenland is a very remote and expensive area to explore. It therefore requires good geological prospects in order to attract exploration under any allocation system.) This interest is illustrated in Table 11 below.

Table 11: Mineral Exploration in Greenland: 1992-1997[191]

	1992	1993	1994	1995	1996	1997 (April)
Prospecting licences	12	15	17	21	22	22
Exploration licences	22	23	25	35	60	70
Area under licence(km^2)	10, 029	10,790	8,788	23,127	60,525	75,810
Exploration expenditures	$6.2m	$10.9m	$10.8m	$16.0m	$15.3m	-
Metres drilled.	0	6,679	12,733	17,134	8,538	-

Note: Expenditures are given in Canadian dollars.

Greenland versus the Yukon

A company holding the minimum 5km^2 exploration licence in Greenland for five years will pay $5,750 in fees, and must spend a minimum of $203,550 exploring the area over the five years. The equivalent in the Yukon would be a company holding a block of 24 quartz claims. Total fees for those claims are $240 and work obligations over the five years total $12,000 — a substantial difference. The difference becomes even more substantial over a 10-year span. Holding the

[190] Mineral Resources Administration for Greenland. 1990. pp.26-29.
[191] Mineral Resources Administration for Greenland. 1997. p.36.

5km^2 in Greenland for 10 years will currently cost $40,250 in fees and $741,050 in work requirements. The Yukon equivalents will total $240 in fees and $24,000 in work requirements.

From the sustainability perspective, Greenland's approach to mineral allocation has several advantages over the free entry system of the Yukon. Adopting a version of it would allow the Yukon to screen prospective miners, eliminate field staking, and discourage the holding of large blocks of land for speculative purposes.

CHAPTER 5: DURING MINING

While mining is underway, meeting the criteria of sustainability requires that rents are collected efficiently and that environmental damage is minimized through out the mining process. In addition, where there is a community totally dependent on a mine (e.g. Faro) the issue of sustaining the community also arises. This chapter examines these three issues.

THE COLLECTION OF MINERAL RENTS

When faced with the task of collecting the rents that are its due, government has four broad objectives in view. These are: to maximize the revenue collected, to ensure the neutrality of the rent collection system (i.e. to avoid distorting the investment decisions made both within the mining industry and between mining and other industries), to reduce the uncertainty and risk both for itself and for the industry, and, perhaps least importantly, to avoid undue delays in the collection to rents.[192]

There are many possible mechanisms available to governments for the collection of mineral rents. These fall into two basic categories: *ex ante* (i.e. rents are collected prior to production), or *ex post* (rents collected after minerals have been produced). *Ex ante* mechanisms include fixed fees and cash bonus bidding. Although cash bonus bidding is commonly used in the oil and gas industry, it has not been used in the mineral industry. *Ex post* options include royalties and various forms of profit or income taxes.

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[192] Garnaut, Ross and Anthony Clunies Ross. 1983. Taxation of Mineral Rents. p. 87.

Options For Collection

Ex ante options:

Selling mining rights for a fixed fee is a means of collecting rents regardless of the outcome of the investment. In fact, the government collects "rents" even if there is no investment at all.[193] If all mining operations begin with the payment of the same fixed fee then the effect is to raise the production cost curve in Figure 3. At any given price level, this reduces the number of economically viable operations but ensures the collection of at least some of the overall mineral rent, represented by the area between the old and new cost curves. By treating all operations identically however, the fixed fee approach fails to collect any of the differential rent generated by the most cost-effective operations (those on the bottom end of the cost curve). In general, a fixed fee approach to rent collection:

> "...is most appropriate when the government has little idea of the value of what it is selling or the investor of what he is buying, and where the actual proceeds will be hard to assess in any case. Thus it may be suitable for the sale of exploration, as distinct from extraction, rights..."[194]

Fixed fees are simple to administer and provide a high degree of certainty to both industry and government, but are somewhat distortionary and tend to leave much of the available rent in the hands of industry.

Cash bonus bidding, in which companies bid for the mineral rights over particular areas, are a variation of the fixed fee approach. The fee, however, is set by auction, not government fiat. Under ideal conditions, with near perfect information as to the productive power of the asset shared by enough bidders, the cash bonus bidding system would be the perfect means of rent collection. It would be completely non-distortionary with the most efficient operator paying the entire differential rent for that asset through their bid. It would be relatively simple to administer, and the government would receive much if not all the rent up front.

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[193] Garnaut and Ross. 1983. p.91.
[194] Garnaut and Ross. 1983. p.91.

Of course geological information is never perfect or even near perfect. The cash bonus bidding system has had considerable success in the sale of offshore oil rights in the continental United States. There the geology was sufficiently predictable to calculate reasonable odds for success, there were sufficient numbers of bidders, and it was possible for large producers to acquire a large number of diverse blocks, decreasing their overall risks. Under those conditions, a reasonable amount of the differential rent of the resource was collected.[195] Cash bonus bidding has not yet been applied to the metal mining industry due to the lack of reliable information on the value of the resource, if any, in an area before it has been thoroughly explored. There is also the problem of attracting sufficient bidders to make the auction meaningful.

Ex post options:

Of the *ex post* means of rent collection, royalties are by far the most common. Royalties are levied either on the amount of mineral extracted or on its value as it is being produced. In either case, royalties have the attraction of being very simple to administer. The amount of ore being produced is easy to check and not open to interpretation. Unfortunately, an amount-based royalty system (which demands a flat fee per unit of mineral produced) does nothing towards collecting differential rent as it has no connection to the price of the mineral. It therefore has a similar effect as fixed fees in that it raises the unit cost of extraction for every operation. On Figure 3 this would result in simply raising the cost curve and, depending on the relative size of each operation, change the shape of the curve slightly. In the event of a sudden price rise and emergence of scarcity rents, an amount-based royalty would collect none of them.

A value-based royalty system is somewhat more effective in rent collection as it is set as a percentage of the mineral's price. As the price rises, the royalty will also rise and so collect at least some of any available scarcity rents. But it too suffers from an inability to collect much of the differential rent as it does not

[195] Garnaut and Ross. 1983. p.91.

distinguish between low and high cost operations. Two operations producing an equal volume of ore — and of course receiving an equal price — will pay identical royalties despite one being at the beginning of the production cost curve and the other operating at the outer margin. In addition, both types of royalty system tend to reduce both the pace and the extent of extraction — the high grading effect. This is socially wasteful as ore is left in the ground even though its price exceeds the social cost of its extraction.[196]

Other means of *ex post* rent collection — all of which attempt to collect the differential rent — involve taxing either the income or profits of mining companies, or taxing the positive net present value of the cash flows of mining operations. The imposition of a higher rate of income tax on mining companies would have the advantage of operating through the existing tax system, and, as a rule, would bring in more of the mineral rents than either the fixed fee or royalty approach.[197] The potential disadvantages of such an approach include: its blanket nature, the problem of setting the rate so as to collect as much rent as possible without discouraging too many potential projects, and the incentive it gives companies to dissipate rents through higher overheads. Ideally, rent collection would be sensitive to the features of each project and would not give the miners of superior deposits the incentive to pad their overhead expenses. A variation of this approach is the progressive profits tax, analogous to the progressive individual income tax system. A progressive tax would likely collect more of the differential rents than the flat higher tax, but it suffers from the same problems of setting the best rate and the thresholds at which the rate will increase.

The resource rent tax aims to tax the positive net present value of a mining project as it is realized. The tax is assessed at a discount rate that would aim to match the investor's discount rate closely, thereby taxing only the positive net

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[196] Garnaut and Ross. 1983.p. 93.
[197] Ibid. p.95.

present value as the investor sees it. All cash flows of a project, both positive and negative, are summed each year to yield a net figure. Those net figures accumulate year by year at a set interest rate until a cumulative total is attained, which is then taxed at the tax rate. The resource rent tax, if properly applied, does ensure collection of much of the differential rent, and does so with minimal distortion of investment decisions. Its drawbacks include the difficulty in matching the investor's discount rate with sufficient accuracy, and the relatively high administrative costs. The resource rent tax is used in Papua New Guinea and in Tanzania. [198]

The Yukon's Mineral Royalty Regime

The mineral rent collection regime in the Yukon is a value-based royalty regime. However, it can also be viewed as a project-specific profit tax because of some of the deductions permitted.

Table 12: The Yukon's Royalty Regime

Value of output	Yukon royalty rate[199]
$10,000 - $1 million	3%
$1 million - $5 million	5%
$5 million - $10 million	6%
> $10 million	+1% for each additional $5 million.

Under the *Yukon Quartz Act* the value of output is calculated as the market value of the ore at the pit mouth less allowable deductions that include:

1. total operating costs of the mine.
2. transportation costs of the ore.
3. an annual depreciation allowance of 15% on plant and equipment.
4. exploration expenditures incurred by the company either on the mine property or elsewhere in the Yukon.

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[198] Garnaut and Ross. 1983. pp.97-99.

[199] Revised Statutes of Canada, 1985. Vol. VIII, Chpt. Y4, Sec. 100.

5. all other taxes payable on the profits of the mine or profits made in smelting and refining the ore.

This section of the Act has remained unchanged since it replaced the previous amount based royalty regime in 1928.[200]

Any attempt to apply the sustainability criteria to the mineral sector in the Yukon by maximizing the collection of rents must clearly recognize the fundamental conflicts inherent in doing so. First is the conflict between collecting the economic rent now for long-term benefit versus trading off the future benefits for more economic activity and economic development now. In practical terms this is what occurs at the present as government directly and indirectly trades off the mineral rents in an attempt to encourage greater investment by the mineral industry in the Yukon. A second conflict is simply a version of the first. That is, any short-term economic costs (i.e. less mining) stemming from a policy of sustainability would be high for, and be largely borne by, northern residents. The long-term benefits of the policy would be spread throughout the population of Canada.

Fees, Royalties And Administrative Costs In The Yukon

The totals for fees and royalties from the mining industry in the Yukon collected by the federal government are shown in Table 13 below. These totals are annual averages from the early 1990s (each figure's footnote gives its source and coverage). Also shown are the current budgets for both the federal and the territorial governments' spending on the administration and promotion of the mineral sector in the Yukon.

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[200] Statutes of Canada, 1928. Chpt. 53, Sec. 93.

Table 13: Average Annual Fees, Royalties, and Administration Costs of Mining in the Yukon 1992-1997

Fees collected	$1.3 million[201]
Royalties collected	$0.4 million[202]
Territorial costs	-$2.3 million[203]
Federal costs	-$3.0 million[204]
Total	-$3.1 million

Clearly the fees and royalties levied on the mineral industry in the Yukon do not cover the costs of administering, subsidizing, and promoting the industry. Of course, governments also reap tax benefits from the activities of the industry both directly and indirectly. These include corporate income tax, income tax from those employed in the industry, taxes from firms and individuals working as suppliers to the industry, and the general spin-off effects generated by the economic activity.

The territorial government appears to be the only net gainer and only marginally so. Although the Yukon government's corporate tax take tends to be small, the personal income tax generated from mining can be considerable. As a very rough estimate, the total of approximately 920 jobs generated annually in the Yukon (see Table 3 and Table 4) would produce approximately $2.6m in income taxes for the Yukon government.[205] This figure, however, does not take into

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[201] Wiebe, Dave. November 1997. Personal communication. Average for the fiscal years 1991/92 to 1995/96. Includes application and transfer fees, payments in lieu of assessment work, certificates of work, quartz lease renewal fees, and miscellaneous income from the sales of maps and claim sheets. Does not include any fees collected from placer mining. Taken from Yukon Mining Recorder's Annual Reports.

[202] Camlucci, Doug. February 1998. Personal communication. Annual average of royalties collected under the authority of the *Yukon Quartz Mining Act* for the fiscal years 1991/92 to 1996/97.

[203] Abercrombie, Shirley. February 1998. Personal communication. Includes resource assessment, marketing programs, the Yukon Mining Incentive program, mining facilitator, mineral development unit, and the cost-shared geology program (which absorbs nearly $1.4 million of the total).

[204] Estimate only. DIAND Yukon could not give a figure for mineral administration due to the its amalgamated budget system.

[205] Kischuck, Paul. August 1998. Personal communication. Based on assumed $40,000 annual gross salary per job and a territorial tax take of 7% of that gross. The Yukon Government sometimes uses this very rough yardstick.

account any changes to federal transfers that result from the generation of revenue in the territory or any change in population. The federal government and country as a whole likely do not benefit greatly. While it is impossible to accurately predict the exact proportion, some — and perhaps most — of the capital and labour involved in northern mining would be employed elsewhere in the country producing similar benefits if they were not in the North.

THE PROCESS OF MINING

A History Of Environmental Problems At Faro

The Faro mine site is in an area typical of much of the central Yukon Plateau. It is in boreal forest broken up by the foothills of the Anvil Range. These foothills create a number of small watersheds in the area, all of which drain into the nearby Pelly River. Figure 5 shows the general outline of the area and the location of the various ore bodies. The original Faro pit, the mill and the tailings storage area all lie within the Rose Creek watershed. Rose Creek flows northwest before joining Anvil Creek, which flows into the Pelly River. The Grum and Vangorda deposits lie on the Vangorda Plateau approximately 15 km to the south east of the mill. Vangorda Creek drains the area, flowing directly into the Pelly just downstream of the town of Faro.

Concerns regarding land disturbance and eventual restoration (with a focus on the Fanin sheep that use the area) are dwarfed by concerns for the water and fish habitat in the Rose, Anvil, and Vangorda Creeks and in the Pelly River itself. In particular, it is the potential for high levels of zinc in the water and the resulting detrimental effects on the salmon-spawning and rearing areas that is of greatest concern.

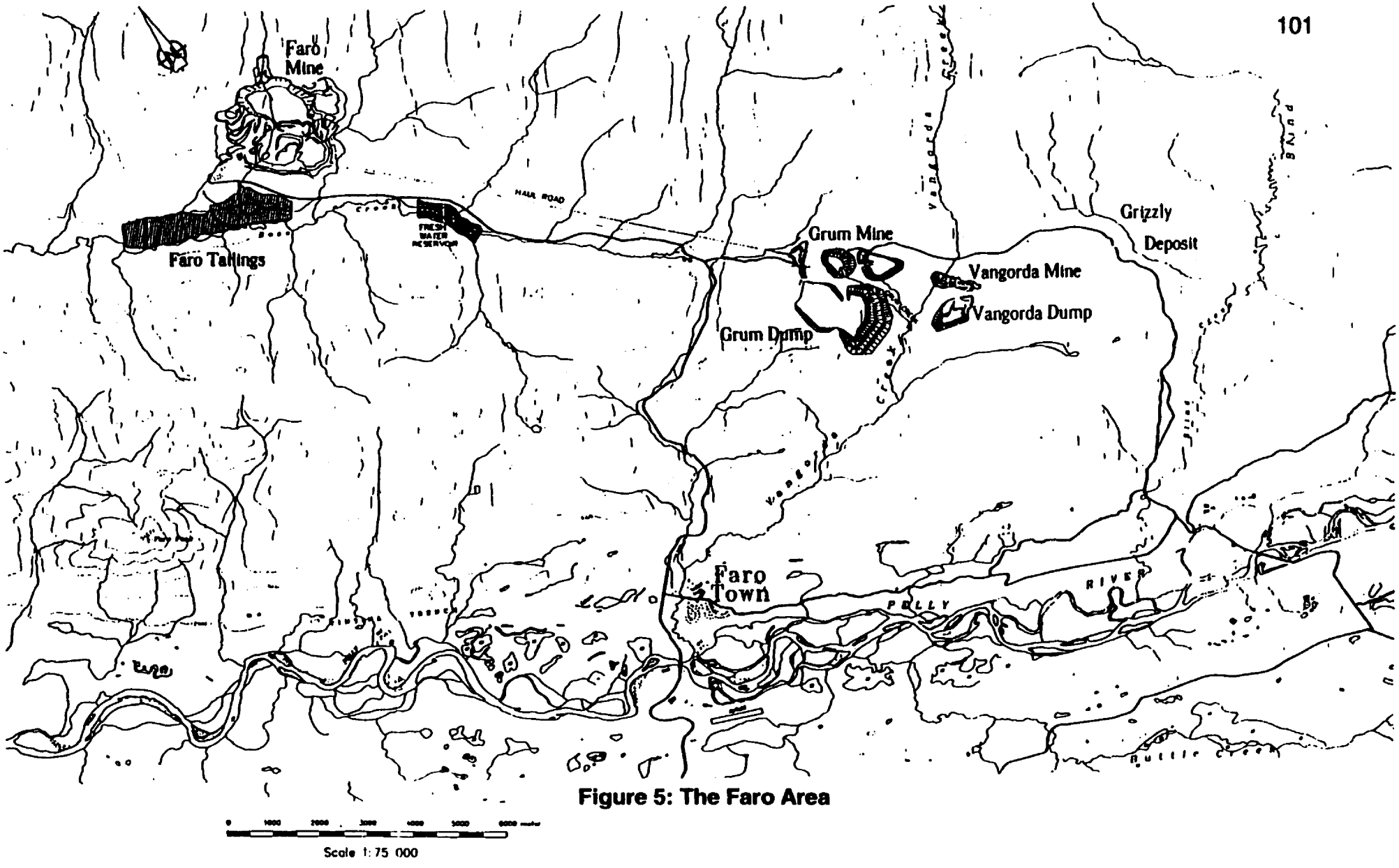

Figure 5: The Faro Area

Like many other mines, Faro has had a long list of environmental problems during its operation, many relatively minor, but some very serious indeed. The mine opened in 1969, before the creation of the Yukon Territory Water Board, and so Cyprus Anvil did not have to go through a public hearing process. Instead, the company had to satisfy the Water Resources Section of the Department of Indian Affairs and Northern Development that the company's plan for tailings disposal and containment were adequate. DIAND did approve the plan submitted, and the original tailings impoundment was built as shown in the upper right portion of Figure 6. All was not well however, and MacPherson writes:

