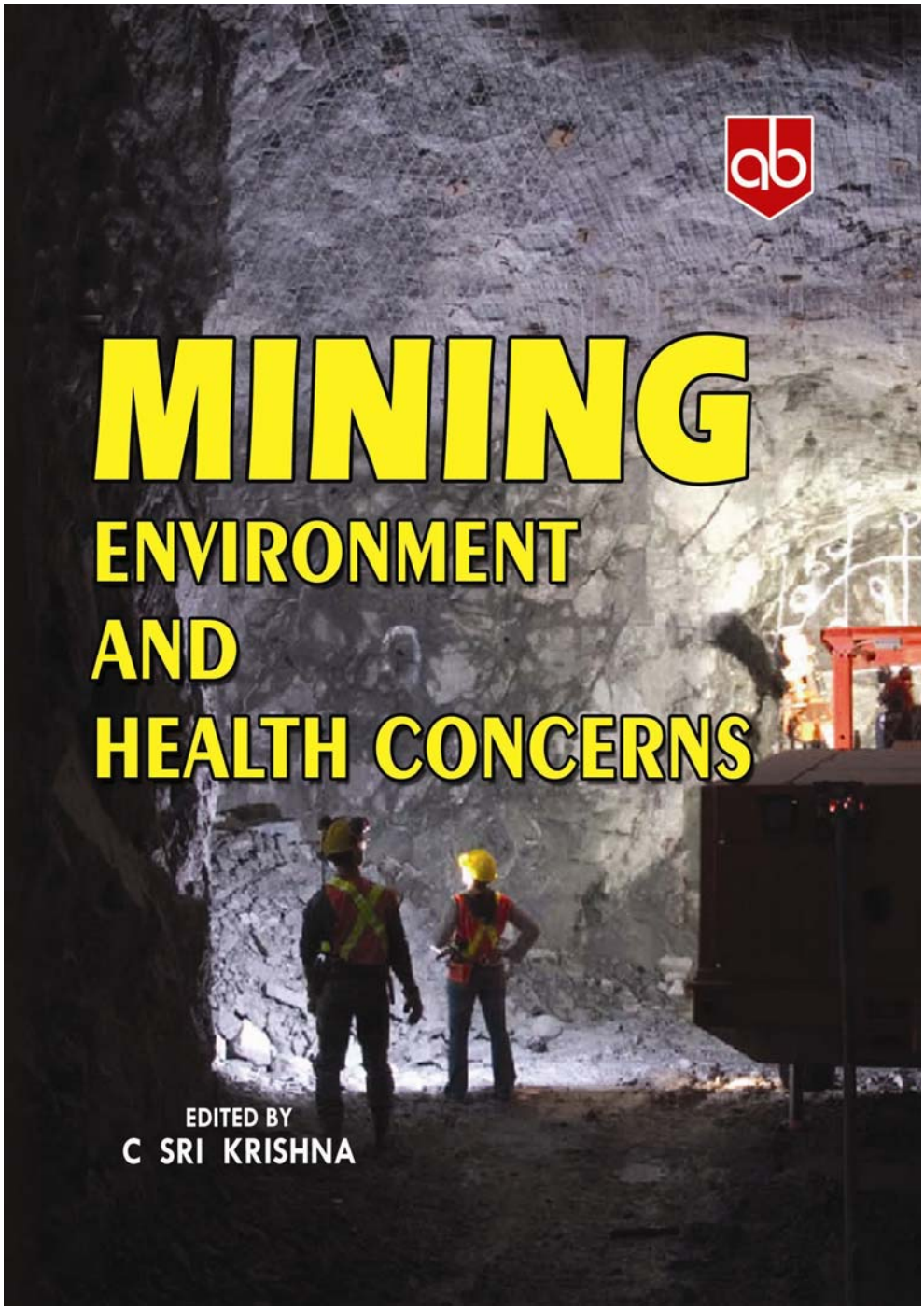
MINING
ENVIRONMENT
AND
HEALTH CONCERNS
EDITED BY
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Mining: Environment and Health Concerns

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Overview

The mining industry is facing serious environmental, safety and health impacts. It has direct impact on the geological terrain of the region and affects the health and safety patterns of the human beings habituated in the region. Mining though regarded as an important source of wealth and employment generation the large scale operation of mines over a period of time damages the textural and structural features of the land causing environmental degradation, health and safety abuses. The gap between actual losses to the environment health, safety standards and the regulatory and enforcement mechanism, tangible benefits received by the employees is very large.

The nature of mining processes creates a negative impact on the environment both during the period of mining operations and even after closure of the mines. The negative impacts prompted the world's nations to adopt various regulations to regulate the negative effects of mining operations. Environmental issues mainly constitute erosion of the land surface, formation of sinkholes, loss of biodiversity and contamination of

soil, surface and sub-surface groundwater by the percolating chemical substances derived from the mining processes. Mining operations apart from soil erosion also affect the topography of the region in terms of subsidence of the land surface, changing the directions of the flow of streams, structural instability of the rock bodies, disturbances in the storage and flow of water in the catchment areas on account of siltation, fertility of agricultural land because of ash dump etc. The presence of waste disposal generated out of the mining operations cause air and water pollution in the areas of mine belt and destructs vegetation of forests. Open cast mining causes changes in topography, land use pattern, percolation from overlying rock masses and drainage pattern whereas as underground mining mainly causes changes in land use, topography and infiltration of water into the deeper parts of the sub-surface areas. The impact of underground mining on the environment is more when compared to surface mining. Mainly lack of organization and responsibility within the mining corporations leads to the environmental degradation.

Environmental damages also have direct impact on the health and welfare of the employees working in the mining companies. The occupational health and safety standards have greater effect on the functioning of the mining system and the poor maintenance of safety norms will have direct effect on social and economic costs such as compensation, livelihood, damage etc. Mining companies when operate in unhealthy environment ignoring the rules and regulations caused health hazards and it will have serious effects on the welfare of women and children working in the mining regions. The pollution of air and water bodies causes immense damage to the health of the people. The air pollution in mining areas resulting from the emission of substances such as nitrogen oxides, sulphur dioxides and other atmospheric particles can cause Upper Respiratory Tract Infections (URTIs) in people especially women and children. Noise vibration resulting from the blasting of ore in large scale mining operation poses a serious problem for nearby

residents. The health of workers is more deteriorated when their mining activities are confined to extraction of coal, asbestos, lead, etc. The presence of high silica – content in the rocks generate a lot of dust in the mineral exploitation process and prolonged exposure of the employees to this dust over a period of time cause silicosis and silico-tuberculosis. The contamination of resources resulting from leakage of chemicals also affects the health of the local population causing several abnormalities. Mining companies are under obligations to follow environmental and rehabilitation codes to provide better working conditions. For example indiscriminate usage and improper application of mercury in the processing of gold by small scale miners injures both nursing mothers and children employed in such unsafe environment.

Poor working conditions and unhygienic environment at the site of mine causes accidents. Mine accidents cause huge loss to the life of the personnel and revenue generation for the company. They mostly occur in developing countries where more number of small scale mining, sectors and abandoned mines are in operation. . Insufficient ventilation in the mines causes exposure of workforce to harmful gases, heat and dust inside sub-surface mines. Mining accidents can have a variety of causes, including leaks of poisonous gases such as hydrogen sulphide, methane, dust explosions, collapsing of mine stopes, mining-induced seismicity, flooding, or general errors from improperly used or malfunctioning mining equipment. In addition to the above causes mining accidents also takes place due to the negligence of the workers in the execution of the duties during the course of employment. The negligence or lapse in the performance of the duties on the part of the workers is due to weariness resulting from over exploitation and stretching of working hours at mine site. Most of the mine accidents can be prevented by taking necessary precautions with regard to installation of safety equipments, implementing mine safety standards and carrying out mine inspection at regular intervals.

The expansion of the mining activities by both domestic and multinational companies has an effect on socio-economic development of the region, employment opportunities and conversion of agricultural land to mining land. Compensation packages paid to the farmers in lieu of lease or sale is very meagre Agricultural production gets reduced due to changes in the land use pattern. The transformation of land use and increased value of the land brings changes in the social structure, social costs, and social relationships. Further it causes radical and sudden changes in the regional cultures, disintegration of social structure and economic ill health.

A framework of environmental law and mining law has been framed by the countries to regulate the mining activities and protect the interests of the workers. The ineffective enforcement and gaps in the legislations encourage mining companies to escape from legal compliance of various rules and regulations. The lack of political will and supremacy of the mining companies has affected the work environment with exposure to high risk of health and safety conditions. Legal remedies available to the workers in terms of compensation in lieu of damage or injury are very less and moreover companies which cause heavy pollution through discharge of acid drainage and mine waste escape with meagre punishment in the form of fine. An appropriate legal framework which effectively monitors and regulates environment, health and safety standards and bridges the gaps between the environmental law and mining law may provide better results.

The article **"Mining and the Environment"** by *Stewart Smith* focuses on the relationship between the mining and environment and its consequences in New South Wales (NSW) region. The region is governed by the Environmental planning and Assessment Act 1979 and Mining Act of 1992. The former deals with assessment, approval for operation and extension or renewal for existing mines and the latter safeguards the environment in and around mining areas. The technique of longwall mining is widely practiced in the underground mines for the exploitation of the coal deposits and over a period of time and caused disturbances in the

topography and hydrogeology of the region which has a direct impact on the livelihood of local communities. The author further refers to the open cast mining operation which affects the streams, alluvial aquifers and alluvial soils resulting in reduction of water storing capacity of aquifers.

George (Rock) Pring in the article **"International Environmental and Human Rights Law Affecting Mining Law Reform"** explains the relationship between The International Environmental and Human Rights (HER) and its role in regulating and setting up standards for mining industry in promoting sustainable development. The inclusion of public participation in resolution of environmental issues relating to energy, transportation and land dispute occupies the primary concern for reforms in the US Mining laws. The development of the hard law and its relationship with soft law has paved way for the strengthening of the regulatory system. The author refers to the significance of the Global Reporting Initiative (GRI) which is a system of principles and indicators that helps a company or an organization to assess potential impacts and risks, overall compliance of environment, health and safety standards and in publicizing their economic, environmental and social achievements.

M A Hermanus in the article **"Occupational Health and Safety in Mining – Status, New Developments and Concerns"** discusses the effects of non-compliance of health and safety standards in the mining industry. Mining industry has witnessed many changes in terms of enforcement of health and safety norms and it is commonly observed that mine accidents are more in case of mining operations and with abandoned mines. The fatality rate in case of mines operating in small scale is higher due to the poor execution of mine planning and non-compliance of health and safety norms in principle. The article makes a comparative study of mining operations and fatalities with respect to South Africa and Australia. The mine accidents take place mainly due to the improper usage of mine explosives and non-specific incidents and health hazards are due to the airborne pollutants like silica dust, coal dust and noise pollution due to the

usage of heavy machinery and assaying activities. It also refers to the role of Mine Safety and Health Administration (MSHA) in monitoring and improving the mine operations. Identification of the high risk factors such as toxic metals, reproductive hazards, inorganic solvents and radiation are important to find amicable solutions in the form of preventive measures to control mining casualties.

The article **"Mine Water Pollution – Acid Mine Decant, Effluent and Treatment: A Consideration of Key Emerging Issues that May Impact the State of the Environment"** by *Suzan Oelofse* discusses the significance and the impact of Acid Mine Drainage (AMD) on surface and sub-surface ground water pollution leading to costly environmental and socio-economic problems. AMD contains high level of ph value indicating salinity and concentration of heavy metals like cadmium, cobalt, zinc and other toxic substances which adversely affect soil quality, aquatic habitats and environmental degradation. The release of mining waste causes damage to the surrounding environment leading to the ecological imbalances. Surface source of AMD affecting the environment are coal discard, gold tailings, waste rock dumps and uranium slimier dams.

The article **"Prosecution for OHS Offences: Deterrent or Disincentive?"** by *Neil Gunningham* discusses the role of prosecution in effective enforcement of occupational health and safety legislations. The Occupational Health and Safety Amendment (Workplace Deaths) Act 2005 of NSW is meant to prevent mining causalities and regulate the working conditions The Act is an outcome of the different breaches committed by the mining corporations and the strict enforcement of the Act is carried out by initiating preventive or corrective actions against the offenders through imposing penalties. The article explains the role of prosecution at different levels with the help of an enforcement pyramid which provides a valuable conceptual framework disclosing different forms of punishment and various tools for enforcement officers to effectively investigate the compliance system.

The article **"Coal Mine Safety and Health"** by *Linda Levine* refers to the different types of mine casualties and its contributing factors. The number of casualties in mining sector of US has reduced when compared with total recorded fatalities in the manufacturing sector. The most common health hazard observed among the coal mine workers is the Coal Workers Pneumoconiosis (CWP) which is popularly referred to as black lung which is claiming 1000 lives every year. The mine operations are basically monitored by MSHA and to make the system efficient the US government has enacted S-Miner Act with required provisions for regulating the mine safety and health standards. An independent investigation team for examining the accident sites causing multiple injuries or deaths in addition to the various activities as carried out by the MSHA is more beneficial in reducing the mine fatalities.

Semere Solomon, Beate Kristiansen, Aage Stangeland, Tore A. Torp and Olav Karstad in their article **"A Proposal of Regulatory Framework for Carbon Dioxide Storage in Geological Formations"** explains the various regulatory issues pertaining to Carbon Capture and Storage (CCS). The storage of CCS involves selection of site, scale of operation and risks associated with performance which are the key factors that play an important role in the framing of regulatory mechanism with regard to geological storage of carbon dioxide. Any lack of complete knowledge in the process of carbon dioxide trapping in strata or coal seams or swellings would result in reaction between the carbon dioxide and coal leading to the damage of the coal seam rather than enhancing coal bed methane. A proper regulatory framework is essentially required to monitor the allowed concentration of impurities and the lowest level of allowed carbon dioxide that can be reasonable at the time of injections.

The article **"Livelihood Issues and Concerns of Women and Men in Small Mines and Quarries of South Asia"** by *Kuntala Lahiri-Dutt* analyses the various aspects related to the gender discrimination and protection of rights and interests with reference to artisan and small scale

mining companies. This lack of control has led to employment of women in different activities like digging carrying loads, and extracting minerals from informal mines and quarries. The workforce have very poor living and working conditions, lack of accessibility to clean and safe drinking water, electricity, health services and educational facilities for the children. There is a need for strict implementation of the legislation to eradicate gender bias and harassment, regulation of working conditions and acceptance of their multiple roles concerned with the mining activities under safer environment.

1

Mining and the Environment

*Stewart Smith**

Mining makes a significant contribution to the Australian and NSW economy. This article briefly places the contribution of mining into the context of the wider economy. It focuses on the impact of coal mining on both natural and agricultural areas of NSW. The environmental regulatory regime that mining companies operate under is reviewed, and the environmental impact of coal mining is presented for both underground and open cut mines. The Environmental Planning and Assessment Act 1979. has two environmental planning instruments, the State Environmental Planning Policy (Major Projects) 2005 is concerned with the development assessment and approval process whereas State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 deals with the assessment of new mining, petroleum production and extractive industries proposals. The environmental impact of mining is dependent on several factors, including the extraction technique and where the mine is situated. The article looks at both extraction methods and reviews their environmental impact. Environmental groups and some sectors of the

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Source: www.ccag.org.au

community are in favour of greater environmental protection of natural features from the environmental impacts of coal mining, particularly subsidence.

The Environmental Impact of Mining

The environmental impact of mining is dependent on several factors, including the extraction technique and where the mine is situated. For instance, in regards to coal mining, underground mining has different impacts compared to open cut mines. This paper looks at both of these extraction methods and reviews their environmental impact.

Coal resources in the Southern Coalfield, located in the Illawarra region of NSW, is extracted using the technique of long-wall mining. This is a method of underground coal mining whereby blocks of coal, known as 'panels', are extracted from a coal seam by a shearer moving along the face of the panel. As mining progresses along the length of the panel, the overlying strata collapses behind the advancing long-wall face. Subsidence, or the lowering of the land surface is an unavoidable consequence.

There has been significant community concern about the impact of coal mining on the natural features of the Southern Coal Fields. The NSW Department of Environment and Climate Change noted that long-wall mining subsidence is frequently associated with cracking of valley floors and creek-lines with subsequent effects on surface and groundwater hydrology. Of particular concern is the potential for long-wall mining to affect upland swamps on the Woronora Plateau. Upland swamps, particularly peat swamps, are important to catchment hydrology and ecology because they absorb water and allow runoff for long periods after rainfall has ceased.

The Sydney Catchment Authority has noted the lack of scientific data to help assess the precise nature and extent of the damage from subsidence to groundwater systems. Groundwater may play a crucial role in maintaining stream flows during periods of severe drought, and subsidence impacts on system water yield are not well understood.

In regard to the environmental impact of underground mining, the NSW Minerals Council noted that:

- Subsidence from underground mining will have some environmental effects – as do most kinds of development. The question that needs to be answered is one of the acceptability of impacts.
- Environmental impacts may be insignificant in a regional context. The impacts of mining may be localized or temporary, and not as relevant when considered in the context of other land uses in the region.
- The Government must make decisions on the acceptability of impacts by assessing a project's net benefit or cost to society by taking into account all economic, social and environmental factors.

To help inform it in late 2006 the NSW Government established an Independent Review of Coal Mining in the Southern Coalfield. The Review concluded that with few exceptions, at depths of cover greater than about 200 m coal cannot be mined economically by any mining method without causing some degree of surface subsidence. If mining of hard coking coal in the Southern Coalfield is to continue, then a certain level of subsidence impact must be accepted as a necessary outcome of that mining. In terms of planning approvals for new or extension of existing mines, the Review concluded that the key role of the Part 3A approval under the *Environmental Planning and Assessment Act 1979* should be to clearly define required environmental outcomes and to set appropriate performance standards. The subsequent role of the Subsidence Management Plan should be one of management.

On 22 June 2009 the Minister for Planning Hon Kristina Keneally MP made her first Ministerial determination on a Southern Coalfield mine since the release of the Southern Coalfields Review. The Metropolitan Colliery Project approval provided for specific environmental conditions, expressed in terms of performance measures.

The impact of mining on agricultural areas has been the focus of much recent attention. These concerns have arisen due to the granting of coal exploration licences in the in the Gunnedah Coal Field. For instance, in April 2006 the NSW

Government issued BHP Billiton a five-year coal exploration licence covering 344 square kms at Caroona in the Liverpool Plains region of NSW. In August 2008 the Government granted an exploration licence to the China Shenhua Energy Company for the Watermark area near Gunnedah for a period of five years.

A major concern of the Liverpool Plains community is the impact of coal exploration and mining on underground and water resources. These concerns are not restricted to this region alone, so it is potentially illuminating to see what restrictions or guidelines on the coal industry have been applied in another major agricultural region, the Hunter Valley.

Open cut mining is the main extraction method in the Hunter Valley. This involves scraping off overburden and digging out a pit to recover the coal. This can result in a whole different set of environmental impacts compared to underground mining.

Open cut mining can have major impacts on streams, alluvial aquifers and alluvial soils. Mining which removes alluvium to reach coal beneath has an obvious impact on an alluvial aquifer, requiring it to be dewatered during mining, and with very little probability of successful restoration afterwards.

Salt occurs naturally in many of the rocks and soils of the Hunter Valley. Some of this salt is leached into groundwater and nearby rivers. During coal mining, salty water collects in mine pits, and has to be pumped out to allow mining to continue. What to do with this saline water is a major management problem for many coal mines.

Underground coal mining close to or beneath alluvial aquifers, or open cut mining close to alluvial aquifers may lead to fracturing of the hard rock layers that confine the ground water. The result is that any significant degree of fracturing will establish additional conduits for increased movement of saline groundwater into the alluvial aquifers, and to surface water features.

In response to these concerns, Government agencies operate under an informal policy that no further open cut mining should take place within the Hunter River's alluvial floodplain and its prime alluvial aquifer. There has also

been a guideline on the management of stream and aquifer systems in the Hunter Valley, which provides for 40m setbacks in the case of underground mines to alluvial aquifers, and a 150m setback for an open cut mine.

On the 14th May 2009 the Hon Lee Rhiannon MLC introduced a Private Members Bill into the Legislative Council. The *Mining Amendment (Safeguarding Agricultural Land And Water) Bill 2009* sought to amend the *Mining Act* to protect prime agricultural land and water sources that feed it from mining operations and mining exploration. The Bill, whilst supported by the Coalition Opposition, was negatived at the Second Reading Speech stage on June 4th 2009. One of the disputed points was how to define and identify prime agricultural land.

In response to community concerns about the impact of mining exploration on the water resources of the Namoi River catchment, the Minister for Primary Industries Hon Ian Macdonald MLC established a water study working group in August 2008. Chaired by former Member the Hon Pam Allan, the Minister told Parliament on 4th June 2009 that the working group had finalised and agreed to a draft terms of reference for an initial water study in the Namoi catchment.

Mining contributes enormously to the Australian and NSW economy. The minerals industry is NSW's largest export industry, accounting for export revenue of $11.1 billion in 2006-07, which is 39% of total NSW exports. However, this is not without cost. Environmental groups and some sectors of the community would like to see greater environmental protection of natural features from the environmental impacts of coal mining, particularly subsidence. Similarly, the potential impact of mining on water resources of the State has created conflict in agricultural communities. With estimated Australian coal reserves of some 200 years, this debate seems far from over.

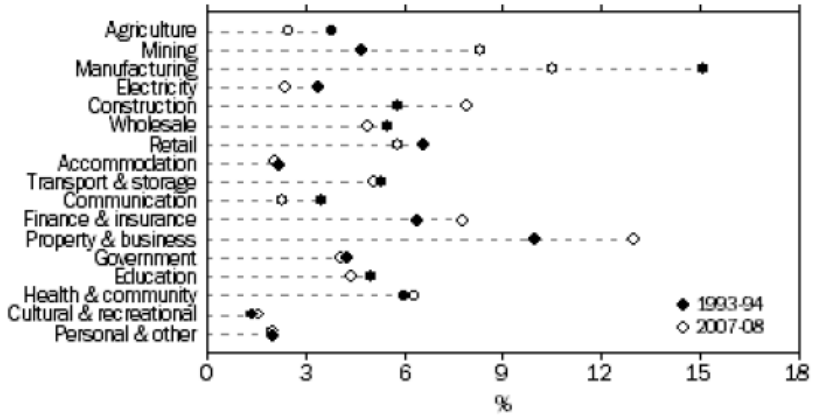
1. Introduction

Mining makes a significant contribution to the Australian and NSW economy. This paper briefly places the contribution of mining into the context of the wider economy. It then focuses on the impact of coal mining on both natural and agricultural areas of NSW. The environmental regulatory regime that mining must operate under is reviewed, and the environmental impact of coal mining is presented for both underground and open cut mines.

2. The Economic Contribution of Mining to Australia and NSW

Contemporary Australia has an economy based on services. Figure 1 shows the industry share of Gross Domestic Product (at basic prices excluding ownership of dwellings) for the main sectors of the economy, both for 1993-94 and 2007-08. It shows that Mining has increased its share over the period from around four percent of the GDP to eight percent. Over the same time, Manufacturing has shrunk considerably, and the share of Agriculture has reduced from around four percent to less than three percent.

Figure 1: Industry Share of GVA, 1993 – 94 and 2007 – 08



Industry GVA at basic prices as a proportion of total GVA at basic prices.

Source: ABS, Australian System of National Accounts, 2007-08 Cat No 5204.0, 31/10/2008.

The ABS reports that Mining industry profits increased by 160% between 2002-03 and 2007-08. Over the same period the investment undertaken by Mining increased by 212%. However, over the same period Mining gross value added in volume terms increased by only 12%, with the significant increase in profits driven by growth in the prices of mining commodities.[1]

2.1 NSW Mineral Production

NSW produces a diverse range of minerals including coal, metals, industrial minerals and construction materials. The total value of this production in 2007-08 was over $14 billion. Coal production contributed the greatest proportion of this

value, with an estimated worth of over $10 billion (70% of total).[2] The minerals industry is NSW's largest export industry, accounting for export revenue of $11.1 billion in 2006-07, which is 39% of total NSW exports. Coal accounts for 56% of the total of NSW mineral and metal exports. The NSW minerals industry is based on:

- 60 coal mines (29 underground, 31 open cut);
- 12 major metalliferous mines;
- 11 significant industrial minerals operations;
- a large number of smaller metallic and industrial mineral mines and numerous construction materials operations.[3]

Coal mining is mainly concentrated in the Sydney – Gunnedah Basin within the State's five coalfields: Hunter; Newcastle; Gunnedah; Western; and Southern, as shown in Figure 2. Metallic mining operations are concentrated in three main areas of the State: Broken Hill; Orange and Cobar.

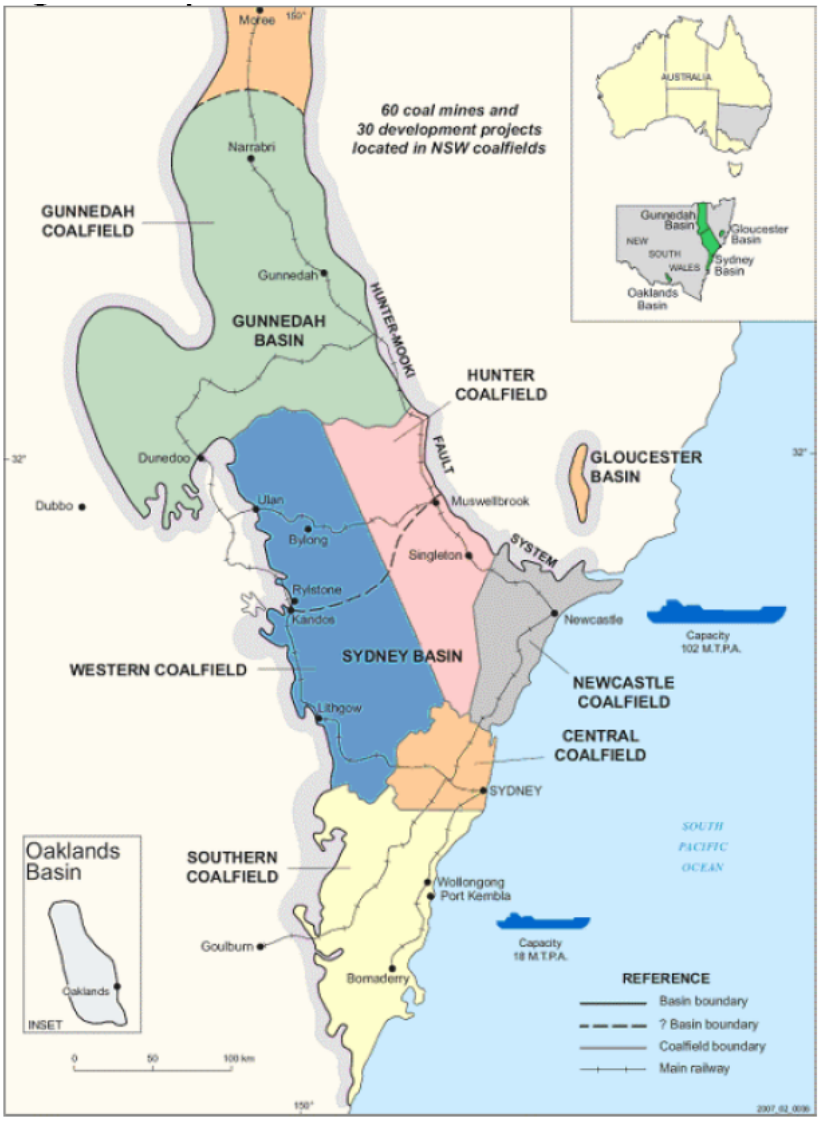
In 2007 – 08 the NSW Government approved a number of new coal and other mineral projects along with extensions to existing mines, including the:

- $405 million Moolarben coal mine near Ulan in the Western Coalfield.
- $140 million stage one of the Narrabri North coal mine in the Gunnedah Coalfield;
- $35 million Belmont coal mine (recently renamed Rocglen), also in the Gunnedah Coalfield;
- $105 million Snapper mineral sands project in the Murray Basin.
- Extensions to the Bengalla, Bulga, Drayton, Invincible, Liddell, Mt Arthur and Mt Owen (Glendell extension) coal mines.[4]

At the end of 2007-08 it was reported that there are more than 40 coal and mineral projects and mine extensions proposed for development over the next decade in NSW. If all were to proceed the cumulative investment in NSW would be more than $7 billion.[5] In particular, higher coal prices have stimulated investment in the NSW coal industry, which has triggered a community response in certain areas.

Total NSW mining royalties in 2007-08 was around $573.57 million, of which coal royalties contributed $494.39 million (86%).

Figure 2: Map of NSW Coalfields



Source: NSW Department of Primary Industries, 2008 New South Wales Minerals Industry Annual. 2008.

3. The Mining Regulatory Regime

In regards to the environment, there are two main legislative provisions that relate to the regulation of mining. These are the:

- *Environmental Planning and Assessment Act 1979:* which covers the assessment and approval of new mines and the extension of existing ones.
- *Mining Act 1992:* This was significantly amended in 2008, incorporating key environmental provisions.

Both of these legislative provisions in the context of mining are outlined below.

3.1 The Environmental Planning and Assessment Act 1979

Proposed mining operations, like other development, must be approved via the *Environmental Planning and Assessment Act 1979*. This Act has two environmental planning instruments that may apply (depending on the size of proposed development). The first of these is the State Environmental Planning Policy (Major Projects) 2005 and the second is SEPP (Mining, Petroleum Production and Extractive Industries) 2007. The impact of these SEPPs and how they relate to the Environmental Planning and Assessment Act in relation to the mining regulatory regime is reviewed below.

State Environmental Planning Policy (Major Projects) 2005

The aim of this Policy is to identify development to which the development assessment and approval process under Part 3A of the Act applies. Under this part of the Act, the determination of a development application is removed from the local consent authority to the Minister for Planning.

1. Mining development where Part 3A applies:

    a. is coal or mineral sands mining, or

    b. is in an environmentally sensitive area of State significance, or

    c. has a capital investment value of more than $30 million or employs 100 or more people.

2. Extracts a bulk sample as part of resource appraisal or a trial mine comprising the extraction of more than 20,000 tonnes of coal or of any mineral ore.

3. Development for the purpose of mining related works (including primary processing plants or facilities for storage, loading or transporting any mineral, ore or waste material) that:

    a. is ancillary to or an extension of another Part 3A project, or

    b. has a capital investment value of more than $30 million or employs 100 or more people.

From 2010 all proposed extensions to underground coal mining operations will require approval under Part 3A of the *Environmental Planning and Assessment Act 1979*.[6]

Similar provisions apply to petroleum (oil, gas and coal seam methane) development. Extractive industries included under Part 3A are those that:

a. extract more than 200,000 tonnes of extractive materials per year, or

b. extract from a total resource of more than 5 million tonnes, or

c. extract from an environmentally sensitive area of State significance.

Any development for the geosequestration of carbon dioxide will be assessed under Part 3A of the Act.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

This SEPP was gazetted in February 2007, and consolidated previous provisions and introduced new provisions with the aim to ensure that potential environmental and social impacts are adequately addressed during the assessment and determination of these development proposals.

The Policy includes provisions for:

- Prohibited development;
- Permissible development;

- Complying development; and
- Exempt development.

The SEPP highlights some key natural resource and environmental management issues that must be addressed when assessing new mining, petroleum production and extractive industries proposals, including:

- Impacts on significant water resources, including surface and groundwater resources;
- Impacts on biodiversity including threatened species;
- Greenhouse gas emissions (including downstream emissions) having regard to any applicable State or national policies, programs or guidelines concerning greenhouse gas emissions.

An assessment of land-use compatibility is now required as part of an application for a new mine, quarry or petroleum production facility. In addition, a land-use compatibility assessment will also be required for any proposed development adjacent to an existing mine, quarry or petroleum production facility or development on land identified as containing minerals, extractive materials or petroleum resources. The assessment will be used to determine the potential for land-use conflict and land-use constraint in respect to adjacent land uses.

3.2 The Mining Act 1992

The *Mining Act 1992* was widely amended by the *Mining Amendment Act 2008*. However, many of the provisions in the amending Act have yet to commence.

The Amendment Act included a rewrite of the objects of the Act as follows:

> The objects of this Act are to encourage and facilitate the discovery and development of mineral resources in New South Wales, having regard to the need to encourage ecologically sustainable development, and in particular:
>
> a. to recognise and foster the significant social and economic benefits to New South Wales that result from the efficient development of mineral resources, and

b. to provide an integrated framework for the effective regulation of authorisations for prospecting and mining operations, and

c. to provide a framework for compensation to landholders for loss or damage resulting from such operations, and

d. to ensure an appropriate return to the State from mineral resources, and

e. to require the payment of security to provide for the rehabilitation of mine sites, and

f. to ensure effective rehabilitation of disturbed land and water, and

g. to ensure mineral resources are identified and developed in ways that minimise impacts on the environment.

