Mining's Toxic Orphans:
A Plan for Action
on Federal Contaminated and Unsafe Mine Sites

Submitted to:

The Honorable David Anderson, Environment
The Honorable Paul Martin, Finance and Regional Development
The Honorable Lucienne Robillard, Treasury Board
The Honorable Ralph Goodale, Natural Resources
The Honorable Robert Nault, Indian Affairs and Northern Development
The Honorable Herb Dhaliwal, Fisheries and Oceans
The Honorable Alan Rock, Health
The Honorable Jane Stewart, Human Resources Development

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Introduction

In a recent speech to the House of Commons, David Anderson, Minister of the Environment, expressed a commitment to address the serious national environmental and health threat posed by contaminated sites left behind by various industries across Canada. He announced that the federal government had committed $38 million to the clean up the Sydney Tar Ponds - the most highly contaminated site in the country - and went on to say that:

> *Of course, more will be required on the financial side and more will have to be done. There are literally 1000s of contaminated sites which are under federal jurisdiction and many more which we describe as orphan sites where there is an abandoned mine and there is no possibility of finding an organization who will pick up the clean-up costs*.[1]

It is an important step for the Minister to acknowledge that orphaned mines are a substantial economic liability for the federal government and the Canadian taxpayers. The full impact of these sites, however, goes far beyond the financial burden that they pose. Many of these sites present pressing safety hazards (e.g., open shafts, cave-ins) and serious health concerns (e.g., radiation, metal contamination) for nearby communities, and are affecting the viability of local subsistence economies and commercial fisheries.

These ongoing daily costs are being borne by communities across the country, yet there has never been a coordinated assessment of either the full extent of these costs or the price to clean-up this lethal legacy of toxic waste. At this time there is not even a national inventory of all the orphaned/abandoned mine site locations in Canada.

The standard definition of an "orphaned mine" is "a mine for which the party or parties responsible for contamination cannot be found or are unwilling or financially unable to carry out necessary remedial measures within a satisfactory time frame"[2]. We have used the term "abandoned" inter-changeably with "orphaned" for the purposes of this paper.

Orphaned sites become a federal responsibility for many reasons:

- The mine is situated on federal land, and/or lands of aboriginal use or interest
- The fishery, transboundary waters, or navigable waters are affected by the site
- There is a threat to human health or the environment from the site
- The site is under the jurisdiction of a federal crown corporation like DEVCO
- The site has uranium wastes or tailings with radiological effects

MiningWatch Canada and its member organizations have prepared the following paper to make recommendations to the federal government about dealing with this responsibility. Many different

ministries are affected by the problem of abandoned mines, including Environment, Indian and Northern Affairs, Fisheries, Natural Resources, Health, Human Resources, Finance, and Treasury Board.

The paper is organized in four sections:

Section One is a discussion of the current state of knowledge with respect to the numbers, distribution and dangers of orphaned mine sites in Canada. Although Treasury Board is presently undertaking an inventory of contaminated federal sites, and there have been other studies, none of these adequately capture the extent of the problem.

Section Two attempts to assess the extent of federal responsibility for mine clean-up in Canada - well in excess of a billion dollars – and suggests research that must be undertaken to better estimate the financial extent of federal responsibility.

Section Three provides suggestions for a federal action plan to protect the public interest from contaminated mine sites. A comprehensive federal action plan would include the following:

1) A national inventory of abandoned mine sites;
2) Physical and chemical site assessments to determine the contamination associated with the sites and assess actual and potential safety hazards, and;
3) A transparent and efficient plan to choose priority sites for clean-up; resources to clean-up the sites in a thorough and timely fashion, including provisions for community involvement in monitoring and remediation; an increase in funding for research into clean-up strategies and technology;
4) A funding mechanism - based on federal principles of polluter pays, the precautionary principle, and participation - to pay for the costs of cleaning up the mine sites.

The "toxic orphans" of the mining industry have indeed come of age.[3] They are a serious and immediate danger to human health and the environment. They are already costing taxpayers millions of dollars in clean-up, cancers, lost fishery, forestry and farm income, and they stand to cost billions more. They are a public relations nightmare for the mining industry. In 1995, the Auditor-General made it clear that the enormous liability they –and other contaminated sites- represent should be shown on the public accounts.

We hope this action plan helps the federal government in dealing with its enormous responsibility.

1.0 Abandoned Mines in Canada: the current state of knowledge

1.1 The scope of the problem

As mentioned above, there is no national inventory of abandoned/orphaned mines. In all provinces and territories, databases of mineral producers (past and present) exist, and some provinces have begun to develop databases of abandoned mine sites. Unfortunately, the quality of data and the methodologies used to gather information and perform site assessments are variable. As a result, it is difficult to get a clear picture of the scope of the problem.

Below is a preliminary summary of the status of abandoned mine inventories in some of the provinces and territories. MiningWatch Canada has contracted WOM Geological Associates to undertake a more detailed survey of the status of abandoned mine inventories across the country. The results of this survey should be available on January 31, 2000.

While it is impossible to pin down the exact number of abandoned mine sites in Canada, it is safe to say that there are at least 10,000 known abandoned mine sites spread across the country.

1.2 Existing databases, and the problems associated with them

1.2.1 DIAND Databases

The Department of Indian Affairs and Northern Development (DIAND) has conducted contaminated site inventories and created databases of contaminated sites in the Yukon, Northwest Territories (NWT) and Nunavut. As well, DIAND has created a database for Environmental Issues that are present on Aboriginal lands. All of the DIAND inventories include some abandoned mines.

Yukon Database:

Ninety-eight abandoned mining and advanced exploration sites were identified in the initial contaminated sites inventory, and 50 sites were deemed to be federal responsibility, and required site assessment. Of the 50 sites, 43 were found to require remediation action. There are several deficiencies with the inventory and information contained in the waste database. The most significant problem is that at least a dozen major mine sites were excluded from the inventory, even though these sites will remain as federal responsibility through devolution and the resolution of First Nation land claim processes.[4] According to DIAND officials, these major sites were omitted from the inventory because they either still have owners or are in receivership.[5] It also does not include placer mine sites, mines where there are active but unassociated claims in the area, or mines where ownership is

currently debatable but the sites are likely to become federal liabilities. These same deficiencies also apply to the DIAND NWT database.

Northwest Territories Database:
Thirty-two abandoned mining sites are identified in this database.