> "... throughout the early 1970s the tailings dam structure failed on a number of occasions. Seepages of effluent discharges, resulting in 'high pH, lead, zinc and arsenic levels in the tailings pond effluent and Rose Creek downstream from the effluent,' were also noted by government officials. The mine was requested to implement corrective measures... concern was also expressed about the potential production of acid mine water and serious seepage problems."[206]

The company responded to the dam problems in 1973 with plans to expand the tailings pond — and thereby create a new and presumably better dam — to allow increased production of concentrates at the mill. The expansion plans required a water licence, and the Water Board becoming involved in the operation for the first time. The Board held a public hearing in May of 1973, and commissioned a number of studies to identify problems and suggest solutions. The problems nevertheless continued. MacPherson writes:

> "Concerns about seepages and difficulties with Anvil's tailings disposal practices were reiterated throughout 1973 and 1974. Government officials requested that remedial action be taken. The general manager of Anvil acknowledged the seriousness of the problem... [A]s early as July 1973 Montreal Engineering [an independent engineering firm hired by government] criticized the methods used... to construct the tailings dam... [and] suggested that it was 'questionable whether the stability of a dam

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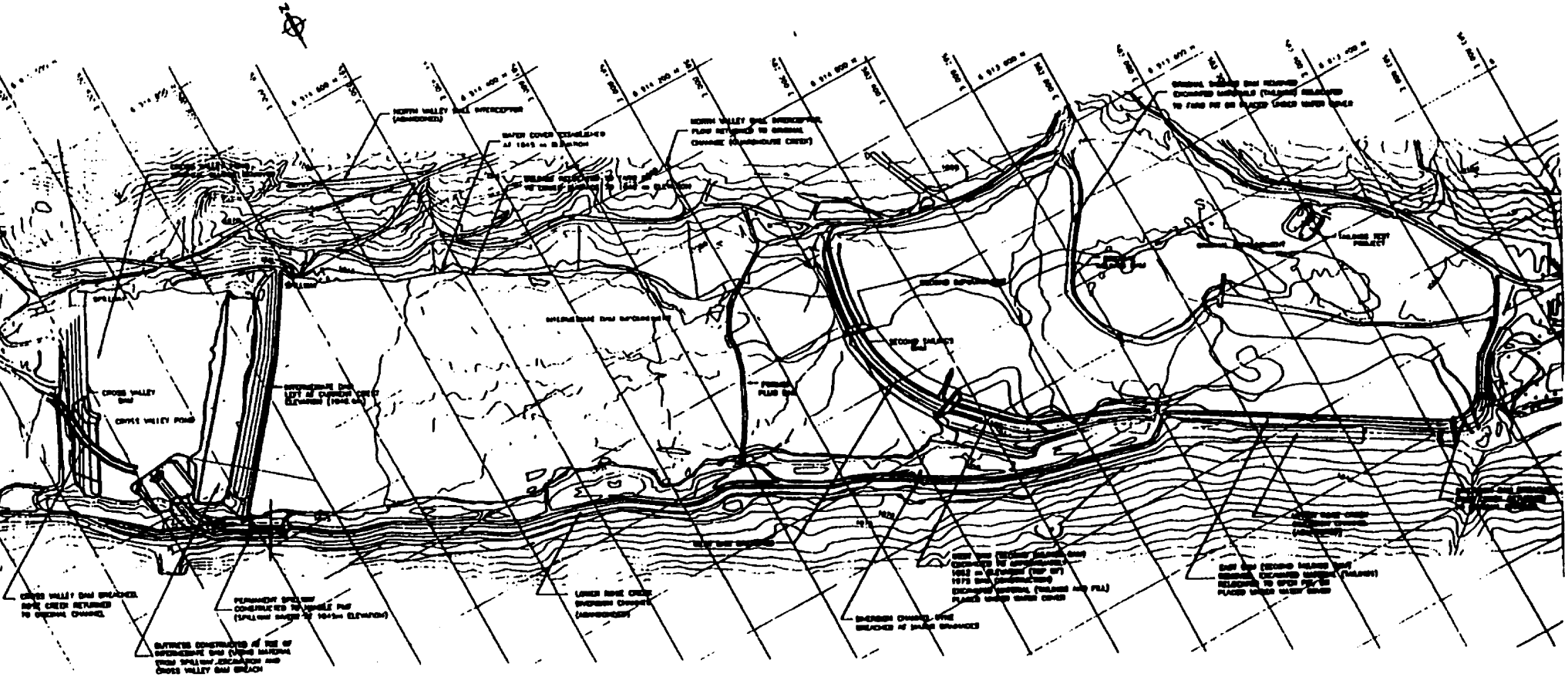
[206] MacPherson. 1978. p.132.



MAPPING COMPILED BY THE ORTHOSHOP, CALGARY, ALBERTA, JANUARY, 1991. BASED ON AERIAL PHOTOGRAPHY, SEPTEMBER 17, 1990, AT A SCALE OF 1 : 10 000. SURVEY CONTROL WAS SUPPLIED BY CURRAGH RESOURCES INC

CONTOUR INTERVAL = 5 METRES
COORDINATES ARE UTM IN METRES
ELEVATIONS ARE RELATIVE TO MEAN SEA LEVEL (NAD27)

0 100 200 300 400 Metres

SCALE 1 : 10 000

Figure 6: The Rose Creek Tailings Area

> constructed by this method can be assured bearing in mind the possibility of earth tremors, future increases in height and other factors.' The ... report also stated that: '...As presently operated, the tailings pond provides insufficient retention which results in an effluent discharge of poor quality... The tailings contained in the system, and from which the dam itself is constructed, are reported to contain at least 25% pyrites (66% according to the amended application data) which must result in the generation of acid seepage and runoff from the dam... This will be particularly problematical when the mine is closed.'"[207]

The new dam to contain the second tailings pond appeared to be no better than the original. Grave concerns were raised about both existing problems and inevitable problems at abandonment, but a water licence was issued effective December 1974 and good until November of 1979. Terms of the licence included specified limits to various contaminants in the waste discharge.
There was requirement for an abandonment plan. The only abandonment requirement was that the company clean up garbage dumps and stabilize the waste rock dumps and tailings pond upon shutting down the mine.[208]

On March 19, 1975, two of the tailings-pond dikes at the mine broke, and approximately 54,000,000 gallons of tailings escaped into Rose Creek over the next three days. The spill resulted in the creek's floodplain being completely covered with tailings for three to four miles, and tailings were found up to ten miles downstream. Four charges were laid against Cyprus Anvil as a result of the spill, three under the *Northern Inland Waters Act* and one under the *Fisheries Act*. The company eventually pleaded guilty to the Fisheries charge and paid a fine of $4,500 (just under the $5,000 maximum) while the other charges were dropped.[209]

In early 1976, less than a year after the rupture of the tailings pond, Cyprus Anvil was again causing serious environmental damage. A heating system problem

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[207] MacPherson. 1978. p.134.
[208] Ibid. pp.134-135.
[209] Ibid. p.135.

led to the company spilling large quantities of sodium cyanide into its tailings pond, which then began discharging out and migrating down Rose Creek. An anonymous caller informed government officials who then took samples and reported that "the levels of cyanide which occurred in the decant and in the seepage, and which were found up to the confluence of the Anvil Creek and the Pelly River, can be classified as highly toxic, and would have killed any fish living in the waters up to the confluence of the Pelly River and Anvil Creek."[210] The mine was ordered to stop the discharge and warned that the mill might have to shut down to avoid possible overfilling of the tailings pond. The discharge out of the pond was stopped, but the mill continued to operate, causing the tailings pond to be filled above its safety level. The company then reopened the pond discharge and continued to operate the mill until threatened with a court injunction. As a result of this incident, Cyprus Anvil was charged and convicted with a number of offences and fined a total of $49,000.[211]

Mining proponents often point out, and quite rightly, that the practices used and mistakes made in the past make easy targets for criticism in the present. Times have changed, they argue, and the industry's outlook and practices have also changed. There is a large degree of truth in that argument, but there is also considerable evidence that when it is more convenient or when money is tight, poor practices rapidly come to the fore. At Faro, this propensity is illustrated by Curragh's construction of the Vangorda waste rock dump in 1990. There was inadequate preparation of the foundation of the dump resulting in shifts and slumps, and the sulphide wastes, while segregated in their own cell, are covered with a highly inadequate dry till, which is allowing acid drainage to proceed largely unhindered. The upshot is greatly increased and unnecessary acid drainage potential and greatly increased costs to either the environment or in clean up and maintenance costs.

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[210] MacPherson. 1978. p.136.
[211] Ibid.

The problems and expenses of decommissioning, using Faro as an example, are examined in some detail in Chapter 6.

MINING COMMUNITIES: THE SEARCH FOR SUSTAINABILITY

Community Economic Development: A Brief Introduction

The people who live in them has long recognized the benefits of stable and sustainable communities, but it is only in the past several decades that these benefits have been explicitly recognized in government, business, and academic circles. Stable communities with a sustainable economic base tend to be more cohesive, encourage strong social ties between residents, and generally are seen to be a safe, desirable place to live. People tend to develop a strong sense of place and are often tenacious in their efforts to remain in the community even when economic circumstances turn against it.

The spatial and social inequalities inherent in the market-driven economic system ensure that economic circumstances will eventually turn against many, if not most, communities. Demand or supply shifts in the economy mean that some communities benefit while others lose. Community economic development (CED) is a relatively new approach to economic development and is a broad-based effort to understand the development and disintegration of communities. In practice, CED is usually an effort to swim against the tides of market forces by a community that is losing its economic health. Critics of CED question its effectiveness, particularly in the long term. Those who believe that the market alone should be the determinant of the survival of any particular community often argue that market forces are irresistible and point to the perceived overall economic benefits of a highly mobile labour force. Most residents of economically stricken communities on the other hand, resent arguments of economic determinism and resent even more the implication that they are simply economic pawns in the greater economy.

Mining communities are particularly vulnerable to the upheavals of the market and have been receiving increasing attention in the literature of economic development. Mining communities in the developed world share many features that make them economically and hence socially vulnerable. Apart from the fundamentally non-sustainable nature of their major economic activity, these communities tend to be geographically isolated, have extremely narrow economic bases, and usually suffer from a high turnover of residents mirroring the high labour turnover endemic in the mining industry. The town of Faro clearly demonstrates these and other features of mining communities that make them an especially difficult challenge for practitioners of CED.

Originating as a response to a combination of the need for economic development and the self-determination movement of African-Americans in American inner cities in the mid 1960s, CED was quickly adopted as a potential strategy for the renewal of any depressed community whether urban or rural.[212] At its simplest, CED may be thought of as the development *of* the community *by* the community. There is, however, much disagreement over the meaning of community economic development.

There is no single, agreed-upon definition of community economic development. Indeed, the plasticity of the concept adds considerably to its appeal. CED can mean quite different things to different people. For example, Shaffer and Summers write, "The goal [of CED] is to create appropriate jobs and raise the real incomes of residents. The locality is treated very much as if it were a business firm."[213] While Nutter and McKnight state, "...CED does not seek to make existing conditions in the community more bearable. Instead, CED seeks to change the structure of the community and build permanent institutions..."[214]

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[212] Perry, Stewart E. and Mike Lewis. 1994. Reinventing the Local Economy. p.2.
[213] Shaffer and Summers in: Christenson, J.A. and J.W. Robinson Jr. eds. 1989. Community Development in Perspective. p.173.
[214] Nutter and McKnight in: Galaway, Burt and Joe Hudson eds. 1994. Community Economic Development: Social and Economic Perspectives. p.95.

There is general agreement, however, that there is no general economic theory explaining community economic development and therefore it is not accepted as belonging to the economics discipline.[215]

Boothroyd and Davis sort the different approaches to community economic development into three categories: the communalization approach, the structural change approach, and the growth promotion approach.[216] While some CED practices straddle these categories, this structure provides a useful means of distinguishing among the myriad of philosophies and practices.

The communalization approach might also be termed the alternative approach to CED. In this view, the market system, with its emphasis on the individual, competition, and efficiency is the root cause of many of the social and economic ills facing the community. Thus the emphasis is on the community aspects of community economic development. Boothroyd and Davis write that, in the communalization approach:

> "The primary goal of community economic development is to create equality and strengthen the sense of community among all individual members. The aim is to develop mutual aid institutions in which production and consumption patterns are based on social rather than market principles...The workplace should be designed to promote not competition but cooperation... All community members must be empowered to participate in decision making processes that shape the community's economic future."[217]

A recurring theme in the alternative branch of CED literature is the need for "empowerment" of individuals[218] and of the community.[219] Some authors call for

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[215] See for example: Shaffer, Ron. 1989. Community Economics: Economic Structure and Change in Smaller Communities. p.41. Also see: Bingham, Richard D. and Robert Mier eds. 1993. Theories of Local Economic Development: Perspectives From Across the Disciplines. p.xv.

[216] Boothroyd, P. and C. Davis. 1991. The Meaning of Community Economic Development.

[217] Boothroyd and Davis. 1991. p.15.

[218] See for example: Wilson, P. A. 1996. "Empowerment: Community Economic Development From the Inside Out." pp.617-630.

[219] See for example: Shragge, Eric ed. 1993. Community Economic Development: In Search of Empowerment and Alternatives. p.iii.

a renewed emphasis on and respect for the informal economy as a whole,[220] while others focus on ecological[221] and social justice[222] issues. There are few pure examples of the alternative approach to CED in the literature. But there are many initiatives that have many of the goals given above. Some of these are held up as shining examples of what can be accomplished while others have had mixed results at best. International examples include the Mondragon Basque worker co-op in Spain[223] and the Grameen Bank in Bangladesh.[224] A Canadian example is A-Way Express, a courier company that is designed to give employment to former psychiatric patients, and turn a profit.[225]

The structural change approach occupies the middle ground of the CED field. This approach, while largely accepting the existing economic framework and rational, attempts to replace the goal of quantity of growth with the goal of quality growth and long-term stability. It attempts to blend economic development goals with those of social justice. Boothroyd and Davis argue the approach is based on the assumptions that:

> "The local economy extends beyond monetized marketplace transactions. It includes the largely locally controlled and relatively stable non-cash economy which makes a major contribution to well-being... The primary purpose of community economic development is to increase stability in the short and long terms... If growth is sought, its nature in terms of smoothness, sustainability, and balance, should be of central concern... Monetary flows into

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[220] See for example: Ross, D.P. and P.J. Usher. 1986. From the Roots Up: Economic Development as if the Community Mattered.

[221] See for example: Nozick, Marcia. 1992. No Place Like Home: Building Sustainable Communities. pp.18-23. Also see: Wismer, Susan and David Pell. 1985. "Living the Good Life: Ecodevelopment." pp.27-31.

[222] See for example: Shragge. 1993.

[223] There is an extensive literature on the very successful Mondragon co-op. The co-op has a strong emphasis on the goals of social equity and the preservation of Basque culture. See: Whyte, W.F. and K.K. Whyte. 1988. Making Mondragon: The Growth and Dynamics of the Worker Cooperative Complex, for an overview of the Mondragon movement. See: Thomas, Henk and Chris Logan. 1982. Mondragon: An Economic Analysis for economic analysis. See: Booth, D.E. and L.C. Fortes. 1984. "Building a Cooperative Economy: A Strategy for Community Based Economic Development." 1984 for an argument for the extension of the Mondragon experience.

[224] See: Borstein, David. 1996. The Price of a Dream: The Story of the Grameen Bank and the Idea That is Helping the Poor Change Their Lives. and Todd, Helen. 1996. Women at the Center: Grameen Bank Borrowers After One Decade for more on the Grameen Bank.

[225] Perry and Lewis. 1994. p.17.

> and through the community should be stabilized through local ownership, local resource control, or diversification of exports... The internal structure of the local economy should not be left to the uncontrolled consequences of market actions guided by the dictates of the principle of comparative economic advantage. CED should involve deliberate restructuring of the local economy by people who are part of that economy." [226]

These assumptions, with their emphasis on long-term stability and local control, mesh well with the ideas of sustainable development.[227] It is into the structural change category that most of the programs and initiatives labeled community economic development fall. These include: First Nation development corporations, Aboriginal capital corporations, community development corporations, cooperatives, credit unions, collectives, worker owned businesses, and local exchange systems. The growth promotion, or standard, approach to community economic development has its roots in the small town boosterism and promotion that municipalities and local chambers of commerce have been indulging in for well over a century. The growth promotion approach is based on the following assumptions according to Boothroyd and Davis:

> "The community economy is the totality of monetary transactions... The production of non-marketed goods and services are not counted as contributions to growth... The community is better off when employment is increasing... Cultural, social, or environmental costs of increased employment are secondary considerations... Increased employment is most effectively advanced by increasing the flow of money into the community. This is accomplished largely by increasing the level of exports and by attracting outside business into the community... The community's internal economy is best left for the market to determine... The benefits of increased employment will trickle down through the community..." [228]

The assumption that a community's economic structure is best left to the market is the key difference between the standard approach to CED and the structural change or communalization approaches. The standard approach can be divided

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[226] Boothroyd and Davis. 1991. p.12-13.
[227] See for example: Nozick. 1992.
[228] Boothroyd and Davis. 1991. pp.6-7.

into what is derisively known as "smokestack chasing" by its detractors,[229] and the planned growth model, which is now the dominant model in standard CED.