The Act includes provisions for the regulation of mineral exploration and mining leases, including environmental management and rehabilitation.

As discussed later in the paper, subsidence of land forms due to underground mining is a key regulatory issue. Under the enforcement powers of the *Mining Act 1992,* the NSW Government introduced a new subsidence management policy and approvals process in March 2004. As part of these reforms, Subsidence Management Plans (SMP) are now a requirement of all underground coal mines, whether they are new or expanding projects. Plans must be based on a full land use description and impact assessment. Physical landforms and surface infrastructure must be addressed, along with ecosystems and items of potential heritage or archaeological significance. The onus is on the company to demonstrate how it proposes to manage any subsidence which may be caused by underground mining.[7]

A Subsidence Management Plan is first assessed by an internal Department of Primary Industries review committee, which reviews the technical merits and adequacy of the Plan regarding the potential impacts of subsidence. This committee may request amendments, or refer the Plan to an interagency committee comprising representatives from DPI, the Department of Environment and Climate Change (DECC), the Department of Planning (DoP), and the Mine

Subsidence Board. Representatives from other agencies (such as the Sydney Catchment Authority, Dam Safety Committee, Roads and Traffic Authority and Heritage Office) are also involved where appropriate.

The committee develops conditions of approval and makes recommendations to the approval authority, which is the Director-General of DPI. These approvals are restricted to a maximum period of 7 years and are subject to annual review.[8]

In the case of new coal mines, the key approval remains the development consent process in the *Environmental Planning and Assessment Act*. The Department of Primary Industries states that subsidence impacts are primarily considered as part of the consent process. Subsidence and its impacts must be addressed within the necessary environmental impact statement. The preparation and approval of a Subsidence Management Plan in compliance with this process will then be required as a condition of consent. Approval of the Plan is necessary prior to mining commencing.[9]

4. The Environmental Impact of Mining

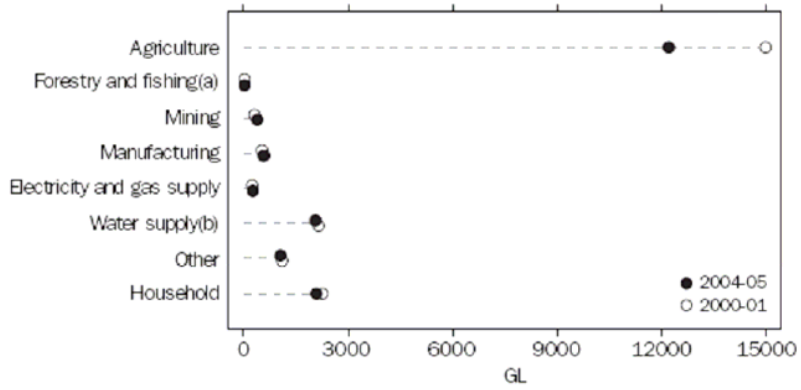
The environmental impact of mining is dependent on several factors, including the extraction technique and where the mine is situated. For instance, in regards to coal mining, underground mining has different impacts compared to open cut mines. This section of the paper first looks at the issue of water supply and mining, and the balance looks at the wider environmental impact of coal mining.

4.1 Water Consumption by Sector

A major criticism of mining operations has been their use of water, especially in the face of drought, climate change and other uses, principally agriculture. Hence it is pertinent to look at industry sector water use.

The Australian Bureau of Statistics publishes *Water Account Australia*, with the latest release 2004-05. Water consumption in Australia for 2004-05 was 18,767 Gigalitres (GL), a decrease of 14% from 2000-01. In 2004-05, the agriculture industry had the highest water use, accounting for 65% of total water consumption – see Figure 3.

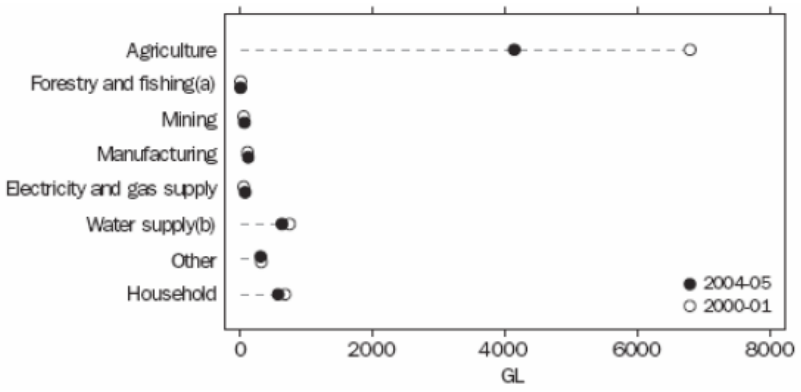
Figure 3: Australian Water Consumption by Sector 2004-05 and 2000-01



Source: ABS, Water Account Australia, 2004-05, Catalogue No. 4610.0.

In New South Wales and the ACT combined, water consumption was 5,978 GL during 2004-05. Again the highest consumer was the agriculture industry with 4,134 GL or 69% of water consumption – see Figure 4.

Figure 4: Water Consumption by Sector – NSW / ACT Combined 2004-05 and 2000-01



a. Includes Services to agriculture; hunting and trapping

b. Includes Sewerage and drainage services.

Source: ABS, Water Account Australia, 2004-05, Catalogue No. 4610.0.

Table 2 summarises water consumption of the agricultural and mining sectors for 2004-05. There has been considerable community debate about the impact of coal mining on agricultural areas, and in particular access to water resources.

The data in Table 2 shows that in NSW coal mining uses two percent of the water used by livestock agriculture. Total mining consumes 1.5 percent of the water used by total agriculture.

Table 2: NSW Water Consumption by Sector 2004-05	
	Water Consumption ML
Agriculture	
Dairy farming	262,547
Vegetables	68,692
Sugar	531
Fruit	133,540
Grapes	171,450
Cotton	964,306
Rice	624,422
Livestock	259,177
Pasture	693,508
Grains	838,321
Other	116,042
Total Livestock	1,907,048
Total Agriculture	4,132,536
Mining	
Coal mining	39,289
Oil and gas extraction	
Metal ore mining	14,702
Other mining	8,877
Total mining	62,868
Source: ABS, Water Account Australia, 2004-05, Catalogue. No. 4610.0.	

However, whilst mining may consume a small percentage of total water use, critics of mining identify the detrimental environmental impact of mining on water resources such as aquifers and surface streams as a concern. The next section of the Paper expands on this issue and looks at the wider environmental impact of mining.

4.2 The Wider Environmental Impact of Coal Mining

In recognition of the strategic role of coal mining to the NSW economy and its potential impact on the environment and communities, the NSW Government has commissioned a variety of reviews to assist environmental assessment of proposed mines. For instance:

- In January 2004 the Government granted approval for a 25,000 tonne bulk sample of coal from Bickham in the Upper Hunter Valley, which generated significant community concern. In tandem with this approval, the Government also announced a strategic investigation into the implications of extending coal mining in that region.[10]

- On 6 December 2006 the NSW Government established an independent inquiry into underground coal mining in the Southern Coalfield.[11]

- On 5 February 2007 the NSW Government appointed an Independent Expert Panel to conduct a strategic inquiry into potential coal mining impacts in the Wyong Local Government Area. The Inquiry was established by the Minister for Planning due to concerns held by the community over potential future mining-related impacts on the Central Coast.[12]

- In 2009 the Department of Planning commissioned an independent review of the cumulative impacts of coal mining on the village of Camberwell in the Upper Hunter Valley.[13] The Department has engaged independent experts to undertake this review.

4.3 The Environment and Mining in the Southern Coalfields

The Southern Coalfield extends along the Illawarra Escarpment to the south of Sydney and southwest to Bargo and Berrima. Coal mining has occurred in the

Illawarra for more than 150 years. One of the miners in the area, BHP Billiton, has estimated that extractable coal reserves utilising current technology would see a viable industry continuing for at least another 30 years.[14]

The primary method of coal extraction in the Southern Coalfield is long-wall mining. This is a method of underground coal mining whereby blocks of coal, known as 'panels', are extracted from a coal seam by a shearer moving along the face of the panel. As mining progresses along the length of the panel, the overlying strata collapses behind the advancing long-wall face. Subsidence, or the lowering of the land surface is an unavoidable consequence of any mining method that extracts large proportions of the coal resource, such as long-wall mining. The coal miners operating in the Southern Coalfields state that long-walls are the most efficient, safest and economically viable method to extract coal in that area.[15]

The extent to which subsidence occurs in a particular location depends upon the width and height of the coal extracted, its depth from the surface, and the rock types found in the overlying strata.[16] The NSW Scientific Committee has listed 'alteration of habitat following subsidence due to long-wall mining' as a key threatening process under the *Threatened Species Conservation Act 1995*. The Minister for the Environment has determined that the current Subsidence Management Plan process addresses this key threatening process and that the development of a Threat Abatement Plan would be unnecessary.[17]

The Southern Coalfield contains significant natural features including rivers, associated sandstone river gorges, major cliff lines and upland swamps. It also contains important flora, fauna and aquatic ecosystems; many listed threatened species, populations and endangered ecological communities and a significant number of Aboriginal heritage sites. The major land use includes water supply catchment for the Sydney and Illawarra Regions and associated dams and other major water storage infrastructure.[18]

There has been significant community concern about the impact of coal mining on the natural features of the Southern Coal Fields. For instance, the Board of the Environment Protection Authority noted:

> There is significant evidence of the impacts resulting from current operations in the Southern Coalfields including extensive and irreversible damage in

some areas that has been well documented. It is imperative that impacts resulting from existing or future operations be avoided in sensitive areas.[19]

The NSW Department of Environment and Climate Change noted that long-wall mining subsidence is frequently associated with cracking of valley floors and creeklines with subsequent effects on surface and groundwater hydrology. Of particular concern is the potential for long-wall mining to affect upland swamps on the Woronora Plateau. Upland swamps, particularly peat swamps, are important to catchment hydrology and ecology because they absorb water and allow runoff for long periods after rainfall has ceased. Surface cracking as a result of long-wall mining subsidence can have a variety of impacts on riverine features or attributes. These include:

- Loss of surface flows or water levels;
- Loss of aquatic or instream habitats. Complete drying of river pools or wetlands has occurred. The loss of these surface features is potentially irreversible in some cases;
- Loss of connectivity between pools as surface water is lost to subsurface flows;
- Loss of water quality (Increased iron oxides, manganese, sulphides and electrical conductivity, and lower dissolved oxygen).
- Simplification of remaining instream habitat due to the growth of iron-oxidising bacteria which can also be seen as a rusty-coloured mass in the water.
- Release of gas into the water column.[20]

The Department of Environment and Climate Change (DECC) considered that much of the impact / damage to natural features from long-wall mining is unacceptable as many are irreversible and contrary to the principles of ecologically sustainable development. Of key concern to DECC is that subsidence due to long-wall mining has had significant impacts on:

1. River health and water dependent ecosystems, including threatened species and endangered ecological communities;
2. Aboriginal culture and heritage.[21]

4.3.1 Longwall Mining in Water Catchment Areas

The Sydney Catchment Authority (SCA) manages greater Sydney's drinking water catchment areas. To ensure quality raw water, land around some of the Authority's dams has been declared 'Special Area'. These areas are managed by the SCA and Department of Environment and Climate Change. A long-standing regulatory framework excludes access and limits activities inside Special Areas to certain essential services such as water monitoring. Other significant activities in Special Areas are associated with the surface workings related to underground long-wall mining.

The Upper Nepean and Woronora catchments south of Sydney include the catchments of the Cataract, Cordeaux, Avon, Nepean and Woronora rivers. The entire Upper Nepean catchment is declared a Special Area, known as the Metropolitan Special Area. The Woronora Catchment is also a declared Special Area.

Underground long-wall mining in the Southern Coalfields occurs under much of the Metropolitan Special Area. Mining occurs mainly under the Cataract, Cordeaux and Woronora dam catchments which form part of the Upper Nepean and Woronora water supply systems. Around 20 percent of the water supplied by the Sydney Catchment Authority is sourced from these catchments. The Authority estimates that within the next 20 years, 91 percent of the Special Areas will have been undermined by either long-wall or bord and pillar coal extraction methods.

In their submission to the Southern Coalfields Review, the Sydney Catchment Authority highlighted the lack of scientific data to help assess the precise nature and extent of the damage from subsidence to groundwater systems. Groundwater may play a crucial role in maintaining stream flows during periods of severe drought, and subsidence impacts on system water yield are not well understood.

4.3.2 Case Study on Waratah Rivulet

The Metropolitan Mine operation began in 1995 and the extraction of coal from the planned 17 long-walls is expected to be completed by 2009. Long-walls 10 to 14 are 158 metres wide and run adjacent to and under the Waratah Rivulet.

These long-walls resulted in subsidence of approximately 1.3 metres and upsidence of approximately 150mm. The impacts from this subsidence and upsidence on Waratah Rivulet included:

- loss of flows for approximately two kilometers of the rivulet from fracturing of river bed and rock bars;
- changed groundwater flow direction with increased fracture permeability and porosity of aquifer and surface water – groundwater interaction (the extent, direction and permanence of water loss remains unknown);
- water quality affected by mineralisation produced from rock fracturing;
- significant changes to aquatic ecology from loss of water and changes to water quality.[22]

Figure 5: Subsidence Impacts at Waratah Rivulet

Note: cracking of stream bed and no water flow.

Source: Sydney Catchment Authority, Submission to Inquiry into the NSW Southern Coalfields. July 2007.

In contrast to these environmental perspectives, the NSW Minerals Council noted that:

- Subsidence from underground mining will have some environmental effects – as do most kinds of development. The question that needs to be answered is one of the acceptability of impacts.
- Environmental impacts may be insignificant in a regional context. The impacts of mining may be localized or temporary, and not as relevant when considered in the context of other land uses in the region.
- The Government must make decisions on the acceptability of impacts by assessing a project's net benefit or cost to society by taking into account all economic, social and environmental factors.[23]

The Southern Coalfields Review concluded that with few exceptions, at depths of cover greater than about 200 m coal cannot be mined economically by any mining method without causing some degree of surface subsidence. If mining of hard coking coal in the Southern Coalfield is to continue, then a certain level of subsidence impact must be accepted as a necessary outcome of that mining.[24]

4.3.3 Best Practice Assessment and Regulatory Processes

There were a range of views presented to the Southern Coalfields Review of whether the current mining approval process is adequate. For instance, the EPA Board is of the view that there are significant issues with the mining planning approval and regulatory process. It argued that:

- There is insufficient assessment of underground mining impacts at the approval stage. The approvals process needs an effective whole of government approach which would allow all the expertise available to Government to be focused on the issues;
- The present Subsidence Management Plan approach does not appear to be adequate, as it occurs after the mining strategy has already been planned and is too late in the process to properly address impacts and influence mine planning; and
- Environmental matters are not adequately addressed in the Subsidence Management Plan process. Environmental issues should be identified and

> resolved prior to the approval of plans. Furthermore, the ability of government agencies to adequately assess the Subsidence Management Plan process is impaired by short timeframes and insufficient expertise or resources on often highly technical issues.[25]

The Sydney Catchment Authority submitted that past decisions on mining approvals have not fully considered the potential impacts of diminished groundwater reserves and the maintenance of surface flows. Nor have they considered the potential impacts on aquifers, in terms of either their interconnectedness or their capacity to recover lost resources.

In the absence of such confidence the Authority concluded that it can be difficult to determine whether some impacts are so serious as to call into question the viability of the proposed activity or whether, as is often the case, the impacts can be managed through imposing a range of conditions. In addition, very little is known about the long term effectiveness of current remediation techniques in natural systems. The SCA defined three fundamental questions that need to be addressed in any consideration of the management of water resources. These were:

1. What are the medium-term and long-term impacts of mining-related subsidence on water resources and related ecosystems?

2. What are the risks to groundwater and aquifers from subsidence? Where does the water go and how long will it take to restore natural water systems?

3. Is remediation of the impacts of mining-related subsidence possible?[26]

The NSW Minerals Council stated that each mining proposal should be assessed on its own merits. It noted that geology, subsidence behaviour and the nature of impacts and the receiving environment all vary both within and between mining regions. The economic value of coal reserves also varies between different areas. Hence this case by case approach to assessment should continue to ensure informed decision-making.

The Minerals Council strongly argued that mandated setback zones to prevent long-wall mining under significant natural features are inappropriate and

illogical. It considered that the extent and magnitude of subsidence related movements are related to many factors including depths of cover and coal seam characteristics.[27]

Illawarra Coal (a division of BHP Billiton) noted that the imposition of a single environmental standard for natural features in the Southern Coal field would impose considerable costs on the company. For instance, a 1 km buffer to streams would result in the majority of the Southern Coalfield's coal resources being lost.[28]

Illawarra Coal considered that the current risk management framework and approval processes are effective and that interest group concerns revolve around their view of acceptability rather than a whole of community perspective. It also recommended an extension of the current approval process to consider the economic trade-off of different levels of environmental restrictions, including no restriction. In Illawarra Coal's opinion, this economic trade-off should be the primary consideration of government.[29]

4.3.4 The Southern Coalfields Review Response

The Southern Coalfields Review considered these range of views and how the approval and regulatory process works. It concluded that the key role of the Part 3A approval under the *Environmental Planning and Assessment Act 1979* should be to clearly define required environmental outcomes and to set appropriate performance standards. The subsequent role of the Subsidence Management Plan should be one of management. Subsidence Management Plans should demonstrate how the required environmental outcomes will be achieved, what monitoring will occur and how deviations and contingencies will be addressed.

The Review concluded that the acceptability of impacts under Part 3A should be determined within a framework of risk-based decision-making, using a combination of environmental, economic and social values, risk assessment of potential environmental impacts, consultation with relevant stakeholders and consideration of sustainability issues.

In regard to the potential impact on significant natural features, the Review recommended the development of what it termed Risk Management Zones (RMZs). These zones should be identified for all significant environmental features which are sensitive to valley closure and upsidence, including rivers, significant streams, significant cliff lines and valley infill swamps.

The Review recommended that these zones should be defined from the outside extremity of the surface feature, either by a 40° angle from the vertical down to the coal seam which is proposed to be extracted, or by a surface lateral distance of 400 m, whichever is the greater.

The Review did not recommend that mining should not be allowed within these risk management zones. Instead, it stated that approved mining within identified RMZs should be subject to increased monitoring and assessment requirements that address subsidence effects, subsidence impacts and environmental consequences. The Review concluded that due to the extent of current knowledge gaps, a precautionary approach should be applied to mining that might unacceptably impact highly significant natural features. The approvals process should require a 'reverse onus of proof' from the mining company before any mining is permitted which might unacceptably impact highly significant natural features.

The Review concluded that the Government has a responsibility to provide improved guidance on which natural features are of significance and to what extent and what level of environmental risk is acceptable. This is in order to properly inform company risk management processes, community expectations and the approvals process. It found that currently there is a lack of clear guidance regarding which features are of what level of significance, and what level of protection is required for each. It concluded that long-wall mining is a large scale, high productivity, capital intensive mining process with long lead times to establish extraction panels, and that consequently it needs timely approvals to facilitate continued production.[30]

In response to the publication of the Southern Coalfield Inquiry report, neither the mining nor conservation groups were satisfied with its recommendations. The NSW Minerals Council gave a "qualified response", noting that some of the recommendations had the potential to prejudice some future mining operations

in the region.[31] The Total Environment Centre noted: "The Inquiry has been a major disappointment with the recommendations providing the industry the certainty it was demanding through long term approvals, while offering the upland swamps and river systems ... no firm protection in return."[32]

4.3.5 The Metropolitan Coal Project Approval

Metropolitan Colliery is an underground coal mining operation located 30 kilometres north of Wollongong. It currently produces around 1.5 million tonnes of coal per annum. The colliery recently sought an extension of its mine to continue operating for another 25 years.

Project approval to continue mining for up to 23 years was granted by the Minister for Planning Hon Kristina Keneally MP on 22 June 2009. It is the first Ministerial determination for a coal mine in the region since the publication of the Southern Coalfields Review. Hence it provides some guidance on the Government's response to the Review.

The Southern Coalfields Review concluded that a key role of a Part 3A Ministerial determination should be to clearly define required environmental outcomes and to set appropriate performance standards. The Metropolitan Colliery Project approval did just this, and included specific environmental conditions expressed not in terms of setbacks or exclusion zones but in terms of performance measures. These are outlined in Table 3.

Table 3: Environment Performance Measures for the Metropolitan Colliery Approval

Catchment yield to the Woronora Reservoir	Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir. No connective cracking between the surface and the mine.
Woronora Reservoir	Negligible leakage from the Woronora Reservoir. Negligible reduction in the water quality of Woronora Reservoir.

Contd…

Contd…	
Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Long-wall 23 (upstream of Pool P).	Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).
Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Long-wall 26.	Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases).
Threatened species, populations, or ecological communities	Negligible impact.
Cliffs	Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining induced rock fall.
Aboriginal heritage sites	Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.

The exception to this approach involves the protection of three identified swamps. In this case, the approval conditions stated that the Proponent shall not undermine the three swamps without the written approval of the Director-General. In seeking this approval, the Proponent needs to submit the following information:

a. a comprehensive environmental assessment of the:

- potential subsidence impacts and environmental consequences of the proposed Extraction Plan;
- potential risks of adverse environmental consequences; and
- options for managing these risks;

b. a description of the proposed performance measures and indicators for these swamps; and

c. a description of the measures that would be implemented to manage the potential environmental consequences of the Extraction Plan on these swamps and comply with the proposed performance measures and indicators.[33]

4.4 The Environmental Impact of Mining on Agricultural Areas

The Southern Coalfields Review largely focussed on the impact of mining induced subsidence on natural features on the earth's surface. Mining in other coal fields can have impacts in their respective areas. For instance, the impact of mining on agricultural areas has been the focus of much recent attention.

These concerns have arisen due to the granting of coal exploration licences in the in the Gunnedah Coal Field. For instance, in April 2006 the NSW Government issued BHP Billiton a five-year coal exploration licence covering 344 square kms at Caroona in the Liverpool Plains region of NSW.[34]

In August 2008 the NSW Government granted an exploration licence to the China Shenhua Energy Company for the Watermark area near Gunnedah for a period of five years. The licence is for an area of about 190 sq km which is expected to contain shallow coal resources of domestic and export quality thermal coal. Open cut mining is the likely extraction method. As part of the bid China Shenhua Energy Company gave the following commitments:

- Up to $300 million in payments to the NSW Government;
- $1 million annually for five years to a new regional community trust;
- Invest $175 million for transport infrastructure;
- An additional $200 million if a mining lease is eventually granted.

The Minister reiterated that the licence is for exploration only, not mining, and stated: "There is strict environmental regulation, which ensures that exploration does not have any significant impacts on aquifers."[35]

4.4.1 Coal Exploration and the Liverpool Plains

The Liverpool Plains is part of the Namoi River Catchment, which is a highly productive agricultural region of Australia. Ground water in the Namoi catchment supports an irrigation industry worth in excess of $380m as well as being the water supply for many towns and intensive industries such as feedlots. There are a total of 700 licence holders in the Namoi.[36] Figure 6 provides an aerial view of part of the plains around the town of Caroona. The extensively irrigated areas is evident from the image. Figure 7 provides an aerial view of open cut mines near the town of Camberwell in the Lower Hunter Valley. As noted in the introduction to this section of the Paper, the NSW Department of Planning has commissioned an independent study to look at the cumulative effects of coal mining on the town of Camberwell.

Figure 6: Irrigated Fields Surrounding the Town of Caroona, Liverpool Plains

Source: Google Earth, accessed June 2009.

Figure 7: Open Cut Coal Mines near the Town of Camberwell, Hunter Valley

Source: Google Earth, Accessed June 2009.

In 2007 the National Centre for Groundwater Management reviewed the 'knowledge and gaps' of groundwater in the Namoi Catchment Area. Despite being one of the most studied catchments in Australia, it found considerable knowledge gaps. The review recognized that there is a growing interest in both gas and coal potential of the Gunnedah Basin, which underlies the alluvial sediments of the Liverpool Plains, and stated:

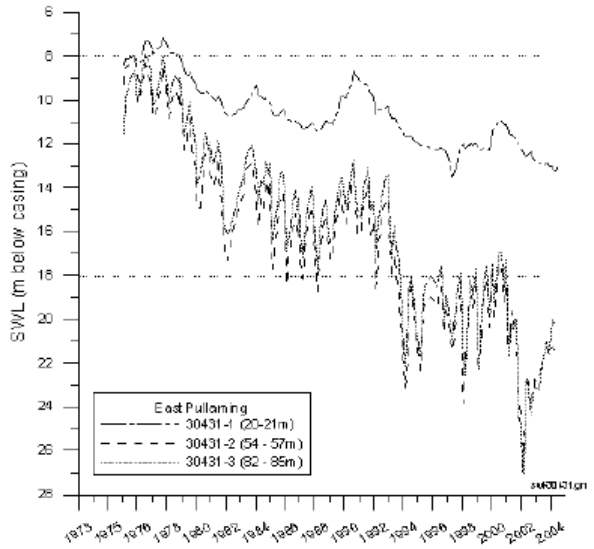
> The development of the Caroona Coal Exploration area has the potential to have significant effects on the local surface and ground water quality and quantity. Of larger concern is that this exploration is only the beginning of the expansion of the coal industry within the Namoi Catchment.[37]

Other leading researchers have also done a significant amount of work on the groundwater of the Namoi Valley. Scientists Timms and Acworth from the University of NSW stated that, based on the research that had been carried out in the past 10 years, they believe that coal mining on the Liverpool Plains will impact on the groundwater system used for irrigation, stock and domestic use if mining is carried out beneath the flat-lying plains. They noted that management strategies on the Liverpool Plains are currently addressing the adverse impacts

that irrigation development has had on the groundwater system. If coal mining is to proceed, the additional impacts on groundwater recharge, groundwater levels and water quality will require careful investigation and management.[38]

Timms and Acworth note that the age of the groundwater in the Namoi Valley is of the order of tens of thousands of years. In parts of the region high levels of extraction have resulted in the reversal of the natural groundwater flow, and the result is that current pumping may effectively be mining the aquifer. Falling groundwater levels are clearly seen at some sites, as shown in Figure 8.[39]

Figure 8: Groundwater Level Declines since the 1970s at a Monitoring Site near Breeza, Namoi River Valley



Source: Timms W. and Acworth I., "Coal mining and the Liverpool Plains: Aquifers and Aquitards" in Plains Talk, June 2006, No. 33.

Initially in response to the granting of an exploration licence in the Caroona area, in 2006 a citizens action *group (the Caroona Coal Action Group on the Liverpool Plains)* was established. The group has the following platform:

> CCAG are pressing for an immediate moratorium on any kind of resource exploration on the Liverpool Plains so that an independent, catchment-wide

water study can be performed to understand the interconnections and intricacies of the aquifers beneath these prime agricultural rich soil plains.[40]

The action group states that it is not opposed to mining so long as it can be shown that any such mining would not pose unacceptable risks to the groundwater systems and environment of the region.

As part of their actions, but without success, landowners have pursued legal avenues in an attempt to prevent BHP Billiton drilling exploratory boreholes on their properties. Things came to a head in mid July 2008 when the local community set up a blockade to prevent BHP Billiton access to a landholder's property. Negotiations with BHP Billiton regarding land access are continuing. In October 2008 BHP Billiton released an interim exploration report which stated the following:

- BHP Billiton is not considering long-wall mining underneath the floodplain of the Liverpool Plains;
- BHP Billiton is not considering long-wall mining underneath the deep alluvial irrigation aquifers;
- BHP Billiton is not considering long-wall mining underneath the Mooki River or the Quirindi Creek;
- BHP Billiton is not considering open cut mining on any part of the Caroona Exploration Licence Area;
- The company will complete its program of regional exploration drilling in the non-target area to further develop knowledge of deep alluvial irrigation aquifers and regional geology within the Exploration Licence Area;
- The targeted exploration area represents approximately 126 square kilometres of the 350 square kilometre Exploration Licence Area;
- BHP Billiton will focus future exploration on the ridge country away from high value agricultural land.[41]

A major concern of the Liverpool Plains community is the impact of mining on underground and water resources. These concerns are not restricted to this region alone, so it is potentially illuminating to see what restrictions or guidelines

on coal mining have been applied in another major agricultural region, the Hunter Valley.

4.4.2 Coal Mining and Agriculture in the Hunter Coalfield

The Hunter Coalfield is currently the major coal producing region in NSW. This is due to its extensive coal reserves, known geology, and well developed transport and other supporting infrastructure.[42]

In 2005 the then Department of Infrastructure, Planning and Natural Resources released a strategic assessment of coal mining potential in the Upper Hunter Valley. The assessment noted the regionally significant prime agricultural lands in the Upper Hunter, with particular value to the equine, dairying, horticultural and cropping industries. It also noted the regional value of the Pages River catchment. Unlike the Southern Coalfield where all coal mining is from underground long-wall extraction, coal mining in the Hunter and Gunnedah Coalfields can be by either open cut or long-wall extraction, depending on the site characteristics of the resource. Long-wall mining in the Hunter Valley can produce similar subsidence impacts as discussed for the Southern Coalfields. Open cut mining involves scraping off overburden and digging out a pit to recover the coal. This can result in a whole different set of environmental impacts.

Salt occurs naturally in many of the rocks and soils of the Hunter Valley. Some of this salt is leached into groundwater and nearby rivers. During coal mining, salty water collects in mine pits, and has to be pumped out to allow mining to continue. What to do with this saline water is a major management problem for many coal mines.

Underground coal mining close to or beneath alluvial aquifers, or open cut mining close to alluvial aquifers may lead to fracturing of the hard rock layers that confine the ground water. The result is that any significant degree of fracturing will establish additional conduits for increased movement of saline groundwater into the alluvial aquifers, and to surface water features.[43]

The Upper Hunter Strategic Review noted that open cut mining can clearly have major impacts on streams, alluvial aquifers and alluvial soils. Mining which removes alluvium to reach coal beneath has an obvious impact on an alluvial aquifer, requiring it to be dewatered during mining, and with very little probability of successful restoration afterwards.

In response to these concerns, Government agencies operate under an informal policy that no further open cut mining should take place within the Hunter River's alluvial floodplain and its prime alluvial aquifer. There has also been a guideline on the management of stream and aquifer systems in the Hunter Valley, which provides for 40m setbacks in the case of underground mines to alluvial aquifers, and a 150m setback for an open cut mine.

The Upper Hunter Strategic Review concluded:

> A formal policy should be developed to avoid or minimise potential impacts of coal mining on major streams and aquifers in the Hunter Valley and elsewhere in the State. Along with this, guidelines should be developed for the assessment of coal mine impacts on streams and aquifers in seeking approvals under Part 3A of the Ep&A Act.[44]

Such a policy has not been developed. The Review noted that the application of such a policy would result in restricting coal mine development within or beneath the alluvium or alluvial aquifers of the Hunter River and its major tributaries.

The Centre for Social Sustainability in Mining monitors the impact of mining on communities. In 2004 it conducted a case study of Muswellbrook, and found the following:

- It is clear that most people in the community accept that the mining industry is a key driver of the local economy and that the fortunes of Muswellbrook are, to a considerable extent, tied to the future of the industry.
- The environmental impacts of mining – both on 'near neighbours' and the wider area – are an important issue for the Muswellbrook community. 'Near neighbours' have a range of specific issues that demand attention, although not all of these are amenable to resolution. The community more generally

has concerns about dust, noise, visual impacts, water quality and the loss of farming land to mining. Most of these concerns relate not to the impact of any one operation, but to the overall – or 'cumulative' – impact that mining is having on the area.

- It is apparent that in Muswellbrook, as elsewhere, trust – or, rather, the lack of it – remains an issue for the industry. While most stakeholders acknowledged that the environmental and social performance of the local mining industry had generally improved in recent years, this was often attributed to stricter regulatory controls rather than to the industry's own efforts.
- Some stakeholders were prone to over-state the extent to which the mining industry and its practices had been the cause of social and environmental changes in the Muswellbrook area. For example, criticisms of the industry's water management practices tended to overlook the fact that the long term decline in water quality in the Hunter River is due largely to land degradation and agricultural practices over many decades.[45]

Two themes emerge from these studies reported above. These are water, the life-blood of agriculture, and the second is the cumulative impact of mines. The Upper Hunter Review noted the characteristics of the Pages River with its relatively high water quality and its importance to the community for a wide variety of users. The Review concluded that a priority was to protect this water source, and concluded that if a new mine could not provide sufficient assurance of sound life of mine water management (including management relating to mine closure and post-mining), then there is little point in a proponent preparing a full environmental assessment and entering the expensive and protracted project approval process.