Nunavut Database:
No information was obtained on any database for Nunavut. The Nunavut Impact Review Board indicated that they did not have one.[6]

Environmental Issues Database for Aboriginal lands:
According to John Sontrop of the Environment and Natural Resources Directorate of Indian and Northern Affairs, DIAND is working on "an inventory of environmental issues of concern on Indian reserves." [7] Within that database, nine "Indian reserves" with mining-related contamination problems have been identified: the Blood Reserve, AB; Shuswap and Chuchuwayha No. 2 Reserves, BC; Nipissing No. 10 and Whitefish Lake No. 6 Reserves, ON; Chicken No. 226 and Stanley No. 157A Reserves, SK; Fort Resolution, NWT; White River First Nation, YT.

There are a number of problems associated with this database. First, the data may be inaccurate. According to Kevin O'Reilly of the Canadian Arctic Resources Committee in Yellowknife, there is no reserve at Fort Resolution.[8] There are only two in the Northwest Territories at Hay River and Salt River. Second, the database fails to examine sites where there is *potential* federal responsibility. For example, there are mine sites that impact lands and waters that are of aboriginal use and interest, e.g., food and water sources. Furthermore, mine sites located off of "Indian reserves" that contaminate waters flowing onto the aboriginal reserves were not explicitly examined for this database, but some cases of this have been identified.[9] Although the federal government might not liable for the contamination in these cases, it would be responsible for protecting the health and lands of the First Nation.

1.2.2 Provincial Databases

Several of the provinces (Ontario, Quebec, British Columbia, Nova Scotia, Manitoba) have inventories of closed and abandoned mines. In most cases, the majority of sites included in the inventories have not been verified by site visits.

Ontario:
The province has a database containing more than 6000 historic or inactive sites, many of which are in the public domain.[10] In the early 1990s, CANMET carried out a 4-year project on abandoned mines in Ontario and Nova Scotia. This project focuses mainly on archival research on the priority sites in each jurisdiction; it does not attempt to inventory all of the abandoned mines in each jurisdiction.

Quebec: Since 1975, the province has know of 1000 abandoned sites; in 1996, a program was initiated to inventory orphaned sites.[11]

British Columbia : No detailed inventory of abandoned mines exists in BC. The provincial government has a database of mine sites that classifies both closed and abandoned mines as past producers. There are some 1800 past producers in the province, and, according to the BC Ministry of Energy and Mines, most of these sites have owners associated with them.[12]
In BC, as in the Yukon, sites are not classified as abandoned because there is still an owner associated with the site. Ownership, however, does not imply activity, especially where site remediation is concerned. There are mine sites in BC that have been producing highly toxic effluent for decades, yet the owners have either ignored government orders to address the pollution problem [13], or the government has been unable to get the responsible parties to clean-up the site[14] .

1.2.3 The Treasury Board

The Treasury Board is presently undertaking a Contaminated Sites Inventory Policy. We understand that fifteen different ministries are being asked to identify any sites in their jurisdiction. The draft policy includes the creation of a database, which is to include only *known* contaminated sites on federally owned lands, as well as non-federal sites for which the government has accepted some or all financial responsibility for site remediation.[15] Deficiencies associated with this proposed database include the fact that there are no plans to investigate other potentially contaminating sites or sites which may end up –through bankruptcy- on the public charge. In addition, the database does not include sites belonging to crown corporations including AECL. The omission of AECL sites from this inventory will seriously distort the results.

No data are presently available from this inventory, which is in a pilot stage.

1.2.4 CANMET and Natural Resources Canada (NRCAN)

In 1994, these two federal agencies prepared a partial inventory of mine wastes in Canada (Feasby and Jones, 1994). This database identifies acid mine drainage sites across Canada. The inventory includes information on the status (active/inactive) and whether or not there is an owner associated with each mine site. However, for several sites ownership information is left blank; and, in the cases where the owner was listed as "crown" it was unclear whether there was provincial or federal liability associated with the site. The study is also now seven years out of date. Given the volatility of the metals sector, many more mines are now likely to be orphaned than at the time of the study.

2.0 Assessing federal responsibility for abandoned mines

2.1 Defining “orphaned” and "abandoned"

The standard definition of an “orphaned mine” is “*a mine for which the party or parties responsible for contamination cannot be found or are unwilling or financially unable to carry out necessary remedial measures within a satisfactory time frame*”[16]. We have used the term “abandoned” inter-changeably with “orphaned” for the purposes of this paper.

We would argue that in order to make a realistic determination of federal responsibility associated with abandoned sites the definition must be broadened. It must not only encompass orphan sites, but also sites where there are definite owners, yet, because of statutory responsibilities (to protect the fishery for example) the government is forced to intervene in the site remediation using taxpayer dollars. The federal government has expended untold staff time and dollars trying to address the acid mine drainage problem at the Mt. Washington mine site in BC.[17]

There are countless examples of situations where the government has assumed some or all of the liability associated with mine sites that have existing owners. When the Ojibways of Pic River First Nation's water supply was contaminated with cyanide, as a result of the operations of the mining at the Hemlo goldfields, the Department of Indian and Northern Affairs built a new water treatment plant for the community and charged the $5 million to the First Nation’s capital account. No attempt was made to recover the costs from the mining companies upstream.[18]

Federal taxpayers have the right to know where their dollars are being spent, and whether or not the investments are prudent. If the government is using federal dollars in situations where owners are not performing the remediation measures that they are legally obligated to carry out, then these expenditures should be open to public scrutiny. This is not to imply that the federal government should not be helping to clean up some of the worst contaminated sites regardless of whether or not there is an owner. It does mean that if they choose to go this route, the public has a right to know, and to know what attempts are being made to recover the costs from the owner.

MiningWatch Canada, therefore, proposes that any inventory of federal liability and potential liablity for contaminated mine sites be broadened to include mine sites that meet the above definition and:

- Are situated on federal land, and/or lands of aboriginal use or interest
- Affect or could affect the fishery, transboundary waters, or navigable waters
- Pose a threat to human health or the environment within definitions of federal responsibility (like the Giant Mine)
- Are under the jurisdiction of a federal crown corporation like DEVCO and AECL
- Have uranium wastes or tailings with radiological effects.