The smokestack chasing approach to CED is both indiscriminate and often counterproductive. The community boosters wish to attract jobs and a tax base, and so a government department or a smelter or anything in between will do equally well. Indiscriminate promotion of growth, however, can often result in the destruction of aspects of the community or its environment that would make it attractive to other forms of development. In addition, such efforts inevitably pit communities against one another and there are far more losers than winners. At its worst, this form of economic development leads to the squandering of public money on subsidies for little or no long-term gain.[230]

The growth planning model is considerably more discriminating and sophisticated than smokestack chasing. Efforts are still made to attract outside employers, but only those that fit into the overall goals of the community. If, for example, tourism is seen as the major source of development for the community, there will be no efforts made to attract heavy industry. There is also considerably more effort made to increase the productivity of local firms and to encourage local entrepreneur. Unfortunately, this approach too can lead the community into the zero sum game of competition between communities.

The concept of community economic development has its critics on both ends of the political spectrum. Those on the political far left, for example, argue that the core structures and mechanisms of the market system make the goals of equity and true community control of the community economy impossible within the system. The capitalist market economy, in this view, not only inevitably creates inequities but also requires those inequities to function effectively.[231]

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[229] See for example: Dauncey, Guy. 1988. After the Crash.

[230] Canadian regional development literature is full of examples of such misplaced efforts.

[231] See for example: Vance, Nicholas. 1993. Community Economic Development and Capital Accumulation.

For those at the other end of the spectrum, most of the concepts of community economic development run counter to the fundamental assumption that the operation of a free market system will always yield the maximum possible welfare to society. For these believers in the efficacy of the market, any effort to guide the functioning of the market for any purpose — other than to increase its efficiency — is at best useless and at worst actively harmful. Particularly harmful is the use of public money in attempts to alter the functioning of the market.

Between the extremes are those who are open to the basic ideas of CED but who recoil from the perceived "flaky" or "touchy-feely" approach of some practitioners. Economists in particular have difficulty with the lack of CED theory and therefore the lack of mathematical rigour in the approach to community development. CED's emphasis on the human and social aspects of development also creates unease among those who wish to keep economic and developmental issues free of "emotional" and "irrational" approaches.

Mining Communities As A Special Case Of Community Economic Development: The Example of Faro

Single-project mining communities present special problems to the practitioners of community economic development. The very existence of the community is entirely dependent on an ore body that must eventually run out. This long-term instability is often exacerbated by short-term instability due to market volatility, labour unrest, and high worker-turnover rates. For mining communities then, CED is effectively synonymous with economic diversification, for without diversification the community will not survive the depletion of the ore body. This focus on diversification means that CED efforts in mining towns have usually taken the growth promotion approach.

Some caution is in order, however. Economic diversification has come to be seen as something of a cure-all for economic problems of all kinds; it is not. As the 1982 Task Force on Mining Communities wrote:

> "...economic diversification is no panacea, and...should be pursued as a complement to other measures such as direct hardship mitigation. Economic diversification must also be pursued with discretion in that some types of diversification may not effectively decrease community vulnerability... Most types of diversification activities that may be suitable for a mining community produce very few jobs." [232]

Similarly, Warrack warns, "...a prosperous but precarious economy is a weak economy and only economic activity that reduces the vulnerability of such an economy constitutes economic development."[233] Economic activities too closely linked to the mine do not fall into this category.

Options for economic diversification

The options for the development and diversification of mining communities can be summed up as follows:

1. further mining development (finding more ore),
2. downstream diversification (processing the ore),
3. upstream diversification (supplying goods and services to the mine),
4. other non-renewable resource projects (including the mining of other minerals),
5. manufacturing,
6. renewable resource projects,
7. government institutions,
8. retirement destination,
9. tourism, and
10. becoming a self sustaining regional centre.[234]

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[232] Task Force on Mining Communities. September 1982. Report of the Task Force on Mining Communities. p.55

[233] Warrack, A. 1986. "Spurs to Resource Development." p.29.

[234] Adapted from: DePape, Denis. 1985. "Alternatives to Single Project Mining Communities: A Critical Assessment." p.92.

All of these options have been tried with varying degrees of success in different mining towns both in Canada and elsewhere. Most have been at least proposed as options for Faro.

Although it is stretching the meaning of the word considerably, finding more ore is perhaps the most obvious means of "diversification" for mining communities. Indeed, a mining policy seminar came up with the following:

> "The best and most reliable form of 'diversification' for a mining community is expansion of the existing ore reserves and finding new ones by successful exploration. Not only does it prolong the economic life of a community, the additional time significantly improves the chances for diversification into other economic activities."[235]

For Faro this has certainly been the most successful of the diversification options. When Cyprus Anvil first went into production at Faro in 1969, they were mining the Faro ore body that had an estimated life of about 15 years. Two other nearby deposits were already known however. They were Vangorda (the site of the original discovery by Al Kulan in 1953), and the Swim Lakes deposits discovered by the firm Kerr Addison in 1964.[236] Cyprus Anvil continued to explore their mineral leases in the area and discovered the Grum deposit in 1973 and the Dy deposit (now named Grizzly) in 1976.[237] These discoveries increased the life of the mine considerably and, with the Grizzly and Swim Lakes deposits, still unmined, continue to offer the promise of continued life for the town. Of course, extending the life of the mine only postpones the day of reckoning, but the longer the life of the mine, the greater the opportunity for true diversification to occur and long-term stability.

Faro lies in the heart of a region rich in mineral potential. Apart from the lead-zinc deposits in the immediate vicinity of Faro, there have been discoveries of gold (a

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[235] Centre for Resource Studies. 1984. Mining Communities: Hard Lessons for the Future. p.183.
[236] MacPherson. 1978. p.116.
[237] Yukon. December 1998. Yukon Mineral Property Update.

gold mine operated at Ketza River approximately 120 km from Faro in the late 1980s), silver, and other minerals in the region. The past several years have seen the delineation of two considerable deposits of copper/lead-zinc/silver/gold roughly 170 km south east of Faro. One of these projects, Kudz Ze Kayah, has completed its environmental screening and has the potential to come into production within two years.[238]

One of the means of expanding the economic base of a mining community is to process the product of the mine in the community. It is an obvious means of generating further economic activity and has long been encouraged by governments in Canada. As a means of diversifying the community's economy however, it is the least desirable means of bringing economic stability to mining communities. If the mine closes the smelter will almost inevitably also close.

Included in the Anvil Agreement was the requirement for Cyprus Anvil to conduct a study on the feasibility of building a zinc-lead smelting complex in the Yukon, and, if it was judged viable to build it within eight years of the opening of the Faro mine. Both the Federal and Territorial Governments were strong proponents of the smelter, seeing it both as providing immediate economic benefit to the Yukon — and to government revenues — and as the foundation of a long-term industrial economic base for the Yukon. The smelter was anticipated to have required a payroll of 552, effectively doubling the mine's workforce and so doubling the size of the community of Faro.[239] The Federal Government in particular wished to see more value-added processing in Canada and less exporting of raw resources. The feasibility study was to be completed within five years of the mine opening . This meant of course that the company would be depleting the ore reserves for five years — and mining its richest areas first in order to take advantage of its tax holiday — before even considering building a

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[238] Yukon. December 1998. Yukon Mineral Property Update.

[239] Reimers, Jan H. August 1974. Feasibility Study of Electrolytic Zinc and Electric Lead Smelter Complex at Little Salmon in the Yukon. p.iv.

smelter. Viability for the smelter was defined in the Agreement as a return of 15% on the total capital cost determined by the discount cash flow method. Cyprus Anvil would provide all the capital required to finance the smelter but the federal government would be responsible for the necessary power and transportation infrastructure.[240]

The feasibility study was completed in August of 1974 and it concluded that a smelter was not economically viable. Several possible scenarios were examined but the best case examined, using 100% of the Faro mine's production of ore and optimistic prices for lead and zinc, yielded only a 7.5% rate of return on an investment of $163.8 million.[241] Two factors ensured that the project could not meet the agreed upon minimum rate of return. The first was that the life of the smelting complex was estimated to be 10.5 years, matching the proven mine reserves at the time.[242] The second was that it was considered economically impossible to market the sulphuric acid byproduct of the smelting process due to the smelter's remote location. The need to neutralize and dump the acid added considerably to the cost estimates.[243] Potential environmental problems, whether short- or long-term, were not considered.

Cyprus Anvil revisited the possibility of building a smelter in 1980. This time the feasibility study assumed an operating life of 20 years for the smelter using 100% of the Faro mine's production.[244] The increase in the operating life was the result of Anvil discovering and delineating new reserves of ore as discussed in the previous section. Again the smelter was deemed not to be economically viable. The smelter would require a payroll of 536 employees, its operating costs would be $76.4 million per year and it would require a capital investment of

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[240] MacPherson. 1978. p.147.
[241] Reimers. 1974. pp.xi and 61.
[242] Ibid. p.114.
[243] Ibid. pp.54 and 61.
[244] Reimers, Jan H. August 1980. Feasibility Study of a Zinc-Lead Smelting Complex in the Yukon and an Alternative British Columbia Site. p.77.

$376.4 million.[245] The smelter was predicted to produce a negative return on investment for all but the last few years of operation.[246] As was the case six years previously, the problem of how to dispose of the sulphuric acid added considerably to the costs. And again, potential environmental problems were not examined.

Upstream diversification is, like downstream, a form of vertical diversification and so has the weakness of being too closely linked to the mine to provide stability to the local economy in the event of a shutdown. Upstream linkages, however, appear to be a critical first step toward further diversification in mining communities. Faro has had a mixed record in this aspect of diversification. Prior to the mine's shutdown in 1982, the development of industrial supply businesses was constrained by a shortage of commercial and industrial land in the community,[247] and by the shortage of housing (the issue of housing will be discussed in some detail below). After the 1982 shutdown a high degree of uncertainty over the stability of the mine was added to these constraints. Despite these constraints, some suppliers did establish themselves in the community. CIL for example, has manufactured explosives and copper sulphate (used in the milling process) at their plant near the mill since 1970. Another example is Finning (a supplier of heavy equipment) that established a branch in Faro in the 1970s, pulled out during the shutdown in the early eighties, returned when the mine reopened in 1986, pulled out again with the 1993 shutdown and has now refused to risk a return since. Generally the mine at Faro and the mining exploration in the region have been and generally continue to be supplied and serviced from either Whitehorse or even Vancouver and Edmonton.

An exception to this rule has developed with the establishment of the Ross River Dena Development Corporation (an arm of the Ross River Dena First Nation)

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[245] Reimers, Jan H. August 1980. pp.vi and viii.
[246] Ibid. p.81.
[247] Makale and Kyllo. June 1981. Town of Faro Official Community Plan: Volume I. p.11.

based in the community of Ross River approximately 70km south east of Faro. The Development Corporation offers services to the mining industry in the area including: staking, line cutting, expediting and hauling. Ross River's gain in this area of economic development is Faro's loss. It is increasingly unlikely that businesses offering these services can also be based in Faro in the future due to a limited market.

Most of the renewable resource projects that have been suggested as a form of economic diversification for Faro suffer from the same problem of distance from markets. The suggestions have ranged from a small sawmill to reindeer ranching to fish farming to fur ranching.[248] The supply of timber in the area is small and is not considered to be sufficient to support long-term employment.[249] The latter three suggestions appear to be non-starters due to distances from markets. Apart from a small amount of hay growing and some intermittent small scale logging there are currently no renewable resource projects in the Faro area.

Any manufacturing industry in Faro not directly supplying the mine (such as CIL) would face steep challenges. The isolation of the community from potential markets and high transportation costs are the biggest stumbling blocks. Various suggestions have been advanced for manufacturing in Faro including souvenirs and crafts, metal fabricating, furniture, and clothing.[250] The metal fabrication would have to be linked to supplying the mine, while the souvenirs and crafts would likely be aimed largely at the tourist market. A number of people have made souvenirs as a form of cottage industry, and two former mine-workers have begun manufacturing and marketing a plant food product.

Tourism is often the first possibility considered for the diversification of a mining community's economy. For many who are not involved in the tourism industry it

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[248] Makale and Kyllo. June 1981. p.11.
[249] David Nairne and Associates Ltd. 1988. Keeping Faro on the Map. p.15.
[250] Makale and Kyllo. 1981. Volume II. p. 14 and David Nairne and Associates. 1988. p.16.

is seen as an easy and relatively painless way of making money. Spruce the town up a bit, put in a RV park, do a little advertising, and the tourists will come and spend their money. The reality of course is very different. The tourism business is an uncertain and often economically hazardous undertaking. Most tourists tend to be quite demanding and not inclined to spend large amounts of money freely. And above all, tourists require something to attract them to an area or a community in the first place. For most mining communities, this is the largest stumbling block and Faro is no exception.

Faro has made considerable progress in the past 10 years in providing services for tourists and generally making the community a more attractive spot to visit. The municipality maintains an attractive wooded full-service RV park in the centre of town, there are two motels and a hotel each with a cafe or restaurant. The entrance to the town has been landscaped, roads have been paved, short hiking trails developed, and a very attractive interpretive centre (giving the history, both natural and human, of the region) opened. But the community still suffers from its location, far off the major tourist corridors, and from its lack of a single, major draw or attraction. When the mine is operating, mine tours are usually offered, but these have limited appeal. The region is largely unspoiled wilderness and is very attractive, but this is true of most of the Yukon.

Generally, the Campbell region (of which Faro is part), receives a very low proportion of the total visitors to the Yukon. A visitor exit survey in 1987 showed that only 4,400 people visited the region that year (representing 2.2% of the Yukon's total visitors) and, of those, only about 1,000 stopped in Faro.[251] Another survey in 1994 showed that there was no significant change in the numbers of visitors.[252] While this does not appear to bode well for the community's hopes of increasing tourism, community leaders are not

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[251] MacKay and Partners. October 1989. Faro Tourism Plan. Appendix I, p.5.
[252] Metz Murray and Associates. May 1995. Situational Analysis Report on Feasibility of a Campbell Region Tourism Association. p.9

discouraged. There is a clear realization that tourism will not become a major industry in the foreseeable future. But with ongoing improvements to the Robert Campbell Highway, the further development of such low key attractions as wildlife viewing, fishing, and rock hounding, and the promotion of the region as "the road less travelled", there is the confidence that tourism will gradually increase and play a greater role in the community's economy.[253] In general, Faro's efforts to improve its tourism sector illustrate the structural change approach to community economic development. The community itself has led the way in most of the initiatives and the municipality owns and runs the RV park, which private enterprise would be unwilling to provide due to a lack of customers.

Many mining communities in Canada lobby governments to locate public institutions in their community in order to diversify the economy and Faro has been among them. Unsuccessful efforts were made to persuade the Territorial Government to relocate the Drury Creek road maintenance camp to Faro, and to establish a vocational school in the community. Other, more ambitious possibilities considered were a jail and an army training centre but these were not seriously lobbied for. The idea of a new territorial jail has very recently emerged once more however, and there is a reasonable likelihood of it being built. Currently there are no major government institutions in Faro but the town does have a community campus of Yukon College offering an assortment of courses. The campus was established in 1989.

The success of Elliot Lake in turning itself into a retirement community after its mine closed has sparked considerable interest among other mining communities in Canada. Often the greatest asset of a mining town is its housing stock, and Elliot Lake capitalized on that asset as well as the desire of many people to retire in a small, friendly and safe community.[254] The possibility of Faro becoming a retirement community is remote in the extreme however. The community's

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[253] McLachlan, Jim. June 1997. Personal communication.
[254] Farkouh, 1992 In: At the End of the Shift p.148.

isolation, cold climate, and lack of advanced medical services make it an unlikely retirement haven.

Becoming a self-sustaining regional centre is the final of the ten possible means of economic diversification for mining communities. Many mining towns have been built with the assumption that they will become a regional centre as the area around them develops. Tumbler Ridge, in north-eastern B.C. is the most recent example where the assumption was made explicit and the town was designed with that goal in mind. Other communities have simply evolved into centres as their regions developed. Sudbury Ontario is the best Canadian example of the process while Kiruna, in Sweden's far north is a rather extraordinary international example.

Housing in mining communities

Housing policy is almost inevitably an issue of great concern in mining towns. Generally, mining companies have no wish to be in the housing business and would prefer workers to supply their own. Companies are also well aware that worker ownership of housing usually means a more stable workforce.[255] Workers, on the other hand, are understandably reluctant to invest in housing in mining communities where the risk of losing equity is ever present. Further, construction costs are often considerably higher in remote mining communities than in urban centres, making workers even more reluctant (or unable) to buy their own housing. An opposing tendency is the strong desire by many to own their own homes, no matter what the risks. Faro provides a good example of these contradictory forces at work as the community has developed. In addition, Faro has been perhaps unique among Canadian mining communities in having most of the housing in the community owned for the past 11 years by a private firm completely separate from the mining company.

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[255] Suzanne Veit and Associates. 1978. p.IV-9.