The Review recommended that any application for coal mining within the Pages River Catchment contain a Water Resource Report and a draft life-of-mine Water Management Plan. In relation to the Bickham proposal (within the Pages River catchment) the Review stated that such a plan should:

i. Examine contained and surrounding aquifers, to confirm whether the low salinity groundwater found to date at Bickham is typical of the proposed mine site and its surroundings or represents a more localised anomaly;

ii. Model and assess groundwater responses to ongoing open cut de-watering and associated aquifer de-pressurisation;

iii. Examine connectivity between the Pages River, its alluvial aquifer and the hard rock aquifers, with particular reference to the G seam in the case of Bickham;

iv. Examine appropriate means of avoiding any significant inflow from the River or its aquifer to the mine, if required;

v. Examine means of minimising generation of mine wastewater, maximising use or re-use of mine wastewater, and options for the mine to achieve a 'nil discharge' status;

vi. Demonstrate that there is negligible residual risk to the River and its ecosystems ... associated with mining;

vii. Discuss potential final void configurations, modelled groundwater inflow post mining, and post-mining management options and outcomes for any residual water resources impacts; and

viii. Report and discuss water resource concerns by the community.

The Review concluded:

> Mining should not proceed if it cannot be adequately demonstrated at an early stage that the River and its associated conservation values will not be significantly impacted.[46]

4.4.3 Coal Exploration in the Namoi Valley – Government Response

On the 14th May 2009 the Hon Lee Rhiannon MLC introduced a Private Members Bill into the Legislative Council. The *Mining Amendment (Safeguarding Agricultural Land And Water) Bill 2009* sought to amend the *Mining Act* to protect prime agricultural land and water sources that feed it from mining operations and mining exploration. The Bill, whilst supported by the Coalition Opposition, was negatived at the Second Reading Speech stage on June 4th 2009. One of the disputed points was how to define and identify prime agricultural land.

In response to community concerns about the impact of mining exploration on the water resources of the Namoi River catchment, the Minister for Primary Industries Hon Ian Macdonald MLC established a water study working group in

August 2008. Chaired by former Member the Hon Pam Allan, the Minister told Parliament on 4th June 2009 that the working group had finalised and agreed to a draft terms of reference for an initial water study in the Namoi catchment. The Minister stated:

> Farmers and mining interests need to work together for the good of each other and the State. I firmly believe farming and mining can co-exist. Mining is the lifeblood of many regional towns while at the same time agriculture obviously makes a significant contribution to both the State and national economy. It puts the food on our tables. ...
>
> The purpose of the water study is to collate quality data to assist in identifying the risks, if any, associated with mining and coal development on water resources. The scope of the study is to be the entire Namoi catchment. I also tell the House today that I am appointing Mr Mal Peters, former President of the New South Wales Farmers Association, to be the independent chair of the Ministerial Oversight Committee to progress the initial Namoi catchment water study. The committee ... will be responsible for the tendering of the project, appointment of an independent expert and ongoing administration of the study. It will conduct a progress review at the start of each phase and undertake a review prior to the release of any information. It will also closely liaise with the stakeholder advisory group, who will keep the community, informed of the progress of the study. There will be an ongoing comprehensive stakeholder engagement process conducted throughout the study.[47]

5. Conclusion

Mining contributes enormously to the Australian and NSW economy. The minerals industry is NSW's largest export industry, accounting for export revenue of $11.1 billion in 2006-07, which is 39% of total NSW exports. However, this is not without cost. Environmental groups and some sectors of the community would like to see greater environmental protection of natural features from the environmental impacts of coal mining, particularly subsidence. Similarly, the potential impact of mining on water resources of the State has created conflict in agricultural communities. With estimated Australian coal reserves of some 200 years, this debate seems far from over.

Summary

Mining makes a significant contribution to the Australian and NSW economy. This paper briefly places the contribution of mining into the context of the wider economy. It then focuses on the impact of coal mining on both natural and agricultural areas of NSW. The environmental regulatory regime that mining must operate under is reviewed, and the environmental impact of coal mining is presented for both underground and open cut mines.

NSW produces a diverse range of minerals including coal, metals, industrial minerals and construction materials. The total value of this production in 2007-08 was over $14 billion. Coal production contributed the greatest proportion of this value, with an estimated worth of over $10 billion (70% of total). The minerals industry is NSW's largest export industry, accounting for export revenue of $11.1 billion in 2006-07, which is 39% of total NSW exports. Coal accounts for 56% of the total of NSW mineral and metal exports. The NSW minerals industry is based on:

- 60 coal mines (29 underground, 31 open cut);
- 12 major metalliferous mines;
- 11 significant industrial minerals operations; and
- a large number of smaller metallic and industrial mineral mines and numerous construction materials operations.

In regards to the environment, there are two main legislative provisions that relate to the regulation of mining. These are the:

- *Environmental Planning and Assessment Act 1979,* which covers the assessment and approval of new mines and the extension of existing ones; and
- *Mining Act 1992*. This was significantly amended in 2008, incorporating key environmental provisions.

Proposed mining operations, like other development, must be approved via the *Environmental Planning and Assessment Act 1979*. This Act has two environmental planning instruments that may apply (depending on the size of proposed development).

The first of these is the State Environmental Planning Policy (Major Projects) 2005. The aim of this Policy is to identify development to which the development assessment and approval process under Part 3A of the Act applies. Under this part of the Act, the determination of a development application is removed from the local consent authority to the Minister for Planning. Under the Policy, coal mining is subject to Ministerial determination.

The second relevant planning instrument is State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007. The SEPP highlights some key natural resource and environmental management issues that must be addressed when assessing new mining, petroleum production and extractive industries proposals.

However, many of the provisions in the amending Act have yet to commence. The Amendment Act included a rewrite of the objects of the Act to include reference to ecologically sustainable development, and in particular to:

a. to recognise and foster the significant social and economic benefits to New South Wales that result from the efficient development of mineral resources.

The Act includes provisions for the regulation of mineral exploration and mining leases, including environmental management and rehabilitation.

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2

International Environmental and Human Rights Law Affecting Mining Law Reform

*George (Rock) Pring**

The international environment and human rights laws are more essentially applicable to protect the interests of the shareholders, stakeholders and achieve sustainable development. This article discusses the various factors that contribute to the evolution of hard law and the principles of soft law associated with the mining system. The main sources for the development of the international environment and human rights standards are the practices that are adopted by the private sector mining companies as a code of conduct. NGOs, like Amnesty examine the role of the mining companies in practicing various norms that intend to improve the functioning of the organization and safeguarding the interests of the workers associated with it. The human rights responsibilities under national laws such as fair and adequate compensation and socioeconomic interest of the local communities are perceived as key areas that contribute to the sustainable development of the mining industry.

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Introduction

Winds of change are sweeping the worldwide mining industry. The reforms reflect a growing consensus that international environmental and human rights (EHR) laws and standards do apply to mining, are essential to protect stakeholders' interests, and actually promote, rather than impede, sustainable development.

All of this is part of the larger trend of growing legal regulation of the mining, energy, and resource-development industries globally. Most of this increased regulation is occurring at the national level, of course, as more and more countries adopt new mining laws and EHR standards or revise older ones, as Finland is doing.

In this new regulation, international (multinational) EHR law is increasingly a factor. There are no comprehensive international EHR laws directly governing the mining industry.[1] But indirectly, international EHR law is increasing mining regulation – through promotion of more stringent national legislation, encouragement of private sector codes of conduct, and buttressing court rulings. Significantly, leading mining industries support this trend, finding that national mining laws and rulings that protect environmental, human, and cultural values enhance shareholder value, host-country investment attractiveness, and the sustainability of businesses in the long term, according to mining industry sources like the Mining, Minerals and Sustainable Development (MMSD) Project.

This is a recent change. Prior to the 1980s, critical attention focused on powerful Multinational Enterprises (MNEs) engaged in mining taking unfair advantage of developing nations and on their labor-management conflicts. Following the 1980s exploration boom, the focus began shifting to mining's negative environmental, community, and human rights problems and these became "the new yardsticks for assessment and criticism of the industry" (Ballard 7).

In reaction to this, the last decade has seen some dramatic changes in the policies of the mining industry, national governments, and civil society. Factors contributing to the hardening of EHR norms include:

- Vastly increased communication technology and networks.
- The development of "virtual communities" monitoring and advocating for environmental and human rights.

- Expanding stakeholder and consumer awareness.
- Enlarged media coverage and criticism.
- Increasing development and acceptance of international environmental and human rights law – both "hard" and "soft."
- An emerging perception that merely complying with (often lax) local or national requirements is insufficient to protect mining operations from scrutiny and potential liability.
- Maturing of the principles and process of "corporate social responsibility" (such that now leading universities offer advanced business degrees in CSR!).
- The outpouring from private sector mining companies and their associations of progressive corporate codes of conduct, principles, guidelines, best practices, and the like.
- Involvement of international governmental organizations (IGOs, such as the UN, OECD) and national governments (like US, UK) in promoting voluntary mining codes.
- NGO initiatives pressuring for adoption of EHR standards and practices.
- The "greening" of international financial organizations (IFOs, like the World Bank) so that EHR requirements are becoming part of their lending "conditionalities."

  (Pring & Noé 11 et seq., Ballard 8).

Application of international law EHR requirements to the mining industry is in its infancy, but constantly evolving. Traditionally, international law applies to states and not private sector corporations like mining companies. However, international EHR "hard" and "soft" law principles are increasingly being imposed on the minerals industry through a combination of factors, including –

- state adoption in national mining law reform, such as is on-going now in Finland;
- corporate adoption in codes of conduct, operating principles, best practices, etc.;

- "soft law" EHR developments by IGOs, IFOs, and other entities that are hardening into law; and
- judicial rulings in cases challenging mining company practices.

After a brief discussion of the concepts of "hard" and "soft" international law, we will examine some of the key EHR developments that should be considered in reforming and evaluating national mining laws in the 21st century. This survey focuses on a representative sample of these international legal documents to provide a solid background for evaluating new mining laws like Finland's, but is not meant to be exhaustive of all the dozens of legal initiatives currently focused on the industry.

"Hard" vs. "Soft" Law

Prior to 1970, international law largely left the mining industry, environment, and human rights alone – recognizing that within their own territories "States have . . . the sovereign right to exploit their own resources" pursuant to their own policies (1972 Stockholm Declaration Principle 21). Sovereigns can of course voluntarily give up portions of their absolute sovereignty, and in so doing create international law through several mechanisms:

- State practice of legal customs (customary international law);
- Entering into binding treaties (conventional international law);
- Evolution of comparable legal principles in many states' national laws (general principles of international law); and
- Judicial decisions and expert commentary (subsidiary means of determining international law).

Rules from these sources are viewed as "hard" law, in the sense that they are legally binding on states.

There is another category of international legal development called "soft" law that is increasingly important, particularly in international EHR law. These norms of conduct are labeled "soft" because they are aspirational – goals

which states agree they should aspire or hope to achieve, but which are not intended to be immediately legally binding from signing. Such "legal authorities" are found in –

- resolutions, declarations, principles, agendas, draft rules, guidelines, etc., promulgated by the UN, EU, and other IGOs;
- policies, guidance, conditions, etc., of the World Bank and other IFOs; and
- codes of conduct, standards, operating rules, best practices, etc., of private sector corporations, industry associations, international standards organizations, financial organizations, insurance underwriters, etc.

Soft law is important because (like wet cement) it can solidify into hard law over time, ultimately becoming accepted as international customary law or becoming incorporated into international conventional law. This "half-way stage in the lawmaking process" is also important because "the soft law process is more dynamic and democratic than traditional lawmaking, embracing a broader range of actors (including scientific organizations, academic specialists, NGOs and industry) and providing a more direct link with the larger society" (Hunter, et. al., 250).

The following sections review the major examples of developed and developing international EHR norms which should be considered in any national mining law revision process. A more detailed comparative analysis of the many specific provisions contained in these legal authorities can provide an extensive "checklist" against which the reform law's comprehensiveness and effectiveness can be judged.

International EHR Hard Law and Mining

The international EHR hard law with the most immediate consequences for the mining industry in Finland is the 1998 United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention).[2] Aarhus entered into force in 2001, and Finland has been a party since 2004. It would be hard to overstate the importance of this treaty, since it

creates more public rights in relation to mining and other forms of economic development than all previous international law put together (Pring & Noé 28-50). In this treaty –

- Finland and the other 45 state parties pledge to adopt detailed national law guaranteeing all "three pillars" of public participation – public access to (1) information, (2) participation in decision-making, and (3) justice, with regard to the environmental aspects of development.
- Its "right to know" provisions require states to freely disseminate detailed lists of documents and information.
- Its participation provisions require states to include the public in decision-making – specifically in minerals extraction, production, and processing developments – in an "adequate, timely and effective manner," to take "due account" of public input, and promptly explain decisions to the public, and covers not only project approvals but legislation and rulemaking as well.
- Its elaborate access to justice provisions require parties to give "wide access" to the "public concerned" before courts of law or other independent adjudication bodies and to provide for "citizen suit" type challenges against acts or omissions of government and private parties.

A close article-by-article analysis of Aarhus will provide a detailed checklist of public rights which should be included in national mining law reform. (For detailed information on the international law of public participation see Pring & Noé.)

A major law reform the US has undertaken in public participation is incorporating Environmental Conflict Resolution (ECR) and collaborative planning and decision-making into the work of its planning and permitting agencies. ECR is defined as "third-party assisted conflict resolution and collaborative problem solving in the context of environmental, public lands, or natural resources issues or conflicts, including matters related to energy, transportation, and land use."[3]

The strongest international law recognition of the rights of indigenous peoples applicable to mining is the 1989 International Labor Organization (ILO) Convention No. 169.[4] While in force, it has attracted relative few parties (only 17 not including

Finland), yet its standards may be moving into international customary law whereby they could become binding on nonparty states like Finland. Actions like the UN General Assembly 2007 Declaration on the Rights of Indigenous Peoples[5] can accelerate this trend.

Courts are also producing hard law – legal precedents – in relation to EHR and mining, including the European Court of Human Rights (ECHR), the Inter-American Court of Human Rights (IACHR), and others. Two examples will indicate the law-building that is resulting and can be expected to continue from courts. In 2004, some 315 Turkish villagers filed a lawsuit against Turkey for its approval over their objections of a cyanide process at the Ovacik mine in Bergama; the ECHR held unanimously that Turkey had violated of Article 8 of the European Convention for the Protection of Human Rights and Fundamental Freedoms (right to respect for private and family life) and Article 6 (right to a fair trial) and awarded damages.[6] In 2007, in a case brought by the Inter-American Commission on Human Rights on behalf of the indigenous Saramaka People against the state of Suriname, the IACHR ruled that Suriname had violated, inter alia, Article 21 of the American Convention on Human Rights (right to property) and Article 25 (right to judicial protection) in granting mining rights on lands traditionally used by the Saramaka. The IACHR based its decision on international law, particularly Article 32 of the UN Declaration on the Rights of Indigenous Peoples, which states that indigenous peoples have the following rights:

- to determine the development and use of their lands;
- to be consulted by states in good faith to obtain their free and informed consent prior to any development affecting their lands and resources (specifically such as mining); and
- to be provided by states with effective mechanisms for just and fair redress for adverse EHR impacts.[7]

Significantly for the Finland context, the Court made it clear that the state had failed to adopt adequate national laws to protect the Saramaka.

National courts can also rule on international law issues, with potential persuasive effect on other national courts and governments. An amazing and perhaps illustrative case is the first known court ruling requiring consideration of

climate change. In 2007, the full Queensland (Australia) Court of Appeal (a division of the state Supreme Court) reversed and remanded a lower tribunal ruling which had approved a coal mine expansion but failed to consider imposing conditions requiring 100% offset of Greenhouse Gas emissions (GHGs) from mining, transport, and use of the coal.[8] The ruling was based on natural justice. Another example is the US Alien Tort Claims Act (ATCA), a "long-arm statute" which permits foreign citizens to sue MNEs in US Federal Courts for violations of EHR rights in their operations in other countries, and under which mining and energy MNEs have been sued.[9]

Another form of hard law – in the sense of legally enforceable requirements – comes from the recent "greening" of IFOs (Multilateral Development Banks (MDBs), bilateral Development Assistance Agencies (DAAs), national export-import agencies (Ex-Ims), and other finance, insurance, and trade entities, public and private). Stung by environmental and human rights disasters they have funded, IFOs have adopted new sustainable development standards, procedures, and contract conditions in their grant and lending programs, imposing a whole new tier of EHR requirements on participating governments, companies, and contractors (Pring and Noé 52-55).

A major shakeup of the World Bank Group (WBG) support for mining came about earlier this decade when it commissioned an independent Extractive Industries Review (EIR) in response to criticisms that the sector was too often associated with poverty, conflict, corruption, and EHR violations. The EIR's highly critical 2004 report[10] confirmed this, recommending a stop to all WBG financing for coal and a phase-out of oil investments. The EIR report listed dozens of recommended reform principles for WBG EI programs in areas of governance, poverty alleviation, human rights and indigenous people, environment, disclosure and transparency, and institutional and procedural change.[11] While the WBG responded that it would continue investments in petroleum and mining, it has adopted a number of the progressive recommendations and is continuing to study and expand the list.[12] Now included in the World Bank's Operational Policies are 10 "Safeguard Policies" to protect environmental and social factors.[13] While IFO standards are not binding on governments and MNEs except on a project-specific basis, a detailed analysis of all such IFO requirements would provide a further checklist of items that should be considered in drafting national mining laws as representative of "international standards".

International EHR Soft Law and Mining IGO Standards

Several IGOs – of which Finland is a member – have adopted agreed "voluntary" standards and guidelines regarding MNEs and mining activities. While such standards are technically nonbinding (soft law), the IGOs view them as "commitments" and expect them to be taken seriously, as indicated by the Organization for Economic Co-operation and Development (OECD) concerning its 2000 Guidelines for Multinational Enterprises:[14]

> "The Guidelines are recommendations to international business for conduct in such areas as labour, environment, consumer protect and the fight against corruption. The recommendations are made by the adhering governments and, although not binding, governments are committed to promoting their observance. . . . In seven years, the Guidelines have consolidated their position as one of the world's principal corporate responsibility instruments."[15]

Finland is an "adhering government" for these OECD MNE Guidelines. They call upon states to recommend and implement progressive MNE practices (many relevant to mining development), including:

- contribute to sustainable development;
- respect human rights;
- encourage local capacity building, human capital formation;
- uphold good corporate governance principles and practices;
- disclose timely, regular, reliable, and relevant information about their activities;
- establish and maintain a system of environmental management;
- provide adequate and timely information on potential Environment, Health, and Safety (EHS) impacts;
- consult communities directly affected;
- follow the precautionary principle;
- allow no undue environmental impacts; and
- provide EHS training to employees.

The UN has instituted a similar program, the UN Global Compact,[16] terming it "the world's largest global corporate citizenship initiative." It too is a voluntary system consisting of 10 "universally accepted principles" in the EHR, labor, and anti-corruption areas and supporting the UN's Millennium Development Goals (MDGs). Its signatories agree to the following EHR principles:

- protection of internationally proclaimed human rights;
- non-complicity in human rights abuses;
- precautionary approach to environmental challenges;
- greater environmental responsibility; and
- environmentally friendly technologies.

While the Global Compact is very vague, generalized, and non-enforceable (to some critics mere "bluewashing", in a play on the UN's color), it at least provides authoritative support for states like Finland to develop progressive national mining law provisions based on these concepts.

Corporate Standards

A very important source for developing international EHR standards, surprisingly to some, is the mining industry itself. Private-sector companies and industry associations are increasingly adopting and publishing voluntary "codes of conduct," "Environmental Management Systems (EMS)," "guidelines," "best practices," and the like These are a unique form of international soft law in that they are created, not by states or IGOs, but by the regulated industries themselves. Regardless of their creators' intent that they are to be voluntary and non-binding (to some critics mere public relations "greenwashing"), these actions are contributing to new international EHR law since national governments, IGOs, and courts naturally tend to treat the industry's own pronouncements as the best evidence of the "international standards" to which they and their competitors should be held (Pring & Noé 55-58).

Corporate mining standards began in earnest in 1991 with the UN-initiated "Berlin Guidelines."[17] The current Berlin II Guidelines (2002) present 58 very detailed pages of principles, guidelines, and practices covering the full mining

life-cycle from exploration through closure-rehabilitation, as well as appendices covering other international mining standards efforts, research work, and websites. Key principles for governments and the mining industry include:

- high priority for Environmental Management (EM);
- environmental impact assessments;
- pollution control and other preventive and mitigative measures;
- monitoring, auditing, and emergency response;
- socio-economic impact assessments and social planning;
- consideration of gender issues;
- highest-level environmental accountability;
- staff responsibility and training in EM;
- participation of the affected community and other directly interested parties;
- adoption of best practices to minimize environmental degradation "notably in the absence of specific environmental regulations";
- environmentally sound technologies;
- funding for improving existing mining operations;
- Risk Analysis and Management (RAM);
- avoid regulations that act as barriers to trade and investment;
- recognize linkages between ecology, socio-cultural conditions and human health and safety, the local community and the natural environment;
- adoption of instruments (such as tax incentives) to encourage pollution reduction and innovative technology;
- reduce transboundary pollution; and
- encourage long-term mining investment by having clear environmental standards and procedures.

The Berlin Guidelines provide more, and in so doing provide another good checklist for successful national mining laws.

Another major force in creating mining industry standards is the International Council on Mining & Metals (ICMM), a CEO-led association of many of the world's leading mining and metals companies and commodity associations headquartered in London.[18] ICMM has developed and its members "have committed to" the 2003 ICMM Sustainable Development Framework, a set of 10 principles plus public reporting and independent assurance undertakings. The principles are based on the work of the Mining, Minerals and Sustainable Development (MMSD) Project, a 2000-2002 mining-industry-supported study of how to integrated sustainable development into the minerals sector. The ICMM principles include:

- ethical business practices and corporate governance;
- integration of sustainable development in corporate decision-making;
- uphold human rights, cultures, customs, and values in dealing with employees and others affected;
- implement risk management;
- continual improvement of health and safety performance;
- continual improvement of environmental performance;
- conservation of biodiversity and integrated land use planning;
- responsible product design, use, re-use, recycling and disposal;
- contribute to the social, economic and institutional development of communities in which we operate; and
- effective and transparent engagement, communication and independently verified reporting with our stakeholders.

Within each of the 10 principles are numerous detailed sub-principles, making this another excellent checklist for measuring a new mining law.

This year 60 of the world's leading financial institutions celebrated the 5th anniversary of the Equator Principles (EP), voluntary standards for financial institutions to manage environmental and social risk in project finance transactions.[19] These nongovernmental principles have become the financial industry's "gold standard" for sustainable project finance, with over 70% of the

US $74.6 billion total debt tracked in emerging markets in 2007 subject to the EPs.[20] Members will not provide loans to projects with significant or limited adverse environmental or social impacts where borrowers are unable to comply with the EPs, including:

- environmental and social screening and categorization of potential impacts and risks;
- a prior social and environmental assessment process;
- overall compliance with applicable industry-specific EHS guidelines;
- an action plan and management system for the impacts and risks;
- consultation with project-affected communities to ensure their free, prior, and informed participation;
- a grievance mechanism;
- independent expert social-environmental review;
- enforceable covenants linked to compliance; and
- independent expert social-environmental verification of monitoring and reporting.

While there are many other corporate EHR standard-setting initiatives, one particularly unique one is worth mentioning – the Global Reporting Initiative (GRI).[21] The GRI claims to be "the world's most widely used sustainability reporting framework," a system of principles and indicators that companies and organizations can use to measure and publicly report "their economic, environmental, and social performance." GRI's "G3 Guidelines" can be used to benchmark an entity's compliance with hard and soft laws, codes, performance standards, and voluntary initiatives and thereby demonstrate commitment to sustainability.

NGO Standards

Environmental and human rights NGOs have become increasingly powerful players in the development of EHR standards for the mining industry (Pring and Noé 68-72). International, regional, national, and local organizations advocating

all facets of rights – environmental, human, indigenous, social-cultural, community, property, good government, labor, safety, etc., – are active or potential participants in mining projects and mining law developments worldwide.

Such NGOs now often play roles in negotiation and implementation of international law agreements, monitoring mining impacts, providing technical support to local communities and developing countries, drafting language, lobbying, acting as observers, reporting violations, critiquing EHR legal compliance, etc.

Amnesty International (AI) summarizes the minerals industry's "basic responsibilities" for human rights as including:

- protecting human rights within all areas and parties of the operation;
- promoting protection of human rights in society;
- non-discrimination;
- protection of life, liberty, and security;
- prevention of slavery, torture and cruel, inhumane, or degrading treatment;
- no arbitrary arrest, detention, or exile;
- protection of privacy;
- protection of property of individuals and communities, without deprivation except by a government authority on just terms with adequate compensation;
- respect for the economic self-determination of communities;
- no infringement on freedom of religion;
- no infringement on freedom of opinions, expression, or association (including collective bargaining);
- labor standards providing safe, healthy, and clean workplace; fair wages; and compliance with the ILO standards and Conventions on Child Labor and Rights of the Child; and
- compliance with the OECD Convention on Combating Bribery.[22]

AI also states that, in addition to these, "the human rights responsibilities of companies are increasingly being recognized as including respect for:

- National Sovereignty – the laws, regulations, values, development objectives, and the social, economic, and cultural policies of the countries in which they operate (insofar as these do not conflict with international human rights standards);
- Workers – fair and adequate compensation that ensures a lifestyle worthy of human existence;
- Local Communities – rights to health, adequate food and housing, and other economic, social, and cultural rights such as the right to primary education, rest and leisure, and participation in the cultural life of the community; and
- Environment – compliance with the national laws, policies, etc., of the countries in which they operate; due regard to relevant international agreements, principles, objectives, and standards; protection of the environment, public health and safety; and acting in a manner than contributes to sustainable development.

Conclusion

International law standards are not an abstract, academic, ignorable issue for the modern minerals industry. When a market-driven industry organization like the Canadian Institute holds a regular conference for mining executives and lawyers on "Managing Global Risks for Mining Operations" (this November 18-19), a majority of its sessions are on topics like –

- "How are international standards trying to promote a new paradigm of sustainability?"
- "What are the newest updates on adopting international standards to create an even playing field for the global mining industry?"
- "Understanding how hard laws, such as treaties, impact mining exploration and development"
- "Understanding how soft laws, such as United Nations and other international bodies' guidelines, affect successful project implementation"

- "Understanding international HSE laws"
- "Latest strategies for mining operations to improve their government, stakeholder and local community relations.[23]

International EHR standards have a great deal of value to contribute to mining law reform, as even this non-exhaustive review shows. The next step in the process would be to analyze comparatively all of the relevant standards lists – those discussed here and any others deemed requisite – and to harmonize and combine them into one list of EHR standards that are viewed as authoritative and essential in the consensus view of responsible government, industry, and NGO leaders.

About the Author

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Endntoes

1 There are of course specific international treaties governing transnational impacts, marine and freshwater protection, hazardous substances, and other matters in which mining operations can become involved. For details on these see Nanda & Pring.

2 http://www.unece.org/env/pp/welcome.html

3 US Office of Management and Budget & President's Council on Environmental Quality, "Memorandum on Environmental Conflict Resolution," http://www.usdoj.gov/adr/pdf/ombceqjointstmt.pdf; see also the website of the US Institute for Environmental Conflict Resolution, a US government agency, at http://www.ecr.gov

4 http://www.unhchr.ch/html/menu3/b/62.htm

5 http://www.iwgia.org/sw248.asp

6 *Ta Kin and Others v. Turkey*, http://www.echr.coe.int

7 Case of the *Saramaka People v. Suriname,* http://www.corteidh.or.cr/docs/casos/articulos/seriec 172 ing.doc (judgment of Nov. 28, 2007); http://www.corteidh.or.cr/docs/casos/articulos/seriec_185_ing.doc (subsequent interpretation of judgment of Aug. 12, 2008).

8 *Queensland Conservation Council Inc., v. Xstrata Coal Queensland P/L & Ors* [2007] QCA 338 (07/2235) Brisb, http://www.sclqld.org.au/qjudgment/2007/QCA/338. The Queensland Parliament subsequently adopted legislation allowing the expansion of the mine, preempting rehearing of the case.

9 An excellent reference guide to the numerous publications on the ATCA can be found at http://www.law.suffolk.edu/library/research/a-z/resguides/atca.cfm

10 http://go.worldbank.org/T1VB5JCV61

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3

Occupational Health and Safety in Mining – Status, New Developments and Concerns

*M A Hermanus**

This article examines the Occupational Health and Safety Performance (OHS) of the South African mining sector against the backdrop of changes in the composition of the sector, international trends in OHS performance, and the agreement on OHS milestones and targets by mining stakeholders at the Mine Health and Safety Summit of 2003. Although OHS performance has improved, progress is slow and there is need for significant rather than incremental change if the targets are to be realized. Since 2003, fatalities and injuries are 20–25% short of annual milestones and not all commodities show consistent improvement. Statistics on occupational health impacts are unavailable, but noise and respirable dust levels are known to be high in mines, with much work lying ahead to address exposures at source. Trends in regulating and addressing OHS hazards are discussed with reference to the notion of 'systemsthinking' and the targets. Efforts to improve OHS and to respond to changes in the sector

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are constrained by a lack of training and consistency in risk management, guidance for junior, small and artisanal miners, and holistic approaches to risk. For example, treating risk holistically would involve taking proper account of contractors and women in the workplace, and attending to human factors and ergonomics.

Introduction

Occupational injuries and ill-health have huge social and economic implications for individuals, their families and their communities. They also have economic impacts in the form of direct and indirect costs for society as a whole. Total costs of occupational accidents and disease have been estimated at between 1 and 3 per cent of GDP in various countries.[1,2] Direct costs include compensation costs, costs associated with damage in the workplace and the costs of interruption of production. Indirect costs include the costs of livelihoods lost, income to dependents, and the cost associated with care-giving by families and the community. Poor communities tend to bear the brunt of externalized indirect costs, but today mining companies can also suffer loss of reputation and withdrawal of investment capital.

In the broader context of sustainable development, healthy and safe working conditions are among the first expectations for sustainability, i.e., the expectation that risks in mining will not deprive workers of their livelihoods or of their quality of life. Occupational accidents and health hazards can also affect public health and safety, and the environment. These factors, the effects on the health and safety of people, costs to the economy and impacts on the environment, link efforts to address occupational health and safety to the broader social agenda for sustainable development.

The accident and ill-health record of the mining sector compares poorly to that of other economic sectors such as manufacturing, construction and rail, leading to mining's reputation as the most hazardous industrial sector. Mine environments are especially challenging because they can degrade fairly rapidly and they change as mining progresses. Dust and noise are inherently

associated with rock breaking, and in underground mines, air and light must be supplied artificially. Blasting, as well as mining itself, releases harmful gases into the underground environment. Ergonomic hazards are common in mining as miners generally handle heavy equipment and do heavy work, often in cramped conditions. In some instances ergonomic hazards, which are associated with poor engineering design, contribute to increased safety risks. An example from South African mines is the positioning of the driver's seat in many of the locomotives still used in haulage – at the back of the vehicle and at right angles to the direction of travel.

South African mines currently employ about 460.000 workers and contribute significantly to GDP (7.1%),[3] exports (34% of value)[4] and formal employment (6.5%).[5] Most workers are employed in gold and platinum mines in Gauteng and the North West Province. Mining also has a multiplier effect on the rest of the economy, which, when taken into consideration, raises the contribution of mining to the GDP to close to 12%[6] Given the importance of mining to employment and in the economy, there is significant value in addressing health and safety systematically.

When mining started on an industrial scale in the 1880s, miners faced very high levels of risk to both safety and health. Over the years the safety performance of mines improved, but not at the same rate as at in other major mining countries such as Australia, Canada and the USA. It is difficult to compare health performance. In 1995, the Commission of Inquiry into Mine Safety and Health concluded on the basis of a number of studies that exposures to dust in mining had remained unchanged for 50 years. The Commission attributed this to an absence of systemic approaches to controlling respiratory disease.[7] In recent years, changes in legislation, better appreciation of the relationship between silica exposure, TB and HIV/AIDS, and commitments made by industry stakeholders have resulted in fresh efforts to reduce health and safety risks. However, comprehensive initiatives to control health exposures are still new and in development. Since exposure data for airborne pollutants and noise indicate that risks to health are serious, they are likely to remain so until effective control strategies are implemented across the sector.