2.2 Preliminary Estimate of Federal Responsibility

Using the broadened definition of an abandoned mine above, the following is a preliminary estimate of remediation costs associated with sites where the federal government has or may have liability (see Table 1 for a summary). This partial list of liabilities shows that the federal government may be responsible for at least a billion dollars in clean-up costs. In most cases, these estimates do not include the capital required to establish a fund for perpetual care and monitoring of the closed out sites.[19]

2.2.1 Sites in the Yukon and Northwest Territories

It has been estimated that it will cost approximately $10 million to rehabilitate the 43 small abandoned hardrock mine sites identified in the Yukon waste database,[20] and $50-60 million to rehabilitate 21 known abandoned mine sites in the Northwest Territories.[21]

These cost estimates do not include the cost of remediating abandoned placer mines. They fail to consider sites that were previously rehabilitated "to the standards of the day" that may now be considered environmental problems. For example, the Port Radium site in the NWT may need further work.[22] The estimates do not include major mine sites that will remain federal responsibility after devolution and the resolution of First Nation land claim processes, or mines where ownership is currently debatable but the sites are likely to become federal liabilities through bankruptcy.

> **BYG's Mount Nansen Mine:** This site in the Yukon is a recent example of a company folding, and leaving as its legacy millions of dollars in environmental liabilities. In 1999, the company, BYG, declared bankruptcy. The Mt. Nansen site went into receivership, only to have the receiver walk away from the site when the mine's creditors decided to stop funding mine-site maintenance work.[23] Such a move left the liability for the site squarely in the lap of the federal government. Only $225,000 was available in securities for the reclamation of the mine, which DIAND estimates will cost $2 million per year to maintain and $8 million to reclaim.[24]

The BYG Mt. Nansen site is small and contained in comparison to the 14 other major mine sites in the Yukon where the federal government is likely to have some financial liability. These sites include Faro, United Keno Hill Mines, Clinton Creek, Ketza, Arctic Northern, Mac Tung, Can Tung, Tom, Whitehorse Copper, Coal Lake, Western Copper, Casino, Wellgreen and Skookum Gold.[25]

> **Faro Mine:** The only other Yukon site for which the cost of clean-up is known is the Faro mine. The federal government has assumed a great deal of responsibility and liability at the Faro mine. In August, 1999, the government signed a deal with Cominco Ltd.,

which freed the company of approximately $126 million in potential environmental liability related to the mine.[26] "If it turns out the mine is never reactivated, the trust will abandon the assets and the government would then be responsible for the reclamation costs," says Robert Lauer, chief of financial analysis and royalty administration for DIAND.[27]

Giant Mine: In the Northwest Territories, DIAND is presently attempting to recoup $293.5 million from the new Royal Oak (Royal Oak Mines Inc.) to cover the clean-up costs at the mine site.[28] Since the appropriate technology for cleaning up the arsenic trioxide at this site is not yet determined, this estimate is considered to be low by many observers.

2.2.2 Sites on lands of aboriginal use or interest

The nine Indian reserves with mine-related contamination problems have been identified in the DIAND Waste Inventory Database are a very limited window on the extent of this problem. If federal fiduciary responsibilities for aboriginal people are used in defining the scope of this inventory, it becomes much larger. To our knowledge there are many other First Nations not on this list who are dealing with mine contamination problems, including Michipicoten, Missinabie Cree, Maniwaki, Serpent River, Hatchet Lake, Mistissini, Ross River, Little Salmon Carmacks, Wahnapitae First Nation, and Whitefish River[29]

2.2.3 Acid Mine Drainage (AMD) sites

Feasby and Jones (1994) estimated that there were 1.8 billion tonnes of tailings and 700 million tonnes of acid-generating waste rock in Canada. This amount has been growing every year since their study. They estimated the costs of cleaning up all sites at $5.25 billion and the costs of cleaning up crown-owned acid-generating sites (provincial and federal) to be $440 million.[30] (For a visual view of the scope of the AMD problem in Canada, see the map produced by MiningWatch Canada).

2.2.4 Fisheries-related sites, and sites impacting on international waters

Although provinces have responsibility for most abandoned sites within their boundaries, the federal government is responsible for the protection of the fishery and for transboundary waters. Contaminated mine wastes usually impact on water, and where any fish are still alive, on fish. The extent of federal liability has not been clearly established in the following cases, and there is a possibility that some federal funds will need to be put toward remediation of these highly contaminated mine sites. Already, millions of dollars worth of federal resources have had to be spent on studies and environmental monitoring at the following sites.

Mt. Washington in BC: To date, this acid mine drainage site has cost provincial and federal taxpayers and the local community an estimated $60 million (the federal

government has spent millions of dollars in studies at this site, and a $2 million/year local salmon and cutthroat trout fishery has been destroyed).[31] The annual cost of perpetual treatment of AMD at this site is likely to be more than $6 million.[32]

Britannia Mine in BC: The federal government has already had to invest time and money into studying and monitoring the Britannia mine site, which drains into Howe Sound. For example, in 1994, "in the absence of an owner willing to take responsibility for the pollution," Environment Canada and the province of BC funded the acquisition and installation of devices used to measure flows at the mine.[33] It is estimated that it will cost $11 million to build a lime-based treatment plant, and $800 thousand per year to operate it. The BC Ministry of Energy and Mines estimates that a reserve fund of $25 million will be required to allow the treatment plant to operate in perpetuity.[34] Thus, a reasonable estimate of the cost of reclaiming the Britannia site is $36 million. We do not know how much of this will fall on federal shoulders.

2.2.5 Crown Corporations

Devco in Nova Scotia: The crown corporation projects it will cost $110 million to clean-up mines sites and operations once the corporation has been phased out. Consultants put the clean-up costs between $72 and 158 million. Estimates include $8 million for building demolition, $5 million for clean-up, $72 million for earthworks, $10 million for water treatment and $15 million for other reclamation costs.

AECL. We have no information about any sites under the jurisdiction of AECL

2.2.6 Uranium and radiological effects

The Atomic Energy Control Board is responsible for the oversight of operation and decommissioning at any uranium mine. All of these sites will require perpetual monitoring and maintenance, so in many cases, they are now abandoned, or will be in the future. Uranium City presents a serious case in point. Although we know AECB has a database of site, we have no figures from AECB on potential liability for these sites, nor on the location and numbers of them.