From the earliest townsite planning stages, Cyprus Anvil made it clear that it did not wish to become a large-scale landlord for its employees.[256] The company also recognized that: "To attract good workmen who will be prepared to stay, there must exist the opportunity of buying a home at a reasonable price..."[257] The company did not get its wish and, throughout Cyprus Anvil's tenure at Faro, the company owned the vast majority of the housing in the town and acted as landlord to its employees. Indeed, the company subsidized its housing to such an extent that for an employee to buy (given the option) would have been a sign of financial insanity. Throughout the 1970s and early 1980s, 3-bedroom houses in Faro were rented to mine employees for approximately $30-50 a month to start and the rent dropped by 10 percent per year. The rent included heat, utilities, and all maintenance and repairs. In the early years, the company would even change the light bulbs as needed. One resident of Faro related that when her brother and his family left Faro in 1981, his total housing costs were $8 a month while his income from his job at the mill was approximately $40,000 a year. Once it had started to offer subsidized housing at the beginning to attract employees, Cyprus Anvil found it could not stop. The subsidy, which was tax free through this period, became a permanent arrangement.

It is also clear that the potential problems of supplying sufficient housing for those who would work in the service industries in the new community were recognized from the onset.[258] Early recognition of the problem did not lead to a solution however. The lack of housing for everyone except mine employees was a perennial problem for the community and acted as a brake on economic diversification and the development of the town. The high costs of construction in the community and the reluctance of business people to risk building housing in a single-industry town led some to seek creative solutions to their housing problems. A former Faro resident relates that, after arriving in 1975:

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[256] Thompson et al. 1967. p.14.
[257] Thompson et al. 1967. p.14.
[258] Ibid. p.57.

> "I started working in the restaurant and the bar of the hotel and was glad of it . Housing proved to be more of a problem until myself and one other member of the crew landed the use of a cabin on an island in the Pelly River. The cabin had no door, only a hatch in the roof. That was no problem. Lifting my dogs through the roof was the least of my worries. Getting to the island proved to be more of a challenge as there was a bridgeless, fast flowing branch of the river to contend with. This was solved by stretching a rope from one side to the other and purchasing a small red plastic child's rowboat/canoe type vessel. We went across one at a time, one dog each trip... Hand over hand we pulled ourselves across the river to the cabin with the door in the roof." [259]

The housing shortage never really eased through the 1970s and early 1980s despite the creation of a mobile home park and the construction of more housing as the mining operation expanded. One result was that Faro's service businesses were largely dependent on the spouses of Cyprus Anvil employees to staff their firms.[260]

When Curragh resources took over the mining operation (and the housing) in late 1985, the company made it abundantly clear that it would certainly not continue subsidizing housing to the extent that Cyprus Anvil had, and that it would prefer not to own any housing at all. In January of 1986 Curragh announced that it was selling 421 housing units in the town to a newly formed company, Faro Real Estate Ltd. The sale was a complex arrangement, with Faro Real Estate paying nothing up front but instead taking on approximately $7 million of Curragh's debt. Included in that figure, however, was the $3.4 million mortgage provided to Curragh by the Yukon Government, which was interest free for 5 years. The assessed value of the properties was in the neighbourhood of $20 million.[261] Faro Real Estate acquired the housing for one third of its value, but that value existed only if the mine was operating. If not, the value of the firm's holdings would approach zero as would the rental cash flow.

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[259] Kathy Aurich Piowar in Madmen and Dreamers. Pelly Historical Society eds. pp.46-47.
[260] Makale and Kyllo. 1981. p.37.

The deal between Curragh and Faro Real Estate was a complex one. Although title to and responsibility for the properties passed to Faro Real Estate, the new owners did not have an entirely free hand. Curragh — and its successor Anvil Range — retained the rights of rental to 60% of the properties. Those units had to be retained for the use of the mining company (that is, rented only to mine employees) and could not be sold without the company's permission. And only a handful of houses have been sold since 1986. Apart from the uncertainty potential buyers feel over the fate of the mine, CMHC has a policy of not approving mortgages secured against the house in single-industry communities and therefore the banks will not provide the mortgages. This eliminates the possibility of buying a home for the vast majority. Despite the formidable obstacles to home ownership, close to 20% of residents own their own homes, although many of these are mobile homes which can be moved elsewhere if necessary.[262]

The highly unusual and perhaps unique arrangement of housing ownership appears to have worked reasonably well. The mining company got out of the property management business while Faro Real Estate has managed to do well enough to survive the 1993 shutdown, no mean feat in itself. Rents appear to be quite reasonable, ranging from $400 to $600 a month. There is still a small housing subsidy in place, amounting to approximately $100 to $150 per month on average. The cost of heat and utilities however, make the old timers sigh and yearn for the good old days. During a cold winter, heat and utilities can easily approach $1,000 per month.

But Faro's recent housing ownership arrangement was only possible because most of the value of the properties was effectively written off through the sale of the mine by Dome. No private company would have assumed the enormous risk of losing their investment while paying full value for the properties. Thus the

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[261] Whitehorse Star. January 27, 1986.
[262] McLachlan. 1997.

arrangement could only work in other communities if a comparable situation developed.

Macro stabilization policies for mining communities

In addition to economic diversification and other largely local efforts to provide stability to mining communities, there are other macro scale initiatives and policies designed specifically to help stabilize mining communities. These include mining reserve funds, personal adjustment funds, and the Swedish investment fund system.

The Manitoba Mining Community Reserve fund is the prototype of one form of this kind of fund in Canada. The Manitoba mechanism involves the diversion of 3% of mining taxes paid in the province annually into a fund that is used to help mining communities and workers adjust to shutdowns, whether temporary or permanent. The fund has been used by communities to support job creation projects, retire infrastructure debts, and offset revenue shortfalls in order to maintain municipal services.[263] The experience in Manitoba indicates that this form of fund operates effectively and that mining towns have found it very helpful during mine shutdowns.[264]

A second form of reserve fund has been proposed but not implemented in Canada. This form of fund would be community or region specific and would be built up by the diversion of a portion of municipal revenues with matching funds from senior levels of government. This form of fund is envisioned to be aimed specifically at providing a fund for economic diversification projects and would be subject to a high level of local control.[265]

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[263] Canada Employment and Immigration Advisory Council, 1987. p.63.
[264] Manitoba. Energy and Mines Manitoba 1985. p.30.
[265] Ibid.

Neither the Yukon nor the Federal Government has an established fund of either sort, but there have been various ad hoc initiatives during mine shutdowns. The most notable was the waste rock stripping program at Faro in 1983 described above in the brief history of Faro. In 1993 a federal summer work program was adapted to allow for the town to create some jobs and undertake community improvement and cleanup projects.

Various means of providing greater stability for individuals working in the mining industry and living in mining communities have been proposed though none have as yet been implemented in Canada. A personal adjustment plan for mine workers would function rather like an RRSP, with workers and employers making tax-free contributions to a fund which could only be accessed by the worker in the event of a mine shutdown.[266] Other proposals have included the improving the transportability of pensions and the official recognition of certain mining jobs as trades in their own right (with training and certification to match).

The Swedish investment fund system

The idea that Canada should adopt a version of the Swedish investment fund has been raised in connection with stabilizing the mining industry by several commentators.[267] The Swedish system — which is applied to all firms, not just to those in the mining sector — was designed to help counter the large swings in business cycles by providing strong tax incentives for companies to invest in plant and equipment during cyclical troughs rather than at the peaks. The system was instituted in 1938 and remains a part of Swedish tax law today, but it only acted as it was designed to (as a countercyclical force) in the 1950s and 1960s. Since the mid 1970s, it has effectively become a general tax incentive for investment in plant and equipment as the incentives are now available in virtually every year.[268]

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[266] Manitoba. Energy and Mines Manitoba 1985. p.31.
[267] Locke, 1986. pp.17-18 and Committee on Resource Dependent Communities in Northern Ontario, 1986. Recommendation No. 29 and Department of Energy and Mines Manitoba, 1985. p.29.
[268] Taylor. 1982. p.60.

During the 1950s and 1960s the system allowed firms to allocate up to 40 percent of their pre-tax profits to an investment fund. Of this deduction, 46 percent (40 percent prior to 1961) had to be deposited in a non-interest bearing account at the central bank. The use of the remainder, plus the additional after tax profits generated by the deduction, was not constrained in any way. The full use of the deduction would decrease the firm's effective tax rate from 52 percent to (0.4) (46) + (0.6) (52) = 49.6 percent.[269] The deduction was therefore attractive even if the funds held at the central bank were never used again. It was made even more so by the provision that the firm could withdraw up to 30 percent of the funds on deposit after five years at its own discretion for investment purposes.[270]

In the main however, the fund could be withdrawn (tax free) by the firms and used for investment during periods of recession. Such withdrawals were authorized in 1958, 1962, and 1967. Moneys from the funds could only make up 46 percent of the investment purchases (40 percent prior to 1961) and the firms were granted a deduction of 10 percent of the total value of the investment. Depreciation of such investments was not tax deductible however. The net result was an effective reduction in the price paid by the firm.[271] Investments funded under this system were predominantly plants and other buildings rather than equipment (the ratio in the early 1960s was 5 to 1) due to the non-deductibility of depreciation. In some cases however, the system was used to finance inventory investment.[272]

While there is general agreement in the literature that the Swedish system worked as a counter-cyclical force in the 1950s and 1960s, there is some

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[269] Taylor. 1982. p.62.
[270] Ibid. p.65.
[271] Ibid. pp.62-63.
[272] Ibid. pp.64-65.

disagreement over its degree of effectiveness.[273] Whatever its exact degree of effectiveness however, there would be problems in implementing such a system in Canada. The first, obvious from the Swedish experience, is the pressure the government would feel to authorize the release of funds as often as possible. Another would be the difficulty in judging the release of funds well enough to produce the desired counter cyclical effect rather than reinforcing the cycle (although this seems to have been managed reasonably well in Sweden). If such a system were introduced (as has been suggested) strictly for the mining industry, there would be objections from every other industry over such special treatment. A detailed model of how such a system would work in Canada would be required in order to judge whether the potential benefits would outweigh the problems.

Can mining communities be sustainable?

The Kiruna example

The Swedish community of Kiruna is located above the Arctic circle and approximately 250 km from the nearest port, Lulea on the Gulf of Bothnia. The municipality is the northernmost in Sweden, has a population of 26,000 and covers an area of 20,000 square km. The town was founded in 1900 to allow for the exploitation of a very large body of iron ore. Like Sudbury, Kiruna has had the advantage of a very long-lived mine; it has been in continuous operation for 96 years but has only exhausted one third of its reserves. It is an underground operation however and so must be very efficient in order to compete with open pit iron mines elsewhere. This search for efficiency has seen the mine and mill, which produces iron pellets which are sold to smelters elsewhere, automated to an extraordinary degree. During the 1980s, the mining work force in Kiruna fell from 5,000 to 1,900 as the automation was carried out.

[273] Taylor. 1982. p.87 and Soderson. 1989. p.671.

In response, the community moved to diversify its economic base and has done so with great success. One of the focuses was the development of a year-round tourist industry. The municipality and its businesses work closely together, offering outdoor experiences of all kinds: canoeing, river rafting, hiking, hunting, fishing, skiing, and dogsledding. The indigenous Lapp peoples are very involved in tourism, offering cross-cultural holidays. One highly unusual winter attraction is a hotel, complete with a gallery, chapel, exhibit hall and bar built each year entirely of ice. Kiruna's tourist industry has now reached 330,000 guest nights per year. An offshoot of the tourist trade is a school that specializes in offering courses in tourism-related issues.

Kiruna has a small manufacturing sector, with only some of it linked to the mine. An example of an independent manufacturer is one which designs, manufactures and exports specialized hip controlled trucks. The community's location above the Arctic circle proved to be an asset in attracting a satellite control centre, several other space related organizations, and a variety of other research institutes studying such things as climate and the environment. Finally, Kiruna has been successful in attracting government institutions including the Swedish postal institute, a TV licencing agency, and the Swedish land surveying agency. Kiruna's level of diversification is likely unparalleled for a relatively small and relatively isolated mining community.

CHAPTER 6: MINE DECOMMISSIONING AND ABANDONMENT

From the perspective of sustainability, the issues of mine decommissioning and abandonment are very similar to those of mineral exploration. At both ends of the mining process, the primary goal for meeting the criteria of sustainability is to minimize environmental damage and hence minimize the dissipation of economic rent. If government must assume the responsibility of cleaning up an abandoned mine, any rents collected from that mine disappear quickly. Indeed, such a cleanup might well exceed the total royalties collected from the mine while it operated.

This now appears to be the case with the mine at Faro. Unless a buyer for the property — and the attached environmental liability — is found, the federal government will be responsible for that large liability.

THE ISSUES OF MINE ABANDONMENT

In almost all cases there are two overarching issues to be faced when a mine is abandoned: potential water contamination and land reclamation. Water contamination, and particularly acid drainage, tends to be the more important of the two as it has the potential to affect an area very much larger than the site itself.

Contaminated Water And Acid Drainage

Mining produces many possible contaminants, depending on the type of ore and how it is milled or treated, but those associated with acid drainage are among the

most common. They are also potentially the most expensive. Estimates of total environmental liability in Canada directly attributable to acid drainage range from $1.9 to $5.3 billion.[274] Acid drainage (also known as acid rock or acid mine drainage) occurs when oxygen and water encounter sulphide-bearing rocks. The product of the process is water typically very low in pH (i.e. highly acidic) and high in dissolved metals and sulphates. While acid drainage can and does occur under undisturbed conditions, the reaction tends to occur slowly, usually due to a small surface area of rock being available or to limited supplies of oxygen or water. The mining and milling of sulphide ores — and the dumping of sulphide-bearing waste rock — suddenly exposes very large quantities of sulphide materials and greatly increases the surface area exposed to oxygen and water, resulting in a sharp increase in the rate of this process.[275]

Acid drainage is a progressive, three-stage process. The first stage, often kept in check for a time by naturally occurring buffering agents, is chemical oxidation. When that neutralization potential is consumed however, the process moves to the second stage and becomes a biochemical process. In the second stage, acid generation accelerates, pushed by the bacterium *Thiobacillus ferroxidans,* commonly found around sulphide-bearing rocks. The reaction rate during the second stage is normally several orders of magnitude greater than the chemical oxidation. Indeed, the reaction can be so fast that changes are detectable from day to day. Once the pH of the water involved reaches very low levels (pH 2, similar to battery acid), the third stage begins, and the reaction reverts to the slower process of chemical oxidation. The greatest potential environmental impact of acid drainage is the loss of fish and fish habitat in the waters downstream from the operations.[276]

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[274] Feasby, D.G. et al. 1997. "A Decade of Technology Improvement to the Challenge of Acid Drainage — A Canadian Perspective." pp. iv.
[275] Ripley, Earle A. et al. 1996. Environmental Effects of Mining. p.117.
[276] Ripley, Earle A. et al. 1996 and Rodger, Robert. 1993. Faro Mine Decommissioning Options and Issues Paper. p.ii

Although there has been considerable progress in understanding and dealing with acid drainage, particularly in the past decade, there are no silver bullets, no magic solutions to the problem. It is very clear, however, that preventing acid drainage is much easier and cost-efficient than attempting to stop or reverse the process once it has begun. The best means of prevention remains the straightforward storage of unoxidized sulphide-containing wastes under water. There, the lack of free oxygen slows acid production to almost zero. Unfortunately, about half of mine waste sites in Canada are not physically suitable for water covers. There is also the problem of building and maintaining adequately water-tight structures to contain the wastes in perpetuity. There are ongoing experiments to find other means of stopping acid generation, including dry and organic covers for the wastes.[277]

Once acid drainage has begun, collection and treatment of the acidic water is necessary to reduce its acidity and to remove the dissolved metals from it. The currently accepted technology for such treatment is the addition of lime to the acid drainage. The highly alkaline lime acts both to neutralize the acid and causes the precipitation of metals out of solution as carbonates in a sludge. The sludge itself then requires safe disposal, particularly as any zinc carbonates remain chemically unstable, and the metal can be re-released into solution quite easily. Waste rock piles containing sulphide-bearing rocks often require this form of treatment as they do not readily lend themselves to preventive methods. It has become standard practice to segregate the sulphide waste rock to reduce this problem. Collection and treatment can become very expensive, especially when required in perpetuity.[278]

At the Faro mine, acid drainage and the related leaching of metals are the two largest environmental concerns. Copper precipitates rapidly as the pH of the water rises, forming non-toxic, stable compounds. Zinc, however, remains in

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[277] Feasby, D.G. et al. 1997. pp. iv-vi.
[278] Ibid, and Rodger, Robert. 1993. p.14.

solution except under very alkaline conditions. Therefore, simply neutralizing the drainage can still result in high zinc levels downstream from operations.[279]

Land Reclamation

The land reclamation of abandoned mines is normally a much smaller concern than issues of potential or actual water contamination. Generally, land reclamation involves: the prevention and control of erosion and ground slumps, the cleanup of any contaminated ground, the re-vegetation of disturbed ground, the decommissioning and/or removal of buildings, power lines, and roads, and the general ensuring of the safety of the site by plugging portals etc.