Recent developments such as increasing numbers of contractors working on mines, the emergence of 'junior' mining companies, the recognition of small-scale and artisanal mining, and the presence of women in mining pose new challenges for health and safety regulation and practice, for example:

- With more contractors and contracting companies on site, occupational health and safety management is more complex. Given the need for contractors to quote competitively for work, tensions between health and safety goals, and production outputs are heightened. In 1999, the number of subcontractors employed in the industry was estimated at 10%.[8]
- Many junior mining companies lack the resources of their larger counterparts to identify best practice for health and safety, and to develop comprehensive approaches to risk management.
- Until recently, artisanal and small-scale mines, which play a role in poverty alleviation by providing employment, were not catered for in South African mining policy. About 20 000 small-scale and artisanal miners are active in the country.[9] Small scale and artisanal miners often lack business management skills, awareness of the legal requirements for mining and the means to address health and safety risks.
- Women in mining face greater risks to their safety than men because they use machinery, tools and equipment that have been designed for men. Furthermore, given that the physical demands of mining are matched to physiology of a select group of men, women face increased risks of injury and ill-health.

Mine Safety

The International Labour Organisation (ILO) estimates the annual number of work-related fatalities that occur worldwide. Among the figures published by the ILO are estimates of the number of work-related fatalities in South Africa. According to the ILO 1908 workers in total died in work-related accidents in 2001.[10] In the same year, 288 workers died in mine accidents.[11] Given that miners account for fewer than 500 000 workers (less than 4% of the total workforce) in the national workforce which is nearly 14 million strong, a disproportionate percentage of work-related fatalities (approximately 15%) are associated with mining.

Table I sets out the numbers of fatalities and fatality rates per million hours worked in South African Mines in the last four years.[12]

In contrast to these relatively high rates, in Australia in 2003 (the most recent year for which data are available) the fatality rate was 0.05 fatalities per million hours worked, and corresponded to the deaths of 12 miners.[13] Comparison of Australian and South African rates suggest that miners are 4-5 times more likely to lose their lives in mine accidents in South Africa than in Australia. A major difference between South Africa and other major mining countries is the depth of gold mines, the labour intensiveness of gold and platinum mining, and the large number of workers on a single mine (the last presents significant organizational and logistical challenges). In contrast, Australian mines are more mechanized and fewer people are directly exposed to mining hazards. The fatality rates of the South African coal sector are more comparable to the national rates for Australian mines, reflecting greater similarity in mining methods and conditions.

It is estimated that the safety performance of the South African mining industry must improve by at least 20% per year to reach by 2013, the average performance of Australia, US, and Canada (Ontario).[14] In 2005 the best ever improvement in one year, 16%, was achieved.[15] Figures 1 and 2 show how the safety performance of gold and coal sub-sectors of the South African mining industry changed over time.[16] For gold mining (Figure 1), the fatality rate declined sharply from 1904 to 1922. From then on until 1943, the rate of improvement slowed. From 1944 to the present day improvements continued slowly and were punctuated by several reversals corresponding to years in which mine disasters occurred. The overall trend in injury rates (steep rise until 1943 and then a steep fall until 1988) cannot be easily explained, and suggests incompleteness in the data.

The steep peaks that punctuate the downward trend in the fatality rates in Figure 2, for coal mines, clearly show the effect of mining disasters on fatality rates (sharp reversals in safety performance in years in which disasters occurred). The trend in the injury data suggests incompleteness, as is the case for the gold sector.

Table 1: Annual Number and Rate of Fatalities in Mining 2003-2006		
Year	**Number of Fatalities**	**Fatality Rate per Million Hours Worked**
2003	270	0.29
2004	246	0.25
2005	202	0.21
2006	191 (provisional)	0.19

Figure 1: Fatality and Injury Rates in South African Gold Mines

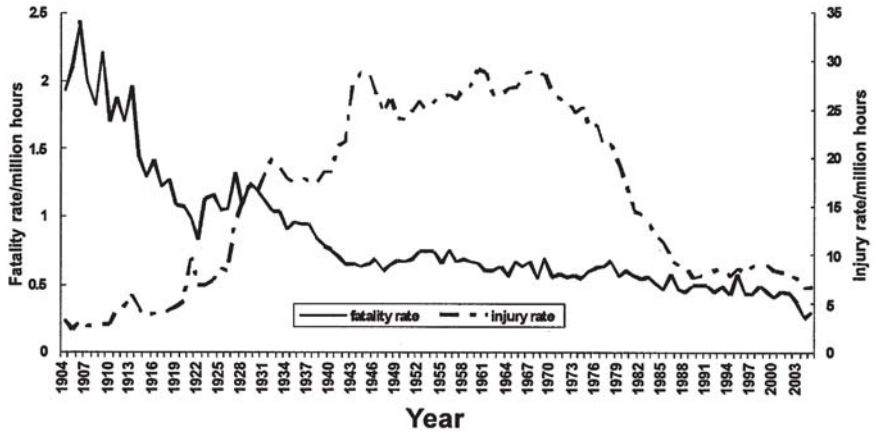
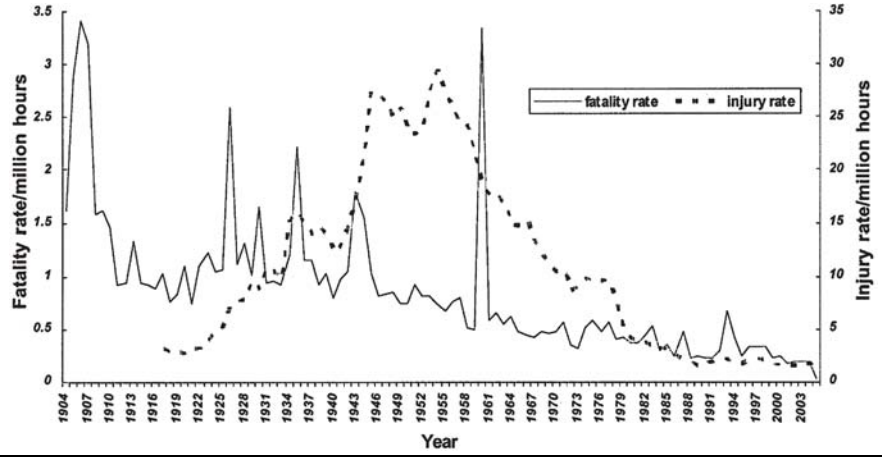


Figure 2: Fatality and Injury Rates in South African Coal Mines, 1904-2005



Safety data published by the Department of Minerals and Energy (DME) only includes data on fatalities and injuries that result in workers being away from work for at least 14 consecutive days. In short, the data are restricted to serious accidents and these are mainly associated with falls of ground, transportation, and machinery, approximately 30%, 20% and 7% respectively in 2006.[17] Analysis of this data suggests that the major causes of fatalities tend to be the same as those for serious injuries, while disasters have a different profile. In the last decade, mining disasters were associated with explosions due to flammable gases, a conveyor belt fire, an inundation of mud and water, and rock bursts. There is, however, another large category of accidents that is non-specific, entitled 'general', which confounds analysis of accident trends. This general category accounts for 40% of all accidents, most of which result in non-fatal injuries, and includes slips and falls, and hand injuries.

Some of the interventions that have over the years contributed to reducing safety risk levels include:

- standards for explosives used in mining
- administrative control of explosives underground
- stone-dusting in coal mines
- flame-proofing of equipment
- improved cap lamp technology and control
- improved ventilation systems
- installing explosion-proof walls to seal off mined out areas
- explosion barriers
- regional support systems in seismically active mines
- hydraulic props and other forms of active roof support.

Current ideas on addressing safety (and health) emphasize the role of leadership in setting clear OHS expectations, leadership's role in aligning business and OHS goals, proactive risk management based on leading indicators, communication, and responsiveness to feedback.

Mine Health

Most countries do not have comprehensive sources of occupational health data. Much of the data are fragmented and when taken together, also incomplete. Exposure data, which can be predictive of disease, are particularly scarce and unreliable. This is because the requirements for representative sampling, sample analysis and data analysis are stringent and complex, and different criteria apply in different countries and industries. Reliability of the occupational health data is especially a problem in developing countries where reporting systems and reporting criteria are not well established. In 1999, it was conservatively estimated that world-wide there were 7000 000 deaths due to occupational disease, i.e., upwards of seven times more than the estimate of fatalities due to occupational accidents.[18] The ILO estimated that the total number of occupational disease-related deaths in South Africa was 8229 in 2001. It is not clear how many of these deaths were associated with mining, although the available data suggest that the number would be significant and disproportional to the number of workers employed in mining and that there is a huge burden of occupational disease among former and current miners.

Major health risks encountered in mining include airborne pollutants such as silica dust and coal dust, noise, heat and vibration. Other significant health risks include chemical risks, which are not related to underground air pollutants or gases, skin disorders, ergonomic stresses, ionizing radiation and, in the diamond sector on the west coast of the country, decompression illness associated with diving. Although health risks can be avoided by implementing controls at source in the work environment, designing such controls for mining environments presents considerable challenges because dust and noise are generated by mining itself.

Other factors also raise the level of risk to health in South African mines. Approaches to dust monitoring delayed the recognition of the severity of the risks posed by airborne pollutants. Gravimetric dust sampling methods were introduced into the mining sector only in the late 1980s, and until then averaging of exposures measurements from diverse situations was commonplace. Added to the problem of recognizing the severity of health risks are the effects of changes in employment patterns and working hours on

exposure time. For many decades after the start of mining in the country, miners worked on mines for limited periods before returning to the rural areas. It is a possible that these miners left the industry before respiratory diseases such as silicosis became evident. By the mid-1980s, however, many miners remained in mine employment for more than two decades, suffering prolonged exposure to dust and developing occupational diseases in greater numbers.[19] More recently, the adequacy of protection systems designed around occupational exposure limits for eight-hour working days has been called into question. It is common in older mines for miners to spend 10-11 hours underground, with much of the extra time taken up by journeying to and from their workplaces.

Dust Exposure

Studies on South African underground mines show that individual dust control measures can achieve reductions of between 25 to 50% of respirable dust.[20] A range of control measures that act together to reduce exposure risks is therefore necessary. These could include methods for minimizing dust levels by reducing dust generation and methods for dilution, suppression, capture, and containment. Current guidelines on addressing airborne pollutants emphasize the importance of identifying and characterizing all sources of airborne dust, both primary and secondary, and properly integrating control interventions into procedures for choosing and maintaining equipment, and into the daily work cycle. While significant uncertainties remain in controlling dust exposures and maintaining the effectiveness of controls, the use of appropriate Personal Protective Equipment (PPE) is important.

In recent years in the United States legal rules for verifying dust control plans in coal mines have been developed. At operational level it is expected that the following be checked before the start of shift: water pressures and water flow to dust suppression sprays on continuous miners; air quality and air velocity at the locations where machinery operates; dust collectors on drills and other equipment; and any other controls specified in mine ventilation plans. Should controls be found wanting, production must be halted until they are properly functional.[21] Areas of research in the US to improve monitoring and control of dust, include real-time dust monitoring tools to check whether airborne dust is maintained within acceptable limits, improving dust collection

units on machines through redesign and repositioning, and reducing dust levels within the enclosed cabins of older equipment by retrofitting dust filtration and pressurization units.

Noise Exposure

Noise exposure is a widespread problem in mining because of the use of heavy equipment; drilling and rock breaking; transferring, sorting and milling of rock; and the confined working environment. Available data for noise exposure for South African miners suggest that nearly half the workforce is exposed to deafening noise, and of these workers more than 90% work in zones in which noise exceeds the 85 dBA time weighted average, with 11% working in zones in which the noise levels are even higher.[22] There were approximately 4 000 cases of noise-induced hearing loss in 2004 and approximately R75 million was paid out in compensation. As noise levels remain high in the sector and noise abatement interventions are still in development, PPE is very important in preventing hearing loss. In some working areas, noise levels associated with unsilenced pneumatic drills are so high (in excess of 115 dB (A)) that PPE cannot provide adequate protection. It is therefore likely that noise-induced hearing loss will continue among miners in the sector, and the number of compensable cases will rise again in the future when the threshold for compensable hearing loss is breached.

The South African situation is mirrored in mining environments elsewhere. According to the National Institute for Occupational Safety and Health (NIOSH) in the US, 80% of miners work in environment in which noise levels exceeds 85 dBA, 25% are exposed to noise levels above 90 dBA, and 90% of coal miners and 49% of metal/non-metal miners are hearing impaired by the age of 50.

Preventing hearing loss at present involves a range of strategies, which include engineering controls, education, surveillance and inventions to improve compliance to hearing conservation programmes. Examples of engineering controls adopted in mining to address noise include enclosure of equipment, dampening of noise vibrations, the redesign of equipment, and remotely controlled operations. Co-operative efforts involving the suppliers and manufacturers of equipment could bring far-reaching change if pursued on an industry-wide basis.

Respiratory Diseases, Tuberculosis (TB), HIV/AIDS and Silicosis

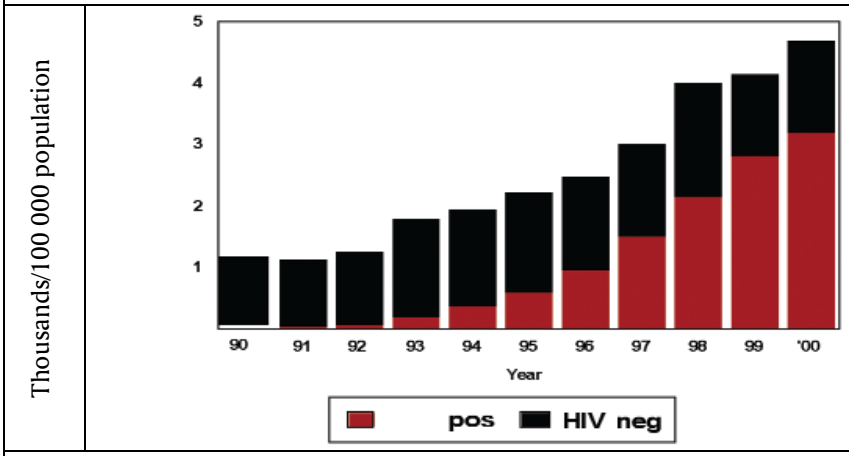
In the period 1973 to 1993 (20 years) the Mineral Bureau for Occupational Disease certified 128 575 cases of occupational lung disease. The actual numbers of cases of disease is known to be higher, since black workers who are more likely to have been exposed to high levels of respirable dust, were not entitled to benefit examinations in the past. Today, occupational disease is still unlikely to be diagnosed among former mineworkers served by resource strapped clinics in rural areas. Information available on exposure to airborne health hazards suggest that, depending on the commodity under consideration, between 9 and 50 per cent of exposed workers, who account for about half of the workforce, are overexposed to airborne pollutants.[23]

TB and HIV/AIDS are significant health risks in South African mining because these diseases are bound up with the living and working conditions of miners, such as migrant labour, single sex hostels, undiagnosed active TB, closed ventilation systems in underground mines, and dense living arrangements. Tuberculosis control is failing over much of sub-Saharan Africa, the region of the world most affected by HIV/AIDS, since HIV infection increases susceptibility to TB. The same effect is seen on mines. In addition, exposure to silica in mining operations together with HIV infection, multiply the risk of active TB. These combined factors also contribute to high rates of TB transmission. To reduce the TB on mines, TB must be identified early and treated, and both silica dust exposures and HIV infection must be controlled.[24] Data sources, which are most reflective of the risk of respiratory disease in mining, are the records of TB notification cases collated by the Chamber of Mines and collected by the health services at mines. TB notification rates have increased rapidly since 1988 in the mining sector as a whole, but are particularly high for gold mines for which notification rates are three times higher than among coal and platinum miners.[25] Figure 3 shows how TB notifications to the Chamber of Mines have increased over time. The proportion of TB cases involving HIV infection is also indicated in the graph. Gold mining TB rates are also well above the TB rates for the general population of South Africa. A large-scale intervention involving Isoniazid Preventative Therapy (IPT) for TB is underway in the gold mining sector, which has the potential to reduce the risk of TB among miners by eliminating latent or recent TB infections, and reducing the possibility of subsequent infections.[26]

The Health and Safety Milestones

At the Mine Health and Safety Summit of 2003, the tripartite stakeholders in mining agreed to targets and milestones, which are aimed at addressing the major health and safety concerns of the sector. The milestones are considered to be the intermediate steps to achieving targets of zero fatalities and injuries, silicosis elimination and the elimination of noise-induced hearing loss. Current trends in the available data indicate that the sector is not achieving the level of improvement needed to reach the milestones. However, significant resources have been galvanized, for example, to share information, identify helpful existing technologies, develop new technologies, support technology transfer, closely monitor trends, and understand the role of leadership. These activities bode well for the future.

Figure 3:TB Notification Cases[27]



Source: Aurum Institute, Johannesburg.

The three mining industry targets and their associated milestones are set out below.

The sector target for safety is zero fatalities and injuries. The milestones associated with this target are:

- *In the gold sector* – To achieve by 2013, safety performance levels at least (i.e., the average of the safety performance of mines in the US, Australia and Canada) equivalent to current international benchmarks for underground metalliferous mines.

- *In the platinum, coal and other sectors – to* achieve by constant and continuous improvement, at least equivalent performance levels to current international benchmarks.

One of the sector's health targets is to eliminate silicosis. The milestones associated with this target are to:

- By December 2008, reduce 95% of exposures to below the occupational exposure limit for respirable crystalline silica of 0.1 mg/m3 (these results are individual readings and not average results).
- After December 2013, using present diagnostic techniques, cause no new cases of silicosis to occur among previously unexposed individuals (previously unexposed individuals are workers who would not have been exposed to silica prior to 2008, for example workers who are new entrants to the industry in 2008 or who have worked on mines or in occupations in which silica exposures were absent).

The second health target, which is also the final target of the sector, is to eliminate Noise-Induced Hearing Loss (NIHL). The present noise exposure limit specified in regulation is 85 dB(A). The milestones associated with this target are that:

- After December 2008, hearing conservation programmes must ensure that deteriorations in hearing are no greater than 10% amongst occupationally exposed individuals.
- By December 2013, the total noise emitted by all equipment installed in any workplace must not exceed a sound pressure level of 110 dB (A) at any location in that workplace.

Systems Thinking and Occupational Health and Safety

Questions have always been raised over how legislation can best influence OHS in the workplace, how OHS relates to other managerial responsibilities, whether the results of incident investigation can meaningfully support prevention, and how/why operations become vulnerable to small deviations in human behaviour. In recent decades the notion of systems has been helpful in developing answers to these questions.[28]

A 'system' is understood as an aggregate of interrelated components that have an overarching purpose. Components may include policies, standards, institutions, people and machinery. An important characteristic of systems is that they are dynamic. They change when individual components change. Keeping a system aligned with its purpose and ensuring the systems respond appropriately to change requires conscious effort, for example responding to changes in employment patterns, working hours and management.

In systems, both the components and dynamics (within the components and between components) are important. For occupational health and safety, typical system components are stakeholder groups, OHS committees, policies, procedures, standards, specific accountabilities, auditing and monitoring protocols, and performance indicators. The dynamics of the system are provided by the actions and interactions of these components. This includes leadership, involvement, commitment, planning, consultations, interactions with regulators, responses to problems and acting on audit findings. Well developed system components can be an advantage but in the absence of good dynamics (e.g., commitment, involvement, feedback or responsiveness), system performance is likely to be sub-optimal.[29] Today, evidence of systems thinking can be found in OHS legislation, workplace programmes and in approaches to stakeholder engagement, risk assessment and accident investigation.

Law

Mining legislation in South Africa and elsewhere developed piecemeal, usually in response to disasters involving loss of life and multiple injuries. The fact that safety risks are more manifest in the workplace than health risks has also skewed legislation towards safety and physical hazards. In practice in the long-term, however, more deaths and disability are associated with health risks than with safety risks. The period of latency between exposure to a health hazard and disease is one of the major reasons why health risks are underestimated or unrecognized.

In 1972, the report of a committee of inquiry into health and safety at work in Britain (the Roben's report), which was chaired by Lord Roben, laid the basis for more comprehensive and systemic approaches to health and safety. Roben

criticized the bias in law and regulation towards safety and physical conditions; the absence of provisions for addressing health risks in the workplace; prescriptive legislation; and reactive approaches to developing law. He called for broadening perspectives on OHS to include consideration of the organization of work and human factors; ongoing engagement between employers and workers on health and safety, and employers' duties to manage OHS on a continuous basis. He also proposed that prescriptive legal provisions be replaced by performance or outcomes requirements, which were to be supported by a general duty of care placed on employers.[30]

The Roben's report influenced the thinking of the ILO,[31] and the design of legislation in many countries, for example Britain, Australia, New Zealand, Norway and Sweden. In South Africa, the Commission of Inquiry into Safety and Health in the Mining Industry, which published its report in 1995, was also strongly influenced by the approach advocated by Lord Roben and by his concerns. The Commission recommended that legislation be promulgated to address occupational health in mines, and that mine employers take urgent steps to improve monitoring standards and practice, medical surveillance, and the control of health risks.[32] The Mine Health and Safety Act of 1996 (MHSA) arises out of the findings of the Commission and is enabling rather than prescriptive. Its main features are that:

- Employers bear primary responsibility for a safe and healthy work environment
- Risk management approaches to addressing health and safety hazards are mandatory
- Workers have rights to participate in health and safety, to health and safety information, to training and to withdraw from dangerous workplaces
- Tripartite institutions are charged with responsibilities to develop policy, legislation, regulations and promote a culture of health and safety.

In South Africa, all regulatory instruments for mines, e.g., regulations and codes of practice, tend to be framed as outcomes statements. In contrast in Britain, where performance-based approaches were pioneered, the approach of the Health and Safety Executive (HSE) is more nuanced. While the HSE generally follows a goal-setting approach, prescription is considered to be appropriate for

certain situations. For example, mines are required to provide two exit routes in Britain. The HSE also requires licensing of inherently hazardous activities such as explosive use and asbestos removal.[33]

Another international trend concerns the consolidation of all occupational health and safety legislation into single overarching statutes,[34,35] as well as the amalgamation of the institutions responsible for OHS. This process is still being played out in South Africa,[36] where a decision of the Cabinet in 1999 to harmonize and consolidate OHS legislation and institutions is under consideration, under the leadership of the Department of Labour.

Engagement

Workers have a fundamental interest in occupational health and safety because it is their health, lives and limbs which are at risk. A common observation in research and accident investigations is that workers have not been engaged in ways that enable them to inform management of specific OHS concerns, or to contribute their experiential and tacit knowledge of work and of OHS hazards. Adversarial or poor labour relations can rule out any form of partnership between managers and workers on health and safety[37] and can affect communication. The review of the 2005 accident at BP's Texas City Refinery, flagged as important willingness by managers to listen to the workforce and appreciation by the workforce of how safety considerations shape management decisions.[38]

Another barrier to effective engagement may be managers' concerns that participatory processes will undermine their control of operations. Yet evidence suggests the contrary. For example an audit of the internal responsibility system in Ontario Mines found that: 'The workplaces in which workers and supervisors were involved heavily in planning the work, tended to be the mines where there were fewer accidents (as measured by medical aid cases).[39]

Risk Management

Risk management processes are fundamental to the Mine Health and Safety Act and most other modern OHS statutes. The underlying premise of risk management is that improvements in health and safety can be made by

correctly identifying and addressing hazards or factors (which may be underlying or direct) that contribute to occupational risk. The main components of risk management are hazard identification, risk assessment, implementation of controls, monitoring of controls, review, and adjustment or redesign of controls as necessary. The practice of risk management has led to understanding and appreciation of the following:

- Effective risk management is founded on good engineering design and systems of work.
- Where risk cannot be eliminated, control strategies can be designed to reduce the consequence or the likelihood of the risk (or both). An understanding of the impact of control strategies is important for both contingency planning and improving controls over time.
- When risk assessments are done too late, little can be done to avoid hazards.
- Complex work processes such as those with numerous interdependent activities and many levels of supervision, offer more opportunities for human error and equipment failure.
- To prevent deaths at work, severe risks must be eliminated or reduced, e.g., separating the travel paths of heavy mobile equipment from small vehicles or pedestrians, or using remote controls that enable people to stay out of hazardous areas.
- Risks are reduced by keeping low inventories of hazardous materials on work sites (e.g., low volumes of explosives or chemicals).
- Human beings are fallible, and designs should be tolerant of human failure and error.
- The factors that shape unsafe behaviours in the workplace, can be identified and eliminated or modified through appropriate interventions and changes in the overall system.
- Repeat accidents occur because the lessons of previous accidents are not learned or forgotten or are not passed on.

Accident Investigation

Many theories of accident causation can be traced back to the work of Herbert Heinrich who studied 75 000 industrial accident reports in the 1920s. He concluded that 88% of accidents were caused by unsafe acts, 10% by unsafe conditions and 2% were unavoidable.[40] Heinrich's theory (the domino theory) places the actions of workers at the centre of accidents. In South Africa this theory dominates thinking on accident investigation, but enhancements have been made to factor in risk management practice, and procedural and operational control. These enhancements and more recent approaches to accident causation recognize the 'multi-factoriality of the accident phenomenon'[41] and include consideration of the organization of work, ergonomics, the work environment, abnormal working situations, process safety and the responsibilities of employers to provide safe systems of work and safe working environments.

Internationally, interest has shifted to applying systems theory to accidents. In systems theory accidents are viewed as 'flawed processes involving interactions among system components including people, societal and organizational structures, engineering activities and physical system components'.[42] Models based on system theory are nonlinear and are unlikely to conclude, or reinforce the idea, that one cause, someone or something, is directly to blame for an accident. Instead they provide insight into the factors related to organizational structure, engineering design, manufacturing and operations that move systems into states in which small deviations from the norm can trigger catastrophes.

Constraints in the South African Environment

Identification, assessment, elimination or control of risks is a tenet of the Mine Health and Safety Act, yet training in risk management is not well established. In Australia where risk-based approaches are also rooted in law, such training is accredited by regulators in many states and risk management practice has become more standardized.[43] In South Africa, the absence of consistent approaches to risk management is a concern.

Effective engagement among managers, supervisors and the workforce is vital to improving OHS performance. Unfortunately, South Africa's history of division along the lines of race, language, class, gender and educational

opportunity presents significant barriers to building common cause around OHS, and creating open and responsive working relations. However, a number of examples of good practice exist, which could be documented, shared and emulated.

Contractors now perform a wide range of functions on mines from shaft sinking, to development work, mining itself, and other general work, but specific guidelines on contractor safety have not yet been considered, despite the vulnerability of contract workers. Reasons for this include incomplete data on the health and safety of contract workers, and the absence of systems to enable training and registration of contract workers.

Performance-based approaches in health and safety law do not meet the needs of companies that are small and underresourced, and that require explicit guidance on what is required of them. Greater appreciation of the circumstances of junior, small-scale and artisanal miners could support the development of appropriate OHS policy and intervention strategies.

The enabling approach of the MHSA places more demands on regulators. Mine inspectors have to exercise professional judgement in many instances and cannot confirm compliance by simply comparing their observations against items on checklists. Programmes for the development and training of inspectors are important in addressing this concern.

Historically high-risk work has been assigned to men, and women have been excluded from such work. Work in the mining sector falls into the category of high-risk work. Reproductive hazards[44] in mining include ionizing radiation, inorganic solvents and toxic metals. For biological reasons, women may be more at risk from some of these hazards than men. Heavy physical work is also a reproductive hazard for women, and heavy work as well as equipment designed for men, expose women are necessary to more risks. More holistic approaches to risk management, which include consideration of gender implications of risk involving women workers in risk assessments, and rethinking approaches to ergonomic factors, if the participation of women is to be sustained in mining.

Conclusions

When mining started on a large scale in South Africa in the late 19th century, mine workers faced very high levels of risk to both safety and health. Over the years the safety performance of mines improved, but not at the same rate as mining countries such as Australia, Canada and the USA.

Given that the miners account for fewer than 4% of the total workforce in South Africa, a disproportionately high percentage of occupational deaths, 15% of the estimated total for the country, are associated with mining. Globally, the sources of data on occupational disease are fragmented and incomplete and exposure data is scarce and unreliable.

Nonetheless, in South Africa, the available data suggest there is a significant burden of occupational disease among former and current miners.

'Systems thinking' has strongly influenced developments in legislation, and approaches to risk management, accident investigation and worker involvement in health and safety. The full implications of this approach, which are entrenched in the Mine Health and Safety Act, have not yet been properly appreciated and incorporated into practice.

Constraints to improving OHS and responding to changes in the mining sector in South Africa include a lack of:

- Resources and guidance to address the needs of contract workers, junior, small and artisanal miners
- Training and consistency in risk management practice
- Holistic approaches to addressing risks by, for example, properly considering OHS risks to women, human factors and ergonomics; and
- Improving the quality of engagement between managers, workers and supervisors.

The sector's historical legacy of underestimating health risks constrains current efforts to improve OHS performance. The burden of occupational disease associated with past practice has not yet run its course. In the longer term, however, the impacts of current initiatives, which are mindful of the influence of TB and HIV/AIDS, should be beneficial.

The targets and milestones, which the tripartite mining stakeholders agreed to at the Mine Health and Safety Summit of 2003, are aimed at addressing the major health and safety concerns in the sector, and are driving more systematic efforts to address the causes of fatalities, injury and ill-health.

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4

Mine Water Pollution – Acid Mine Decant, Effluent and Treatment: A Consideration of Key Emerging Issues that May Impact the State of the Environment

*Suzan Oelofse**

Acid Mine Discharge (AMD) is a contaminated waste generated out of the mining activities both during and after the operation period AMD has adverse impact on the socio-economic conditions of the people residing in and around mining site. It basically constitutes substances having high salinity, toxic elements and salts which pollute surface and sub-surface ground water. AMD in addition to polluting the ground water also affects the flora and fauna, soil degradation and the infiltration of the heavy metals into sub-surface of the regain. The release of mining waste has a direct relationship on the rise in the global warming and atmospheric ozone depletion. The potential impact of mining on water resources can be analysed from to the intensity of mining activity, volume of contaminated

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waste and its seepage into the sub-surface terrain, rate of re-watering and dewatering. The article refers to the possible remedies to environmental pollution which include prevention of intermixing of AMD with water flow, percolation of AMD into the underground water system, diversion of water streams away from the residue storage areas and controlled placement of acid generating waste.

Introduction

A major environmental problem relating to mining in many parts of the world is uncontrolled discharge of contaminated water (or decant) from abandoned mines (Banks et. al., 1997, Pulles et. al., 2005). Commonly known as Acid Mine Drainage (AMD), there is wide acceptance that this phenomenon is responsible for costly environmental and socio-economic impacts. While South Africa has made significant progress in shifting policy frameworks to address mine closure and mine water management, and the mining industry has changed its practices to conform to new legislation and regulations, vulnerabilities in the current system still remain.

AMD is characterized by low pH (high acidity), high salinity levels, elevated concentrations of sulphate, iron, aluminium and manganese, raised levels of toxic heavy metals such as cadmium, cobalt, copper, molybdenum and zinc, and possibly even radionuclides. The acidic water dissolves salts and mobilizes metals from mine workings and residue deposits. Dark, reddish-brown water and pH values as low as 2.5 persist at the site (Akcil and Koldas, 2006). AMD is not only associated with surface and groundwater pollution, but is also responsible for the degradation of soil quality, aquatic habitats and for allowing heavy metals to seep into the environment (Adler and Rascher, 2007). An exacerbating characteristic of AMD is its persistence – it is extremely difficult to rectify.

Certain expert assessments by the Environmental Protection Agency in 1987 concluded that "problems related to mining waste may be rated as second only to global warming and stratospheric ozone depletion in terms of ecological risk. The release to the environment of mining waste can result in profound, generally

irreversible destruction of ecosystems". In many cases the polluted sites may never be fully restored, for pollution is so persistent that there is no available remedy (EEB, 2000).

In South Africa, an example of AMD is occurring on the West Rand in Gauteng Province. Acid mine water started to decant from defunct (closed) flooded underground mine workings on the West Rand in August 2002. "Decant has subsequently been manifested at various mine shafts and diffuse surface seeps in the area. Up until early-2005, and completion of storage and pumping facilities to contain and manage on average of 15 Mega-Litres per day (ML/d) of decant, the AMD found its way into an adjoining natural water course and flowed northward through a game reserve, and towards the Cradle of Humankind World Heritage Site" (Oelofse et. al., 2007).