Table 1. Summary of Estimates of Potential Federal Liability

Item	Cost
Yukon: 43 abandoned mines sites	$ 10 million
Faro Mine, YT	$126 million
Mt. Nansen Mine, YT	$ 10 million
NWT: 21 abandoned mines sites	$ 60 million
Giant Mine, NWT	$293 million
Nunavut	?
Aboriginal Lands: 9 mine sites on reserves	?
National Parks	?
Clean up of acid mine drainage sites on crown land	$440 million
Sites where there are transboundary or fisheries issues:	
Mt. Washington, BC	?
Britannia Mine, BC	?
DEVCO	$110 million
Uranium mines	?
Others	?
Preliminary estimate of federal liability associated with abandoned mines sites:	**$1.049 billion**

2.2.6 Health costs

There are considerable health concerns associated with abandoned mines sites, that may not show up for years after the mine has closed down. Leaching heavy metals contaminate water supply and the animals and plants that live near them. Most of these contaminants do not show up in blood tests (where they are even done), but in body fat.[35] Families living downstream from the Deloro site suffered higher than usual incidence of leukemia. Traditional aboriginal people in Ross River are finding that they can no longer eat caribou; people in Little Salmon Carmacks are developing reactions to salmon. In Sudbury, heart disease and cancers are at elevated rates. There is a great need for careful epidemological testing for the health effects of closed out mining sites on humans living near or downstream from them.

3.0 Toward a federal plan for addressing abandoned mines

This is a four-pronged plan for federal action to address the issue of orphaned mines in Canada.

- First, determine the scope of the problem: conduct a survey of abandoned mines to produce a national inventory of sites.
- Second, carry out site assessments to verify and identify the extent of chemical and physical hazards associated with the sites
- Third, initiate a program for remediating abandoned mine sites including a method for determining priority sites, immediate action on some of the worst sites, and a timely and effective plan for remediation of all sites.
- Fourth, create a mechanism to cover the cost of remediating orphaned sites that enshrines the principles of polluter pays, fairness, transparency and sustainable development

All four prongs of the plan are needed if the problems associated with abandoned mines are to be seriously addressed. Within the four general areas, however, there is room for flexibility on the implementation of each area.

3.1 Develop an inventory of orphaned mines

There is a need to develop a national inventory of abandoned mine sites, complete with details of the immediate and potential[36] health, safety and environmental hazards posed by each site. Without detailed information on the number of sites and potential hazards associated with them, it is impossible to determine the scope of the problem and form a realistic estimate of the federal government's financial liability with respect to the full cost of clean-up and remediation of abandoned mines.

3.1.1. Benefits of an inventory

First and foremost, an accurate inventory, will enable the government to prevent further health, economic and environmental crises from erupting and to build a strategy for clean-up. An inventory will clarify federal responsibilities and liabilities related to abandoned mines across Canada. It will provide industry with valuable information on site characteristics such as geology, tailings, mineralogy, etc. The site geology and mineralogy will help companies to determine the potential for, or existence of, poor quality runoff (e.g., risk of acid mine drainage). As a result, companies will be better able to avoid the purchase of problem properties, and to steer clear of high-risk areas or developments. Mineralogical data may also provide information on opportunities for the re-mining of old tailings.

An inventory will help to identify potential impacts on communities related to abandoned mines and enable these communities to plan to deal with them.

3.1.2 Purpose and scope

The purpose of the inventory is to identify abandoned mine sites using the broad definition of abandoned mine outlined in Section 2.1, where the federal government has responsibility.

The scope of the inventory should include abandoned mining and exploration sites[37] that:

1) are located in the Yukon and Northwest Territories. A survey of these sites must include placer mines, major hardrock mines that will remain under federal responsibility through devolution and the resolution of First Nation land claim processes, and mines where ownership is currently debatable but the sites are likely to become federal liabilities.
2) occur in national parks[38] or affect aquatic or terrestrial ecosystems adjacent to a park. For instance, mine sites that are not located within park boundaries but contaminate waters flowing onto National Park land.
3) are on lands of Aboriginal use and interest. This includes mine sites that are not necessarily located on reserves but impact aquatic or terrestrial resources used by Aboriginal peoples.
4) are owned by crown corporations, like DEVCO and AECL

5) impact areas of federal jurisdiction, e.g., fisheries[39] and international boundary waters.[40]
6) generate acid mine drainage and leach heavy metals or have uranium wastes or tailings with radiological effects

3.1.3 Methodology

The collection of information for an inventory of closed and abandoned mines should entail the following:

- Preparing a survey of closed and abandoned mines. This survey needs to include data on the state of rehabilitation efforts, on geophysical and chemical properties of the sites, on ownership.
- The production of maps of known abandoned and closed sites requiring rehabilitation. Maps will assist consultations with communities and industry workers, and aid in identifying priority sites for clean-up efforts.

Data can be collected through:

- Geophysical and chemical archival research. A literature review should be conducted for all closed and abandoned mines focussing on available physical and chemical data for these sites.
- On site research. This should include geophysical and chemical research and verification of existing data. This work should involve local communities and draw on local knowledge.
- Drawing on "anecdotal" information from concerned government agencies. A great deal of information can be found in the files of regional offices and through the people who are presently or have previously worked in those offices.
- Broad consultations with local industry workers and community members. Local residents and land users can help assess the accuracy of the maps, and suggest additional sites. For example, GETIC, a research institute associated with the University of Laval, along with Makivik Corporation, has undertaken a pilot project aimed at identifying all of the abandoned mineral exploration sites near the community of Kangiqsujuaq in northern Quebec. The team intended to utilize Radarsat to identify sites. That technology proved too expensive and researchers drew, instead, on traditional knowledge to locate abandoned exploration sites. The pilot project would have been impossible without input from local aboriginal communities.[41]
- Partnerships with provinces, territories and First Nations. Further development of provincial and territorial abandoned mine site inventories, and inventories of sites on lands of Aboriginal use and interest should be encouraged. As mentioned in Section 1.2, some provinces already have inventories underway. The federal government could offer financial incentives for the provinces to start, or continue, their work, standardize the databases, and compile information from the various jurisdictions into one central, easily accessible database.

3.1.4 Products

1) A National Database of Closed and Abandoned Mines

All data collected should be entered into a publicly accessible database. Information in the database would include mine location, status, detailed assessments of existing as well as potential

(e.g., PAG-potentially acid-generating rock) contamination problems, and site stability concerns. This information is key to determining estimates of clean-up and rehabilitation costs for each site. As site rehabilitation information becomes available, this information should also be entered into the database. Feedback of results of rehabilitation projects into the inventory database will be important to help identify whether reclaimed sites resulted in expected environmental benefits, and to gauge which reclamation techniques and technologies were most effective.

2) Maps

As information on sites becomes available, this information could be presented in a visual format, for use by communities, the mining industry and other interested parties. Items to be mapped include the location of all closed and abandoned mines and exploration sites across Canada. The maps should also display potential problems associated with the mines, nearby communities, and water courses potentially impacted by the mines.