Erosion control is now considered a given for good mine engineering. Most erosion can be prevented through good design and careful construction of roads and waste-rock piles. When mining first began at Faro, it appears that the stability of waste-rock dumps was given little consideration beyond that required for basic safety. Later dumps however, were designed with lesser slopes and terraced to help prevent erosion. It was only when corners were cut (as with Curragh's Vangorda dump) that slumping and erosion problems occurred. If any such problem areas exist, fixing them is among the first priorities of a land reclamation project. The other top priority is the cleaning up of any contaminated ground. A wide variety of contamination can occur at a mine site, but the most common are hydrocarbon spills of various kinds, most of which are amenable to current cleanup technologies.

The removal of buildings and power lines is perhaps the simplest (and often the cheapest) of the steps toward a mine site reclamation. Much of the material can be salvaged, and this tends to keep costs low. Concrete slabs and foundations are easily broken up and buried. The decommissioning of roads tends to be somewhat more of a problem. There is a general reluctance to completely

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[279] Curragh Resources Inc. 1988. 1988 Abandonment Submission: Summary Report. p.5.

remove roads, especially in areas where there is still the possibility of fresh mineral discoveries. This will almost certainly be the case at Faro, where the mine site covers a very large area, and the actual mining roads provide access to a further network of minor exploration roads and tracks. And there is often support from the local community to keep the roads in place as they provide access to the bush for hunting, fishing, and other recreational pursuits.

Usually, the most problematic issue in the land reclamation of mining sites is re-vegetation. At a minimum, the mine site must be re-vegetated to the point where the natural succession process can take hold. Ideally, this can be done with native grasses and vetches that stabilize the soil surface and prevent wind erosion, allowing willows and other pioneer tree species to gain a foothold. Getting to that point is often difficult on mine sites as much of the disturbed ground often has very little fine soil materials (e.g. the waste rock piles), and what little there is often subject to severe wind erosion. Hydro-seeding, the process of spraying a mixture of grass seed, water, and fertilizer onto an area, will often achieve good results even under difficult circumstances however, especially if there is follow-up watering of the area during the first growing season.

Consequences of Abandonment Without Decommissioning

What would be the environmental effects of completely abandoning the mine site at Faro without doing any decommissioning work or monitoring — i.e., simply walking away? The consequences — outlined by Robert Rodger, a mining engineer, in a report[280] written for DIAND in late 1993 — are as follows:

> "The ARD generation process at Faro is in the early stages of chemical oxidation. After neutralization potential is consumed, the process moves into biochemical oxidation. The rates of oxidation in the second phase can

[280] Rodger, Robert. 1993.

be several orders of magnitude higher than the rate of chemical oxidation... After Curragh Inc. stopped tailings deposition in the Down Valley Impoundment, zinc concentrations in the water increased to above allowable levels. Without the addition of lime to the water in the impoundment, zinc levels in the water discharged... will exceed licence levels. It can also be expected that the acidity of the water in the impoundment will also increase over time. As the ARD process develops, the levels of zinc and other metals can be expected to increase dramatically over time.

"The impact, over time, of high zinc releases in Rose Creek will be elimination of the fish population in Rose Creek below the mine and in Anvil Creek downstream from the confluence with Rose Creek. The loss would be essentially permanent. This would include utilization of Anvil Creek by the chinook salmon for spawning and rearing. The impact on the Pelly River can not be forecast with the available information... [h]owever, since chinook salmon may have to migrate through a contaminant plume, both upstream as adults and downstream as juveniles, the impact could potentially be significant.

"At some point in time, structures such as the Intermediate Dam [see Figure 6] will fail, resulting in tailings entering Rose and Anvil Creeks. The Cross Valley Dam might provide a first line of defense but the capacity of the pond is limited. It will fill with tailings and/or fail... Depending on the type of failure, tailings would wash out of the impoundment and could travel some distance down Rose and Anvil Creeks. After a failure, tailings would continue to wash out of the impoundment and would probably reach the Pelly River with time. Tailings entering Rose and Anvil Creeks will result in vegetation kill all along these creeks and could exacerbate the effects of high zinc and/or other metal levels.

"Seeps from the [Faro pit] waste dumps contain high zinc values. This water presently flows into the DVT Impoundment and would add to the zinc loading entering Rose Creek. After the Faro pit has filled with water, discharge from the pit will flow through the Zone II pit and waste dump into the North Fork of Rose Creek. The discharge water will become contaminated and would add to the zinc loading entering Rose Creek. The Faro Creek diversion channel will fail in time, and the creek will flow into the Faro pit. Depending on where this failure occurs, the high sulphide waste in the waste dump in the Faro Creek channel north of the pit could contribute to zinc loadings in the water of Faro pit.

"Without water treatment, zinc levels in the water discharged from the Vangorda collection pond will exceed licence limits. It can also be expected that acidity of the water in the pond will also increase over time. The impact over time of high zinc levels in Vangorda Creek is expected to

be significant. Large numbers of juvenile chinook salmon (up to 20,000 at one time) utilize the lower reaches of the creek. During the summer, the total number of juvenile salmon utilizing the creek could be several times larger. All may be affected by the contamination, either succumbing to it or becoming increasingly vulnerable to predation... The Vangorda Creek diversion channel will fail in time, and the creek will flow into Vangorda pit. Since the inverted metal culvert is only designed for a 20 year flood event, failure in that section would probably occur within a short time frame."[281]

THE PROBLEMS AT FARO

Following Curragh's bankruptcy, Cominco Ltd. and several partners examined the Faro mine before making an offer to the receiver. From that examination came some very harsh criticism of the abandonment plans and planning at Faro. The comments on the various parts of the Faro property quoted in the following two sections are from a memo written by Cominco's environmental manager:[282]

The Faro Pit and Rose Creek Tailings Impoundment

"Faro pit problems include:

- "Pit water quality now deteriorating, sulphides in pit walls, higher waste areas and Zone II pumpback are causes. Not anticipated in planning.

- "Feasibility of Plug Dam highly questionable, high water losses would, at least, make pumping very expensive and add to treatment burden or, at worst, lead to unmanageable flow of contaminated water from Zone II pit.

- "Faro Creek — limited, if any, data on stream hydrology. Very large overflow rates from pit would occur in spring. No provision for channeled conveyance to below Rose Creek tailings. Could be a near impossible treatment in the likely situation of a permanently contaminated Faro pit.

- "Waste Dumps — leaching from sulphide areas in main waste dumps could be a problem in the North Fork of Rose Creek and will always be a factor in tailings water quality. Requirements for collection and treatment are unknown. Remediation to control leaching is likely an impossible task.

"Likely problems [with the plan to reprocess majority of tailings] include:

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[281] Rodger, Robert. 1993. pp.29-31.
[282] Kuit, Walter. December 1, 1993. "Faro Closure Issues."

- "Capital is provided to start-up tailings recovery and processing but all forward costs are assumed to be paid back from concentrate revenues.

    - "Retreatment has been done only at testwork level, actual mill recovery and concentrate grades an unknown.
    - "Marketability of bulk con. highly questionable, if it could be sold the likely returns are unknown irrespective of metal prices. Penalties could consume most of the values.
    - "Note final shutdown assumes value in mill equipment, likely a liability.

- "Plan assumes good water quality in pond discharge. If not large flows would be an impossible treatment requirement. Even if metal concentrations are low, high flows could result in degradation of water quality downstream. (CCME guidelines will be downstream criteria).

- "Permanent stability of Intermediate Dam is a major question mark, particularly in the minds of DIAND engineers.

The Vangorda Plateau

"Final closure [of the Vangorda and Grum pits and waste dumps] entailed the relocation of the water treatment plant down the hill to serve only the treatment of contaminated drainage from the Vangorda and Grum waste dumps. Both pits were to be flooded (assumed good water quality) with discharge to Vangorda Creek. The creek diversion would be breached and allowed to flow through the Vangorda pit. It was assumed that contaminated waste dump drainage from both mine areas would be effectively collected and treated in perpetuity. Concerns with the plan include the following:

- "Pits — the assumption of good water quality in the 'lakes' is likely invalid at least for the Vangorda pit. It has high sulphide areas above the ultimate water line but a simple till 'dressing' will not prevent these from leaching. Future uncontrollable water quality problems could be very severe.

- "The future treatment requirements are unknown as Grum sulphide wastes have yet to be generated. Present allowance is for about $250,000 / year treatment / maintenance costs which is extremely light. Future sludge disposal requirements (i.e. $/ton etc.) have not been addressed. Every $100,000 of annual costs will require about $3-4 million security deposit at closure.

- "Experience at the Vangorda dump indicates that collection is not simple and that the dump design is flawed (the till cover on a high sulphide cell does not work). Poor collection of drainage will ultimately reflect in deterioration of Vangorda Creek quality. Remediation (e.g. extensive well collection or ?) would require major capital and substantially increased treatment costs."

Cominco's memo makes an interesting (and marked) contrast with the normally optimistic, can-do approach to environmental problems by mining companies. Cominco was attempting to buy the property at the time however, and clearly did not wish to underestimate the potential problems. If the company had acquired the mine, it would doubtless have found more reasons for optimism.

ABANDONMENT PLANS AND PLANNING: FARO'S ABANDONMENT SAGA

The inevitability of extensive environmental damage — damage that will continue for a very long period — makes planning for mine abandonment crucial. Despite all parties concerned being very aware of the importance of planning for abandonment, the process at Faro spanned many years.

There was no requirement for an abandonment plan in the approvals neither for the mine when it opened in 1969, nor during the term (1974 to 1979) of its first water licence. The Water Board made its first demand for Cyprus Anvil to come up with an abandonment plan when the company applied to renew its licence in 1979. Included in that application was a request to increase the size of the tailings disposal area to allow for an increase in production from a new zone in the Faro pit and for the eventual mining of the Vangorda and Grum deposits. (The increased tailings area, shown in Figure 6, became known as the Down Valley Tailings Impoundment. It is the area down Rose Creek to the Intermediate and Cross Valley dams).

There were serious concerns with the expansion plans. At a Water Board hearing in 1980, a spokesperson for the Environmental Protection Service argued that:

> "The long-term risks related to this proposal probably rank amongst the most serious problems that have been considered by the Yukon Territorial Water Board...[there is a] lack of information [on] abandonment... The Cyprus Anvil tailings are massive sulphide and will be prone to generate acid once the discharge of alkaline tailings slurry from the milling operation ceases... Our conclusions are, firstly, that prior to decision on the licence application the company should be required to produce an abandonment and reclamation plan in conjunction with the design of the facilities..."[283]

At the same hearing, Cyprus Anvil's manager of operations made clear commitments to developing and implementing an abandonment plan:

> "Cyprus Anvil is committed to developing a long-term tailings disposal and stabilization abandonment plan. We stated this at the hearing in January when we were applying for a renewal of our existing Water Licence... We shall develop an abandonment plan within the life of the current licence, which is to November of 1984..."[284]

Cyprus Anvil received approval to proceed with the expansion immediately. However, the Water Board withheld the issuance of a water licence renewal (other than a temporary extension of the existing licence) until the company presented an acceptable abandonment plan.[285]

Cyprus Anvil's Plan

In its initial study, Cyprus Anvil identified three possible options for the final abandonment of its tailings area and the Faro pit. (No development had yet taken place on the Vangorda Plateau.)

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[283] Yukon Territory Water Board. September 1980. Public Hearing. pp. 36-41.
[284] Ibid. p.3.
[285] Klohn Leonoff Consulting Engineers. February 1981. Cyprus Anvil Mining Corporation: Phase I Report Faro Abandonment Plan. p.1.

The first was to simply improve the existing diversion canals for Rose and Faro Creeks and then cap the tailings with clay to isolate them from both ground and surface water. For the company, this was the most attractive option as it would use most of the engineering works already in place and, therefore, would be the cheapest of the alternatives. The glaring disadvantage was that it was not likely to work effectively — or perhaps not at all — and would require extensive maintenance of the canals in perpetuity.[286]

The second option considered was to flood the tailings and thereby create an abandonment reservoir over the tailings area. All streams and overflow from the pit would flow into the reservoir, and the containment dam would have an overflow structure capable of handling the probable maximum flood. Before flooding, the tailings would be covered with a clay cap. The major advantage of this option would be the reduction of acid generation to very low levels in the tailings. The disadvantage, from Cyprus Anvil's point of view, was the expense involved in the construction of the reservoir.[287]

The third option considered was a plan to remove all the tailings from the impoundment area and return them to the pit on abandonment. Rose Creek would be returned to its course and, "... the probability of long term water contamination is minimized."[288] This option was the least desirable to Cyprus Anvil because of its very high capital cost.

The Water Board's response to the three options presented was swift. In March of 1981, it rejected Option 1 outright, asked that Option 3 be retained as an alternative, and asked the company to continue to work on Option 2 as the most likely abandonment plan. Option 2 became a requirement of the water licence. The Board, however, did have concerns that the proposed reservoir dam might

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[286] Klohn Leonoff Consulting Engineers. February 1981. pp.39-40.
[287] Ibid. pp.40-43.
[288] Klohn Leonoff Consulting Engineers. February 1981. p.42.

not be stable over the long term and that the reservoir might become contaminated by acid drainage from the abandoned pit and waste rock dumps.[289] The company's initial cost estimate for Option 2 was $51.1 million and for Option 3 was $179.6 million.[290]

With the mounting financial difficulties of Cyprus Anvil and the closure of the mine in June of 1982, planning for abandonment came to a halt. Cyprus Anvil's final contribution to an abandonment plan for Faro was a request, which the Water Board granted in October of 1985, for an emergency amendment to its water licence. The amendment was the elimination of the requirement to carry out the existing abandonment plan. The request was granted by the Board primarily to remove an obstacle to Curragh Inc.'s acquisition of the mine. The requirement to carry out an abandonment plan was a financial liability that Curragh could not or would not shoulder. The Board required Curragh to produce a new abandonment plan by the end of December 1986 as a condition of its new licence.[291]

Curragh's Plan

Curragh appeared not to be in too much of a rush to develop an abandonment plan. It commissioned a study, not completed until November of 1986, that strongly emphasized the need for any plan to be within the financial means of the company and for implementation to be incremental over the mine's operating life.[292] The study did not produce an abandonment plan but did identify Curragh's favoured option for final abandonment of the tailings. That option was a variation on Cyprus Anvil's proposal to flood the tailings. It was summed up as:

> "...: 0.6m of till over the original impoundments and flooded tailings in Down Valley impoundment. Rose Creek is maintained in its present channel and long term maintenance is provided. If groundwater contamination occurs interceptor wells will be installed and a treatment

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[289] Klohn Leonoff Consulting Engineers. September 1981. Cyprus Anvil Mining Corporation: Faro Mine Tailings Abandonment Plan. Appendix I.
[290] Ibid. pp.61-64.
[291] Yukon Territory Water Board. October 1985. Reasons for Decision.
[292] Robertson, Steffen et al. November 1986. Final Report 60601. p.i.

> plant will be installed and operated...[this plan] has the greatest potential of being within the fiscal capabilities of Curragh Resources. It is the favoured option."[293]

The Water Board's response to Curragh's initial effort was uncomplimentary to say the least. The Board wrote:

> "Curragh has not lived up to its obligations under the terms of its licence. It made commitments that it has not kept. Nor was Curragh diligent in striving to meet the date it had requested. The emergency amendment was granted in October 1985 yet Curragh did not hire people to work on the abandonment plan until April 1986... All parties at the hearing agreed that serious environmental harm could occur if a proper abandonment plan is not implemented."[294]

The Board considered canceling Curragh's water licence but decided that shutting the mine for non-compliance was not in the best interests of either the environment or society. Instead, it required Curragh submit details of a new abandonment plan by March 31,1988.[295]

In what was quickly becoming a pattern, Curragh did not complete the work required by the deadline. It provided the Board with only partial (and conditional) plans for abandonment of the Faro pits and some of the associated water courses. Among the plans were:

> "Both Faro pits will be flooded with water. Provisions are made to collect and treat overflow if water quality is unacceptable... Backfilling of the Zone II pit will be completed. Interceptor ditches are being constructed to minimize water flow through acid-generating rock... After 1990 all sulphide waste will be dumped back in the Zone I/III pit below the level to which the pit will be flooded... The old dumps, and Curragh's non-sulphide dumps will be assessed for their potential to generate acid... Faro Creek will be diverted into the Zone I/III pit. If long term water treatment is required, Faro Creek will be returned to an upgraded diversion channel... [It] will be designed to minimize transport of metal contaminants into the pit by the creek, either by constructing a lined dyke and channel or by removing the acid-generating portion of the dump."[296]

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[293] Robertson, Steffen et al. November 1986. p.iv.
[294] Yukon Territory Water Board. June 1987. Reasons for Decision. pp.15-16.
[295] Ibid.
[296] Curragh Resources Inc. April, 1988. 1988 Abandonment Submission: Summary Report. pp.8-12.

Though woefully incomplete even in the areas with which it dealt, the Water Board accepted the proposed abandonment measures and set yet another deadline, March 31, 1991, for an abandonment plan covering the tailings impoundment and the Rose Creek diversion.[297]

In April 1991, Curragh submitted its decommissioning plan for the tailings area.[298] In it, the company again examined a number of options and this time chose an alternative (number 5 on the list), that involved reprocessing a substantial portion of the tailings in the impoundment and covering the remainder in water. The advantages of this approach were clear. Curragh estimated that the recovery of metals from the tailings would, at a minimum, pay for both the capital and operating costs of moving, processing, and disposing of the remaining tailings in the main pit at Faro.[299] Option 5 would allow use of the existing Intermediate dam, with minimal improvements, to retain the remaining tailings under a water cover. It would also act as a collecting pond for both surface and ground water runoff from the pit and areas upstream.