In April 2005, the media drew attention to the West Rand basin with news headlines such as "A rising acid tide" and "Acid river rocks Cradle of Humankind". The reports went on to state that "South Africa's renowned Cradle of Humankind in Gauteng, home to one of the world's richest hominid fossil sites, is under threat from highly acidic water pollution..." (Independent online, 14 April 2005) and "It is also threatening to drown the Sterkfontein caves." (Mail and Guardian, 12 April 2005). The Mail and Guardian also accused scientists, mining companies and government of reluctance to discuss the mine water decant and its impact publicly "...and yet it is the start of a problem of such magnitude that it will affect our environment and health for decades to come" (Mail and Guardian, 12 April 2005). More recent media reports have drawn attention to mine water pollution contaminating the Loskop Dam, Randfontein and Wonderfontein Spruit areas.

Specific water quality problems that are highlighted in the South Africa Environment Outlook Report (DEAT, 2006) include salinity and acidification. Acidification is directly related to mining, while mining is but one contributing factor leading to increased salinity (DEAT, 2006). The effect of mining on the environment includes the release of many chemical contaminants into water resources, environmental damage that can persist for a long after mine closure, and the health and safety of nearby communities being compromised.

Discussion

Discharges of contaminated water from abandoned, derelict and/or ownerless mining sites is common to all countries where mining started prior to the promulgation of environmental legislation. In South Africa, the defunct Chamber of Mines Research Organisation (COMRO) conducted studies on the impact of gold mining activities on the environment of the Witwatersrand. More recently, the European Commission's 5th Framework R&D project carried out by the ERMITE (Environmental Regulation of Mine waters In The European Union) Consortium arguably represents the most comprehensive attempt to develop guidelines aimed at understanding and addressing mining impacts on the water environment within the context of catchment management strategies. This project has no doubt to some extent addressed the substantial gap in consistent information on how mining wastes are managed in different countries (Pulles et. al., 2005), at least within the European Union.

The potential impacts of mining on the water environment are subdivided (ERMITE, 2004a) into those associated with phases of mining operations, namely:

- the act of mining itself;
- seepage of contaminated water from mine residue deposits (waste rock dumps and tailings dams) resulting from mineral processing/beneficiation;
- dewatering of active mining operations; and
- rewatering (flooding) of defunct/closed mine voids and discharge of untreated mine water.

A definition of "mine water" after ERMITE (2004b) reads "Mine water is water in mined ground including waste rock/tailings depositories and/or draining into an adjoining body of water including streams, lakes, aquifers, wetlands, and oceans". Sulphide minerals such as pyrite occur in most metal sulphide deposits and associated mining waste. The oxidation of these minerals in the presence of oxygen and water, produces acid mine water which manifests as AMD. Surface sources of AMD that present the greatest threat to the environment are coal discard dumps and slurry dams, gold tailings/slimes dams and waste rock dumps, and uranium slimes dams. Subsurface impacts are generally associated

with water ingress (flooding) into underground mine workings, with the attendant threat of dewatering the source (and often pristine) groundwater regime and, in the post mining phase, providing a source of acid mine water for potential migration into the groundwater environment during rewatering (Banister et. al., 2002).

A further consideration is the potential long-term pollution threat, since production of AMD may continue for many years after mines are closed and tailings dams decommissioned (Johnson and Hallberg, 2005). The persistent nature of AMD has been discussed by Younger (1997), who recognizes two components in its evolution over time. The shorter term component is associated with vestigial acidity (generated during rewatering) that declines over a period of 10 to 40 years. The longer term component is associated with the generation of juvenile acidity (formed in the zone of water table fluctuation after rewatering), and which "...will persist for several hundred years until mineral sources are depleted." (Younger, 1997).

The release to the environment of mining waste can result in profound, generally irreversible destruction of ecosystems. In 1989, it was estimated that about 19 300 km of streams and rivers, and about 72 000 ha of lakes and reservoirs worldwide had been seriously impacted by mine effluents, although the true scale of the environmental pollution caused is difficult to assess and quantify accurately (Johnson and Hallberg, 2005).

A study by Naicker et. al., (2003) revealed that the groundwater in the mining district of Johannesburg, South Africa, is heavily contaminated and acidified as a result of oxidation of pyrite contained in the mine tailings dumps, and has elevated concentrations of heavy metals. Where the groundwater table is close to surface, the upper 20 cm of soil profiles are severely contaminated by heavy metals due to capillary rise and evaporation of the groundwater. The polluted groundwater is discharging into streams in the area and contributes up to 20% of the stream flow, causing an increase the acidity of the stream water. The effect of the contaminated water from the mines can persist for more than 10 km beyond the source (Naicker et. al., 2003). Evidence of radionuclide pollution was found in the Wonderfonteinspruit Catchment (Wade et. al., 2002; Coetzee et. al., 2006; National Nuclear Regulator, 2007).

AMD is the most difficult mine waste problem to address (Durkin and Herrmann, 1994). Elaborate pumping systems were employed in the beginning of the 20th century to increase profits, resulting in the modification of the water table, the appearance of sinkholes, and elevated levels of water, air, and soil pollution (Adler and Rascher, 2007; Adler et. al., 2007; IIED, 2002). Post-closure decant from defunct coal mines is estimated at 62 ML/d (DWAF, 2004), and in the order of 50 ML/d of acid mine water discharges into the Olifants River Catchment (Maree et. al., 2004). It is clear, therefore, that significant volumes of polluted water need to be managed on a continuous basis for decades to come. These circumstances, however, do not imply only doom and gloom. The Emalahleni Water Reclamation Plant at Witbank is a state-of-the-art treatment plant able to treat 25 ML/d of acid mine water to a potable water standard (Günther et. al., 2006). Although the principal beneficiary of the treated mine water is ostensibly the Emalahleni Local Municipality, it is arguably the receiving aquatic environment of AMD that benefits most, albeit incalculably, from the initiative in that less than AMD reaches it (Hobbs et. al., in press). In a water scarce country such as South Africa, this key emerging issue also represents an opportunity.

A high confidence study of the fate and pathway of heavy metals and radionuclides associated with mine decant and AMD should be undertaken. This study will reveal where the pollution is traveling and if there is human risk involved, and therefore where management intervention is required. In addition a high confidence epidemiological study of off-mine populations impacted by mining activities is required. To date there are no reliable data on human-related impacts associated with mining activities.

The extent of mine pollution impacts need to be determined. Remediation priority areas and actions need to be identified based on location and extent of mine pollution impacts. AMD follows the same flow pathways as water, and can therefore best be controlled by controlling water entry into the site of acid formation, by diversion of surface water away from the residue storage areas, prevention of groundwater infiltration into the mine workings, prevention of hydrological seepage into the affected areas and controlled placement of acid-generating waste (Akcil and Koldas, 2006).

Research is also required on strategies to utilize the storage potential of defunct/closed underground mine voids in optimally managing the generation of AMD in order to control its potential impact on the receiving surface and groundwater environments. Research is required on the further field impacts of AMD on potentially receiving dolomitic (karst) environments and the re-activation of springs dried-up due to dewatering.

Conclusions

AMD is the single most important environmental concern from mining activities. It is a common problem in all countries where mining started prior to the promulgation of environmental legislation. Many mines are reaching the end of their productive life and as a result, dewatering is terminated and rewatering results in the decant of AMD, often at unpredictable locations. In addition, tailings dams and waste rock dumps constitute surface sources of AMD.

The threat of AMD to the environment is not solved in the short to medium term; it is likely to persist for centuries to come. Whilst AMD threatens the scarce water resources of South Africa, and as a result also human health and food security in mining areas, it also presents an opportunity to provide usable water through appropriate treatment technologies.

The legacies of the historic sites will remain problematic for many years to come due to the vast magnitude of the associated impacts. There are no easy solutions to the problem, but concerted efforts could lead to vast improvements and reductions in the environmental impacts associated with the historic sites. The primary management issues therefore include long term decant risk, acid mine drainage, water pumping and treatment and allocation of responsibility especially in light of the interconnectedness of the mines (Pulles et. al., 2005).

Institutional fragmentation and overlapping or vaguely defined roles and responsibilities regarding the management and control over mining waste are common to Europe, the United States of America and South Africa (Godfrey et. al., 2007). In general, waste management falls within the mandate of environmental authorities or agencies, while mining is addressed by mining authorities with little or no specific reference to mining waste. A single law

devoted to mining waste will remove confusion and ambiguity in legislation. Policy and/or regulations based on sound scientific evidence, including the research described in this essay, should be developed.

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5

Prosecution for OHS Offences: Deterrent or Disincentive?

*Neil Gunningham**

The role of prosecution in achieving compliance with Occupational Health and Safety (OHS) legislation is a highly contentious issue, particularly in the mining industry. In New South Wales, what is perceived by some as a newly aggressive approach to prosecution has brought to the foreground a number of critically important questions concerning how best to regulate OHS. This article seeks to identify a number of principles relating to prosecution policy that would achieve more effective OHS outcomes. In particular, it seeks to steer a middle path that neither rejects prosecution as an important deterrent at the top of an enforcement pyramid, nor uses it in circumstances where it is likely to do more harm than good.

1. Introduction

Prosecution? 'Make it achievable and make it fair!' (a NSW Mine Manager).

It is fundamental that the criminal law must be administered in an appropriate fashion. The legislature has chosen to emphasise the importance of occupational health and safety matters by creating absolute

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> offences. If the prosecution of offences is undertaken in an arbitrary, capricious and irresponsible fashion, the laws themselves are brought into disrepute for reasons that are obvious. This is especially so in the area of occupational health and safety prosecutions where it is the custom of the prosecutor to seek a moiety of the penalty, that is payment of one half of any amount imposed by way of penalty – *Newcastle Wallsend Coal Company Pty. Ltd., v Inspector McMartin* [2006] NSWIR Comm 339 at [755] (Marks J).

The role of prosecution in achieving compliance with OHS legislation is a highly contentious issue, particularly in the mining industry. Nowhere is this more so than in New South Wales, where, following the Gretley disaster,[1] the Department of Primary Industries[2] developed a new found enthusiasm for punitive action, particularly following fatalities. It has, moreover, chosen to prosecute not just companies but also individual mine managers and other statutory duty holders.

The Department's prosecution policy,[3] and the approach of the independent Investigations Unit charged with investigating fatalities,[4] has precipitated a seething dispute between the New South Wales Minerals Council and major mining companies on the one hand, and the mine safety regulator and the mining trade unions on the other. The companies argue that prosecution is counter-productive, inhibits adequate safety investigation, encourages a defensive rather than a proactive OHS culture, and drives away would-be mine managers at a time of severe labour shortage. The enactment of the Occupational Health and Safety Amendment (Workplace Deaths) Act 2005, introducing a higher penalty regime for workplace fatalities involving recklessness or intent, has fuelled their concerns. The trade unions, on the other hand, welcome these developments as providing effective deterrence to corporate law-breaking and urge regulators to expand their use of prosecution to a far wider range of circumstances.

Although a similar prosecution policy has not yet been adopted by regulators in Queensland or Western Australia, there are, nevertheless, glimmerings of prosecutorial activism in both states, notwithstanding a dearth of previous

prosecutions by agencies with a strong philosophical commitment to an 'advise and persuade' approach. In consequence, many companies are watching anxiously, fearing that New South Wales' new found enthusiasm for prosecution will infect their own states. The mining trade unions on the other hand, urge that this is precisely what is needed to achieve improved OHS outcomes.

The ongoing debate in a number of jurisdictions, concerning the virtues of introducing industrial manslaughter legislation,[5] has added to employers' concerns, not just in mining, but across industry generally. This has caused the Australian Chamber of Commerce and Industry (ACCI), amongst others, to call for a major rethink of OHS policy.[6] What the ACCI argues for example, is that the current system of OHS regulation is seriously deficient, that a more enlightened approach is needed than a one-sided 'employer blame-game' and that current laws undermine a culture of shared responsibility.[7]

At the heart of many of these questions (though rarely articulated in these terms) is the appropriate role of prosecution and the criminal law more generally, in enforcing OHS offences.[8] On the one hand, penalties are imposed that are intended by the courts to serve the functions of individual and general deterrence. If successful, these deterrent messages will provide disincentives to non-compliance and reduce levels of work related injury and disease. On the other hand, criminal law often serves a much less pragmatic role, fulfilling moral, symbolic and retributive functions. As Hawkins argues:

> Prosecution is a ceremonial restatement of norms by which people and individuals order social life. Its use sustains the moral world which the regulatory organization inhabits. One way it does this is through the satisfaction given by the prosecution of a blameworthy defendant that moral boundaries are being maintained and reinforced… In making public those standards of behaviour deemed proper, decent and desirable, prosecution can be cathartic, since it can sometimes satisfy a demand, whether from the victim, the victim's family, the media or people generally, for a public statement of the worth of the victim and the culpability of the defendant.[9]

Unfortunately, these instrumental and expressive roles are rarely well integrated and commonly the pursuit of one serves to undermine the other. It will be argued that much of the conflict between employers and unions over the role of prosecution can be understood in these terms. Reconciling these roles is not easy and in some circumstances is likely to prove impossible, making hard choices between prevention and retribution unavoidable.

This article describes the current approach to prosecution adopted by the mines inspectorates in New South Wales, Queensland and Western Australia. It also summarises the implications of the international evidence-based literature on the impact of 'deterrence' and 'compliance' approaches to enforcement, in order to identify the ingredients of a rational and effective approach to prosecution. In doing so it seeks to identify a number of principles that, if adopted, would be much more successful in preventing work-related injury and disease than current prosecution practice. These principles, it is suggested, should steer a middle path between an over-zealousness that may inhibit accident investigation and chill safety initiatives, and a timorousness which, by failing to deter the recalcitrant, may prove equally antithetical to safety.

The debate with which this article engages is by no means confined to the mining industry, although it finds expression in that industry in a particularly acute form. Accordingly, the principles proposed below have more general application both to occupational health and safety generally, and to related areas of social policy.[10]

2. Current Prosecution Practice in the Mining States

Until quite recently, none of the inspectorates of the three mining states engaged in prosecution to any significant extent. For example, in New South Wales, according to the report of the Gretley Inquiry, in the seven years before that disaster there had been 33 deaths in New South Wales coal mines without a single resulting prosecution.[11] Further, the very few prosecutions that had taken place in the mining industry in other circumstances (relating to metalliferous mines) had involved low penalties, were poorly publicised, and

failed to send any significant deterrent signal.[12] This led to a general perception, particularly within the mining trade unions, that prosecution was a 'dead duck'.[13]

It was the unwillingness of the New South Wales mines inspectorate to prosecute, coupled with political pressure (especially from the Construction, Forestry, Mining and Energy Union (CFMEU)), that prompted the establishment of an independent Investigations Unit in 1998. Following the Gretley disaster, Justice Staunton's call for the 'timely prosecution' of mining companies and senior officials, was particularly influential on enforcement policy. Two mine managers, a surveyor and a number of under-managers were prosecuted in relation to Gretley (as well as the companies involved).[14] Convictions against the mine manager and former mine manager were upheld on appeal (although no conviction against the latter was formally recorded).[15] Another mine manager suffered a similar fate following a death at Awaba.[16] The employers associations maintain that in neither case did the circumstances merit prosecution, and that the prosecution of individuals was particularly inappropriate. A number of other cases involving death or serious injury (and a handful that did not)[17] have also been prosecuted in the period since 2001.[18]

Strikingly, behaviour that exposes workers to serious OHS risks, but which does not result in death or injury, only exceptionally attracts prosecution, even if it is calculated or reckless.[19] This is a matter of some considerable concern, since the relevant legislation makes it clear that neither death nor injury is a prerequisite to prosecution. On the contrary, the offence lies in the act or omissions that led to the worker being exposed to potential death or injury.[20]

Queensland and Western Australia have been, and remain, substantially less prosecutorial in orientation than New South Wales, although the trend in both states is towards more prosecution, albeit from a very low base. In Queensland, there is no evidence of there being any prosecutions in the coal mining industry and, until the last few years, there were only a relatively small number related to metalliferous mines. Even in relatively recent years (from around 2002 on) however, official reports identify less than a handful of prosecutions each year, including some against site senior executives.[21] All of these have involved some

serious injury or death. The level of fines themselves has been modest, with a maximum of $30,000 against a contractor and $3,500 against individuals.[22] Prosecutions relating to fatalities have so far all produced guilty pleas with no substantial penalties imposed.[23]

In Western Australia, it is very difficult to obtain information about the level of prosecutions, and there has been a considerable reluctance on the part of the inspectorate to disclose relevant information about prosecution practice. According to the 2004 Ritter Report:

> [T]he level of prosecutions would appear (on the basis of the very limited information provided by DOIR) to be very low. Notwithstanding very frequent identification of breaches by the inspectorate, there is very little evidence of any formal action being taken, beyond the giving of directions on some occasions.[24]

A few prosecutions, even in the absence of death or serious injury, can be identified from press reports, with companies being fined low five-figure sums, but these, so far as one can tell, are highly exceptional. This, however, may be changing, with responsibility for mine safety being shifted to the Department of Consumer and Employment Protection, following inquiries which expressed concern about the danger of the mine safety regulator being captured by the very industry it purported to regulate.[25] Whether the 2006 prosecution of BHP Billiton in relation to a death in the Pilbara and the ensuing fine of $200,000 are symptomatic of a more general change of approach remains to be seen.[26]

The paucity of prosecutions cannot be explained by any practical difficulties in gathering evidence, by the costs of mounting prosecutions, or by any lack of specialist expertise in conducting such proceedings (although all of these may be significant in particular circumstances).[27] Rather, as a number of reports have pointed out, it reflects a cultural antipathy to prosecution,[28] and the underlying belief that much more can be achieved by advice and persuasion than by coercion.[29] In Queensland and Western Australia, the mines inspectorates continue to subscribe to an 'advise and persuade' philosophy which leads them to operate almost exclusively in the lower reaches of the enforcement pyramid outlined in Figure One below.[30]

This cultural aversion to prosecution would not be apparent from a review of formal policy documents. For example, in Western Australia, the relevant policy states that:

> Enforcement is an essential element in controlling or regulating activities and gaining compliance with statutory requirements. This is done by detecting breaches, bringing them to the attention of the alleged offender, requiring corrective or preventative action, applying penalties (directly or through the courts) and providing deterrence.[31]

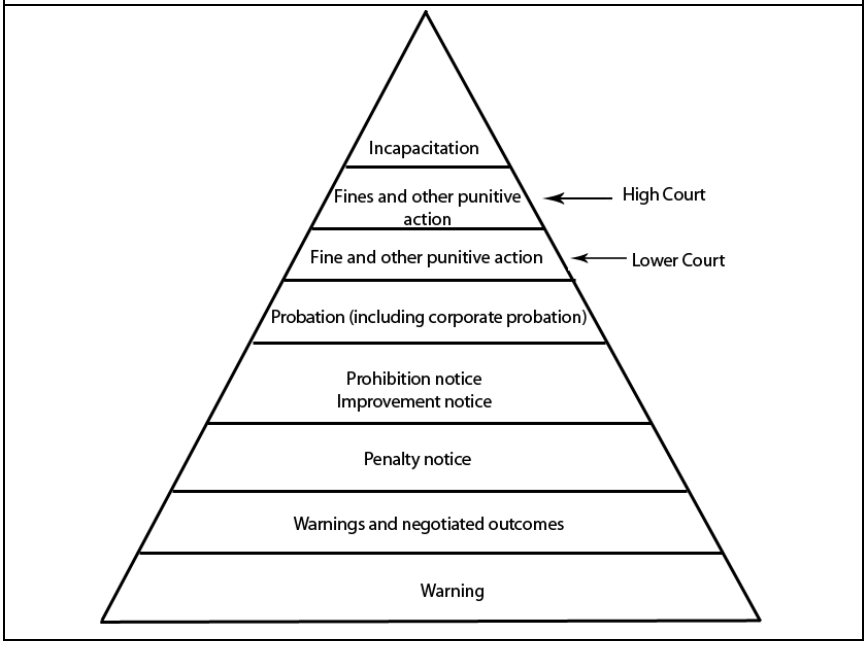
The Queensland Compliance Policy, whilst emphasising a co-operative approach, also refers to the capacity to initiate prosecutions against people or companies for failing to meet safety and health obligations.[32] In these states, there is good reason to conclude, as the Ritter Report stated, that there is a 'very large gap' between official policy, and what inspectors do 'on the ground'.[33]

To summarise, in Queensland and Western Australia, a cultural antipathy to prosecution has resulted in a paucity of prosecutions and the failure to provide any credible tip to the enforcement pyramid described in Figure One below. In New South Wales, the situation is more complex. Prosecution policy has lurched from a pure 'advise and persuade' approach (which still prevails in the large majority of circumstances), to one in which prosecution has become routine in the case of fatalities, even where the culpability of the defendant is (at least as perceived by the industry and its associations) relatively low.

As will become apparent, neither this extreme reluctance to prosecute on the one hand, nor zealous prosecution in a limited range of circumstances, on the other, are rational or remotely optimal enforcement strategies. To understand why this might be the case, we turn next to the empirical evidence as to the strengths, limitations and potentially counter-productive consequences of deterrence in general, and to prosecution in particular, and to the even greater limitations of a 'compliance' strategy at the other end of the compliance-deterrence continuum.

3. Compliance, Deterrence and Prosecution

Figure 1: The Enforcement Pyramid



A useful heuristic in thinking about the role of prosecution as a component of overall enforcement policy is the widely recognised concept of the enforcement pyramid as conceived by Ayres and Braithwaite.[34] This pyramid, which involves advisory and persuasive measures at the bottom, mild administrative sanctions in the middle, and punitive sanctions at the top, is intended to assist in determining what enforcement tools to use in any given case. According to its proponents, regulators should begin by assuming virtue (to which they should respond by offering co-operation), but when their expectations are disappointed, they respond with progressively punitive and deterrent-oriented strategies until the regulated group conforms.

Central to this model are the need for (i) gradual escalation up the face of the pyramid and (ii) the existence of a credible peak or tip which, if activated, will be sufficiently powerful to deter even the most egregious offender. The former (rather than any abrupt shift from low to high interventionism) is desirable because it facilitates the 'tit for tat' response on the part of regulators which

forms the basis for responsive regulation.[35] Although the concept of an enforcement pyramid has its critics, it provides a valuable conceptual framework for thinking about the various tools available to enforcement officers, and how they might be used to optimal effect.[36]

In the past, regulators in all the mining states have prosecuted and obtained legal sanctions against violators in only a very small number of cases, if at all. They have dealt with most detected violations by means of advice, warnings and demands for remedial action at the bottom of the 'pyramid of sanctions', or at its middle levels through various forms of administrative action and directions. They have adopted what the regulatory literature terms a 'compliance' strategy: one which relies heavily upon advice and persuasion to the virtual exclusion of more punitive policies and sanctions, and which rejects deterrence and prosecution almost entirely.[37]

Whilst there are understandable reasons in terms of politics and history as to why such an approach evolved,[38] there are no convincing reasons as to why it should continue. The empirical evidence is both compelling and well known and need not be rehearsed at length. In essence, there is little if any evidence that a policy of de facto non-prosecution (or even a combination of minimal prosecution and small penalties in the few cases that get to court) will achieve improved OHS outcomes.[39] Under such policies, regulators have no credible means of dissuading the recalcitrant from exposing their workforce to unacceptable risk. Unsurprisingly, in a number of well-documented cases,[40] such an approach has failed to prevent high levels of work-related injury, disease and death.[41]

Such policies have also aroused considerable criticism, not just from the trade union movement, but also from a range of official inquiries.[42] For example, the Laing Report took the view that it was fundamentally important that 'those who are unwilling to comply with their safety and health obligations understand that prosecutions will be taken if there is a failure to comply with the Act',[43] while the Ritter Report was also heavily critical of what it regarded as a fundamental failure of enforcement.[44] The 1997 New South Wales Mine Safety Review also expressed concern regarding inadequate levels of enforcement,[45] as did a 2005 review of the Queensland Inspectorate.[46]

The failure of a pure compliance policy has led some commentators to emphasise the virtues of deterrence and to suggest that prosecution and the imposition of substantial legal penalties are crucial to achieving improved OHS outcomes.[47] There is indeed considerable evidence to suggest that deterrence can and should play an important role in an overall enforcement policy,[48] but unfortunately that role is complex. Further, as we will see, a 'pure' deterrence strategy may prove almost as unsuited to achieving improved OHS outcomes as a 'pure' compliance strategy.

At the risk of simplifying a difficult subject, there is evidence that both specific and general deterrence[49] play variable but important roles in any credible enforcement policy.[50] From this it might appear, as one overview of the literature states, that deterrence is demonstrably 'an effective means of securing compliance.'[51]

However, upon closer examination, it becomes apparent that the problem is not so much with a generalised belief in the value of deterrence (and prosecution as a vehicle to achieve it), but with how deterrence and prosecution are invoked in practice. For just as there is evidence of the positive benefits of prosecution, so there is also evidence of its negative impact when it is inappropriately used. For example, there is evidence that a confrontational style of enforcement may diminish the willingness of firms to cooperate and learn from past experience as well as make them reluctant to share information and unwilling to consult regulators for fear that their disclosures may be used against them.[52] Similarly, it may inhibit in-firm accident investigation, prevention and remedial action. Individual prosecutions against statutory office holders may make it difficult to attract well qualified applicants to such positions and reduce the skills base of the industry.[53] In sum, the evidence in favour of deterrence described above, must be weighted against evidence suggesting that its indiscriminate use can be counter-productive.

A further challenge is that in so far as general deterrence 'works', it does so only in some contexts and to some extent. Different types of firms, different sizes of firms, and different types of office holders, are all likely to react differently to the signals sent by prosecutions. For example, there is some evidence to suggest that deterrence is likely to have much greater impact in relation to small and

medium sized enterprises than in relation to large ones.[54] The simpler management structures of small firms and the relative incapacity of key decision-makers within them to avoid personal liability, also make them much easier targets for prosecution.[55] The size of penalty may also be an important consideration: mega-penalties tend to penetrate corporate consciousness in a way that other penalties do not.[56]

Deterrence is also likely to have a different impact on firms who are differently motivated. It is likely to work best in relation to those who deliberately choose non-compliance for pragmatic reasons (usually because they perceive that they can make a greater profit by non-compliance than by compliance). But whilst deterrence may be effective in causing 'reluctant compliers' and the recalcitrant to improve their behaviour, the prosecution of firms who perceive themselves as 'good guys' (for example, committed compliers and those who go 'beyond compliance') may be counter-productive, causing resentment and generating a culture of 'regulatory resistance.'[57]

Deterrence also works better in relation to individuals than to organisations, but once again much depends upon the context. It is one thing to prosecute key decision-makers in small organisations (where they are both readily identifiable and amenable to incentives to comply) and another to prosecute senior officers in large organisations whom, while appropriate targets in principle, are exceptionally hard to convict in practice. It is yet another to target middle management (who often lack decision-making power and are widely perceived as innocent scapegoats). Prosecuting 'wrong' individuals – those who are vulnerable and easy targets for example, rather than senior decision-makers – creates a considerable sense of injustice and damages the legitimacy of the entire regulatory regime.

Specific deterrence, it seems, has a substantially greater impact than general deterrence, although this impact is more theoretical than real. This is because it is practicable to prosecute only a small number of enterprises and individuals, with the consequence that the 'reach' of specific deterrence will necessarily be extremely limited. Prosecutions have been, and will continue to be, rare events in the experience of individual firms.[58]

From this evidence, it may reasonably be concluded that prosecution should be used sparingly, and carefully targeted to appropriate circumstances, and to actors who are most likely to respond positively to it. But what precisely does this mean and what would an optimal prosecution policy look like? How can the positive impact of deterrence be enhanced while minimising its adverse and counter-productive impacts? How can a balance be achieved between the use of deterrence and the use of other less coercive strategies?

On the one hand, an under-investment in deterrence (manifested through the relative infrequency or absence of prosecutions) may send insufficient signals to some duty holders to focus on safety and improve their OHS performance, and in extreme cases, may result in a complete collapse of a credible enforcement strategy. On the other hand, an inappropriate, misdirected or indiscriminate use of prosecution can create a culture of regulatory resistance, destroy trust between regulators and the regulated, send perverse incentives, inhibit OHS information flow and chill corporate OHS initiatives.

At the time of writing, none of the three mining states have managed to steer a middle course between the perils of an extreme compliance strategy on the one hand, and the heavy handed use of deterrence following death or serious injury on the other. Nor do the three mining states appear to have developed any strategies or principles to assist them in this regard, beyond some rather loosely worded enforcement and compliance policies to which we will return.

4. Principles for a More Rational and Effective Prosecution Policy

Against this backdrop, the following sections articulate a series of design principles intended to achieve a more balanced and effective prosecution strategy. To foreshadow the detailed discussion below, the first two of these principles suggest means of avoiding the counter-productive consequences of both under-prosecution and over-prosecution. The third identifies criteria to determine what sorts of circumstances should justify prosecution, emphasising the importance of culpability, risk and track record. The fourth suggests that prosecutions should generally take place irrespective of whether harm results, while preserving a role for 'event based' prosecutions at the tip of the enforcement pyramid. The fifth principle identifies circumstances in which

deterrence is likely to be effective as well as those where it is not and suggests how and when individual decision-makers should be targeted, and who they should be. The last two principles concern the appropriate role of retribution and the circumstances in which more might be achieved by applying the techniques of restorative justice.

The first two of these principles may be seen as precursors to the others. Since they flow directly from the discussion in the previous section, they can be briefly stated. The first, which flows from the well-documented limitations of a pure compliance strategy, and from its demonstrable failure to provide incentives to the recalcitrant to improve their safety performance, is as follows:

A. A Policy of De-facto Non-prosecution (such as has Characterised the Mines Inspectorate in Western Australia and Queensland) will Send the Wrong Signals to the Recalcitrant and Result in Seriously Sub-optimal OHS Outcomes – The Question is not Whether there should be Prosecutions but Rather When there should be Prosecutions

However, it is also clear from the analysis in the previous section that prosecution does not work across the board and the available evidence suggests that prosecution should be used sparingly – carefully targeted to appropriate circumstances and to actors who are most likely to respond positively to it. For just as there is evidence of the positive benefits of prosecution, so also there is evidence of its negative impact when it is inappropriately used. A confrontational style of enforcement or enforcement against 'good' enterprises at a low level of culpability may diminish the willingness of firms to cooperate and learn from past experience, as well as generating a variety of defensive behaviour which impedes preventative action. This leads to a second principle.

B. Prosecution may be Counter-productive if Inappropriately Used

However, this begs the question of what is meant by 'inappropriate'. This is a question on which there is a diversity of competing views. Trade unions and mining communities, especially following a fatality or serious injury, argue in favour of prosecution, even against those whose culpability is quite low. On the other hand, mining companies, managers and other statutory position holders

are inclined to suggest that prosecution should be reserved for 'bad apples' which they tend to equate with the reckless and willful. Accordingly, prosecutors, in determining which cases to prosecute, and in seeking to identify an acceptable basis for prosecution, find themselves between a rock and a hard place. They will inevitably either offend those who demand retribution or those who put prevention first and argue that retribution, particularly against those whose culpability is relatively low, is seriously counter-productive. As a result, politics, rather than rational decision-making, often holds sway.[59]

In later sections, it will be argued that to some extent this conflict can be minimised, and a number of suggestions will be made as to how this might best be achieved. However, there will remain a range of circumstances where it is probably impossible to identify any commonly agreed position. The best that can be done here is to identify the writer's own value position and then attempt to develop a set of principles which would most likely achieve those values.

The value position of this article is that the primary purpose of prosecution is preventative: to reduce the level of work-related injury and disease. Although it does not reject retribution in its entirety, it suggests that, to the extent that the two principles are in conflict, prevention should be given precedence. Those who believe that the principal role of the criminal law is retribution will likely disagree with the analysis that follows. Its virtue, however, is to identify principles which, if followed, will send a set of signals that deter 'bad actors' from wrongdoing without inhibiting 'good actors' – or even those capable of becoming good actors under the right circumstances – from pursuing strategies conducive to improved workplace safety and health. Overall, it is submitted that implementation of the principles identified below will prove effective in preventing accidents, whilst also (to the extent that it is consistent with achieving prevention) recognising the moral and expressive needs of victims and their families for 'justice'.

C. Prosecutions should Relate to the Culpability, Risk and Track-record of the Defendant

Accepting for present purposes that the primary role of prosecution is prevention, how should prosecutions be targeted? What general principles and approach should shape enforcement policy? What criteria should determine the sort of

non-compliance which merit action at the top of the enforcement pyramid and which do not? These are hardly new questions, but they are ones which have not been satisfactorily addressed under current prosecution policy in the mining industry.