3.1.5 Possible priorities for the inventory process

- concentrate inventory work in areas that have the highest potential for impacting water quality and human health. In this instance, mapping, using Geographic Information Systems (GIS), can be extremely useful. For example, the Environmental Mining Council of BC has used GIS to determine that of the 1809 closed and abandoned mines in BC, 76 are in parks or recreation areas, 127 are in community watersheds, 582 are within 1 km of major rivers or streams and 289 are within 3 km of a city or town. The same analyses should be done on a national level, to determine, for example, abandoned sites upstream from communities.
- investigate abandoned mines in areas where there is a history of mining and the geology is such that there is a concern for contamination, and areas where there is a history of mining but inventories have not been conducted.[42]
- conduct work in areas where inventories have not been verified.[43]

3.2 Site Assessments

As abandoned mines of federal concern are identified, sites assessments have to be conducted to verify mine locations, conduct water and soil sampling, determine if the site has the potential to produce acid mine drainage and/or radioactivity, and assess physical and chemical stability and safety hazards[44].

3.2.1 Benefits of Site Assessments

The importance of site verification by field visit cannot be over-emphasized. In developing an inventory of abandoned sites in the Sudbury district, Tony Ingram verified 135 out of over 730 sites on the Ontario government inventory, and found that most of them were not in the place identified, had an inaccurate list of contaminants, or had changed since the record was made.

Inaccurately identified orphaned sites present serious risks to health and the environment. Recent mine subsidence problems from the Hollinger Mine in Timmins are one example.[45]

Further, field visits present a unique opportunity to create public interest in the issue of contaminated sites and generate local employment in some of the more remote areas of the country. It is a labour intensive activity for which local people can be trained.

3.2.2 Physical assessments

Physical assessments should evaluate public and wildlife safety hazards such as open adits, and areas where subsidence is imminent. Where safety hazards are encountered, the areas of concern should be immediately fenced off, and steps taken to permanently remove the hazard.

3.2.3 Chemical assessments

1) It is essential to evaluate the acid generating potential of tailings and waste rock. According to the BC Acid Rock Drainage Guidelines, the onset of acid mine drainage and subsequent heavy metal contamination problems may not occur until decades after mines have closed.[46] Thus, tailings mineralogy should be determined and tests conducted to assess potential for future AMD potential.
2) Consideration must be given to the appropriate timing of assessments. For example, in many regions of British Columbia the optimum season for taking water samples at mine sites is during spring freshet, since this is when the most significant loadings of metals tend to occur.[47]
3) It should not be assumed that if a site has neutral pH that metal contamination is, or will be, negligible. Neutral drainage does not necessarily prevent metal leaching from occurring. Elements such as antimony, arsenic, cadmium, molybdenum, selenium and zinc remain relatively soluble and can occur in significantly high concentrations at a neutral pH. High concentrations of metals in neutral pH drainage can result from localized relatively small zones of acidic weathering.[48]

3.3 Site Remediation Strategy

A number of considerations are paramount in site remediation, including effective protection of public health and environment, ability to create economic benefits, and establishing the priority of particular sites.

3.3.1 Effective protection of public health and environment

Natural Resources Canada has undertaken a number of studies through the MEND program and others on the most effective ways to limit acid mine drainage from mine sites. NRCan is best equipped to lead the necessary scientific research into new technological, chemical and bacterial solutions to mine waste problems. However, there is a need for public oversight and input from independent scientists into the choice of subjects for research and to evaluate conclusions.

Certainly, solutions that will generate employment for industries other than mining need to be fed into the mix. For example a polymer filtration method for removing toxic metals contaminants developed at Los Alamos shows promise.[49]

3.3.2 Ability to Create Economic Benefits

The spin-off economic benefits of a nation-wide remediation strategy are potentially huge. Sudbury compensated for a six month shutdown by INCO in 1982 with a region-wide re-greening strategy. The technology and skills developed at Laurentian University during the reclamation process have made the City internationally known for its expertise in land reclamation after mining and smelting damage. Research into the employment generation potential of a national program needs to be undertaken by Human Resources Canada.

A number of First Nations have begun to take advantage of these economic opportunities. Wahnapitae First Nation received an $80,000 grant from Fednor, a federal economic development agency, in 1999. This grant was designed, in part, to aid the First Nation in developing the skills necessary to start up a mine reclamation business and clean up INCO's Whistle Mine site in Northern Ontario, which is on their land.[50] Similarly, DIAND recently awarded a $2 million contract to a consortium of aboriginal businesses in the NWT to undertake final reclamation activities at the Colomac Mine[51].

Communities should be actively involved in the site remediation process, since they are the ones most affected by the legacy of nearby abandoned mines. Also, when mines close, local mine workers are seeking new employment opportunities.

1) If federal funds are disbursed to remediate abandoned mine sites, efforts should be made to hire local firms to carry out the work. If the engineering or technical expertise does not exist within the community, efforts should be made to hire local labour for the less technical work.
2) Communities should be able to apply to get funding to clean up known abandoned mine sites or to have site assessments, e.g., water sampling, conducted. The application process should not be so onerous as to prevent communities from seeking funds.

Technological innovation and technology transfer opportunities abound. The environmental business sector is growing rapidly in Canada. According to the Delphi Group there is a tremendous demand from the mining industry for pollution prevention technologies, sophisticated monitoring systems and instrumentation, programs for recovering materials from waste rock and tailings, and other innovative businesses.[52] Stimulation to this sector could do a great deal toward solving the massive problems of toxic mine sites.

3.3.3 Determining Priority Sites.

Since it is impossible to clean up all sites immediately, a principled and publicly acceptable strategy for determining which sites should receive priority is essential**.** One approach might be

to establish a multi-stakeholder advisory board including the various levels of government (federal, provincial, municipal, First Nations), community-level representatives, ENGOs and industry. This would make the process more transparent and participatory. The board should have the ability to ask for research as required.

The following are some ideas for determining which sites should be cleaned-up first:

- A "worst-case-first" inventory and prioritization process. The State of Montana puts advertisements in local papers asking citizens to nominate the worst abandoned mine sites. This has helped to reduce inventory costs and has ensured priority action on sites of greatest concern to the public.
- Historic sites that are most severely out of compliance with current regulations, with top consideration given to sites posing the most immediate threat to human health and safety, fisheries and biological resources.
- Evaluation and determination based on effected watersheds instead of mine-by-mine, because the impact (e.g., metal loadings from a number of sites) on a watershed from many small abandoned mines may be as detrimental as impacts from one large mine.
- Remoteness should not preclude sites from being given priority for remediation, especially if they are having a significant impact on biological ecosystems.