The Water Board responded to Curragh's plans with some caution. It wrote of its decision:

> "Option 5 (water cover with re-processing) was identified by Curragh as the preferred option... Curragh stated that there would be no commitment to this option until Curragh was satisfied that revenue generated from the sale of the concentrate would potentially cover the cost of tailings relocation and reprocessing... Option 5 has been incorporated into the water use licence, but is subject to the completion of a feasibility study and a financing plan and to subsequent public review of both the conclusions of the study and the financing plan. In the interim, Option 4 will be the contingency plan."[300]

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[297] Yukon Territory Water Board. October 1988. Reasons for Decision.
[298] Curragh Resources Inc. April 1991. Down Valley Tailings Impoundment Decommissioning Plan: Faro, Yukon.
[299] Ibid. p.11-10.
[300] Yukon Territory Water Board. November 1992. Reasons for Decision. pp.2-4

The contingency option referred to would involve raising the Intermediate dam by 10m to allow a water cover over the tailings in the down valley impoundment, and covering the tailings in the original and second tailings ponds with a composite soil cover.[301]

By 1991, the basics of an abandonment plan (though somewhat contingent) were finally in place but the abandonment dance between the Water Board and Curragh was not over. In 1990 a separate water licence was issued to allow the development of the Vangorda and Grum ore bodies. That licence required that the company operate a water treatment plant at Vangorda Creek in perpetuity. It was clear from the onset that acid drainage would be an inescapable and potentially serious problem at Vangorda. There was also the condition that the company submit a detailed abandonment plan for the Vangorda project by June of 1994.[302]

Having separate plans for different portions of the same property did not seem to be a sensible approach. The Board therefore set aside the requirement for the Vangorda plan and substituted a requirement that Curragh submit an integrated comprehensive abandonment plan (ICAP) by December 1994.[303] In the same report, the Board wrote that:

> "... serious concerns were expressed regarding the ability and, to some degree, the commitment of the Licencee to pay for the abandonment of the entire site... adequate security must be a component of this licence."[304]

The issue of paying for abandonment and adequate security examined in following sections on the environmental liability and the trusteed environmental fund.

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[301] Curragh Resources. April 1991. p.6-5.
[302] Yukon Territory Water Board. September 1990. Reasons for Decision. pp.7-8.
[303] Yukon Territory Water Board. November 1992. p.5.
[304] Ibid.

Curragh never did complete an ICAP for the Faro mine. As the company's financial problems mounted in 1992, it applied for extensions on the Water Board's deadlines. The Board did agree to a year's extension for submitting a feasibility study on the tailings recovery, but it did not grant the requested extension of the deadline for submission of the ICAP.[305] The point became moot however, with the bankruptcy of the company and the shutting down of the mine in April 1993.

Anvil Range's Plan

In 1994, Anvil Range acquired the Faro mine and inherited the existing water licences, complete with their requirements for completing an integrated comprehensive abandonment plan. Unlike its predecessors, Anvil Range did complete a plan,[306] submitting it to the Water Board in November 1996, one month before closing down the mine. The ICAP is the first such complete, integrated plan for any mine abandonment in the Yukon.

Anvil Range's plans for the Faro pit and its surrounding waste rock dumps were substantially different from those of Curragh's. The ICAP shares Cominco's view that contaminated overflow and seepages from both the pit and the waste dumps will continue in perpetuity. It therefore plans to isolate the pit as much as possible from all water flows and use it as a contaminated water storage facility. Maintenance of the existing Faro Creek diversion would minimize the flow of clean water into the pit. The creation of an additional reservoir for contaminated water at the current mill site would intercept additional seepages from the waste dumps. A water treatment plant would bring all outflows up to acceptable standards. Disposal of the contaminated sludge from water treatment would be

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[305] Yukon Territory Water Board. September 1993. Reasons for Decision. pp.3-4.
[306] Robertson Geoconsultants Inc. November 1996. Anvil Range Mining Complex: Integrated Comprehensive Abandonment Plan.

by injection into the underground areas of the pit.[307] The plan for the pit area is shown in Figure 7.

The ICAP chooses the option of reprocessing a portion of the tailings contained in the Rose Creek tailings impoundments. The tailings would be pumped to the existing mill, processed, and the remains dumped into the main Faro pit, where they would be underwater. Covering the remaining tailings with water in situ complete the tailings impoundment plan. Removing enough tailings from all three of the impoundment areas allows flooding the remainder to a minimum of three metres without raising the existing Intermediate Dam. Keeping the Cross Valley Dam in place allows for treatment of pond discharge until acid generation within the pond ceases. Then the Cross Valley Dam would be removed (see Figure 6).).[308]

[307] Robertson Geoconsultants Inc. November 1996. pp.7-1 to 7-17.
[308] Ibid. pp.7-19 to 7-23.

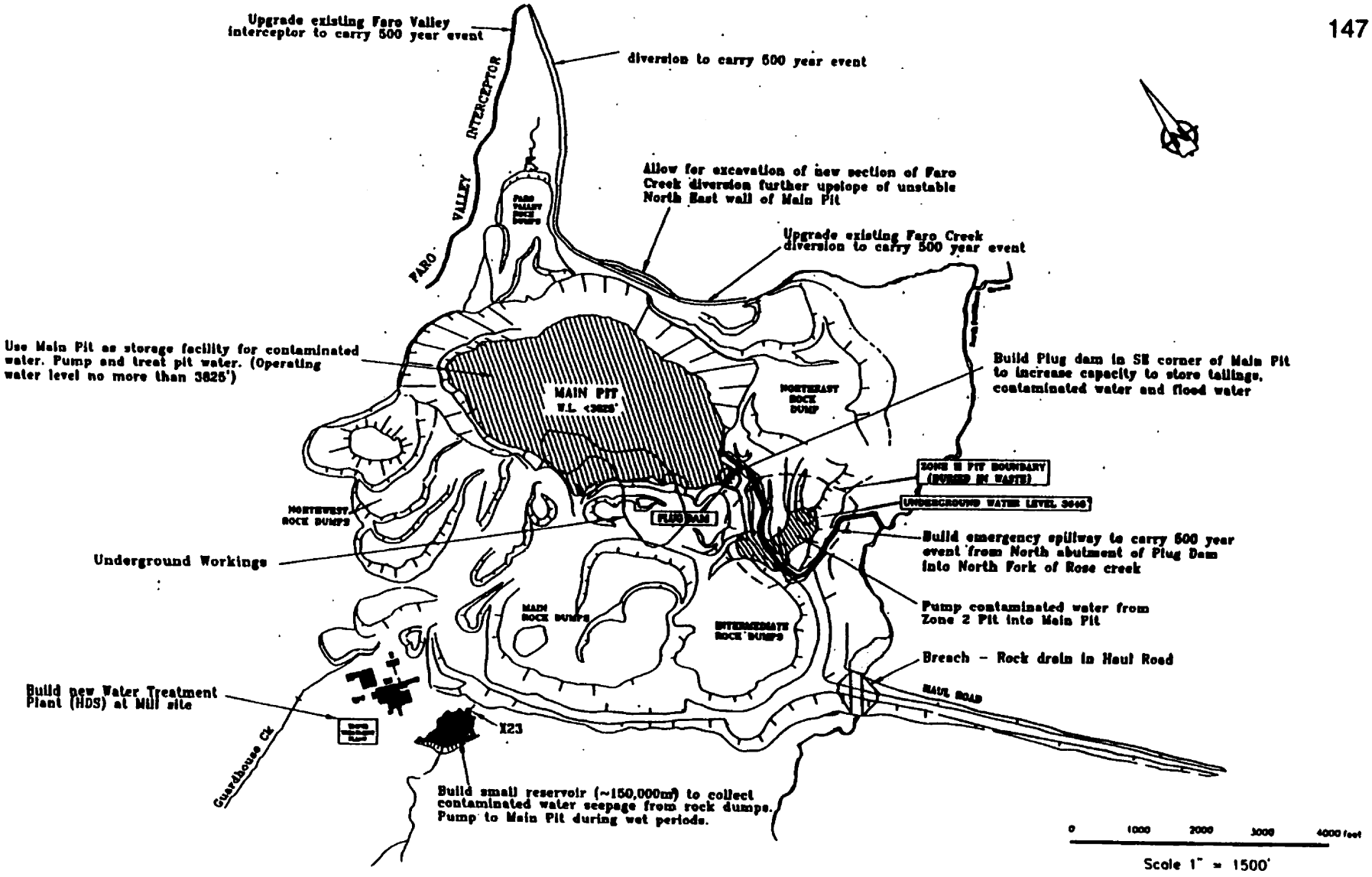

Figure 7: Faro's Main Pit

For the Vangorda pit, Anvil Range's ICAP adopts the same approach of isolating the pit and using it as a contaminated water storage reservoir. Again, it is not considered possible that the water in the pit could possibly meet the required quality needed to allow it flowing untreated into Vangorda Creek. Maintaining the Vangorda Creek diversion channel allows the use of the pit over the long term to store all contaminated water collected over the entire Vangorda/Grum area, including that from the sumps and wells around the waste rock dumps. Water from the pit would then be run through a treatment plant before being discharged into the creek. Planned sludge disposal is by injection into the underground portion of the Grum pit. [309]

The Grum pit differs from the Vangorda and Faro pits in that there is not a significant amount of acid generating rock exposed above the maximum flood level in the pit. Once the pit is full of water, therefore, there will be no acid generation. Unfortunately, filling the Grum pit could take a very long time, more than 100 years, as there is no major water drainage to it. During the flooding process, the water in the pit would be contaminated from exposed acid-generating rock. The ICAP planned to shorten the flooding period to 25 years by initially pumping the contaminated water collected from the Vangorda pit and waste dumps into the Grum pit. When full, water in the pit could be treated in situ to achieve a clean lake, or the discharge water could be treated as needed.[310]

At the core of the ICAP for the Faro property is the recognition of the need to maintain active water-treatment facilities for many decades (or in perpetuity) after the final closure of the mine to meet water quality standards. The ICAP also points out, however, that most of the work required to prepare for this very long-term treatment will itself not be carried out until well in the future.[311] This has very

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[309] Robertson Geoconsultants Inc. November 1996.. p.8-3.
[310] Ibid pp.8-9 to 8-10.
[311] Ibid. p.11-2.

large implications for the final cost of abandonment and long-term maintenance of the property, as will be discussed in the section below.

FUNDING DECOMMISSIONING AND ABANDONMENT

The various plans and part-plans for the eventual abandonment of the Faro property have had wildly varying estimates of the total abandonment costs attached to them. In 1981, Cyprus Anvil tentatively put the cost of decommissioning just the existing tailings area at between $51 million and $180 million depending on the option selected.[312] Curragh's overall estimate came in at approximately $50 million.

One independent estimate of decommissioning costs was done in 1993 on behalf of the Department of Indian Affairs and Northern Development.[313] A summary of the estimated capital costs of decommissioning and the estimated fund required to supply sufficient income for monitoring, maintenance, and water-treatment costs in perpetuity is shown in Table 14 below. All figures given are the high-end estimates, and are shown in constant 1993 dollars. It is assumed that all decommissioning work is to be done in the near future, and therefore the related capital would be required in the short term.

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[312] Klohn Leonoff Consulting Engineers. September 1981. pp.61-64.
[313] Rodger, Robert. December 1993. Faro Mine Decommissioning Options and Issues Paper.

Table 14: Decommissioning and Maintenance Costs

	Decommissioning capital cost ($ million)	Monitoring/maintenance fund required ($ million)
Down Valley Tailings	58.5	5.06
Faro pit	8.4	12.5
Vangorda	16.1	12.28
Mill and facilities	5.1	6.07
Totals	88.1	35.9
Grand Total	**$124.0 million**	

The total price tag of about $120 million was considered by Cominco a much more realistic assessment of probable costs than the estimates made by Curragh. Indeed, Cominco thought even the high estimate might prove inadequate. Cominco's assessment was:

> "Estimates of the costs to meet these combined requirements [of decommissioning and monitoring/maintenance/treatment] have ranged from $50 million to $120 million. The higher estimate was prepared by a consultant to DIAND and, in our experience, represents a more realistic assessment than the lower number. It is also important to note that this range of potential liability is based on assumptions that certain proposed closure related activities will be effective. When dealing with a potentially massive acid drainage situation such as exists at Faro, costs can escalate dramatically."[314]

The figure of approximately $120 million is still the one generally accepted as being realistic, particularly within government.

In stark contrast to the $120-million figure is the more recent estimate by Anvil Range in its ICAP. Anvil Range estimated that the total required for both the capital costs of decommissioning and the operating costs after decommissioning was $32.9 million. There appear to be a number of reasons for this much lower figure. Among them is that the ICAP assumes (somewhat unrealistically it

[314] Miner, Richard B. February 22, 1994. "Letter to KPMG."

seems) that both the capital and operating costs for the processing and relocation of the tailings would be paid for out of the revenue generated by the processing. Contingencies allowances are set at approximately 10%, less than in some other estimates. The largest single factor for the low estimate, however, is the assumption that the large majority of the up front decommissioning work would not be carried out until several decades hence, and so the related capital costs are heavily discounted. The $32.9-million figure represents what would have been required to be set aside as a lump sum in 1996 to earn sufficient funds to pay for all costs as they came up over the decades to follow.

Security Deposits And Bonds

How are the costs of decommissioning, reclamation, and long-term water treatment to be paid for? Until the 1960s, it was commonly thought that reclamation work and its costs fell naturally to governments. This outlook has changed considerably, and now it is accepted that closure costs are simply another cost of doing business for the mining company.[315]

There are a number of devices used to raise and maintain the funds needed for abandonment. Of course, it would be possible to simply trust that the mining company would live up to its environmental obligations after mining is completed. Long experience has shown, however, that this is simply not a realistic option. Other devices used are security deposits from operators deposited with the government either in the form of cash or of a bond, and various forms of trust or sinking funds.

Security deposits are sureties — that is, they are held by government until all decommissioning and reclamation work is completed and then are returned to the operator of the mine. In theory, sureties should be large enough to cover all the costs of abandonment that the operator fails to perform. If the security

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[315] Waters, Donovan. June 1989. Report by Donovan Waters. p.4.

deposit is large enough, then the environmental liability is completely covered from the onset of mining, and there is no risk of costs falling onto the public purse. However, such a large deposit would be prohibitively expensive for almost any company and almost any mine — especially a long-lived mine. In Canada, security deposits are generally required but are set at a fixed rate, sometimes at a legislated cap, sometimes per acre of the property, and sometimes per tonne mined. Such fixed rates do not allow governments to keep abreast of real reclamation costs, and tend to provide little incentive for operators to clean up as they mine, especially smaller operators who can more easily walk away from a property and the deposit.[316]

Agreements to create sinking or trusteed environmental funds that will eventually provide the moneys necessary for abandonment of mines can be crafted in a variety of ways, but all share certain characteristics. All are designed not to produce maximum income or maximum capital growth, but rather to produce a certain sum at a certain point in time. These types of funds are also designed so that they may be used only for their designated purpose. The great advantage of such funds is that they greatly reduce the financial strain on mining companies, particularly at the beginning of projects when that strain is the greatest. The great disadvantage is that the use of a sinking fund presupposes that the mine will operate — and usually that it will operate profitably — until ore is exhausted. If the mine is closed prematurely, or if the operator is bankrupt, then the government must effectively act as guarantor to the fund and make good its deficiencies. In effect, the public is exposed to the environmental liability, albeit gradually shrinking, throughout the life of the mine.[317]

The Faro property has and does have both security deposits and environmental trust funds in place. When Curragh took over the property in 1985, it was required to provide a security deposit of $500,000 as a condition of its water

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[316] Waters, Donovan. June 1989. pp.6-12.
[317] Ibid. pp.17-20.

licence. It also entered into an agreement (initially not a condition of the licence) with DIAND to create a trusteed environmental fund, the first of its kind in the Yukon. The agreement went into effect in March of 1987, and under its terms, Curragh would pay into it at a rate of 25 cents per wet metric tonne of mineral concentrate shipped until the fund reached a total value of $7.5 million.[318] There were concerns from very early on that the fund would be inadequate for the task it was to perform. The annual contribution rate — $130,000 in 1989, for example — was seen as woefully low, and the cap was also considered far too low.[319]

When Curragh received approval to begin the development of the Vangorda and Grum deposits in 1990, it was given a separate water licence with different conditions from those attached to its Faro licence. The licence was granted for a 13-year term and required a security deposit of $943,700. In addition, the company was required to pay $560,000 annually for 12 years into a trust fund for abandonment. The annual figure was determined to be approximately 1/12 of the total estimated abandonment costs of $6.7 million for the Vangorda area.[320]

When Curragh went bankrupt and the mine shut down in 1993, DIAND seized the security deposits for both the Faro and the Vangorda water licences. Nearly all of the Vangorda security ($943,700) was quickly spent doing some remediation work considered critical on the Vangorda waste rock dump and water courses. The Faro security was rolled into the existing trust fund.[321]

When Anvil Range purchased the property in 1994, the company entered into a new agreement with the government to provide for abandonment costs.[322] This new agreement was rolled together with the existing trust fund to create a reclamation trust indenture in 1995.[323] Anvil Range was required to post the

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[318] Canada. Redrafted Trust Indenture Draft. January 30, 1990.
[319] Canada. February 2, 1990. Statement of Intervention.
[320] Yukon Territory Water Board. September 1990. Reasons for Decision.
[321] Sherstone, Dave. 1998. Personal communication.
[322] Canada. November 8, 1994. Reclamation Security Agreement.
[323] Canada. March 15, 1995. Anvil Range Reclamation Trust Indenture.

same security deposits for the Faro and Vangorda water licences as Curragh had — $500,000 and $943,700 respectively. It was also required to continue the annual payment of $560,000 toward the Vangorda cleanup. Instead of paying 25 cents per wet tonne of concentrate into the trust fund as Curragh did however, Anvil Range was to pay a percentage of its quarterly mining revenues from the property as a whole, including the Grizzly deposit if it went into production. This was known as the NSR levy. The percentage was set on a sliding scale based on the price of zinc in that quarter. A minimum total payment of $175,000 per quarter ($700,000 per year) was required from the company regardless of the zinc price; however, that minimum would be reduced by the total of any other payments the company was required to pay into the trust fund. In effect, this provision meant the annual minimum was actually $140,000 after the annual $560,000 payment on the Vangorda licence was made. A final requirement was for the company to begin, three years into production at the mine, to make $500,000 annual payments for 12 years (the "Dy Payments") all of which would be credited against the NSR levy.[324]

When Anvil Range took over the property, the trust fund contained approximately $4.4 million.[325] Unfortunately, the fundamental weakness of these trust funds as a mechanism for paying for abandonment was demonstrated in this case. If the mine had continued to operate as planned, and especially if the price of zinc remained high, the trust fund would likely have ended up being substantial. However, Anvil Range remained in business for less than two years, and the trust fund for the Faro property currently contains a total of approximately $11.5 million. Set against the estimated need for $124 million to cover the environmental liability, this is woeful indeed.