One critical question to ask in this context is: what degree of mental culpability on the part of the defendant is sufficient to justify, either in law or as a matter of administrative practice, the regulator defaulting from an 'advise and persuade' approach, or gentle (and increasingly less gentle) prodding at lower levels of an enforcement pyramid, to a punitive, prosecution-oriented approach? This question is a complex one, which will be answered first by describing the current legal approach and identifying its limitations, and then by proposing an alternative strategy.

Under the legal and regulatory status quo, the body of law which is relied upon to define culpability, and form the basis for prosecution, is OHS legislation. This includes the mainstream OHS law and specialist mining statutes which together form the legal regime relating to mining OHS in New South Wales and the specialist and mine-specific OHS legislation of Queensland and Western Australia.[60]

Under that legislation, the employer and various other duty holders must comply with a set of general duties (in all jurisdictions except Queensland) or risk-based standards (in Queensland), with this obligation being either (a) one of absolute liability (subject to certain defences including that of reasonable practicability), as in New South Wales, or (b) subject to a 'reasonable practicability' qualification, as elsewhere.

The main distinction between these two approaches is that under (a) above, the onus is on the defendant to invoke one of the defences (including that it was not 'reasonably practicable' to comply) on the balance of probabilities, whereas under (b) it is for the prosecution to prove all aspects of its case (including that the defendant failed to do what was reasonably practicable) beyond reasonable doubt.

Under both versions, the mental element required to establish guilt is in effect the standard of negligence in civil law ('reasonable practicability' being seen by the courts to be in effect a codification of the negligence calculus).[61] Negligence, on

this standard, involves a failure to live up to the standards of the 'reasonable person' acting in the circumstances of the case.[62] It is how the negligence standard (or in legal terms under New South Wales law, the 'reasonable practicability' and 'due diligence' defences) has been interpreted in the Gretley case, summarised below, that have given rise to considerable controversy and angst within the mining industry.

The Gretley Decision

The facts of the Gretley disaster and the subsequent judicial findings are well known and can be stated briefly. Four miners at Gretley colliery punched into old and flooded mine workings. There was an in-rush of water and the miners were drowned. An inquiry into the incident by former Justice James Staunton made recommendations concerning prosecution and charges were subsequently brought in the New South Wales Industrial Commission, both against the two former operating companies and against a number of individuals. Commissioner Justice Patricia Staunton found that the corporate defendants had failed to ensure the health, safety and welfare of their employees, and two former mine general managers and a mine surveyor were '[d]eemed to have committed the same offences as the corporations, having failed to satisfy the onus placed upon them' to exercise due diligence to protect workers (*McMartin v. Newcastle Wallsend Coal Company Pty. Ltd.,* [2004] NSWIRComm 202 at 979). Although the defendants argued that they were entitled to rely on old plans of the old workings supplied by the relevant government agency, Justice Staunton found that this:

> [D]oes not excuse the defendants from their independent statutory obligation … to ensure a safe system of work. Nor does it relieve the defendants of their obligation to satisfy themselves by way of their own research as to the accuracy of … [the Department of Minerals and Resources plans which] [o]n any considered view … were seriously deficient in purporting to depict old coal workings in a way that one could be confident of their accuracy ([2004] NSWIRComm 202 at [806]).

On appeal to the Full Bench of the Industrial Court of New South Wales, the conviction against the two companies was affirmed, as was that against the mine manager and former mine manager. The conviction of the surveyor was overturned on the basis that he was not 'concerned in the management' of either

company. His role was 'not managerial, but rather more akin to that of an advisor or consultant to mine management in relation to surveying' (*Newcastle Wallsend Coal Company Pty. Ltd., v. McMartin* [2006] NSWIRComm 339 at [517]).

Because prosecutions under OHS legislation take place at a relatively low point in the culpability hierarchy (that is, they are usually based on negligence rather than on intent or recklessness), the penalties imposed themselves have tended to be low, particularly against individuals. This sends out the unfortunate signal that breaches of OHS law are 'not really criminal'.[63] Low penalties are also 'indicative of the inherent difficulty associated with assessing the appropriate penalty … where conviction is not the result of individual criminal culpability in the normally understood sense'.[64]

However, in New South Wales, recent political pressure for increased levels of prosecution and higher penalties has resulted, particularly, but not exclusively, in the Gretley decision described above, in substantial penalties being imposed both on the operators and owners and on an individual manager. The fine of $42,000 imposed on the mine manager in Gretley was a substantial one for an individual. But even if it had been less, an individual mine manager (who is unlikely to fall foul of the criminal law in any other context) is likely to experience such prosecution as a traumatic event. As a result, fear of such prosecution is in the forefront of many managers' minds.

If such penalties serve to send the message that OHS offences really are criminal, then this is no bad thing. But the way that negligence was interpreted in the Gretley case had caused not only considerable angst within the mining industry (which in itself might only suggest that the law is now finally having 'bite'), but also a number of related adverse consequences for preventative OHS. For example, much energy is expended by companies on defensive training on matters such as how to avoid self-incrimination and disclosure of the circumstances relating to an alleged breach and on a number of other strategies described earlier that are antithetical to OHS.

The mining industry's position is that the prosecutions (both against the companies and against particular individuals) were inappropriate in the circumstances of the case. However, their greatest concern relates to the

prosecution of the individual statutory duty holders (for example mine managers). The industry's perception is not only that these individuals have been held liable in circumstances where their level of culpability is relatively low (negligence to civil standard), but that the interpretation of the negligence standard by the courts is an unreasonable one, making the prosecutions wholly unjustified. Indeed, Hopkins goes so far as to claim that we have arrived at a point where individuals are held culpable 'for failure to live up to an idealised reasonable person standard'.[65] Similarly, one industry association has argued that 'the concepts of 'reasonably practicable', 'foreseeable' and 'control' have been significantly distorted … to the point where they no longer reflect what is reasonable, practicable and achievable'.[66]

The industry's position may in some respects be overstated. As regards prosecution of the companies in Gretley, the focus of the courts in recent years (in interpreting 'reasonable practicability') has been on the necessity for systematic occupational health and safety management and risk management.[67] This is entirely consistent with industry OHS initiatives and best practice. In the circumstances of Gretley, where if the risk of water in-rush eventuated, the likely consequences included multiple deaths, then it seems 'reasonably practicable' for the company to have had systems and risk management arrangements which would have led them to challenge the information contained in problematic government plans. However, whether individual mine managers were negligent, is more doubtful. Certainly it is arguable that a mine manager who relied on the judgment of the surveyor (that there was no need to check those plans, which the government had supplied) had discharged his obligation to demonstrate 'due diligence', although it is far less obvious that the surveyor himself could have done so. The situation is muddied in this regard by the fact that the original surveyor (who was terminally ill by the time of the court case) was not prosecuted, and by the finding of the appeal court that the other surveyor was not 'concerned in the management' of the enterprise and so could not be liable.[68]

Nevertheless, although the culpability of the mine managers in the Gretley case is a matter on which reasonable people can disagree, there is little disagreement (i) that the industry's perception of the Gretley decision is that it was grossly unfair; (ii) that as a result the regulatory system has lost legitimacy in the eyes of many duty holders; and (iii) that they (including leading companies

who by and large aspire to go beyond compliance) have responded by invoking a number of defensive strategies described above, many of which are antithetical to the cause of preventative OHS.

One may conclude that the current approach to prosecution is counter-productive, and there is a strong argument to be made for developing a very different approach in the interests of improved OHS. But what would this involve? At what point in the culpability hierarchy should prosecutions take place? Answering this question involves a delicate balancing act between the virtues of deterrence on the one hand, and encouraging open reporting and investigation, nurturing a safety culture and maintaining the industry skills-base, on the other.

Perhaps some guidance as to where this balance should be struck is to be found in James Reason's well known argument in favour of nurturing a 'just culture' in relation to OHS. Reason emphasises that 'valid feedback on the local and organisational factors promoting errors and incidents is far more important [to improving safety] than assigning blame to individuals'.[69] However, he also recognises that an undiscriminating, across-the-board 'no blame' culture is neither feasible nor desirable.[70] A small proportion of human unsafe acts are egregious and warrant sanctions, so what is needed is not a blanket amnesty on all unsafe acts, but a just culture which generates:

> … an atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information – *but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour*. [Emphasis added.][71]

Whilst this advice was intended to apply to internal corporate management, it may also prove useful in a regulatory context, where it can be argued that the line should be drawn at a point that would encourage reporting and avoid the sorts of defensive individual and corporate behaviour documented earlier, whilst making clear that behaviour which departed substantially from reasonable expectations, would not be countenanced. This has been the approach of a number of high reliability organisations which are distinguished by their exemplary OHS performance. For example, British Airways Flight Crew Order 608 suggests that disciplinary action should only be taken against an employee

where they have taken action or risks which, in the Company's opinion, no reasonably prudent employee with his or her training and experience would have taken.[72]

To ensure that the line is drawn so as to only encompass serious departures from reasonable expectations and to avoid the sorts of borderline decisions that caused such counter-productive consequences following Gretley, it is submitted that only cases involving a substantial falling short of reasonable expectations should merit prosecution. That is, prosecutorial discretion should only be exercised when there is at least this degree of culpability. To avoid ambiguity, a broader elaboration of what is contemplated might be provided in prosecution guidelines. Crucially, these would make clear that prosecutions would be contemplated where there has been system failure (that is, a failure by the enterprise to engage systematically with OHS issues) as well as in the case of individual failings. Under such a test, it is suggested that the employers in the circumstances of Gretley would still be culpable (for there was indeed a substantial falling short of what was required to prevent systemic failure) whilst the mine managers would not.

However, it is not suggested that culpability alone should be sufficient to justify prosecution. For reasons which will be explored below, two other considerations should be weighted in the balance: the degree of risk and the defendant's past OHS performance.

Risk is important because some failures on the part of a duty holder expose others (usually workers) to a substantial risk of serious harm, while other failures are of far less significance.[73] Inspectoral resources are scarce and prosecution is a particularly expensive and time consuming activity, which must be reserved for those cases where it is likely to have most effect. Cases involving serious risk with potentially severe consequences fall within this category. This category extends to circumstances where, although the degree of risk is not particularly high in any individual identified circumstance, nevertheless, the general quality of occupational health and safety management demonstrated by the enterprise is poor. Systemic failure on the duty holder's part is a matter for serious concern, particularly where 'a duty holder's standard of managing health and safety is found to be far below what is required by health and safety law and to be giving

rise to significant risk'.[74] Thus, a focus on risk enables substantial consideration to be given to prosecutions which target the failure to deal with crucial issues such as management systems and risk control, and which are geared to promote the proactive and preventative 'systems-based' aspects of OHS management.

The final factor which should be weighted in the decision to prosecute is the past OHS record and approach of the defendant. All else being equal, there is a stronger case for prosecuting those whose past OHS record has been poor (as evidenced by a history of incidents, warnings and other documented action by the inspectorate) than those whose previous performance has been a positive one. Where, in the words of the UK Health & Safety Commission, 'there have been repeated breaches which give rise to significant risk, or persistent and significant poor compliance' or failures to comply with improvement and prohibition notices or their equivalent, or 'a breach which gives rise to significant risk has continued despite relevant warnings from employees or their representatives, or from other affected by a work activity', then this should weigh substantially in the decision to prosecute.[75]

Of course, real world cases do not present themselves in neat, clearly labeled categories, and neither the prospective defendant nor the circumstances of the case are likely to enable categorisation at the extreme of culpability, risk severity or leader-laggard continuums. Faced with shades of grey rather than black and white, regulatory decision-makers must weigh competing considerations. Does an employer who is (seemingly), seriously negligent but not reckless, who has a reasonable (but not impressive) past safety performance, and who exposed a single employee to a fleeting but serious risk merit prosecution? What of someone who was reckless and exposes multiple employees to a serious risk with potentially severe consequences, but has an exemplary past record? Does an uncharacteristic failure (even involving substantial negligence) merit action at some lower point on the pyramid, and does one which seems part of a pattern of neglect going back some time, deserve prosecution?

The best that can be done when making hard choices is to use a calculus as a guide to enable a preliminary decision (that is, the higher the composite score in terms of culpability, risk and poor past record, the higher the chance of prosecution). However, mechanistic approaches to decision making have their

limitations and numerical calculations can give rise to a spurious impression that a scientific and objective judgment has been reached. In practice, putting things to numbers provides useful guidance and a frame of reference on which to base provisional decision-making, but not complete answers. There is no alternative but to rely upon human judgment,[76] and the best that can be hoped for are consistent, transparent decisions,[77] made in accordance with clearly stated prosecution guidelines, made at arms length by an expert committee.

The approach proposed, involving a weighing of three different considerations, does not preclude prosecution where serious injury or death has eventuated, but nor does it privilege what Johnstone describes as 'event'-based prosecution (that is, those that follow particular incidents, usually involving injury or death) over 'pure risk' prosecution (that is, those that focus on the risk of injury or death rather than upon consequences).[78] It also ensures that some prosecutions will be undertaken in large part as a result of the defendant's unsatisfactory past OHS record. For example, a duty holder with a history of non-compliance with OHS regulation, who has been negligent and exposed a worker to a substantial risk, might justifiably be prosecuted applying the calculus, whereas one with a better past record might not.

The importance of taking account of a duty holder's track record in a substantial proportion of prosecutions cannot be over-emphasised. The essence of responsive regulation and the enforcement pyramid referred to above is that, where persuasion fails, then a tit-for-tat strategy involving a gradual escalation must ultimately result in the prosecution of the recalcitrant at the top of the pyramid, otherwise action at lower levels will lose its credibility and the entire strategy is likely to fail. That is, it is only if OHS duty holders believe that persuasive and administrative enforcement mechanisms at the lower levels of the pyramid are being backed up by big sticks at the top of the pyramid, that specific and general deterrence are credible, and that 'rational calculators', in particular, are given sufficient incentive to comply with their legal obligations.

Of course, under the sort of calculus proposed above, not all prosecutions will be influenced by track record. A duty holder who intentionally or recklessly exposed a worker to a serious risk of severe harm might be prosecuted, even in the absence of a poor past safety record, but one who was less culpable (and for

this reason had a lower aggregate score) might not. For example, permitting work underground without adequate roof support would merit prosecution even if no harm eventuated and even if this was seemingly out of character. The point is not that such prosecutions are inappropriate, but rather that they must be complemented by prosecutions in which track record is a substantial consideration, for it is these which give the enforcement pyramid credibility.

What must be emphasised above all else about the above calculus is that it would result in the prosecution of only the worst cases, or in Reason's terms the 'small proportion of human unsafe acts [that] are egregious, and warrant sanctions'.[79] By doing so, it would emphasise that OHS offences really are criminal and should be punished as such, that the enforcement pyramid really does have 'bite' and provides a credible deterrent, but that at the same time, the large majority of duty holders, even when they break the law, can be dealt with effectively at much lower points in the pyramid and without need for prosecution. In this manner, it should be possible to demonstrate the fairness of the prosecutorial approach, to preserve the legitimacy of the law and to avoid the counter-productive consequences that have flowed from the industry's response to the Gretley decision.

Strikingly, it is doubtful whether many of the principal cases prosecuted to date would have justified prosecution under the calculus proposed above (although there are other cases that would – and should, in the writer's view – be prosecuted under this calculus). In Gretley, for example, there was, at most, negligence to the civil standard, and the defendants would have ranked low in terms of track record. As has been emphasised:

> [T]he judge found that the defendants, both corporate and personal, were generally safety conscious; the company had an effective safety management system; there was "an active workplace safety culture among employees and corporate defendants"; and workers were encouraged to cease work when they encountered a hazard.[80]

Thus, it is only in terms of risk and potential severity of consequence that the case would have received a high scoring. It is reasonable to suggest that the low scoring it would have received on the other two variables go a substantial way towards explaining the strength of feelings the case has aroused and to the decision's perceived lack of legitimacy in the eyes of employers.

Finally, in terms of policy reform, the approach proposed above could be achieved without any change to legislation, by adopting formal prosecution guidelines and an enforcement policy incorporating these principles. It is, in fact, not wildly different from some of the existing state enforcement policies. However, many of these, while 'touching the right bases' do so in ways which provide relatively little guidance in actual decision-making. For example, the Queensland Department of Natural Resources, Mines and Water *Compliance Policy* (2001) identifies the need for enforcement measures which are commensurate with the seriousness of a situation and the need to escalate where previous measures have been ineffective.[81] It also emphasises the need to assess the level of risk, the seriousness of the situation and the immediacy of the problems detected. These are helpful parameters which are coupled with assessment-response guidelines and procedures for assessing recommendations. However, insufficient attention is given to the relative weight of different factors, leaving very large discretion to decision-makers. This in turn has enabled an 'advise and persuade' policy to prevail in almost all circumstances.[82]

D. There is no Rational Reason to Confine Prosecutions to Circumstances where Death or Serious Injury has Taken Place – Nevertheless, there Remains a Role for an 'Event Focus' at the Tip of the Enforcement Pyramid

Under the calculus set out above (and in contrast to a number of existing enforcement policies), it was made clear that the actual severity of harm caused – or the absence of harm – should not be regarded as a material factor in determining whether to prosecute. There are a number of reasons for this.

The OHS legislation clearly provides for prosecution irrespective of whether injury eventuates. Its intent is to prevent exposure to the risk of harm (for example through an unsafe work system) and it is the seriousness of the risk, rather than the actual consequences of the breach, that are its concern. There is considerable judicial support for this view. For example, the Full Court of the Industrial Court has stated, in no uncertain terms, that:

> The general duties created by the Occupational Health and Safety Act, such as in SS 15 and 16 (now Sections 8 and 9), are clearly directed, we think, at obviating "risks" to safety at the workplace; it would be therefore

> wrong in considering whether an alleged breach of those general duties had been made out in a particular case to reason from the actual occurrence of an accident … The accident may well, and probably does, manifest the existence of a detriment to safety and will, no doubt, be some measure of the degree of severity of the detriment; but it seems to us, it is to the essential ingredients of the offence charged which one must attend by assessing the objective facts causing the detriment to safety and the causal connection therewith of the employer.[83]

Yet in New South Wales, prosecutions have largely been undertaken, and at one stage exclusively, as a reaction to a work-related death or serious injury. This is not only contrary to the spirit of the legislation, it is also undesirable on broader policy grounds. Johnstone in particular has argued that what he terms 'the reactive and event-focused emphasis of OHS prosecutions' does little to take account of the importance of systems of work or OHS management systems, but instead constructs OHS contraventions as a chain of specific actions leading to a specific injury or death:

> Consequently, arguments in mitigation of penalty use 'isolation techniques' which shift the sentencing court's attention away from an analysis of the failure of the OHS system, to scrutinising the minute details of the events leading to the inquiry. This enables defendants to shift blame onto workers and others and facilitate uncontested claims to be good corporate citizens; coupled often with the allegation that the accident was a "freak" or "one off".[84]

As was argued earlier, it is only when an event-based focus is largely replaced by 'risk-based' prosecution, in accordance with the calculus set out above, and under a genuinely pyramidal approach, that prosecution can be used to optimal preventative effect.

This is not to suggest that events and their consequences will invariably be unimportant as regards the decision to prosecute. There remains an exceptional category – offences where the duty holder's state of mind – coupled with the consequences of their act or omission – are so heinous that the full weight of the criminal law should be brought to bear upon them.

While many would argue that the principal justifications for prosecution in these circumstances are 'moral, symbolic and retributive, and show society's intolerance for organisational behaviour causing workplace deaths',[85] there is also a preventative rationale for prosecution in these circumstances: namely that it is desirable to identify a class of offences at the top of the enforcement pyramid that are so heinous that the full weight of the 'real' criminal law can be applied to them. Prosecution here is also seen to address 'public disquiet… about the leniency afforded to workplace deaths in comparison to other forms of homicide occurring outside the workplace'.[86]

According to the McCallum Committee, the failure of sentencing patterns to keep pace with legislated increases in maximum penalties, particularly in relation to cases involving workplace death, and the apparent associated failure of general deterrence, makes special legislative provision for such cases essential.[87] This sort of reasoning has led to demands for the introduction of an additional tier of liability for offences which are 'really criminal' (that is, involve intent or recklessness coupled with serious consequences: severe injury or death).[88] A number of jurisdictions have been exploring this general approach in recent years, particularly with regard to the introduction of a new offence of 'industrial manslaughter'.[89]

Consistent with this general approach, New South Wales enacted the Occupational Health and Safety Amendment (Workplace Deaths) Act 2005. This legislation amended the OHS Act 2000 (NSW), the Occupational Health and Safety Regulation 2001 (NSW) and the Criminal Appeal Act 1912 to include a new offence with a maximum penalty of $1.6 million for corporations and $165,000 and/or imprisonment of 5 years for individuals, where a breach of safety legislation results in death at a workplace. According to the Minister, this targets the small minority of employers (so called 'rogue employers') who demonstrate little or no regard for the safety of their workers – and are reckless or intentional in their behaviour.[90] However, the introduction of this legislation does not (at least in principle) diminish the role of prosecution under the OHS Act with regard to reckless conduct in the absence of death (or injury).

Nevertheless, the relationship between OHS regulation and the 'real' criminal law (such as the Workplace Deaths legislation) is an uncomfortable one, with

relatively light penalties under the former being juxtaposed with potentially heavy penalties under the latter in such a way as to suggest that OHS offences are minor offences, and not 'really criminal'.[91]

While the tension between criminal and OHS law cannot be fully resolved, the use of both types of prosecutions in tandem will at least avoid the suggestions that corporate offenders are not subject to mainstream criminal law. The fact that the provisions of the Occupational Health and Safety Amendment (Workplace Deaths) Act 2005 form part of the *OHS Act* 2000 (as amended) can only assist such integration. Moreover, if prosecutions under OHS statutes are only taken (as proposed above) where there is (at the very least) substantial negligence, coupled with serious risk and poor track record, then prosecutions will only take place in circumstances involving serious wrongdoing. If so, then one can reasonably expect penalties to increase to reflect this fact. This too would serve to reduce the perception that such behaviour is 'not really criminal'.

Beyond this, and in terms of the framework of this article, the introduction of 'Workplace Deaths' or similar legislation, at the very least serves to integrate the mainstream criminal law into the pyramid and to maximise the deterrent effect of the top of the pyramid.

E. Deterrence is Particularly Effective when Applied to Individual Decision-makers – However, it is Crucial that the Appropriate Decision-makers are Targeted, and this Implies a Focus on Senior Corporate Managers and Directors, Rather than Mine Managers and Surveyors

As indicated earlier, prosecution also has a greater deterrent impact in relation to individuals than to organisations, but much depends upon the context. Accordingly, although there are sound arguments in favour of prosecutions against individuals in some circumstances, it remains crucially important that the appropriate level of management is targeted for prosecution; otherwise the outcome may not only be unjust but may also fail to send the deterrent message to the right audience.

In New South Wales, the practice has been to target mine managers, surveyors, and under-managers on the basis that they are 'concerned in the management' of the corporation. This may often be inappropriate, because mine managers are usually (but not invariably) too low in the managerial hierarchy to be responsible for the major decisions that often contribute to death or injury at the workplace. For example, it is usually senior personnel at the corporate level who have the capacity to make the necessary decisions concerning catastrophic hazards[92] or to grant or deny the resources necessary to address a major OHS issue at site level.[93] In contrast, mine managers, under-managers and surveyors operate under constraints and incentives set by mine owners, boards and chief financial officers. One mine manager encapsulated a common view when he told us 'I have real issues because I don't agree with the layout plan, but I have been told by my superior that that's the way it is. Yet the reality is that I am the statutory person who would take the fall, for a system I don't agree with'.

Certainly there are exceptions and Gretley was arguably one of them. With regard to day to day management matters, the mine manager (though far less than the surveyor) is well placed to ensure that various safety rules and procedures are discharged,[94] and could fairly be held responsible if, for example, personal protective equipment is not being used, or support rules were not being complied with.[95] But for the most part, it will be more appropriate to prosecute senior corporate management than site level officials, since major OHS decisions are the responsibility of higher level management.

However, if the regulator targets directors and senior managers (or in Queensland, 'executive officers'), then another difficulty arises. For, although the legislation deems directors and managers of corporations personally to have committed an offence, if a corporation breaches the Act,[96] it also provides them with a defence if they can establish 'due diligence',[97] or that they were not in a position to influence the conduct of the corporation in relation to the offence.[98] The problem here, as experience both in OHS and in the comparable area of environmental regulation makes clear, is the organisational complexity of many corporations, which will often provide a shield for directors and managers which is difficult to penetrate. It is no coincidence that the few cases under safety, health and environmental legislation that have involved substantial penalties against individuals have all involved very small enterprises – the only ones where the

'corporate veil' can credibly be broken down. However, in *Inspector Kumar Ken v. David Aylmer Richie,*[99] a CEO was prosecuted and found guilty because he did not have detailed knowledge of work procedures to be used when cleaning out containers- albeit that this was in circumstances where he was far removed from the business in terms of this level of detail and relied on others to enforce such procedures. Whether this case is an exception or the beginning of a new trend remains to be seen.

As the McCallum Committee has pointed out, this problem might be overcome by differently designed statutory provisions intended to establish relevant occupational health and safety standards for responsible risk management, integrated with appropriate liability principles. Exploring options in relation to the Workplace Deaths legislation described above, they propose the adoption of a Code of Practice creating benchmarks 'against which liability issues can then be evaluated in terms of culpability and the scope for escaping liability *but only in circumstances where it can be demonstrated that a manager/director has been relevantly proactive*' (Emphasis added.)[100] Under this approach a complex hierarchy would no longer provide de facto immunity. On the contrary, in order to establish a defence to personal liability, directors and managers would need to establish that they have relevantly discharged their individual responsibilities in implementing the relevant safety management system in such a manner as to ensure compliance with an objective and measurable code to prevent a corporate culture of risk from developing.[101]

It might appear that the New South Wales and Queensland mine-specific legislation is already heading in this direction, in so far as there are statutory responsibilities relating to the creation and implementation of both OHS management systems and with regard to hazard management plans, and requirements to establish a management structure and register persons occupying positions. However, most specific responsibilities are imposed at too low a level in the corporate hierarchy. For example, under the 1999 Queensland legislation, particular statutory responsibilities are placed on the Senior Site Executive.[102] Certainly identification of a responsible officer gives such a person an incentive to request the enterprise itself to take any necessary steps to protect OHS, including providing sufficient resources to maintain compliance. Furthermore, failure to take such steps would provide evidence of lack of due diligence.

However, a limitation nevertheless remains in that the Senior Site Executive in a large enterprise may have only very limited decision-making power and it is more senior managers and Board members that remain the most appropriate targets for individual liability. The identification of responsible individuals at corporate level will not be easy,[103] and the successful prosecution of directors and senior managers remains problematic under the present system.[104]

F. Retribution (and Prosecution for Retributive Purposes) Sometimes Inhibits Prevention – Retribution should be Confined to Egregious Cases, Otherwise it can be Counter-productive

Although the above analysis has focused on the role of prosecution in preventing work-related injury and disease, (in particular by providing specific and general deterrence), some would argue that prosecution can and should fulfill a further role — that of retribution. Retribution is sometimes seen as appropriate where society seeks to exact vindication by punishing acts considered egregious, to express moral outrage and to reaffirm a commitment to the maintenance of legal and moral standards.[105] For example, according to Kruse & Wilkinson, there are:

> [A] very small number of occasions when prosecution must take place. These are when the seriousness of the breach of the law and or consequences of that breach is such that there is widespread public opprobrium that demands public retribution.[106]

Thus, the goal for those who seek retribution is not an instrumental concern to improve future OHS performance, but rather to satisfy feelings of revenge and to achieve 'justice' in the victim's (or their family's) terms.[107]

Retribution is widely seen as a significant objective of criminal law, and judges frequently invoke it as an important consideration in sentencing. The argument of this chapter is not that retribution is never appropriate, but rather that it is only appropriate in a limited number of circumstances. Applied beyond these circumstances, it will be argued, its use tends to be antithetical to prevention and for this reason, undesirable.

So in what circumstances is retribution appropriate? Because moral and symbolic rationales underlie retribution as a justification for criminal punishment, the defendant's culpability should be a crucial consideration. For this reason, those

who were reckless in their approach to the health and safety of the workforce, and whose behaviour results in serious injury or death, are appropriate targets for retribution. Theirs is the sort of egregious behaviour targeted by the New South Wales Workplace Deaths legislation (confined to offences involving recklessness or intent), by manslaughter under the mainstream criminal law, or contemplated in most proposals for an offence of industrial manslaughter.[108] However, when retribution is extended substantially beyond these circumstances for instance, to cases where the culpability of the defendant is low then, as described earlier in this chapter, it produces results which are widely seen to be unjust, undermines the general belief in the legitimacy of regulatory requirements, and has consequences which are antithetical to preventative OHS.

G. The Legitimate Concerns of Victims, their Families, and Communities can more Constructively be Addressed through Applying the Techniques of Restorative Justice in the Aftermath of a Mining Disaster

There is now considerable evidence that there is a better means than retribution in meeting the legitimate needs of victims or their families and communities for justice in the aftermath of a disaster: restorative justice.

John Braithwaite, who pioneered this approach, argues with considerable empirical support that approaches to regulation that seek to identify important problems and fix them work better than those which focus on imposing the right punishment or 'just desserts'. For example, as was argued in the previous section, beyond a very limited range of circumstances, retribution does not 'work well', both because it is widely perceived to be unfair and because it has counter-productive consequences for prevention.

Yet at the same time, if prevention trumps prosecution and retribution is rejected, then the legitimate concerns of victims and their families for justice, may be ignored. Braithwaite recognises this, and suggests that there is a need for others to 'listen to the stories of our hurts' before we can move on to solve the problem. In his view, restorative justice is 'a process whereby all the parties with a stake in a particular offence come together to resolve collectively how to deal with the aftermath of the offence and its implications for the future' thus showing us the practical paths for moving from healing to problem solving.[109]

Now is not the place for a detailed analysis of restorative justice, but it is apposite to draw from Braithwaite's own work on the enforcement of coal mine safety in the USA, to suggest the specific application of restorative justice techniques in the mining context. Braithwaite argues that what is needed is the creation of restorative justice mechanisms such as community conferences in which workers, victims and their families participate with management (including senior management) in a dialogue about what went wrong and what should be done to make sure it never happens again. He points to the experience in British pits where he found that safety leaders were companies that 'not only thoroughly involve everyone concerned after a serious accident to reach consensual agreement on what must be done to prevent recurrence but also did this after 'near accidents' as well as discussing safety audit results with workers even when there was no near accident.' He concludes:

> After mine disasters… so long as there had been an open public dialogue among all those affected, the families of the miners cared for, and a credible plan to prevent recurrence put in place, criminal punishment served little purpose. The process of the public inquiry and helping the families of the miners for whom they were responsible seemed such a potent general deterrent that a criminal trial could be gratuitous and might corrupt the restorative justice process that I found in so many of the thirty-nine disaster investigations I studied.[110]

In terms of the themes of this article, Braithwaite also connects the role of restorative justice with the enforcement pyramid. He argues that what persuades offenders to participate in restorative justice dialogues and processes at lower levels of such a pyramid is their awareness that the alternative is escalation to more punitive responses.[111] In his view 'offenders who know that they will benefit from … mercy so long as they participate in a high-integrity process of truth-seeking and take active responsibility for the hurts they have caused can help us to learn from the truth they tell'.[112] The result is that by persuading offenders to embrace restorative justice techniques in the lower parts of the pyramid, future preventative safety is substantially enhanced and the need for retribution obviated.

5. Conclusion

This article, which is part of a broader project on regulation and enforcement in the mining industry, has sought to identify a number of principles relating to prosecution policy that would achieve more effective OHS outcomes. In particular, it has sought to steer a middle path that neither rejects prosecution as an important deterrent at the top of the enforcement pyramid, nor uses it in circumstances where it is likely to do more harm than good.

Achieving such a balanced approach is not easy. On the one hand, the evidence suggests that the sort of extreme 'advise and persuade' policy that the Queensland and Western Australian inspectorates have favoured will fail to send appropriate deterrent signals to the recalcitrant. On the other hand, the sort of zealous prosecution policy that New South Wales has applied to fatalities will also fail in preventative terms. As we have seen, vengeful prosecution against those who neither intended harm nor were reckless in their behaviour (epitomised in the Gretley decision) is widely perceived to be unjust, and this has caused the law to lose its legitimacy in the eyes of duty holders. It has also generated a defensiveness on the part of duty holders that results in an unwillingness to examine the root causes of accidents and incidents for fear of being prosecuted.

This article has proposed an alternative approach to prosecution which (i) focuses on risk rather than consequences; (ii) which takes previous track record seriously (and makes escalation up an enforcement pyramid credible); and (iii) which emphasises that prosecution should not take place in the absence of culpability. For these purposes, it has been argued that culpability should mean a substantial falling short of reasonable expectations (a form of negligence), recklessness or intent. The actual decision to prosecute, it has been suggested, should be based on a calculus which takes account of all three of the above factors.