3.4 Create mechanism(s) for generating funds

One of the greatest impediments to abandoned mine remediation is the lack of funding for site clean-up. The federal government will not be able to allocate the billions of dollars required to develop an inventory and remediate all of the closed and abandoned mine sites across the country. We believe that the mining industry and its customers have been the major beneficiaries of the undeclared liability from these historic mine sites, and that fairness requires that the industry be responsible.

This section will provide a brief retrospective of the national contaminated Sites Remediation Program and the 1995 KPMG study of funding options, lay out some guiding principles for funding the remediation of orphaned sites, and give a few examples of funding mechanisms that should be considered in setting up this mechanism.

3.4.1 Retrospective

In 1989, a program was initiated to address remediation of contaminated sites, not just abandoned mines, in Canada. At that time, it was recognized that significant expenditures of general revenue funds would be required to remediate existing contaminated sites, especially in the cases of orphan sites. In response to those realities, member governments of the Canadian Council of Ministers of the Environment (CCME) established the National Contaminated Sites Remediation

Program in 1989. In that program, $250 million was committed from general revenues over five years.[53] We do not know how much of this money went toward remediating abandoned mine sites in Canada. One report stated that the National Contaminated Sites Remediation program was supposed to have spent more than $40 million on cleaning up old abandoned toxic waste sites, but "after a few initial successes, the program was ended prematurely."[54] It was a victim of the cuts to the public service in the mid-90's.

One of the studies commissioned by CCME during that time, was Funding and Administrative Options for the Remediation of Orphan Contaminated Sites, by KPMG Environmental Services. This study provided an analytical framework for discussion and decision-making, weighing policy issues. It was based on the principles endorsed by CCME including "polluter pays", "fairness", and "sustainable development". The KPMG study examined seven main funding options to support the remediation of orphan contaminated sites. They included:

1) General revenue, broad consumer tax and pollution bonds
2) Broad industry tax or insurance liability surcharge
3) An industry sectoral fund which could factor in different risk considerations
4) Activity-based fees or taxes
5) Penalties, fines
6) Financial assurances
7) A combination of the above.

The KPMG study appears to have disappeared entirely from government's historic memory at the time Mr. Anderson raised the issue of contaminated sites. We suggest that it be brought back and considered.

Certainly, most of the principles that CCME was asked to incorporate, still form part of the policy of the government of Canada. Natural Resources Canada's Minerals and Metals Policy is based on the concept of pollution prevention, affirmation of the precautionary principle and recognition of the polluter pays principle.

In October 1998, the International Council on Metals and the Environment commissioned to study the Use of Financial Surety for Environmental Purposes. Written by C. George Miller, it surveys the range and extent of actual policy and practices in "EFS". The study is concerned with new and operating mines, and makes no recommendations about orphaned sites. The study is instructive in that it presents a clear and reasoned articulation of the industry position on environmental financial surety, including the concept of the "exit ticket" which relieves an operator from liability once rehabilitation is deemed to be complete. In other words, liability reverts to the Crown.

3.4.2 Guiding principles for the funding of an abandoned mine remediation program

Drawing on several of the principles articulated by CCME in 1994, MiningWatch Canada suggests the following four guiding principles as a foundation for determining who should pay for the clean up of contaminated mine sites:

1) Polluter Pays

This principle encompasses the notion that the person or party who caused the pollution should pay to clean it up. . The Rio Declaration, endorsed by the government of Canada, states: "National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment"[55]. The polluter pays principle has also been adopted by the Organization for Economic Cooperation and Development (OECD) as one of the foundations of modern environmental law.

In the case of an abandoned mine, where the party who actually caused the pollution no longer exists, it is clear that a strict definition of polluter pays cannot be applied. The KPMG report suggests substituting a more general definition of "polluter" by linking the payment of funds to a group who has "a higher likelihood of being responsible", using aggregations based on industry sector or other risk-related factors. In the case of abandoned mines, the obvious group is the mining industry.

The industry, as a whole, has enjoyed enormous growth over the past century, in part because it has not had to account for the damage it has been causing to the environment. Meanwhile, the majority of Canadian citizens have subsidized industry operations, some of which have resulted in the contamination of public lands and waters. Consequently, it is the mining industry who should be paying the brunt of the cost for cleaning up the thousands of abandoned mine sites scattered across the country.

It is also in the industry's best interest to put resources toward the clean-up of abandoned mines. Under the current investment climate, investors are wary of putting money into what they perceive to be an environmentally damaging industry. Public trust in the mining industry would be fostered if the industry displayed a willingness to take responsibility for its actions.

Further to this principle, any remediation legislation must provide the necessary authority and means to enable the recovery of public funds expended on the remediation of contaminated sites from those persons deemed to be responsible for such sites. Moreover, in bankruptcy proceedings, environmental protection must have priority over all other claims or charges on a mining property that has entered receivership or bankruptcy (save and except wages).

2) Fairness

This principle embodies "the concepts of certainty of process, effectiveness, efficiency, clarity, consistency and timeliness in achieving environmental objectives".[56] The polluter pays approach, which aims to match funding with responsibility, is an example of an attempt to achieve fair funding.

3) Sustainable Development

This very basic goal must be applied when assessing the environmental, social and economic impacts of a funding mechanism and resultant program for remediating abandoned mines. The mechanism must provide incentives for improved performance and be a deterrent to further pollution. The remediation methods employed must contribute to sustainability and community health.

4) Openness, Accessibility and Participation

These concepts support the idea that the creation of a funding mechanism must be achieved in consultation with those who will be impacted by the abandoned mines program that such a fund will support. It is important that both the mining industry and the public be involved in determining how to fund the clean-up of abandoned mines.

3.4.3 What an abandoned mine fund should and should not do

The funding mechanism should not only address past and present abandoned mines, but should also provide contingency funding for situations where existing policies and regulations have not been successful in covering real environmental costs. It could, for example, provide funding to help clean up the Giant Mine site in Yellowknife. In 1999, the mine's owner, Royal Oak, declared bankruptcy, leaving the Department of Indian Affairs and Northern Development (DIAND) with a $293 million liability, and only a meager $400 000 reclamation security bond.[57]

The use of monies from such a fund should not preclude the ability of the government to seek reparation from responsible parties at a future date.

The funding mechanism should not be viewed as insurance for current or future producers. The best way to deal with problems that may arise from current or future mining operations is through prevention, combined with adequate security bonding and enforcement of environmental regulations.