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[324] Canada. March 15, 1995.
[325] Ibid. p.4.

CHAPTER 7: INVESTING RENTS FOR SUSTAINABILITY

Experience in the saving and investment of resource rents has been confined to oil-producing jurisdictions beginning in the 1970s. The surge in the price of oil beginning in 1973 led to enormous windfalls for governments of oil producing regions, and in North America Alaska and Alberta set up funds to save and invest some of it. Norway is another northern oil producer that has set up a fund, but it is a late comer, with its fund starting up only in 1995.

There has been considerable debate about the best means of handling windfall resource revenues. As discussed in Chapter 3, fully meeting the criteria of strong sustainability would require the investment of all non-renewable resource rents in renewable substitutes for that resource. For oil used as energy this would mean investing in the development of solar energy for example. Unfortunately, there is no incentive for any oil producer to make those kind of investments as all others could then benefit from any technological developments made, while spending their own rents in other ways. For other resources such as minerals, this free rider problem is compounded by the lack of certainty over what might be a substitute for the resource. Meeting the criteria of weak sustainability by investing rents in other, sustainable, forms of economic activity is much more likely to occur.

In both Alberta and Alaska in the late 1970s there was broad agreement that at least some of the oil windfall should be saved but considerable debate over how it should then be used. In a paper presented in 1979, McMillan and Norrie laid out the options they saw for Alberta:

> "There are three fundamentally different ways in which the provincial government could handle these windfall resource revenues. The first, often labeled province-building, would be to use them to promote economic growth and the development of a more diversified industrial

> base. The province would invest in a deliberate restructuring of its economy, largely in an attempt to thwart the economic decline that is expected to follow resource depletion. The other two options stem from the quite opposite notion of a rentier society, that is, one in which the government acts as an agent to collect the economic rents and to distribute them to its residents while allowing market forces to shape the economy. The rents could be distributed collectively through the traditional tax-expenditure system by using them to provide public goods and lower taxes. The alternative, and third option, is to distribute the rents directly to residents as a 'dividend' with government expenditures financed out of conventional tax revenues."[326]

McMillan and Norrie argue that the distribution of rents directly to individuals while allowing market forces to shape any diversification of the economy is the best and most economically efficient of the three options. They argue for the creation of a fund that will invest all of the resource rents and distribute the resulting income as dividends to resident shareholders. McMillan and Norrie foresee various flaws in their proposal but offer means of mitigating any problems. Their arguments against the province-building approach boil down to the belief that if there is the potential for economic diversification in a jurisdiction then the market will provide it without government assistance. Distributing the rents via the tax expenditure system (through lower taxes, for example) gets short shrift as the authors argue that such distribution is often highly regressive and leads to a fiscal trap when the royalties dwindle.[327]

Although no jurisdiction provides a "pure" example of any of the three options above, Alaska, Alberta and Norway have each chosen to emphasize one of them. Alaska has gone down the direct distribution to individuals route. Alberta has, until recently, been a believer in the province-building approach. And Norway appears to be favouring a version of the collectivist distribution of rents idea.

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[326] McMillan, M.L. and K. H. Norrie. 1980. "Province-Building vs. A Rentier Society." p.213.
[327] Ibid.

THREE EXAMPLES

Alaska[328]

Alaska's Permanent Fund was created in 1977 when oil began flowing through the Trans Alaska pipeline from the North Slope, and oil royalties and taxes began to flow into state coffers. The fund, which was to receive a minimum of 25% of state oil revenues and whose principal could not be spent, was also entrenched in the state constitution that year. The initial deposit to the fund was $734,000. For the next four years a debate raged in Alaska over whether the fund should act as a public trust fund or as an economic development bank for the state. The argument for the public trust fund won the day and in 1980 the Alaska Permanent Fund Corporation was created to manage the fund independently of the state government. That year also saw legislation passed requiring that 50% of state oil revenues received from fields licenced after 1979 be placed in the fund. In 1980 and 1981 Alaska funneled $2.7 billion over the requirements into the fund, giving its principal a strong boost. In 1982 the fund was permitted to invest in equities and in real estate and legislation was passed requiring the retention of earnings to protect the fund from the effects of inflation. 1982 also saw the beginning of the Permanent Fund's most unusual feature, the dividend paid out annually to every resident of the state, including children.

The fund has the goal of consistently achieving a 4% real rate of return over the long term. Since 1977, it has achieved an annualized return (before inflation) of approximately 12%. Returns have amounted to approximately $20 billion in net income. Legislation caps its equity holdings at 50% of the fund and real estate at 10%. Currently the fund portfolio consists of 44% bonds (both government and corporate), 38% U.S. stocks, 11% other stocks, and 7% real estate. The fund is not permitted to invest in high-risk financial instruments such as derivatives. Another area considered too high risk for fund investment appears to be Alaska

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[328] Unless otherwise footnoted, all information in this section is derived from: Alaska Permanent Fund Corporation. 1999. Various publications.

itself. Of the $25 billion in the fund at the end of 1998, only $18m is directly invested in the state, with a further $300m deposited in Alaskan banks.

The Permanent Fund has been boosted by the annual infusion of approximately 34% of state oil revenues, but even more by high returns from its investments over the past several years. In 1998 the fund earned $2.6 billion in net income. For the first time, fund income exceeded total state oil taxes and royalties. Alaska has certainly been successful in building a very large fund from its oil revenues. Its distribution of much of the income from the fund to individuals does not appear to contribute to long-term sustainability however. Indeed, despite following McMillan and Norrie's prescription and distributing rents to individuals, Alaska has still fallen into the fiscal trap of a government over reliant on resource rents for funding its day-to-day operations.

The Permanent Fund's dividend program

The Permanent Fund has paid out an annual dividend to nearly every resident of Alaska for the past 15 years. Initially the amount of the dividend was tied to an individual's length of residency in Alaska, but the U.S. Supreme Court ruled this unconstitutional. Now anyone who has been a resident for one year is eligible for an identical payment. The dividend is set at one half of the fund's average net income over the preceding five years divided by the number of eligible recipients. In 1998 the total dividend was $869.2 million paid out to 564,085 eligible Alaskan residents (out of a total population of approximately 606,000). Each therefore received $1,540.88.

How do Alaskans spend what amounts to about 5% of the average family's disposable income? Strong anecdotal evidence points to the conclusion that many, if not most, Alaskans treat the dividend as a windfall to be spent on such extras as a winter vacation or a new snow machine. Dividend day is in November each year, and as soon as the amount is announced in late September, radio and newspapers are full of advertisements proclaiming such sentiments as

"Permanent Fund Fun!" and "Its Permanent Fun Time!" Travel out of state appears to be a favourite means of spending the dividend and all airlines serving Alaska put together special ticket packages whose total price exactly match the dividend each year.[329] Doubtless there are some who invest in their education, their retirement, and even in sustainable businesses. But it is clear that Alaska's chosen means of "re-investing" its royalties from a non-renewable resource does not meet any criteria of sustainability.

The Permanent Fund and State Government Revenues

The Alaska State government, while constitutionally forbidden to spend the fund's principal, does retain control over its income. The dividend program is not constitutionally protected, and so it is possible for the state government to discontinue the dividend program and use the moneys for other purposes. Not surprisingly, this is considered to be politically impossible. Even the usual treatment of the annual remainder (after the dividend and allowances for inflation) of the fund's net income, which was designed to flow into the state's general revenues, illustrates how powerful a grip the Permanent Fund has on Alaskan politics. In 1995, '96, and '97 the state government rolled its share of the fund's net income back into the principal. In 1997 this amounted to approximately $803m. When serious financial difficulties forced the government to appropriate its 1998 share (amounting to $1.4 billion) to help cover a revenue shortfall, there was a considerable outcry in the state.

The Alaskan government's financial difficulties in 1998 and 1999 perfectly illustrate the trap waiting for any jurisdiction enjoying a windfall of resource revenues. McMillan and Norrie warned of the trap in 1979, arguing that, while a fund paying individual dividends is the most efficient and desirable of the options for distributing rents, the jurisdiction should distribute *all* such rents. The ordinary business of government should not be funded from a portion of those rents as this will inevitably lead to a fiscal crisis at some point when royalties decline but

[329] Reuters Ltd. November 1996. "Dividend payout fills Alaskans' bank accounts."

program spending (and public expectations) do not.[330] Alaska places about a third of its annual oil revenues into the Permanent Fund, but the remaining two-thirds accounts for roughly 85% of the state's budget. When the price of oil falls (as it did through 1997 and 1998) oil royalties also fall. Brown and Thomas calculate that Alaska requires an oil price in excess of $18 a barrel in order to fund the state's $2.4 billion annual budget.[331] Because the state levies no income or sales taxes, and its overall tax burden is the lowest in the United States, oil royalty declines quickly lead to a crisis.

The Alaskan response to the fiscal crisis of 1998 and 1999 further illustrates features of the resource royalty trap. Not only is the Permanent Fund and its dividend sacred, but most Alaskans also consider it their inherent right to enjoy very high levels of government services while paying next to no tax. Low taxes, good public services and the dividend also act as magnets for migrants who require further services and exacerbate the problems. Proposals to institute an income tax, raise the gasoline tax (unchanged since 1961), and to use a small portion of the Permanent Fund as a fund whose income would pay for education in the state have all been met with howls of outrage. Alaska will doubtless find some means of muddling through the current problems, especially if the price of oil rises, but the fundamental problem will have to be faced at some point. Brown and Thomas argue that in the long run the solution must be a greatly reduced population. When the oil runs out (or production decreases substantially), the state simply will not be able to support as many people as it does now unless there occurs a phenomenal degree of economic diversification. And even given that, they argue, Alaska's environment may not be able to tolerate current population levels for long.[332]

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[330] McMillan and Norrie. 1980. p.213.
[331] Brown, William S. and Clive S. Thomas. 1996. "Diversifying the Alaskan economy: political, social, and economic constraints." p.3.
[332] Brown and Thomas. 1996. p.4.

Economic Diversification in Alaska

In the Yukon there is a commonly held perception that Alaska is economically very different, and much more successful than the Yukon. The private sector is seen to be much stronger (unlike the Yukon's unhealthy dependence on government), taxes much lower, and the economy much more diversified. And, of course, Alaska has its oil wealth. This view is not shared in Alaska however, where the need for economic diversification is as perennial a theme as it is in the Yukon. The oil wealth is there of course, with very low taxes resulting from it. Curiously however, the perception of a highly diversified Alaskan economy dominated by the private sector does not stand up well under scrutiny. In the Yukon, 36% of those employed are employed directly by municipal, territorial, or federal governments. [333] In Alaska, state and local government employ 25% of the workforce,[334] and if federal employees are added (especially given the strong military presence in the state), the two jurisdictions employment patterns begin to look very alike. What Yukoners, casting envious glances across the border, often overlook is the difference in scale between the territory and Alaska. With only one twentieth of the population, the Yukon need only employ one twentieth the numbers of people in any particular industry in order to match Alaska's level of diversification in that area. Only in commercial fishing does Alaska clearly have an industry that the Yukon does not.

Government efforts to diversify the economy in Alaska have met with largely the same lack of success as similar efforts in the Yukon. Efforts at economic diversification peaked in Alaska in the early 1980s when the state government was flush with oil money. Some of the spectacular failures included the $50m spent encouraging barley farming in the state at exactly the time the U.S. federal government was paying farmers nation wide to curtail barley production to ease the glut of grain. Some lucky Alaskans managed to get paid by the state to grow barley and received federal money to not grow it in the same year. The Alaskan

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[333] Yukon Bureau of Statistics. 1999.
[334] Brown and Thomas. 1996. p..3.

Renewable Resources Corporation (ARRC) lent money to prospective industries based on renewable resources. One project receiving considerable support was an effort to build and market washing machines powered by sled dogs. The ARRC was terminated in 1984, writing off $28m in bad loans. [335]

Alberta

Alberta's Heritage Savings Trust Fund was established in 1976 during the height of the 1970s oil boom. It was created with three basic objectives:

1. to save for the future,
2. to strengthen and diversify Alberta's economy, and
3. to improve the quality of life for Albertans.

Despite the somewhat contradictory objectives, it was clear that the government of the day was "openly and avowedly province-building."[336]

From 1976 to 1983, the Alberta government funnelled 30% of provincial oil and gas revenue into the Heritage Fund. From 1984 to 1987 that dropped to 15%, and since 1987 no new money has been put into the fund. From inception until 1982 the fund retained all of its investment income, allowing it to grow more rapidly. Since 1982, however, all the fund's income (including capital gains) has been transferred to the provincial government's general accounts.[337] The fund's fiscal assets quickly stagnated and began to decline shortly thereafter. Mumey and Ostermann write:

> "Though the Fund was created with long-term purposes, by 1983 its financial assets had reached their inflation-adjusted peak and by 1988 even nominal value was in decline."[338]

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[335] Brown and Thomas. 1996. p.4.
[336] McMillan and Norrie. 1980. p.213.
[337] Alberta. October 1998. "1998 Alberta Heritage Savings Trust Fund." Alberta Provincial Treasury: Edmonton, Alberta.
[338] Mumey, Glen and Joseph Ostermann. 1990. "Alberta Heritage Fund: Measuring Value and Achievement." p.30

The fund reached its nominal peak in 1987 at $12.7 billion. Its decline was due to both its entire income flowing into the province's general revenue, but also the beginning of the spending of some of the principal on capital investments in the province. Changes begun in 1995 stopped the spending of any further principal, and the fund began, for the first time in a decade, to retain some of its earnings to offset inflation. The Heritage Fund is now to be a trust rather than an investment fund, and the new, simpler goal is to maximize earnings to support the government's fiscal obligations rather than engage in province building. During the 1997/98 fiscal year the fund earned $947 million on a principal of approximately $12.3 billion. It retained $25 million of earnings to offset inflation and turned over the remaining $922 million to the province.[339]

The Structure and Accounting of the Heritage Fund

Anyone reading the Alberta government's reports on the performance of the Heritage Fund (repeated in part in the paragraph above) would assume that the fund is a distinct pot of money that earns returns and pays those returns to the province — rather like Alaska's Permanent Fund but lacking the individual dividend payment. The true nature of the Heritage Fund is somewhat different and to a large degree its very existence as a fund distinct from provincial finances is open to dispute. An independent corporation does not administer the fund. Its investment board is composed entirely of members of the Alberta legislature. Effectively, decisions of the Heritage Fund are taken directly by the provincial Treasurer and cabinet.[340] And the use of its nominal value has (or has not) been included in the government's public accounting of its finances as political expediency has dictated.

In their 1990 study, Mumey and Ostermann state that:

> "In legal entity and administrative structure, the distinction between the Alberta Heritage Savings Trust Fund and the Alberta government is ambiguous. This ambiguity extends to the Fund's investment portfolio,

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[339] Alberta. October 1998.

[340] Brooks, Stephen. 1987. "The State as Financier: A Comparison of the Caisse dépôt it placement du Québec and Alberta Heritage Savings Trust Fund." p.322.