This approach would ensure that prosecution takes place even where no injury results (exposure to risk, irrespective of consequences, being at the heart of OHS regulation). It would also enable the inspectorate to target failures of risk management, and on general patterns of failure to attend to risk despite warnings, while also reserving the right to take action in the absence of poor past

history if there was high culpability (intent or recklessness) coupled with a high degree of risk or potential for extreme consequences. Such an approach would do much to restore legitimacy to the prosecution process, whilst ensuring that serious breaches of OHS legislation, and those who did not give serious attention to complying with OHS law, were firmly dealt with.

This approach need not imply the need for multiple prosecutions, because the literature suggests that a distinction must be made between the actual chances of detection and punishment, and the perceptions thereof. What is important is the belief that duty holders have of the likelihood and degree of punishment, even if, in actual fact, that belief is overstated.[113] Even a handful of prosecutions in the course of a year can achieve this effect provided the 'right' cases are chosen. That handful of prosecutions will, however, play a crucially important role at the tip of an enforcement pyramid, for without them less coercive policies at the lower levels of the pyramid lose their credibility.

The argument so far has assumed that the principal role of prosecution is as an instrument for achieving prevention, and that it will achieve this outcome largely because of its capacity to provide an effective deterrent. Against this, it might be argued that deterrence does not apparently work across the board, and that it is not necessary in all cases. However, this is not an argument against the need for prosecution, but rather for targeting it to circumstances and actors where it is most likely to be effective. Because the calculus approach described above pays particular attention to track record, it is well equipped to achieve such targeting. It is particularly important that it does so because prosecuting those who aspire to go beyond compliance rather than reluctant compliers or the recalcitrant, can be particularly counter-productive. The incompetent (usually small and medium sized enterprises) present particular problems because prosecution is not well suited to bring about basic levels of competence. On the other hand, license removal for the seriously incompetent, is a strategy well justified in preventative terms.

Finally, it has been suggested that prevention and retribution are not comfortable bedfellows. Prevention is instrumental, while retribution is moral, expressive and symbolic. Sometimes, what satisfies calls for retribution will be antithetical to prevention. Certainly there are circumstances where retribution is appropriate, namely egregious breach coupled with severe consequences

(especially death). If the use of retribution is confined to these circumstances then it can co-exist comfortably with prevention. If it is extended beyond them, it cannot. The Gretley decision was used to illustrate precisely this point. In circumstances such as Gretley, where the degree of culpability of the defendants was low, then the legitimate concerns of victims, their families, and communities can more constructively be addressed through applying the techniques of restorative justice.

An optimal prosecution policy must take account of all the above factors and achieve a trade off between competing considerations, and in some circumstances it must choose between prevention and deterrence. Implementing such a policy, particularly in the emotionally charged atmosphere of the mining industry will not be easy. On the other hand, the adverse implications for preventative safety of the prosecutorial status quo, suggest that there is no credible alternative.

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Endnotes

1 NSW Department of Mineral Resources, *Gretley Inquiry Report*: *Final Report* (1998) ('Gretley Report').

2 Formerly the Department of Mineral Resources.

3 NSW Department of Primary Industry, *The Enforcement of Health and Safety Standards in Mines* (1999) <http://www.dpi.nsw.gov.au/__data/assets/pdf_file/82612/Enforcement-of-Health-and-Safety-Standards-in-Mines.pdf> accessed 2 August 2007.

4 The Investigation Unit was established following the recommendations of the 1997 Mine Safety Review (ACIL 1997) but it was the *Gretley Report*, above n2, that promoted a reconsideration of the role of prosecution, particularly of individuals. The Unit is also responsible for investigating a range of 'prescribed matters'. See NSW Department of Mineral Resources, *The Investigative Unit – general facts* (2005) <http://www.minerals.nsw.gov.au/_data/page/22/Investigations_Unit_FINAL.pdf> accessed 20 October 2006.

5 On the different perspectives relating to the criminalisation of organisational conduct causing the deaths of workers, see the special issue of the Flinders Journal of Law Reform: 'Industrial Manslaughter' (2005) 8 *FJLR* at 1–113; See also Neil Foster, 'Manslaughter by Managers: The Personal Liability of Company Officers for Death flowing from Company Workplace Safety Breach' (2006) 9 *Flinders Journal of Law Reform* at 79–111.

6 Australian Chamber of Commerce and Industry, *Modern Workplaces: Safety Workplaces – An Industry Blueprint for Improving OHS in Australia* (2005) <http:www.acci.asn.au/text_files/review/r123.pdf> accessed 19 October 2006.

7 Id at 3.

8 For a nuanced historical account of the evolution of present enforcement practices and the relationship of OHS offences to the 'read' criminal law, see W G Carson, 'The Conventionalisation of Early Factory Crime' (1979) 7 *International Journal of Sociology of Law* 37. See also Neil Gunningham & Richard Johnstone, *Safeguarding the Worker* (1984) at Chapter 4.

9 Keith Hawkins, *Law as Last Resort: Prosecution Decision Making in a Regulatory Agency* (2002) at 416–417.

10 Principles for more effective OHS prosecutions, with a somewhat different focus (how to create a 'big stick' at the apex of an enforcement pyramid) were proposed in Neil Gunningham & Richard Johnstone, above n9, at Chapter 8.

11 Gretley Report above n2 at 694.

12 In the absence of public records for much of this period I am indebted to information provided by Graham Terrey, former Chief Inspector of Mines, Department of Mineral Resources, NSW.

13 CFMEU National Office, *Submission to the NSW Review of Mine Safety* (2004) at 71 <http://www.cfmeu.asn.au/ > accessed: 19 October 2006.

14 *McMartin v. Newcastle Wallsend Coal Company Pty. Ltd., and other matters* [2004] NSWIRComm 202.

15 *Newcastle Wallsend Coal Company Pty. Ltd., and Ors v. McMartin* [2006] NSWIRComm 339.

16 *Morrison v. Powercoal Pty. Ltd.,* [2004] NSWIRComm 297.

17 See for example, *Morrison v. Peter Dale Ross; Morrison v. Glennies Creek Coal Management Pty. Ltd.,* [2006] NSWIRComm 205.

18 See for example *Department of Mineral Resources (Chief Inspector McKensey) v. Berrima Coal Pty. Ltd., & Anor* [2001] NSWIRComm 130; *Rodney Morrison v. Powercoal Pty. Limited* [2002] NSWIRComm 298; *Rodney Morrison v. Tahmoor Coal Pty. Ltd.,* [2003] NSWIRComm 327; *Rodney Dale Morrison v. Coal Operations*

Australia Limited [2004] NSWIRComm 239; *Morrison v. Powercoal Pty. Ltd.,* [2003] NSWIRComm 342; *Morrison & Powercoal Pty. Ltd., & Anor (No 3)* [2005] NSWIRComm 61; *Rodney Morrison v. Tecrete Industries Pty. Ltd.,* [2003] NSWIRComm 371; *Rodney Morrison v. Anglo Coal (Dartbrook Management Pty. Ltd.,)* [2003] NSWIRComm 397; *Rodney Morrison v. Gregory Alan Gardner* [2003] NSWIRComm 440; *Rodney Morrison v. Waratah Engineering Pty. Limited* [2004] NSWIRComm 38; *Rodney Morrison v. Akula Pty. Limited., formerly known as RaiseBore Australia* [2004] NSWIRComm 41; *Inspector Morrison v. Cumnock No 1 Colliery Pty. Ltd.,* [2004] NSWIRComm 151; *Morrison v. Wambo Coal Pty. Ltd.,* [2004] NSWIRComm 189**;** *Rodney Morrison v. Eureka Opals Pty. Limited.,* [2005] NSWIRComm 437; *Morrison v. Glennies Creek Coal Management Pty. Ltd., and anor* [2006] NSWIRComm 205.

19 That this is the current policy, was made clear by the NSW Chief Inspector, in evidence before the Gretley Inquiry, above n2.

20 See further pp 23–25 below.

21 See for example, Queensland Government Natural Resources Mines and Water, *Queensland Mines and Quarries Safety Performance and Health Report* (2004–2005) <http://www.nrm.qld.gov.au/mines/publications/safety_health/mqsafe05.html> accessed 18 October 2006.

22 'Prosecutions Following Mining Fatality' *Minesafe News* 15 Dec. 2004 <http://minesafe.org/minesafe_news> accessed 10 Nov. 2005> accessed 18 October 2006.

23 See generally Lisa Mathews, 'OHS Crime Seen as 'lesser' Offence?' 42 *Inside OHS* at 42.

24 Mark Ritter, *Ministerial Inquiry Occupational Health and Safety Systems and Practices of BHP Billiton Iron Ore and Boodarie Iron Sites in Western Australia and Related Matters* (2004) <http://www.premier.wa.gov.au/docs/features/BHP_Ministerial_Inquiry_Vol1.pdf> accessed 13 December 2006 ('*Ritter Report*'). Note the power to issue directives under Section 22 of MSIA to mine management to take certain corrective actions or to stop unsafe activity/equipment and withdraw persons from potentially hazardous areas. Directives are recorded in Mine Record Books and in the Mine Record Book database.

25 Id at Appendix 4.

26 Michelle Lam, 'BHP Fine Alerts WA Mining Sector' (2006) *Occupational Health News* 692 at 1.

27 Robert Laing, *Review of the Mines Safety and Inspection Act 1994: Final Report* (2004) ('*Laing Report*').

28 The Gretley Report, above n2; Ritter, above n25 at Appendix 4; Neil Gunningham, 'Negotiated Non-compliance: A Case Study of Regulatory Failure' (1987) 9 *Law and Policy* 69–87.

29 Richard Johnstone, *From Fiction to Fact – Rethinking OHS Enforcement* (Working Paper No 11, National Research Centre for Occupational Health and Safety Regulation, 2003) at 5–7 available: <www.ohs.anu.edu.au> accessed 20 December 2006.

30 See generally The Ritter Report, above n25 and Queensland ACIL Tasman, *Queensland Mines Inspectorate Review: Final Report* (2005).

31 Department of Consumer and Employment Protection (WA) *Resources Safety Enforcement and Prosecution Policy* (2005) available at <http://www.docep.wa.gov.au/ResourcesSafety/Sections/Generic_PDFs/RS_Generic_EnforcProsec_policy_16Nov05.pdf> accessed 20 December 2006.

32 Natural Resources and Mines (Qld), *Compliance Policy* (2001) available at <http://www.minesafe.org/library/files/compliance_policy.pdf> accessed 23 January 2007; currently under review – Natural Resources and Mines (Qld), *Reforms to the Queensland Mines Inspectorate* (2005) available at <http://www.nrw.qld.gov.au/mines/inspectorate/pdf/reforms_inspectorate.pdf> accessed 23 January 2007.

33 Ritter, above n25.

34 Ian Ayres & John Braithwaite, *Responsive Regulation*: *Transcending the Deregulation Debate* (1992).

35 Under this strategy, the regulatory agency approaches each firm in a cooperative, flexible manner, but turns to punishment if and when the firm clearly defects from cooperation. Once the firm begins to cooperate again, the agency does so too. It should be noted that the enforcement pyramid is based on a repeat player prisoner's dilemma, under which the regulator's response (up or down the pyramid) depends upon the previous response of the regulatee.

36 Colin Scott, 'Regulation in the Age of Governance: The Rise of the Post Regulatory State' in Jacinta Jordana & David Levi-Faur (eds), *The Politics of Regulation: Institutions and Regulatory Reforms for the Age of Governance* (2004). A central criticism is that the enforcement pyramid is based on game theory and in particular on a repeat player prisoner's dilemma (or in simplistic terms, a 'tit-for tat' approach). See also Ayres & Braithwaite, above n35 at Chapters 2 and 3. Note in many regulatory contexts, encounters between regulators and regulated are so infrequent as to make such an approach implausible. This is not the case in the mining industry, where in relation to larger mine sites at least such regulatory encounters take place on a regular and routine basis.

37 For an overview see Gunningham, above n29 at 69.

38 See generally Gunningham and Johnstone, above n9 at Chapter 4; Hawkins, above n10.

39 Johnstone, above n30 at 9.

40 As regards the NSW mines inspectorate, see in particular Gunningham, above n41.

41 Significantly, a rise in the incidence of fatalities and major injuries in the UK in the first half of the 1980s occurred at a time when inspection and enforcement activity fell significantly, due to a combination of increased workload and staff cuts. Phil James, 'Reforming British Health and Safety Law: A Framework for Discussion' (1992) 21 (2) *Industrial Law Journal* 87 at 97. For an Australian critique, documenting the failure of this approach in New South Wales, see Gunningham, above n41.

42 See generally Industry Commission, *Work, Health and Safety – An Inquiry into Occupational Health and Safety,* Report No. 47 (1995).

43 *Laing Report,* above n28 at 771.

44 *Ritter Report,* above n25 at Appendix 4.

45 ACIL (1997) *Final Review of Mine Safety in NSW*, A Report to the Minister for Mineral Resources and Fisheries, ACIL Tasman, New Horizon Consulting Pty. Ltd., Shaw Idea Pty. Ltd.

46 Richard Johnston, *Review of Mine Safety in NSW* (1997).

47 Steve Tombs, 'Law, Resistance and Reform' (1995) 4 *Social and Legal Studies* at 343–365.

48 See for example Robert Baldwin & Richard Anderson, *Rethinking Regulatory Risk* (2002) at 11; Wayne Gray & John Scholz, 'Analysing the Equity and Efficiency of OHS Enforcement' (1991) 3 *Law and Policy* 3 at 185.

49 A distinction is made between general deterrence (premised on the notion that punishment of one enterprise will discourage others from engaging in similar proscribed conduct) and specific deterrence (premised on the notion that an enterprise that has experienced previous legal sanctions will be more inclined to make efforts to avoid future penalties). See generally Sally Simpson, *Corporate Crime and Social Control* (2002).

50 See generally Gunningham & Johnstone 1999, above n9 at Chapter 6.

51 Michael Wright, 'Building an Evidence Based Case for the Health and Safety Commission Strategy to 2010', *Health and Safety Executive Research Report* (2004) at 196.

52 Eugene Bardach & Robert A Kagan, *Going By The Book: The Problem of Regulatory Unreasonableness* (1982); Robert Kagan, *Adversarial Legalism: The American Way*

of Law (2001); John Scholz, 'Voluntary Compliance and Regulatory Enforcement' (1984) 6 *Law and Policy* 385; Andrew Hopkins, 'The Gretley Coal Mining Disaster: Reflections on the Finding that Mine Managers Were to Blame' *National Research Centre for OHS Regulation Working Paper 39* (2005).

53 See for example *Submission from the Mine Managers Association of Australia to the Mine Safety Review* (2004) at 9. However, there is as yet, little empirical support for this assertion.

54 Fiona Haines, *Corporate Regulation: Beyond Punish and Persuade* (1997). However, see also Robyn Fairman & Charlotte Yapp, 'Enforced Self-Regulation, Prescription and Conceptions of Compliance within Small Businesses' (2005) 27 *Law and Policy* 4 – this suggests SMEs are rational and that until they are detected their conception of compliance allows them to feel compliant, therefore, being deterred from non-compliance is irrelevant.

55 See Neil Gunningham, *Shades of Green: Business, Regulation and Environment* (2003).

56 See John Braithwaite, 'Restorative and Responsive Regulation of OHS' in Elizabeth Bluff (ed), *OHS Regulation for a Changing World of Work* (2004).

57 Bardach & Kagan, above n53.

58 Much greater impact is likely to be achieved by the strategic (and relatively frequent) use of administrative penalties, improvement and prohibition notices and on the spot fines at in the lower reaches of the pyramid. See Wayne B Gray & John T Scholz, 'OHSA Enforcement and Workplace Injuries: A Behavioural Approach to Risk Assessment' (1990) 3 *Journal of Risk & Uncertainty* 283.

59 Ken Phillips Monday, 'The Politics of a Tragedy: The Gretley Mine Disaster and NSW OHS', *Occasional Paper* (2006).

60 Neil Gunningham, 'Safety, Regulation and the Mining Industry' (2006) 19 *Australian Journal of Labour Law* 30.

61 See for example *Chugg v. Pacific Dunlop Ltd.,* [1988] VR 411 at 414–416; Richard Johnstone*, Occupational Health and Safety Law and Policy* (2004a) at Chapter 4.

62 See *Bankstown Foundry Pty. Ltd., v. Braistina [1986] HCA 20;* (1986) 160 CLR 301.

63 Kit Carson & Richard Johnstone, 'The Dupes of Hazard: Occupational Health and Safety and the Victorian Sanctions Debate' (1990) 26 *Australian and New Zealand Journal of Sociology* 126.

64 Ron McCallum, 'Advice in Relation to Workplace Death, Occupational Health and Safety Legislation and Other Matters', *Report to the WorkCover Authority of New South Wales* (2004) at 10, *available* at http://www.workcover.nsw.gov.au/NR/rdonlyres/CA20497D-E6E8-4CDA-8649-D58A691E51B9/0/final_report_4481.pdf accessed 23 February 2007.

65 Andrew Hopkins, *An Evaluation of Certain Criticisms of the NSW OHS Act*, Working Paper 40, National Research Centre for Occupational Health and Safety Regulation at 7 <http://www.ohs.anu.edu.au/> accessed 18 December 2006.

66 Australian Chamber of Commerce and Industry, *Modern Workplace: Safer Workplace – An Industry Blueprint for Improving OHS in Australia* (2005) at 21 *available* <http://www.acci.asn.au/text_files/review/r123.pdf> accessed 20 December 2006.

67 See generally Elizabeth Bluff & Richard Johnstone, 'The Relationship Between "Reasonably Practicable" and Risk Management Regulation' (2005) 18 *Australian Journal of Labour Law* 197.

68 *McMartin v. Newcastle Wallsend Coal Company Pty. Ltd.,* [2005] NSWIRComm 31; *Newcastle Wallsend Coal Company Pty. Ltd., and Ors v. McMartin* [2006] NSWIRComm 339.

69 James Reason, *Managing the Risks of Organisational Accidents* (1997) at 198.

70 Id at 195.

71 Ibid.

72 Reason, above n70 at 199.

73 Health and Safety Executive, *Enforcement Management Model* (2002) <http://www.hse.gov.uk/enforce/emm.pdf> accessed 18 December 2006.

74 Id at 34.

75 Ibid.

76 Health and Safety Executive, above n74 at 7.

77 Neil Gunningham & Richard Johnstone, *Regulating Workplace Safety: Systems and Sanctions* (1999) at 206.

78 Id at Chapter 6.

79 Reason, above n70 at 195.

80 Andrew Hopkins, 'The Gretley Coal Mine Disaster: Reflections on the Finding that Mine Managers were to Blame' (Working Paper No 39, National Research Centre for Occupational Health and Safety Regulation, Australian National University, 2005) at 11, available at <http://www.ohs.anu.edu.au/> accessed 19 December 2006.

81 Natural Resources and Mines, above n33 at 3.

82 ACIL (2005) *Final Report on the Queensland Mines Inspectorate Review*, ACIL Tasman, New Horizon Consulting Pty Ltd, Shaw Idea Pty. Ltd., at 28–30.

83 *Haynes v. CI and D Manufacturing Pty. Ltd.,* [1995] 60 IR 149 at 158–159.

84 Johnstone, above n30 at 5 – 7.

85 Gunningham & Johnstone, above n78 at 212.

86 Id at 213.

87 McCallum, above n65.

88 Andy Hall, Richard Johnstone & Alexa Ridgway, 'Reflection on Reforms: Developing Criminal Accountability for Industrial Deaths' (Working Paper No 26, National Research Centre for Occupational Health and Safety Regulation, Australian National University, 2004) available at <http://www.ohs.anu.edu.au/> accessed 19 December 2006.

89 Ibid. See also Foster, above n6 at 79.

90 See Foster, above n6 at 107–110.

91 Carson & Johnstone, above n64 at 81.

92 Andrew Hopkins, *Making Safety Work: Getting Management Commitment to Occupational Health and Safety* (1995a) at 130.

93 See for example, Queensland Department of Mines and Energy and the Queensland Mining Council, *Safety and Health Management for Queensland Mines and Quarries: Information Paper* (1998) at 8.

94 *McMartin v. Newcastle Wallsend Coal Company Pty. Ltd.,* [2005] NSWIRComm 31 at 895

95 See for example *Department of Mineral Resources v. Berrima Coal Pty. Ltd.,* [2001] NSWIR Comm 130.

96 *Occupational Health and Safety Act* 2000 (NSW) S 26(1).

97 *Occupational Health and Safety Act* 2000 (NSW) S 26(1)(b); for a detailed analysis see Foster, above n6 at 79.

98 *Occupational Health and Safety Act* 2000 (NSW) S 26(1)(a).

99 [2006] NSWIRComm 323.

100 McCallum, above n65 at 56.

101 Id at 58.

102 *Coal Mining Safety and Health Act* 1999 (Qld) S 33.

103 See *Coal Mine Health and Safety Act* 2002 (NSW) S 37.

104 For an alternative approach see Gunningham & Johnstone, above n78 at 33; See also Andrew Hopkins, 'Holding Corporate Leaders Responsible' (Working Paper No 48, National Research Centre for Occupational Health and Safety Regulation, Australian National University, 2006) available at <http://www.ohs.anu.edu.au/> accessed 19 December 2006.

105 Gunningham & Johnstone, above n78 at 194.

106 S Kruse & P Wilkinson, 'A Brave New World: Less Law, More Safety?' *Paper delivered to New South Wales Minerals Council Health and Safety Conference, 15–18 May 2005* (Leura, NSW) at 5.

107 Dan Dobbs, 'Ending Punishment in "Punitive" Damages: Deterrence Measured Remedies' (1989) 40 *Alabama Law Review* 831 at 844.

108 Andy Hall, Richard Johnstone & Alexa Ridgway, 'Reflection on Reforms: Developing Criminal Accountability for Industrial Deaths' (Working Paper No 26, National Research Centre for Occupational Health and Safety Regulation, Australian National University, 2004), available at <http://www.ohs.anu.edu.au/> accessed 19 December 2006.

109 Tony Marshall in John Braithwaite, *Restorative Justice and Responsive Regulation* (2002) at 11.

110 Id at 64.

111 Id at 298.

112 Id at 29.

113 Simpson, above n50.

6

Coal Mine Safety and Health

*Linda Levine**

Safety in the coal mining industry is much improved compared to the early decades of the twentieth century. Fatal injuries associated with coal mine accidents fell almost continually between 1925 and 2005. In 2006, however, the number of fatalities more than doubled to 47. In spite of moderate coal mine accidents, miners suffer from occupationally caused diseases. Prime among them is black lung (Coal Workers' Pneumoconiosis, CWP), which still claims about 1,000 fatalities annually. MSHA standard-setting activity evolved into a new form after the enactment of the Mine Improvement and New Emergency Response Act (MINER, P.L. 109-236). It emphasized on the factors that have played a role in the Sago disaster (e.g., emergency oxygen supplies, post-accident communication and tracking systems, deployment of rescue teams) and imposed several rulemaking deadlines on MSHA. In January 2008, of the Supplemental Mine Improvement and New Emergency Response Act (S-MINER, H.R. 2768) has been enacted which incorporated language from the Miner Health Enhancement Act (H.R. 2769), which insists MSHA to adopt as mandatory exposure limits recommended by the National Institute for improving the Occupational Safety and Health standards.

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Introduction

News accounts of miners losing their lives as a result of accidents at coal mines have appeared more often in recent years. The methane explosion in 2006 at West Virginia's Sago mine, in which 12 trapped miners died, shined a bright light on working conditions at the nation's coal mines. The partial collapse in 2007 at Utah's Crandall Canyon mine further drew attention to the plight of coal miners. These among other incidents during the current decade have prompted Congress to step up its legislative and oversight activities with respect to the safety and health of those who toil in the country's coal mines.

This report begins by reviewing the record of working conditions in the coal mining industry. It then describes the regulatory regime and recent funding of the US Department of Labor's Mine Safety and Health Administration. The report closes with an analysis of current regulatory and legislative initiatives.

Working Conditions in the Coal Mining Industry Safety

Safety in the coal mining industry is much improved compared to the early decades of the twentieth century, a period in which hundreds of miners could lose their lives in a single accident and more than 1,000 fatalities could occur in a single year. Fatalities associated with coal mine accidents fell almost steadily between 1925 and 2005, when they reached an all-time low of 23.[1]

Nevertheless, coal mining remains one of the most dangerous employment sectors as measured by fatal work injuries. The fatality rate among persons employed in the private sector was 4.2 per 100,000 workers in 2006, the latest year for which data are available from the US Bureau of Labor Statistics, compared to 49.5 fatalities per 100,000 workers in coal mining.[2] In terms of non-fatal accidents, mining does not diverge greatly from the all-industry average.[3] In what follows, then, the concentration is on fatal accidents.

A variety of factors may have contributed to the long-term improvement in safety at the nation's coal mines (e.g., decreased employment, shift from underground to surface mining, and increased productivity). New machinery such as longwall systems not only reduced the total number of workers needed, but also did so at the most dangerous spots (e.g., the active cutting face). Other

measures that likely have prevented many large-scale accidents include controlling coal dust, monitoring methane gas (which is both explosive and poisonous), adequately supporting roofs, and avoiding spark-producing equipment.[4]

It would be very difficult to determine conclusively how much of the progress in safety has been due to the activities of the Mine Safety and Health Administration (MSHA). Much of the industry might have voluntarily adopted the safety requirements in MSHA standards (regulations) without that inducement. And indeed, safety increased for a long time before Congress passed the Federal Mine Safety and Health Amendments Act of 1977 (P.L. 95-164) in which MSHA was established within the Department of Labor.[5]

Despite the progress that has been made in worker safety and their disagreement on the specific course of action to be followed,[6] labor and management concur that there is still room for improvement – especially in light of incidents that occurred in the current decade. For example, the flooding of the Quecreek Mine in Pennsylvania in July 2002 raised questions about the accuracy of underground mine maps and their availability to operators of nearby mines. The Quecreek accident might have been avoided if the mine operator had access to the final map of a nearby abandoned mine that had since filled with water.

In January 2006, a methane explosion at West Virginia's Sago mine, which was precipitated by lightning that penetrated underground, killed one miner initially. Twelve of the 16 miners who survived the explosion became trapped and succumbed ultimately to carbon monoxide from the ensuing fire. The episode raised a number of safety issues that were discussed at a hearing of the Senate Appropriations Subcommittee on Labor, Health and Human Services, Education, and Related Agencies in January 2006, including the possibility that different communication and tracking devices might have enabled the trapped miners to escape or find better refuge, or rescuers to reach them more quickly. In addition, emergency breathing apparatus issued to the miners were rated for only one hour and a number of the apparatus reportedly did not work well. There also was criticism of the fact that it took 11 hours from the explosion until rescuers entered the mine.[7]

Accidents at Sago and other coal mines in 2006 more than doubled the number of fatalities from the record low of 23 in 2005, to 47 in 2006 – a level last reached in 1995. (See **Table 1.)** In 2007, however, fatal work injuries declined to 33 – a level comparable to those of the late 1990s.

Table 1: Number of Fatalities and Fatal Injury Rate in the Coal Mining Industry, 1995-2007

Year	Number of Fatalities	Fatal Injury Rate (Reported Injuries per 200,000 Hours Worked)
1995	47	0.04
1996	39	0.03
1997	30	0.03
1998	29	0.03
1999	35	0.03
2000	38	0.04
2001	42	0.04
2002	27	0.03
2003	30	0.03
2004	28	0.03
2005	23	0.02
2006	47	0.04
2007	33	0.03

Source: US Department of Labor, Mine Safety and Health Administration.

Despite this one-year improvement, the collapse of a Section of Utah's Crandall Canyon mine in August 2007 – which resulted in deaths of six miners and three rescuers (including an MSHA inspector) and injuries sustained by six others – again highlighted the risks of working in the coal mining industry. Rescuers repeatedly sent messages on pager-like devices to the trapped miners, but it is unknown whether they ever were received. As mentioned in connection with the Sago tragedy, other technologies might have allowed communication with and location tracking of the miners.

Health

Accidental injuries can be quantified much more reliably than the extent of occupationally caused disease. It is clear, though, that coal mining causes disability much more by way of long-latency disease than by traumatic injury. Prime among these diseases is black lung (coal workers' pneumoconiosis, CWP), which still claims some 1,000 fatalities per year despite being down by about half since 1990.[8] Deaths tend to occur after a long progression, resulting in one year of life expectancy being lost on average for these cases. However, many years of impaired breathing and debilitating weakness often precede death, which may not be counted as a mining-related fatality because the ill miner dies from other immediate causes.

Improved dust control requirements have led to a decrease in the prevalence of CWP. Among miners with 20-24 years of work experience, for example, the proportion of examined miners who had positive x-rays decreased from 23.2% in the mid-1970s to 2.2% in the late 1990s.[9] Interestingly, sharp drops in rates occurred at certain times: for workers with 25-29 years of mining experience, the rate fell from 20.2% in the 1987-1991 survey to 5.4% in the 1992-1996 survey; the former cohort began their careers around 1962, the latter around 1967. Under the Federal Coal Mine Health and Safety Act of 1969 (P.L. 91-173), commonly referred to as the Coal Act, tighter dust standards were phased in from 1970 to 1973.

During the current decade, however, the US Department of Health and Human Services' Centers for Disease Control and Prevention (CDC) found advanced cases of CWP among underground miners younger than 50 to be particularly troubling because they were exposed to coal dust after the preventive measures in the Coal Act went into effect. The CDC suggested four explanations for the continuing development of advanced pneumoconiosis:

> (1) inadequacies in the mandated coal-mine dust regulations; (2) failure to comply with or adequately enforce those regulations; (3) lack of disease prevention innovations to accommodate changes in mining practices (e.g., thin-seam mining) brought about by depletion of richer coal reserves, and (4) missed opportunities by miners to be screened for early disease and take action to reduce dust exposure.[10]

The Regulatory Regime

MSHA is charged with overseeing the safety and health of those employed in coal and other mining industries. Its budget for FY2008 of about $334 million is less than that of its sister agency, the Occupational Safety and Health Administration (OSHA), but OSHA is responsible for protecting many more workers: MSHA oversees a mining industry (including surface operations and all other minerals besides coal) of about 200,000 workers, while OSHA is responsible for most of the more than 100 million employees in the remainder of the workforce. Thus, while OSHA targets its inspections mostly on firms with the worst accident records in a few sectors, MSHA is able to cover its whole industry. Indeed, it is mandated to inspect each underground mine at least four times a year and each surface mine twice a year. Both agencies can assess financial penalties, but MSHA has direct authority to immediately shut down dangerous operations.

MSHA regulations, often referred to as standards, cover a wide range of equipment, procedures, certifications and training including methane monitoring, dust control, ventilation, noise, electrical equipment, diesel engines, explosives, fire protection, roof support, hoists and haulage, maps, communications and emergencies. (See *Code of Federal Regulations,* Title 30, Chapter 1; coal mines are specifically addressed in Subchapter O.)

Safety

In the wake of the Sago accident in January 2006, the agency was criticized for its slow pace of rulemaking, allegedly withdrawing 18 proposed standards that had been pending as of January 2001.[11] The Administration said in response that it was pursuing a revised agenda,[12] and being more frank by no longer listing long-term projects on which little progress had been made.

MSHA rulemaking activity started to quicken later in 2006, however, after enactment in June of the Mine Improvement and New Emergency Response Act (MINER, P.L. 109-236). In December 2006, for example, a final rule on emergency mine evacuation went into effect that reconciled MSHA's emergency temporary standard with the new law. The final regulation includes requirements for increased availability and storage of breathing devices (self-contained

self-rescuers, SCSRs), installation and maintenance of escape guides ("lifelines") in underground coal mines, and immediate notification of accidents at all mines. In March 2007 (as opposed to the MINER act's deadline of December 2006), MSHA issued another final rule; it raises the civil penalties for all mine safety and health violations including those specified in the MINER act.

In addition, MSHA announced in late January 2008 its first approval of a wireless communications system. "Since 2006, MSHA has issued 36 new or revised approvals for communications tracking systems.... Currently, the agency is examining 41 additional communications and tracking applications, including other wireless systems."[13] The MINER act imposed a deadline (June 2009) for underground mine operators to adopt two-way wireless communications and electronic tracking systems. The act also set a deadline (December 2007) for MSHA to promulgate new requirements that mine operators must meet concerning rescue teams; in February 2008, MSHA issued a final rule that among other things mandates the number of hours of training for mine rescue team members.