3.4.4 Funding options for abandoned mines program

MiningWatch Canada does not assume that it can present the definitive solution to funding an abandoned mines program. In all likelihood, the funding will come from a variety of sources. There are some innovative ideas for funding that are outlined in the KPMG study, which the federal government should seriously revisit at this point in time.

3.4.4.1 Mining-specific tax[58]

Funding could be based on a tax imposed on polluting substances. Options for the fund include an industry-specific tax or fee, or a broad tax on all polluting industries. Some examples include:

1) South Dakota established a limited time fee to capitalize a Mining Inventory Fund. Active

surface gold mines were charged two cents for every pound of cyanide used. The fund is being used to conduct an inventory of abandoned mines in the Black Hills.
2) Montana imposes a tax on resource extraction that is used to fund public agencies efforts to remediate environmental damage to public resources from non-renewable resource extraction.
3) Nevada imposes a net proceeds tax on mining.

3.4.4.2 Broad-based industry tax/fee for polluting

A tax could be imposed on all companies, not just mining operations, that are releasing toxic substances to the environment. The amount of tax paid into the fund could be based on the amount of pollutant released as reported in the National Pollutant Release Inventory. The monies collected from this tax could then be used to clean up contaminated sites, including abandoned mines.

- Such a fund has the potential to generate millions of dollars per year. For example, in 1997, if all on-site and off-site transfers of pollutants were taxed $100/tonne, such a tax would have generated $25,821,700.[59]
- This tax would not pose a heavy burden on individual companies. Most mining operations release less than 1 tonne of NPRI substances every year, and few release more than 100 tonnes.
- Companies able to recycle components of their pollutant stream could be given a break[60], i.e., either no tax or a substantially lower tax could be imposed on these substances.
- Funds for monitoring compliance with the NPRI would have to be increased if this options were introduced.
- A twist on this tax would be to impose a higher tax (e.g., $1000/tonne), but allow the companies to recoup the money that they contributed to the fund (without interest), subject to a set of conditions. For example, a company would recoup their contributions if their pollutant releases did not contravene any regulations, and only after all reclamation obligations had been met. A larger fund would be generated this way, and the interest from the fund could be used to pay for clean-up of abandoned mines.

3.4.4.3 Federal seed money for an Orphaned Site Cleanup Fund

Establishment of a fund with federal dollars similar to the National Contaminated Sites Remediation Fund, to undertake the inventory, lay the ground work for site verification and assessment, and set up the remediation plan and funding mechanism. The matter of orphaned contaminated mine sites is urgent, and must be begun now.

Endnotes

1. Hon. David Anderson, House address, reply to the Throne Speech, Thursday, October 14, 1999, 36th Parliament, 2nd Session. Edited *Hansard* (3:1710-40).
2 Canadian Council Ministers of the Environment 1992
3 “Mining’s Toxic Orphans come of Age”, National Post, September 18, 1999
4. Sue Moodie, Yukon Conservation Society. Pers. Comm. January, 2000.
5. Mark Palmer, Manager, Indian and Northern Affairs, Contaminants/Waste Program, Whitehorse, YT. Pers. Comm. December, 1999.
6 Communication January 10, 1999 with Nunavut Impact Review Board.
7. Email from John Sontrop to Lisa Sumi. Thursday, December 16, 1999. "With regard to mining issues off reserve that may be of concern to the nearby reserve communities, the department has funded a number of interventions and studies over the years under the Indian Environmental Assistance Fund (IEAF)… I would suggest that if you would like further detailed information on these that you request this via a formal letter to the Director of Environment and Natural Resources."
8 Communication Kevin O’Reilly to Lisa Sumi, January 6, 1999.
9 Communication between Roy Michano, Chief, Pic River First Nation and Joan Kuyek, September 20, 1999, and between John Peterson, Chief, Michipicton First Nation, October 15, 1999.
10. Cowan, W. and Robertson, J. 1999. "Mine rehabilitation in Ontario, Canada: Ten years of progress," in *Sudbury '99 Mining and Environment II, vol. 3*. D. Goldsack, P. Yearwood and G. Hall, eds.
11. Communication between Catherine Coumans of MiningWatch Canada and Robert Trembley, Government of Quebec.
12. BC MINFILE; John Errington, BC Ministry of Energy and Mines, Pers. Comm.
13 For example, Britannia Mine
14 For example, Mt. Washington Mine
15. Kristine Taylor Lee, Analyst for the Treasury Board. Pers. Comm.
16 Canadian Council Ministers of the Environment 1992
17. In the Federal Government’s Response to NAFTA CEC Complaint filed by the Sierra Club of BC, the Environmental Mining Council of BC and the Taku Wilderness Association, the government mentions that: Environment Canada (EC) helped to fund an overview study of the AMD problem at Mt. Washington; in 1996, EC re-installed a flow monitoring station near the mine site, and contracted with Golder Associates Ltd to study passive methods of treatment appropriate to that site; the Department of Fisheries and Oceans (DFO) provided core funding to the Tsolum River Task Force which was founded in 1997 to, amongst other goals, identify factors which were limiting salmon production in the Tsolum River; and EC also retained a specialist to advise on wetland treatment options.
18 Communication with Roy Michano, op.cit.
19 In 1992, Hatch engineering of Mississauga and D. R. anderson Sssociates developed a method to calculate the amount that needed to be set aside at development to provide for perpetual monitoring and care of mine sites
20. Mark Palmer, Manager, Indian and Northern Affairs, Contaminants/Waste Program, Whitehorse, YT. Pers. Comm. December, 1999.
21. Scott Mitchell, Head, Indian and Northern Affairs, Contaminated Sites Offices, Yellowknife, NWT. Pers. Comm. December, 1999.
22. Scott Mitchell, Head, Indian and Northern Affairs, Contaminated Sites Offices, Yellowknife, NWT. Pers. Comm. December, 1999.
23. John Hutchion, "Tax payers stuck with tab for BYG mine," *Yukon News*, August 6, 1999.
24. Dave Sherstone, Water Resources, DIAND. Whitehorse. Pers. Comm. January, 2000.
25. Sue Moodie, Yukon Conservation Society. Pers. Comm. January, 2000.
26. Dave Sherstone, Water Resources, DIAND. Whitehorse. Pers. Comm. January, 2000. In 1994, government estimates of the cost of clean-up at the Faro mine were $126 million, based on the amount of work required to make the mine environmentally safe with minimum intervention/maintenance. Sherstone says that amount is higher now, but no study has been conducted to determine how much more work is required to reclaim the site.
27. Allan Robinson. “Cominco’s Faro deal frees it from liability,” *Globe and Mail*. August 19, 1999.