> where obligations of the Provincial government and its Crown Corporations comprise much of the asset position, and where Alberta government subsidies and guarantees increase the Fund's reported earnings."[341]

More specifically, Mumey and Ostermann point to such accounting problems as the 1987 withdrawal of $1 billion in cash from the fund by the Alberta government. The cash was replaced by promissory notes that were insubstantial as the maker and the payee are the same legal entity. Some of those notes were redeemed but, as Mumey and Ostermann point out, over 4 percent (or $553 million) of the Fund's 1988 reported assets were Alberta notes that had no independent value to the Fund.[342] An even larger problem was that, of assets totaling some $12.6 billion in 1988, more than half ($6.4 billion) were invested in five of Alberta's crown corporations. As a result, as the Liberal party complained:

> "At the same time as these 5 crown corporations are paying close to $1 billion in interest to the Fund, the Conservative government will be subsidizing the operating losses of these same 5 crown corporations to the tune of approximately $350 million."[343]

Another interesting feature of the Heritage Fund's accounts commented on by Mumey and Ostermann was the approximately $2.8 billion labeled deemed assets:

> "For example, a tally of past spending on medical research is reported as a 'deemed asset'. This 'asset' may be valuable because of future prospects for better health or jobs in the province, a productive investment consistent with an Heritage Savings goal, but it cannot be used to pay bills if energy prices suddenly drop."[344]

On straightforward accounting grounds alone, Mumey and Ostermann concluded that the value of the Heritage Fund in 1988 was not the $12.6 billion shown on the books, but $11.2 billion at best. Not included in this reduction was the $6.4 billion on loan to crown corporations, or any allowance for the $3 billion invested

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[341] Mumey and Ostermann. 1990. p.29.
[342] Ibid. p.34.
[343] Quoted in: Mumey and Ostermann. 1990. p.32.
[344] Mumey and Ostermann. 1990. p.30.

by the capital projects division of the fund at the time, almost all of which showed no financial return.

Investing in Province Building

That the Heritage Fund is expected to promote provincial economic development is very clear from the statutory requirement that 65% of the funds assets be invested in Alberta-based projects that have the goal of strengthening and diversifying the province's economy.[345] The fund was permitted to invest up to 20% of its assets in capital projects designed to provide long-term economic and social benefits that needed to show no financial return. (In addition, there was no limit on the amount that could be invested in crown corporations, most of which were in the business of developing the provincial infrastructure). Capital project spending included the construction of hospitals, the creation of parks, and the funding of medical and scientific research. Efforts at economic diversification included investments in forestry, petrochemicals, agribusiness, and tourism. Defenders of such spending (i.e. the provincial government itself) point out that such projects are paid for and their benefits continue to flow to Albertans.[346] Critics tend to offer the less charitable view that the Heritage Fund was treated as a giant political slush fund and much of the spending was misdirected and wasteful.

Curiously, the provincial government, while defending past capital project spending by the fund has not allowed any since 1995 and it seems unlikely to resume. Have the efforts at province building and economic diversification been successful? As is usual in these sorts of circumstances, it is very difficult to judge. While Brooks, in 1987, judged diversification efforts to that point a failure, Alberta's economy today is far less dependent on oil and the government on oil revenues than a decade ago. How much of this change would have occurred irregardless of investments by the government both through the Heritage Fund and outside of it is very difficult to judge.

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[345] Brooks. 1987. p.322.

Generally the Heritage Fund appears to have suffered from a case of excessively divergent goals. Attempting to be a hybrid between a trust fund and an economic development fund, it has not been conspicuously successful as either. If a fund's purpose is to smooth out a government's revenue stream, then such practices as claiming billions of dollars in intangible 'deemed assets' is entirely inappropriate. If economic development and diversification is the goal then using the fund to smooth out a government's revenue stream is inappropriate. In any case, using over half of the Heritage Fund to finance crown corporations appears to be a completely unnecessary piece of financial sleight of hand. The Alberta government could, and should, fund its corporations directly rather than the circuitous route now used through the Heritage Fund.

Norway

Norway has, over the past two decades, become the second largest oil producer in the world. Like other oil producers, it has benefited from substantial oil royalties and has used those royalties to build infrastructure, fund social programs, and attempt to maintain some diversity in the economy. It is a relatively small country (population approximately 4.5m) and the continuing oil boom has resulted in steady growth of GDP (averaging over 4% annually) and a 3.5% unemployment rate.[347] The country has an enviable set of social programs and an exceptionally tightly woven social safety net. By any standards, Norway is exceptionally rich.

Norway has only recently followed the example of Alaska and Alberta in creating a fund from its oil royalties. That Norway is currently following a collectivist approach to the distribution of its oil rents is clear from the treatment of the

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[346] Alberta. October 1998.
[347] The Economist. 1999. "Norway can afford to do its own thing: Well-oiled independence."

Petroleum Fund as an integrated part of the national government's fiscal budget. Money flows into the fund only when the national budget shows a surplus. The Ministry of Finance sets investment guidelines for the fund and the Norges Bank (the central bank) is in charge of portfolio management. Initially the fund was invested only in other governments' bonds abroad, with the investments distributed and weighted to match Norway's international trade relationships. More recently, the fund has begun investing in foreign securities as well, and is seeking out higher returns generally. No investments have been made in Norway itself as the economy is judged to be running at full capacity already.[348]

The Petroleum Fund began with a deposit of US$302 million in 1995 and grew, with extraordinary rapidity, to total $16 billion by mid-1998. Predictions were that the fund would reach $40 billion by the end of the year 2000 and exceed $60 billion by 2001, but low oil prices have reduced these estimates somewhat. One tentative goal for the fund set by the Norwegian government is to allow it to grow to the point where its income will completely cover all unfunded national pension liabilities.

Exactly what route Norway will take with its fund is still somewhat open to question. While the political culture of the country makes an individual dividend scheme highly unlikely, there is considerable political pressure to spend all the oil revenues on extending social programs still further rather than saving it. If that view prevails it is a near certainty that the country will fall into a version of the fiscal trap that Alaska currently finds itself in. Oil production is expected to start declining within a decade (though natural gas reserves remain large) and maintaining the very high level of social services without oil revenues will likely be impossible. Working in the country's favour in avoiding the fiscal trap is its ability to stop in-migration — which it does, as Norway is not an immigrant society — its relatively high general tax rates, and a certain degree of economic

[348] Norway. January 1997. Various publications.

diversification. As always however, the degree of such diversification is considered inadequate by many.[349]

Norway's fund is still in its infancy, and the country is engaging in a debate similar to Alaska's when it founded its Permanent Fund. Of the three examples examined here, Norway is the most likely (in the sense of being in the best position) to create a truly rentier society, where the income resulting from the rapid exploitation of non-renewable natural resource wealth may effectively pay many of society's bills for the foreseeable future.

RENTIER SOCIETIES, PROVINCE BUILDING AND SUSTAINABILITY

If a society such as Norway managed to become, at least in part, a rentier society with its oil wealth invested and producing a steady stream of revenue, questions of sustainability would still arise. Not simply questions of sustaining adequate rates of return on investments, but of what kinds of economic activities those investments are funding. If the investments are in non-sustainable forms of activity and production located elsewhere, then global sustainability has not been advanced, indeed it may have suffered a setback.

Similarly, if investments in province building are actually investments in non-sustainable production or in further consumption, then sustainability may have suffered a setback rather than being advanced. This is a possibility, but one which can be guarded against. It should not be used to dismiss efforts at province building or economic diversification in general any more than investment failures should.

While it is the received wisdom (especially in the business press) that governments are impossibly incompetent in making investment decisions — and

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[349] The Economist. 1999.

it can be entertaining to poke fun at some of the more spectacular failures — government led efforts at economic diversification should not be dismissed out of hand. First is the obvious, though often overlooked, fact that private investment also has frequent and sometimes spectacular failures. Indeed, the freedom of a business to fail, usually dragging down other people's money with it, is touted as a necessary and healthy part of a successful free-market system. Second, government-sponsored (and often subsidized) efforts at diversification can lead to the creation of a critical mass within new industries or sectors and so becoming economically self-sustaining. And finally, only governments have a realistic chance of investing for the truly long term, looking ahead over not just decades, but over several generations. Such forward thinking is needed if any effort is to be made toward true sustainability and inter-generational equity.

CONCLUSION

Many dismiss the very idea of reconciling the exploitation of non-renewable resources with the strictures of sustainability. Sustainable mining is an oxymoron. Of course, the use of any finite and non-renewable resource is obviously not sustainable in the long term — how long the term could be depends on the overall stock and the rate of use of the resource. A resource, however, is usually not valued for itself alone, rather for its useful properties that provide welfare for humans. Thus, exhausting any particular resource does not compromise the overall sustainability of the economic system provided that system continues to generate a "sustainable income" in the Hicksian sense of a level of consumption that can be sustained indefinitely without degrading the overall stock of capital (including natural capital).

Sustainable Mining: An Oxymoron?

Can the use of non-renewable resources be reconciled with the strictures of sustainability or is the idea of sustainable use of non-renewables an oxymoron? From the arguments presented in Chapter 1, it is clear that conceptually the idea is not oxymoronic. Even meeting the strictures of strong sustainability is theoretically possible, provided the full rent of a resource is collected and is correctly invested to provide renewable substitutes. This also meets the criterion of inter-generational equity as the substitutes (and the economic activities connected with them) will benefit future generations. But the gap between theory and practice gapes large; perfect rent collection and reinvestment never occur in an imperfect world. Given a good faith effort at rent collection and reinvestment using the best-known practices, however, a close approximation of economic sustainabilty is possible.

What of environmental and community sustainability? As argued in Chapter 1, using Green's sustainability test (or something similar) as a framework provides not only a long-term vision of what sustainable mining would look like, but also shows how progress toward almost any of the criteria reinforces and helps progress toward some or all of the others. Therefore pursuing narrower and shorter-term goals such as economic sustainability need not impede progress toward the larger goal of sustainability as a whole. Part of the central theme of this thesis has been an examination of various means of progressing towards meeting the economic criteria of sustainability for mining in the Yukon. The section below summarizes specific steps that could be taken in various areas throughout the mining cycle. Taking these steps would both make mining in the territory more economically sustainable, but would also move environmental sustainability forward.

The Changes Required

Having mining meet the criteria of economic sustainability will require changes to how the industry is conducted and regulated in the Yukon. The changes are in: the free entry mineral allocation system, the means of collecting mineral rents, the funding and enforcement of mine abandonment, and the potential reinvestment of mineral rents. It must be stressed that none of these possible changes, either individually or collectively, are a silver bullet that will instantly create a sustainable mining industry in the Yukon. Instead, they will hopefully be part of a long-term process of moving toward overall sustainabilty in the territory.

Free Entry

As argued in Chapter 4, the current free entry mineral allocation system used in the Yukon (and in many other jurisdictions in Canada) is an anachronism that requires reform or replacement. Free entry allows the owner of the resource very

little control over who can mine and where. It encourages inefficiency in exploration by allowing mineral claims to be held for very long periods. It causes unnecessary environmental damage through the requirement for field staking. In general, free entry helps dissipate mineral rents rather than conserve them, and it runs completely counter to the landscape criterion of Green's sustainability test by allowing mineral exploration to occur wherever it is not specifically disallowed.

The Greenland model of mineral allocation offers a practical alternative to the current free entry approach. It allows the government, as owner of the resource, to screen prospective miners and refuse those with poor environmental records for example. It eliminates the need for field staking and therefore some of the inefficiencies and unnecessary environmental damage caused by free entry. Finally, it makes it impossible to hold tracts of land indefinitely for speculative purposes and forces mining companies, through steeply rising work requirements, to concentrate their search for minerals on the most promising areas and to be serious about that exploration.

Rent Collection

As outlined in Chapter 5, the value-based royalty system of rent collection used in the Yukon is inadequate to the task of collecting any existing differential rents and most of any scarcity rents that might appear from time to time. The conditions allowing the proper functioning of a (possibly perfect) cash bonus bidding system are highly unlikely to ever materialize for minerals largely eliminating that possibility for rent collection.

The most effective available alternative is the resource rent tax. The resource rent tax aims to tax the positive net present value of a mining project as it is realized. The tax is assessed at a rate that aims to match the investor's discount rate closely, thereby taxing only the positive net present value as the investor sees it. All cash flows of a project, both positive and negative, are summed each

year to yield a net figure. Those net figures accumulate year by year at a set interest rate until a cumulative total is attained which is then taxed at the tax rate. The RRT, if properly applied, does ensure collection of much of the differential rent, and does so with minimal distortion of investment decisions. Its drawbacks include the difficulty in matching the investor's discount rate with sufficient accuracy, and the relatively high administrative costs. Unless prohibitive however, the higher administration costs might well be worth paying for a more effective means of rent collection for the Yukon.

That the territory needs a better means of rent collection is clear from Table 13. Mineral royalties collected are minimal, and the total of all fees and royalties is considerably less than what governments spend on administering, promoting, and subsidizing the mineral industry in the territory. Apart from a better means of rent collection, governments might also examine their policies regarding the subsidy and promotion of mining as a form of economic development if sustainability is to be achieved. An examination of administration costs might also be in order.

Funding For Abandonment

If lessons are to be drawn from the long and sorry saga of the various abandonment plans for the Faro mine and their funding (or lack thereof) they should be:

1. that all mines post a substantial bond prior to beginning operations,
2. that all mines have a trust or sinking fund with payment requirements that have some bearing on the reality of clean-up costs rather than on the mining company's current financial position,
3. that the required payments to the clean-up fund be ruthlessly enforced, and
4. that the bond posted at the onset be gradually placed into the fund as the mine approaches the end of its life.

It is recognized that while all these points are easy to state — and would likely meet with wide agreement — actually carrying them out is much more difficult. Because governments often see mining as the best form of economic development for the Yukon, there is always considerable pressure from both within and outside government to make exceptions to such requirements. Of course, making exceptions tends to lead straight into a mess like the one at Faro where government is left holding an enormous environmental liability, but the pressure to ease up on requirements, to make the exception, will be no less for the next potential mine.

The Reinvestment of Rents

Although the reinvestment of mineral rents from the Yukon might appear to be something of a theoretical exercise at the present (given that there are effectively no rents to reinvest), this step in the effort to promote economic sustainability and intergenerational equity should not be ignored. Prior to the oil shock of 1973, no one could have predicted that oil-producing regions would be awash in oil royalties. Similarly, although it appears unlikely, hefty price rises for minerals might do mineral-rich regions a similar favour.

Even without such dramatics, a new resource rent tax coupled with a reasonably healthy mining sector would still be likely to result in the collection of significant mineral rents. As has been argued in Chapter 7, to even begin to meet the criteria of economic sustainability there needs to be reinvestment of rents in other, sustainable forms of economic activity. Although it is recognized that such investments may be made in areas that simply result in higher levels of non-sustainable consumption and so run counter to the overall aims of sustainability, that problem will have to be dealt with if it arises.

As has also been argued in Chapter 7, notwithstanding the sometimes painful failures of government efforts at investing in economic diversification,

governments are the only ones likely to be (or capable of) making investments whose benefits will flow to several succeeding generations. The occasional foray into sled-dog powered washing machines should not be allowed to obscure that fundamental fact. If the Yukon began to collect a modest stream of mineral rents, it would likely prove most practical to funnel them (at least initially) into existing programs that provide start-up venture capital and micro-loans to local small businesses. If these investments are chosen with some care much of the issue of investing in further non-sustainable consumption would be eliminated.

THE FUTURE OF FARO: PICKING UP THE PIECES

Throughout this thesis, the mine and town of Faro have been used as illustrative examples. While Faro's history has in many ways mirrored the histories of similar small mining towns; a boom time of high wages and profits followed by a spectacular bust and then several smaller revivals, it does not appear that it will share the final fate of many such towns, complete oblivion. Although the mine has remained closed since its final shutdown in April of 1998, Faro has not become a ghost town. The population has remained stable at about 400 for some time, and the town appears to remain a viable and even vibrant small community.

Likely Scenarios For The Community

Although there remains the possibility that the mine at Faro might be revived once again, it is an unlikely one. Apart from the horrendous environmental liability any new mine owner would have to assume, the receiver for the bankrupt former owner has been selling some of the mine's assets, including the critical heavy equipment and machinery needed for a restart. While some in the community hold on to faint hopes of a restart, most have turned their energies in other directions.

One of the most likely and realistic long term possibilities for sustaining Faro over the long term is its conversion, at least in part, to a bedroom community. The town's greatest asset is its large stock of housing and much of it is now available at very affordable prices. And the summer of 1999 has seen several sales of houses to residents of the town, a marked indicator of confidence in the community. Of course a price tag of less than $35,000 for a 5 bedroom, nearly 3000 square foot house in good repair helps sales along remarkably.

A good possibility for an "industry" in Faro in the near future is the new territorial prison that may be constructed there. While not everyone's idea of an ideal form of job creation, prisons do seem to provide sustainable employment into the foreseeable future. Other forms of economic activity are also happening, led by an increase in tourism. The town has begun to aggressively market itself as a destination and it appears to be having an effect. And a former mineworker has also begun a manufacturing industry in Faro, marketing his liquid plant food across western Canada.

The Environmental Liability

Regardless of the changes the people of Faro make to their community and its economy, the environmental liability of the mine will continue to hang over the town and a considerable swath of the central Yukon downstream of it. Although the federal Department of Indian Affairs and Northern Development will almost certainly end up in charge of the site and responsible for its environment, the government is very unlikely to spend the $120 million plus needed to do the full abandonment and reclamation work required. The most likely scenario is that the government will do the minimum required upkeep and maintenance work, drawing down the existing clean-up funds and hoping the property will eventually find another buyer, one willing to buy the liability along with the remaining ore in the ground.

The Faro mine's environmental liability is a stark reminder that the issues and ideas of sustainability are not simply theoretical exercises with no bearing on the "real world." That real world shows us again and again that we need to go about our economic business with a mindfulness that how we do our business now has a very large bearing on how we, and coming generations, will live in the future. Steps, even small steps taken toward a sustainable economy will make messes such as the Faro mine less likely in the future and so lessen the burdens we place on our environment and on our descendents.

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