28. Keith Damsell. “Witte seeks large payout,” *Financial Post*, Dec. 11, 1995.
29 Aboriginal Communities and Mining, conference report, September 12-15, 1999, Ottawa, MiningWatch Canada
30. Feasby, G. and Jones, R.K. 1994. *Report of Results of a Workshop on Mine Reclamation*, Toronto, Ontario, March 10-11, 1994. p. 10.
31. Environmental Mining Council of BC. 1998. *Acid Mine Drainage: mining and water pollution issues in BC*. Victoria, BC.
32. Brandt, C. 1995. “Tsolum: Concern for this damaged river grows,” *Times Colonist*. October 10, 1995. A5.
33. Agreement between Environment Canada and Copper Beach Estates Ltd, March 30, 1999. File A#-2194, BC Ministry of Environment, Lands and Parks.
34. H.A. Simons, 1999. *Britannia Reclamation and Remediation Project Financial Model*.
35 Dr. Byron Hyde, commjnication January 9, 2000
36. Potential costs may be associated with mine sites that: 1) are not acid generating upon mine closure, but that become acid generating years later; 2) are not presently on federal lands, but that may impact those lands, e.g., wastes located off of Aboriginal lands that leach onto them.
37. The Windy Craggy exploration site in BC is generating acidic runoff. (Environmental Mining Council of BC. 1999. *Acid Mine Drainage in BC: Mining and Water Pollution Issues in BC*. p. 13).
38. We are aware of 16 in BC alone. They are: Monarch, Kicking Horse, Shining Beauty, Wreck Bay, George Island, Shuttle Island Placer, Ellen, East Copper Island, Gigger, Lucky Seven, Jessie, Adonis (L.1865), Lily, Rose (L.1871), Wireless and Oceanic.
39. E.g., For the past 30 years, the Mt. Washington mine has been leaching copper to the Tsolum River watershed, devastating the local salmon and steelhead populations, and costing the community approximately $2 billion/yr in lost revenues. In July, 1999, Environment Canada (EC) sent a letter to four companies believed to have an ownership or other interest in the land where the former mining operation existed. The letter advised them that the discharge from the mine site was acutely lethal to fish, and that the deposit is a violation of subsection 36(3) of the Fisheries Act. The letter also informed them that EC was consulting with the Department of Justice Canada regarding any necessary enforcement actions, and determination of liability. In this case, if no enforcement actions are taken or responsible parties identified, is it the federal government’s responsibility to undertake the necessary remediation at the Mt. Washington mine? (information on EC's actions taken from the *Federal Government’s Response to NAFTA CEC Complaint filed by the Sierra Club of BC, the Environmental Mining Council of BC and the Taku Wilderness Association*.)
40. Within BC, adjacent to the Alaskan Panhandle, several rivers cross the international boundary. Drainage enters marine waters with important fisheries resources used by both Canada and the United States.
41. Example provided by Joan Kuyek, National Coordinator of MiningWatch Canada.
42. The 1992 report entitled *Survey of closed and abandoned mines in British Columbia for acid mine drainage*, written by Steffen Robertson and Kirsten (SRK) BC Inc., identifies the Stewart-Smithers region as an area where site inspections of abandoned mines should be done, because the geology of the area has a high potential to generate acid mine drainage. The same report highlighted the Kootenays as an area of concern because it has a long history of mining activity. Discussions with provincial Ministry of Energy and Mines officials have verified that there are 1000s of abandoned mine sites in the Kootenays that have potential safety risks associated with them, but little documentation exists for those sites.
43. There are several key regions in Ontario (e.g., Sudbury, Thunder Bay) where thousands of abandoned mines exist in the AMIS inventory, but the sites have not been inspected to determine the accuracy of the information contained within AMIS, e.g., location, or safety and environmental problems with the sites. (Dick Cowan, Ontario Ministry of Northern Development and Mines, pers. com.)
44 Personal communication to J. Kuyek and B. Lloyd, July 1999
45 Timmins Daily Press, January 7, 2000 “Rehabilitation funds available for former Hollinger Mine property.”
46. According to the guidelines, the rates and timing of metals leaching and AMD onset are dynamic processes, which are determined by a large number of site-specific mining, geological and environmental factors. In some instances, the onset of acid weathering conditions and ARD are instantaneous. At other mine sites it has taken 10 to 20 years to exhaust the available neutralization (Morin and Hutt, 1997). It may take many years before weathering or leaching conditions cross the biological, physical and chemical thresholds necessary for significant adverse impacts; therefore, the observation that ML/ARD has not yet occurred is, on its own, no assurance that they will not occur in the future. (Price, W.A. and Errington, J.C. 1998. *Guidelines For Metal Leaching and Acid Rock Drainage at Minesites in British Columbia.* BC Ministry of Energy and Mines.Guidelines. s. 1.2)
47. Steffen Robertson and Kirsten (SRK) BC Inc. 1992. “Survey of closed and abandoned mines in British Columbia for acid mine drainage.”

48. Price, W.A. and Errington, J.C. 1998. *Guidelines For Metal Leaching and Acid Rock Drainage at Minesites in British Columbia*. BC Ministry of Energy and Mines.
49 From http://www.min-eng.com/solid.html May 4, 1999
50. Communication between Joan Kuyek of MiningWatch Canada and B. Phillips of Fednor.
51 Press release, DIAND 22 Nov 1999
52 Environmental Business Canada, Spring 1999
53. Task Group On Contaminated Site Liability, 1993. *Draft Report to CCME Ministers*. Appendix 2 of the 1995 KPMG study (see endnote 9).
54. The Gallon Report, October, 1999.
55 The Minerals and Metals Policy of the Government of Canada: Partners for Sustainable Development, 1996
56. This definition comes from p. 16. of the 1995 KPMG study (see endnote 9).
57. MiningWatch Canada news release, August 31, 1999. "Public on the hook for billions of dollars in mine clean-up costs: mine activists demand that industry pay to clean up its own mess."
58. Examples from the Inventory Guiding Principles Group (IGPG). 1996. *Guiding principles for inventorying inactive and abandoned hardrock mine sites.* (www.enviromine.com/guide/inactive.html)
59. From the National Pollutant Release Inventory, 1997 data. In 1997, facilities across Canada reported 161,876 tonnes (on-site releases) + 96,341 t (off-site transfers for disposal) = 258,217 tonnes. Multiplied by $100 per tonne of waste, more than $25 million would have been generated in 1997.
60. In 1997, 124,746 tonnes of toxic substances were recycled or utilized for energy recovery.