Health

On the matter of preventing black lung and silicosis, MSHA is expressly required by its authorizing statute to enforce a dust control standard. The (mandatory) Permissable Exposure Limit (PEL) to respirable dust currently set by regulation is 2 milligrams per cubic meter. The National Institute for Occupational Safety and Health (NIOSH) developed a (voluntary) Recommended Exposure Limit (REL) for coal mine dust of 1 milligram per cubic meter and for silica dust of 0.05 milligrams per cubic meter.[14]

Besides the limit itself, controversy continues about how dust concentrations are measured in mines, and how MSHA monitors operators' plans and performance. After MSHA proposed new regulations in 2000 (superceded by revised proposals in March 2003), it suspended work on a final rule in June 2003 to obtain information on personal dust monitors (PDMs) that NIOSH was testing. PDMs are a new technology that can give personalized, real-time readings of dust concentration and help resolve longstanding disputes about how air samples are to be handled. In May 2007, Jeffrey Kohler, NIOSH's associate director for mining and construction safety, testified at a hearing of the Senate

Committee on Health, Education, Labor and Pensions' Subcommittee on Employment and Workplace Safety, that the institute's research showed miners equipped with PDMs were able to greatly reduce respirable dust exposure based on having real-time dosimetry. The firm that now has the rights to the PDM informed NIOSH that it could have the devices available within four to six months after rulemaking is completed.[15]

Funding

Congress increased MSHA's appropriation from $302 million in FY2007, to $334 million in FY2008. In response to rulemaking activity required in 2008 by Congress in the MINER act and other legislation, MSHA asked the Occupational Safety and Health Administration for volunteers to help develop standards. MSHA's Office of Standards, Regulations, and Variances develops standards for coal and other mining industries covered by the agency; it also processes petitions for modifications that are submitted to MSHA and administers the agency's Freedom of Information Act program. The office employs about 17 full-time equivalent employees.

The Administration has requested a somewhat lower sum, $332 million, for MSHA in FY2009. According to the agency's budget justification, the Administration attributes much of the $2 million net decrease ($20 million gross decrease) to the cost in FY2008 of hiring and training new coal mine inspectors and for overtime and travel of currently employed inspectors (almost $11 million). Only a small portion ($367,000) is associated with cessation of "one-time costs in FY2008 for service contracts pertaining to rule making related to the MINER Act."

Legislative Activity

The MINER Act

The legislative activity undertaken at both the state (e.g., West Virginia, Kentucky, and Illinois) and federal levels in 2006 emphasized factors thought to have played a part in the Sago mine disaster (e.g., emergency oxygen supplies, tracking and communication systems, deployment of rescue teams). The most prominent measure, and first major revision of federal mine safety legislation

since 1977, is the Mine Improvement and New Emergency Response Act (MINER, P.L. 109-236).[16] Congress passed the MINER act, and the President signed it into law on June 15, 2006, within a month of its introduction.

Among its major points that require action on the part of MSHA are:

- *Emergency response* (Section 2). Each mine is to have a plan approved by MSHA that addresses post-accident communications, tracking, and breathable air and lifelines; and sets procedures for coordination between operators, rescue teams, and local emergency response personnel.
- *Rescue teams* (Section 4). Each mine with more than 36 employees is required to have an employee on each shift knowledgeable about emergency response; two certified teams familiar with the mine available, who participate in rescue contests and training, within one hour from the rescue station. More flexibility is provided for smaller mines.
- *Penalties* (Section 8). Increases the scale and scope of penalties including imprisonment and fines up to $250,000 ($500,000 second offense) for willful violators of standards or orders, and a civil penalty of up to $220,000 per violation for a new "flagrant violation" category.
- *Sealing of abandoned mine areas* (Section 10). Increases the existing standard of 20 pounds per square inch pressure resistance.

Dissatisfaction has been expressed with the speed at which MSHA is implementing the statute. As a result, the Consolidated Appropriations Act, 2008 (P.L. 110-161), signed in December 2007, set deadlines for a proposed rule (June 20, 2008) and a final rule (December 31, 2008), consistent with the recommendations of the Technical Study Panel established by Section 11 of the MINER act, on the use of belt haulage entries to ventilate active working places.[17] P.L. 110-161 also directed the Secretary of Labor, within the same time frame, to propose and finalize regulations consistent with the recommendations of NIOSH, pursuant to Section 13 of the MINER act, requiring rescue chambers or equally protective rescue facilities in underground coal mines.

The S-MINER Act

At the time of the MINER act's passage, some Members characterized the law as only a "first step" that would be followed by more measures. In January 2008, the

House passed the Supplemental Mine Improvement and New Emergency Response Act (S-MINER, H.R. 2768) which incorporates language from the Miner Health Enhancement Act (H.R. 2769).

On the health front, Section 8 of the bill would require:

- NIOSH, within 30 days of enactment, to transmit to MSHA its Recommended Exposure Limits (RELs) for chemicals and other substances hazardous to miners; MSHA would then have up to 30 days from receipt of the RELs to adopt them as Permissable Exposure Limits (PELs);
- NIOSH to submit each year new or revised RELs, and DOL to adopt them within 30 days as PELs;[18] and
- MSHA to apply OSHA's asbestos standard to the mining industry within 30 days of the bill's enactment.[19]

An amendment to the bill also requires the Secretary of Labor to study and report on miner substance abuse issues that pose safety risks. Another amendment authorizes $ 10 million for the Secretary, in consultation with the Secretary of Health and Human Services, to award grants for provision of rehabilitation services to current and former miners suffering from mental health impairments.

Section 7 addresses another health issue, namely, respirable dust. H.R. 2768 would, effective on the date of enactment, have mine operators adopt NIOSH' s RELs of 1 milligram of respirable coal dust and 0.05 milligrams of respirable silica dust per cubic meter of air. To ensure that the coal dust standard is being met, MSHA and mine operators would have to sample the amount of dust in the mine atmosphere using Personal Dust Monitors (PDMs) that provide real-time information to the miners equipped with the devices. An amendment to the bill appropriates $30 million to the Secretary to buy PDMs for this purpose.

In light of the use of retreat mining in the 2007 Crandall Canyon tragedy, the bill contains provisions that address the practice.[20] For example, mine operators would be required to have a current pillar extraction or barrier reduction plan approved by MSHA before performing such activities; the Secretary must establish a special internal review process for plans involving miners working at depths of more than 1,500 feet; and the agency must more closely monitor implementation of these practices. The National Academy of Sciences, in

consultation with NIOSH, would be required to make recommendations within one year of enactment about ways to better protect miners during retreat mining and when working at great depths.

In addition to the retreat mining provisions in Section 4 of S-MINER, the Section revisits and supplements the emergency response provisions in the MINER act.

Among other things, MSHA would have to issue regulations in 2008 or 2009 concerning such safety issues as rescue chambers or other refuge designs recommended by NIOSH, survivable mine ventilation controls, flame resistant conveyor belts, and ventilation of active working places. H.R. 2768 similarly sets deadlines on mine operators related to such safety issues as post-accident communication and electronic tracking systems, a pre-shift communication program, and atmospheric monitoring of carbon monoxide levels.

Section 4 also would repeal Section 10 of the MINER act, which imposed a deadline (December 2007) for a final rule on sealing of abandoned mine areas. In its stead, S-MINER would require MSHA to issue a final rule on the matter not later than three months after enactment.[21] Section 4 would, as well, have the National Academy of Sciences (not later than one year from enactment) report on ways to protect miners from the risk of lightning strikes near mines; this was a factor in the Sago mine accident.

Section 5 of S-MINER focuses on enforcement authority. To ensure the agency has sufficient qualified and trained inspection personnel on board before current inspectors retire, the bill would abolish for five years any ceilings on the number of persons in the position. In addition, an office of miner ombudsman would be created in the Labor Department's Office of Inspector General. S-MINER also would permit in instances where a pattern of violations is found (1) assessment of a penalty beyond those already authorized and (2) withdrawal of all miners from an entire mine. The bill would raise the amount of some currently authorized penalties and establish a procedure for dealing with operators who fail to pay final assessments. The Secretary would be required to establish an advisory committee to recommend whether the government should license mines, their operators, and related personnel to guarantee they are not frequent violators of the 1977 statute.

Section 6 of H.R. 2768 addresses rescue, recovery and incident investigating authority. It includes a requirement that within 30 days of enactment a communications emergency call center be created for coal and other mine operations; it must be staffed and operated 24 hours a day 7 days a week by at least one employee of MSHA. Within six months of S-MINER's enactment, guidelines for rescue operations would have to be developed and disseminated; the guidelines must delineate lines of authority within MSHA and between the agency, the private sector and state responders so each can perform their respective responsibilities.

In addition to MSHA conducting all accident and incident investigations, Section 6 would authorize an independent investigation for incidents involving multiple injuries or deaths, or multiple entrapments. NIOSH would appoint team members. Not less than 30 days after its enactment, rulemaking would have to commence on the procedures to be followed in the conduct of independent investigations; rulemaking must be completed by October 1, 2008. However, the bill would not have these other investigations limit the investigative authority of the Chemical Safety and Hazard Investigations Board or the department's inspector general.[22]

Section 6 of H.R. 2768 also would strike Section 7 of the MINER act concerning family liaisons. In its place, S-MINER would have the Secretary designate a full-time permanent employee of MSHA to serve as a family liaison who will, at least in incidents involving multiple miners, serve as the primary communicator with the families of those miners.

A third amendment to H.R. 2768 created Section 9, which establishes a mine safety program fund. Into this account in the Treasury would be deposited mine safety civil penalties and private donations. Sums in the account would be available for mine safety inspections and investigations only.

The Administration's Position: The President has said he will not sign the bill if it arrives at his desk in its current form. When the House Education and Labor Committee was marking up S-MINER in late October 2007, the OSHA Fairness Coalition wrote the Committee to express its opposition to the legislation. It specifically was concerned that requiring MSHA to adopt NIOSH' s voluntary RELs as mandatory PELs would circumvent the participatory rulemaking process

because RELs do not go through a comparable public review.[23] In a statement of Administration policy issued when the House was preparing to vote on H.R. 2768, the Office of Management and Budget (OMB) similarly noted that "This provision would mandate the adoption of potentially hundreds of PELs without any input from stakeholders and without [prior] determination of whether the PEL is economically and technologically feasible."

The OMB further said in the statement of Administration policy that rulemaking already is underway as a result of other bills the President previously signed: H.R. 2768 would "overturn regulatory processes that were required by the MINER Act ... and would impose burdensome and unrealistic time requirements." Moreover, by allowing entities in addition to MSHA investigate certain accidents, S-MINER would, according to the OMB,

> undermine the government's ability to hold accountable mine operators who violate mine safety and health regulations since multiple investigations potentially using different methodologies and reaching different conclusions could prejudice the government's ability to prosecute civil or criminal violations of mine safety and health standards that contributed to, or exacerbated, an accident.

Related Legislation. S-MINER was referred to the Senate in January 2008. It joins S. 1655 (the Miner Health and Safety Enhancement Act of 2007) which was introduced on June 19, 2007, the same day as the initial version of the S-MINER act. While otherwise quite similar, S. 1655 does not contain the retreat mining provisions included in the substitute to H.R. 2768 that the Education and Labor Committee considered in November 2007 (after the Crandall Canyon incident had occurred). In addition, S. 1655 does not include the provisions in H.R. 2768 about a study of substance abuse and related rehabilitation grants (at Section 8), a mine safety program fund (at Section 9), and the appropriation for MSHA to purchase PDMs.

S-MINER also joins in the Senate H.R. 3877/S. 2263 (the Mine Communications Technology Innovation Act), which the House passed on October 29, 2007. H.R. 3877 would have the Director of the National Institute of Standards and Technology (NIST) establish a research, development and demonstration program to develop best practices, adapt existing technology, and

accelerate development of next generation technology and tracking systems for mine communications. The Department of Commerce's NIST also would coordinate with industry and relevant federal agencies to develop consensus standards for communications in underground mines.

Previously, the MINER act (Section 6) created within NIOSH an Office of Mine Safety and Health "to enhance the development of new mine safety technology and technological applications and to expedite the commercial availability and implementation of such technology in mining environments." The 2006 statute further states that the NIOSH office is "responsible for research, development, and testing of new technologies and equipment designed to enhance mine safety and health," and to carry out this responsibility has the authority to award grants to encourage the development and manufacture of mine safety equipment and to award contracts to perform product testing. Separately, the Emergency Supplemental Appropriations Act of 2006 (P.L. 109-234) awarded $10 million to NIOSH to target research into safety technologies specifically related to communications and tracking, among other things, that would be available for use in mines within 24-36 months.

NIOSH, which is part of the CDC, has organized a Mine Emergency Communications Partnership "to facilitate the development, evaluation, and implementation of" post-accident communication and tracking technologies. The partnership initially has focused on applications suited for coal mines. Its members, who include mining associations, unions, state and federal regulatory agencies, equipment manufacturers, and researchers, "are expected to share their knowledge of, and experiences with, communication and tracking systems and provide mine sites where tests and demonstrations of communication and tracking systems can be conducted."[24] MSHA notes that it has been working with this NIOSH partnership to help arrange field tests of new communication and tracking technologies, which could enable mine operators to meet the MINER act's June 2009 deadline for inclusion in MSHA-approved plans of wireless two-way post-accident communication devices and electronic tracking technologies.[25]

Summary

Safety in the coal mining industry is much improved compared to the early decades of the twentieth century, a time when hundreds of miners could lose their lives in a single accident and more than 1,000 fatalities could occur in a

single year. Fatal injuries associated with coal mine accidents fell almost continually between 1925 and 2005, when they reached an all-time low of 23. As a result of 12 deaths at West Virginia's Sago mine and fatalities at other coal mines in 2006, however, the number of fatalities more than doubled to 47. Fatalities declined a year later to 33, which is comparable to levels achieved during the late 1990s.

In addition to the well above-average fatal injury rates they face, coal miners suffer from occupationally caused diseases. Prime among them is black lung (coal workers' pneumoconiosis, CWP), which still claims about 1,000 fatalities annually. Although improved dust control requirements have led to a decrease in the prevalence of CWP, there is recent evidence of advanced cases among miners who began their careers after the stronger standards went into effect in the early 1970s. In addition, disagreement persists over the current respirable dust limits and the degree of compliance with them by mine operators.

In the wake of the January 2006 Sago mine accident, the US Department of Labor's Mine Safety and Health Administration (MSHA) was criticized for its slow pace of rulemaking earlier in the decade. MSHA standard-setting activity quickened starting later that year, however, after enactment in June of the Mine Improvement and New Emergency Response Act (MINER, P.L. 109-236). The MINER act, the first major amendment to federal mine safety law since 1977, emphasized factors thought to have played a role in the Sago disaster (e.g., emergency oxygen supplies, post-accident communication and tracking systems, deployment of rescue teams) and imposed several rulemaking deadlines on MSHA. Accordingly, the agency published final regulations on emergency mine evacuation in December 2006, civil penalties in March 2007, and rescue teams as well as asbestos exposure in February 2008.

Some policymakers remain dissatisfied with MSHA's performance. These sentiments most recently led to House passage, in January 2008, of the Supplemental Mine Improvement and New Emergency Response Act (S-MINER, H.R. 2768). It incorporates language from the Miner Health Enhancement Act (H.R. 2769), such as requiring MSHA to adopt as mandatory exposure limits the voluntary limits (to chemical hazards, for example) recommended by the National Institute for Occupational Safety and Health. S-MINER also requires

MSHA to more closely review and monitor operator plans that include retreat mining, the practice used at Utah's Crandall Canyon mine where six miners and three rescuers lost their lives in 2007. The President has said he will veto S-MINER as passed by the House.

In light of rulemaking activity required this year by the MINER act and the Consolidated Appropriations Act, 2008 (P.L. 110-161), MSHA asked the Occupational Safety and Health Administration for assistance. Congress increased MSHA's appropriation between FY2007 ($302 million) and FY2008 ($334 million). The Administration's FY2009 budget request for MSHA is $332 million.

Endnotes

1 Data available at [http://www.msha.gov/stats/coalstats.asp].

2 The fatality rate in the goods-producing sector, of which mining is a part, was 8.2 per 100,000 persons employed in the sector in 2006. BLS, *The National Census of Fatal Occupational Injuries in 2006,* August 8, 2007.

3 BLS, *Workplace Injuries and Illnesses in 2006,* October 15, 2007.

4 For an overview of safety trends, see Ramani, Raja and Jan Mutmansky, "Mine Health and Safety at the Turn of the Millennium," *Mining Engineering,* September 1999.

5 In prior decades, Congress initiated and gradually expanded safety and health regulation of coal and other mining industries within the Department of the Interior.

6 The United Mine Workers (UMW) union wants MSHA to be more active. It asserts that there are not enough inspectors and that penalties (proposed and negotiated) are not large enough. In general, the UMW would make enforcement of standards the highest priority. The mining industry generally supports the current regulatory approach, but it urges that inspections be focused on mines with evident problems rather than on all mines as currently required by law.

7 Ironically, one of the "lessons learned" from a September 2001 accident at Alabama's Jim Walter No. 5 mine appears to have led to the delay at Sago. Because most of the victims in the earlier accident were responding to a relatively small explosion when a larger one occurred, considerable time was taken to verify the state of the atmosphere in the Sago mine before rescue teams were sent in.

8 US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, *Work-Related Lung Disease Surveillance Report 2002,* Section 2 (CWP and Related Exposures), DHHS (NIOSH) report no. 2003-111, May 2003.

9 Ibid.

10 "Advanced Pneumoconiosis Among Working Underground Coal Miners – Eastern Kentucky and Southwestern Virginia, 2006," *MMWR Weekly,* July 6, 2007.

11 Joby Warrick, "Federal Mine Agency Considers New Rules to Improve Safety," *Washington Post,* January 31, 2006, p. A3.

12 Standards proposed and adopted in the 2001-2005 period include methane testing (alternate means), emergency evacuations, belt entries as air intakes, and training shaft and slope construction workers.

13 "First Wireless Tracking System Approved, May Keep Mandated Rulemaking on Time," *Daily Labor Report,* February 1, 2008.

14 US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, *Criteria for a Recommended Standard: Occupational Exposure to Respirable Coal Mine Dust,* DHHS (NIOSH) publication no. 95-106, September 1995.

15 "MSHA Regulation on Dust Monitors Needed to Require Use in All Coal Mines," *Daily Labor Report,* May 23, 2007.

16 Earlier in the decade, Congress gave MSHA $ 10 million to collect and digitize mine maps and new technologies for detecting mine voids (Consolidated Appropriations Resolution, 2003, P.L. 108-7). The Emergency Supplemental Appropriations Act of 2006 (P.L. 109-234) made available $26 million for MSHA to hire 170 coal mine inspectors above the agency's June 2006 level, and $10 million for NIOSH to conduct research on new safety technologies.

17 On December 18, 2007, MSHA received the final report of the Technical Study Panel on the Utilization of Belt Air. "Belt air" is air directed underground to ventilate active work areas via the same tunnels in which conveyor belts remove coal from mines. Because these tunnels consequently contain a great deal of highly flammable coal dust, some think that using them for ventilation increases the risk of directing fires toward the work areas of miners and toward their evacuation routes.

18 The Secretary of Labor would be allowed to review the feasibility of a PEL before it is put into effect if mine operators or miners provide evidence that feasibility may be an issue. If operators or miners provide evidence that an REL issued by NIOSH lacks the specificity needed to serve as a PEL, the Secretary may defer implementation until NIOSH recommends a more detailed REL.

19 In February 2008, MSHA published a final asbestos standard that includes exposure limits equal to those set by OSHA.

20 When an underground area has been completely mined of its coal, the coal pillars that have been holding up that area of the mine's roof are pulled to obtain their coal content. For an examination of (1) how the operator at the Crandall Canyon mine "conceived, designed, and tested its plans to mine the barrier pillars in the Main West Section and (2) MSHA's review of those plans and its monitoring of safety conditions during mining of the barrier pillars," see US Senate Health, Education, Labor and Pensions Committee, *Report on the August 6, 2007 Disaster At Crandall Canyon Mine,* March 6, 2008. The House Education and Labor Committee is conducting an investigation of the Crandall Canyon incident. MSHA is preparing an accident report as well.

21 In May 2007, MSHA issued an emergency temporary standard to increase protections for those working in underground mines with sealed off abandoned areas. It reopened the comment period for one month (to January 18, 2008) to give individuals time to submit comments on a report by the US Army Corps of Engineers and to prepare testimony for a hearing that was held in mid-January 2008.

22 The Chemical Safety and Hazard Investigations Board is an independent agency of the federal government that, among other things, investigates and identifies the causes of chemical accidents.

23 In addition, the employer group reportedly is concerned that this requirement would set a precedent that Congress subsequently could apply to OSHA. "House Committee Approves S-MINER Bill, Amendment Adds Retreat Mining Provisions," *Daily Labor Report,* November 1, 2007.

24 See the following for additional information: [http://www.cdc.gov/niosh/mining/mineract/mineemergencycommunicationspartnership .htm].

25 See the following for MSHA-approved communications and tracking technologies: [http://www.msha.gov/techsupp/PEDLocating/MSHAApprovedPEDproducts.pdf].

7

A Proposal of Regulatory Framework for Carbon Dioxide Storage in Geological Formations

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CO_2 Capture and Storage (CCS) is getting attention as a viable option to mitigate climate change. The success of CCS as a greenhouse gas mitigation strategy depends on the regulatory framework established to govern its deployment. Several initiatives have been undertaken and are underway to address deficiencies through regulatory working groups and by incorporating a regulatory component within current and planned CCS projects. This article is part of the efforts initiated by the International Risk Governance Council (IRGC) which outlines the attributes that an effective regulatory regime for CCS should posses.

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Thorough examination of the national and international laws to determine how they should be adjusted to clarify the definition of CO_2 including impurities is necessary. As access and property right is the issue of national and international laws and also influences liability, they must be clearly defined. Monitoring and Verification plays an important role in outlining the legal frameworks for CCS and should be based on performance modeling coupled with risk assessment approach for both the short-term (life span of the project) and long-term (certain years after closure) periods. We advocate that long-term be defined as the time after the operational stage (short-term) with certain years after closure based on outputs from performance prediction. There is a need to address especially the long-term liability issues regardless of whether these are environment, in situ, or trans-border. To establish an internationally agreed guiding framework for CCS deployment we propose that legal and regulatory frameworks take into account the technical aspects with respect to the geological storage options including the issues that can arise in geological storage of CO_2. These are specifically site selection, the scale, performance prediction and risk assessment issues as well as mitigation strategies in the events of leakage.

1. Introduction

CO_2 Capture and Storage (CCS) is getting attention as a viable option to mitigate climate change. The success of carbon capture and storage as a greenhouse gas mitigation strategy depends on the regulatory framework established to govern its deployment. With a rapid growth of the number and scope of Carbon Capture and Storage (CCS) projects worldwide the lack of a clear, defined legal and regulatory framework in which to operate is of great concern. Several initiatives have been undertaken and are underway to address deficiencies through regulatory working groups and by incorporating a regulatory component within current and planned CCS projects. This essay is

part of the efforts initiated by the International Risk Governance Council (IRGC) which outlines the attributes that an effective regulatory regime for CCS should posses.

With the available storage options at hand and given the technical challenges to be considered in a storage site, the issues particularly the site selection, the scale of operation and the risks associated with performance predictions need to be considered when laying out the regulatory frameworks for CCS operations. Regulations that take into account the technical barriers and issues are needed specifically that address the site selection, classification of Carbon Dioxide (CO_2), access and property rights, Intellectual Property Rights (IPR), monitoring and verification requirements, safety assessment and liability. A regulatory framework that encourages good practice and incorporates our evolving understanding of risk and its management (mitigation strategy) could promote public trust and widespread deployment of the CCS technology as potential emission reduction option.

2. Overview of Geological Storage

Geological storage of CO_2 can be undertaken in a variety of geological settings in sedimentary basins. Within these basins, oil fields, depleted gas fields, deep coal seams and saline formations are all possible storage formations both onshore and offshore.

Oil and gas fields storage include depleted reservoirs for pure storage, or for the purpose of enhanced resource recovery such as enhanced oil recovery (EOR) and/or Enhanced Gas Recovery (EGR). Although the geological structures and physical properties of most oil and gas fields have been extensively studied and characterized, of great concern are abandoned wells in many mature fields. Plugging of abandoned wells in many mature fields which began many decades ago were not constructed with due considerations that the fields could be used to contain a reactive and potentially buoyant fluid such as CO_2. Therefore, the condition of wells penetrating the caprock must be assessed. [1] In some areas of the world, even locating the wells may be difficult and caprock integrity may need to be confirmed. The capacity of a reservoir will be limited by the need to avoid exceeding pressures that damage the caprock. [2 and 3]

Saline formations are widespread and contain enormous quantities of water, but are unsuitable for agriculture or human consumption. They are in many cases not well characterized as the oil and gas fields and hence CO_2 storage scheme in such formations requires careful site characterization. Typical problems are that the aquifer boundaries are open and presence of abandoned wells which could pose threats for the long-term storage integrity. A third option for CO_2 storage is coal seams, especially when CO_2 is injected into coal seams with the purpose to displace methane, thereby enhancing Coal Bed Methane (CBM) recovery. However, our knowledge in this storage option is limited compared to other options. Major problems are: lack of complete knowledge in the process of CO_2 trapping in coals, coal plasticization or softening, coal swelling, reaction between the injected CO_2 and coal, and the likely future fate of a coal seam.[4]

3. Issues in Geological Storage of CO_2

3.1 Site Selection

The security of carbon dioxide storage in geological formations depends on careful storage site selection followed by characterization of the selected site. Documentation of the characteristics of any particular storage site will rely on data that have been obtained directly from the storage formation. Today, no standard methodology prescribes how a site must be characterized. Instead, selections based on site characterization data are made on a site-specific basis, choosing those data sets that will be most valuable in the particular geological setting.

Appropriate methods for the selection of a site are the most effective means of reducing any potential risks over the long-term. At this stage the technical risk associated with each storage site must be determined at the beginning of a project and subsequently managed. First challenge is to collect the necessary site data. However, how much data collected there will always be some geological uncertainties left. For the accurate prediction of the behaviour of injected CO_2 and hence its migration and long-term fate in the deep sub-surface in different geological formations, standardisation of modelling techniques is another challenge which needs to be considered. The results will influence among others the selection and location of monitoring techniques as seismic and monitoring

wells, design and duration of monitoring and verification requirements for the proposed storage site. An internationally consistent guiding framework, that can address these challenges and that deals with any long-term risks can facilitate full-scale deployment of the CCS technology and can build public confidence.

3.2 The Scale of Geological Storage Projects

A number of pilot and commercial CO_2 storage projects are under way or proposed. The projects are already injecting or planning to inject CO_2 into a variety of formations, such as aquifers, depleted hydrocarbon reservoirs, coal seams, and saline formations on a range of scales and injection rates. For instance at the RECOPOL project in Poland CO_2 is injected at a rate of 360 tonne per year (planned 760 tons total) in coal seams for Enhanced Coal Bed Methane (ECBM) recovery, which is typical of a small-scale project. At the Sleipner project in Norway CO_2 is injected at a rate of 1 million tonne per year (planned 20 million tons total) in saline aquifers, which may be considered a medium-scale project. Similarly at the Gorgon project in Australia potentially 120 million tons at a rate of 3.6 million tons per year is planned to be injected in saline aquifer formations which may be a large-scale project. All these projects mentioned together with the number of CO_2 capture and storage projects which have already been announced demonstrate the confidence in this technology.[4] However, these projects also raise important issues such as the scale and life span of the projects which are critical with regard to site selection, monitoring and verification procedures and mitigation actions as well as the duration required for monitoring and verification and hence outlining the guidelines for regulatory frameworks.

The effects of scale should be considered in outlining the regulatory frameworks for CCS projects. For instance, simulations have shown that the areal extent of a plume of CO_2 injected can reach approximately 100 km^2 [4] and may grow after injection ceases. The approach to dealing with this issue will vary, depending on the legal framework for ownership of subsurface pore space and the liability. In Europe, for example, pore space is owned by the State and, therefore, utilization is addressed in the licensing process. In the United States, on the other hand, the determination of subsurface property rights on non-federal

lands will vary according to state jurisdiction. In most jurisdictions, the surface owner is entitled to exclusive possession of the space formerly occupied by the subsurface minerals when the minerals are exhausted, that is, the 'pore space'.[6] In the example mentioned it is possible that CO_2 could leak far from its injection point and storage area, and if that leakage point is in another country or in international waters, a framework for determining which party is liable to the damages incurred need to be established. This can raise the question on how to determine where local/national liability and international liability differs.

3.3 Performance Prediction and Risk Assessment

When CO_2 is injected into a formation, it displaces saline formation water, oil or gas and then migrates buoyantly upwards, because it is less dense than the formation fluids. When it reaches the top of the formation, it continues to migrate as a separate phase until it is trapped as residual CO_2 saturation or in local structural or stratigraphic traps within the sealing formation (physical trapping of CO_2). In the longer term, significant quantities of CO_2 dissolve in the formation water and then migrate with the groundwater. Carbon dioxide in the subsurface can undergo a sequence of geochemical interactions with the rock and formation, a mechanism known as geochemical trapping. First, when CO_2 dissolves in formation water, a process commonly called solubility trapping occurs. The primary benefit of solubility trapping is that once CO_2 is dissolved, it no longer exists as a separate phase, thereby eliminating the buoyant forces that drive it upwards. Next, it will form ionic species as the rock dissolves, accompanied by a rise in the pH. Finally, after very long periods of time/geologic time some fraction may be converted to stable carbonate minerals (mineral trapping), the most permanent form of geological storage.[4]

Computer simulation has a key role in the design and operation of field projects for underground injection of CO_2. Simulations of the long-term distribution of CO_2 in the subsurface are important for the design of cost-effective monitoring programmes because the results will influence the location of monitoring wells, if suitable, and the frequency of repeat measurements, such as for seismic, soil gas or water chemistry.[4] However, the principal difficulty is that the complex geological models on which the simulation models are based are subject to considerable uncertainties, resulting both from uncertainties in

data interpretation and, in some cases, sparse data sets and associated interpolations in which the models are based. Moreover, predictions of the long-term distribution of injected CO_2, including the effects of geochemical reactions, cannot be directly validated on a field scale because these reactions may take hundreds to thousands of years.

In this connection an analysis of the risks associated to models, performance predictions and the long-term integrity of the storage site will be a requirement. Risk assessment should thus be aimed at identifying and quantifying the potential risks and should be an integral element of risk-management activities. Risk assessment should include spanning site selection, site characterization, storage system design, monitoring and remediation.[5]

Classification of the potential risks with respect to likelihood, spatial scale and time scale with respect to each risk receptor (humans, environmental media and ecosystems) should be incorporated in new regulations governing CO_2 storage in geological formations with adaptability to new information and technology as they become available.

4. Regulatory Frameworks

4.1 Definition/Classification of Carbon Dioxide (CO_2)

To date there is a lack of consistent and clear definition or classification of CO_2. In general, the stored CO_2 can either be classified as an industrial product or as a waste product. The definition of CO_2 and the process by which it is stored is crucial for determining the type and jurisdiction of the regulations covering CCS activities and this distinction is important because industrial projects typically are subject to less stringent environmental regulations than waste disposal projects[7]. Also the impact of impurities in a CCS stream must be considered through all stages of a CCS process because their presence affects the engineering processes of capture, transport and injection, as well as the trapping mechanisms and capacity for CO_2 storage in geological media.[6] Some contaminants in the CO_2 stream (e.g., SO_X, NO_X, H_2S) may require classification as hazardous, imposing different requirements for injection and disposal than if the stream were pure.[7] Regulatory framework must state the allowed concentration of impurities and the lowest allowed CO_2 concentration.

How CO_2 is classified also determines its legality and treatment under international treaties and national laws and regulations.[8] Classification of CO_2 as "waste" or industrial "by product" is covered under the London[9] and OSPAR[10] Conventions because the texts state "waste or other matters". According to the Legal Experts,[11] whether CO_2 is "waste" or "other matter" is thus not essential and the Basel Convention[12] only applies to "hazardous waste" and CO_2 is not a "hazardous waste". Under the EU Directives concerning waste and water,[13] the Basel Convention becomes presumably relevant. Current projects are allowed as industrial storage or enhanced resource recovery projects under the marine treaties. [9,10,11,12,13,14] and [15] Typical example is the Sleipner project[16] in Norway where the CO_2 extracted is considered the result of industrial activities, it has generally been accepted to be allowed under the international marine pollution treaties. The treaties were established before the emergence of CCS as a major option for reducing CO_2 emissions, and so a new framework may be needed to deal specifically with CCS projects, including those offshore projects, such as Sleipner, that do not include enhanced resource recovery.[7] However, recently the London Protocol,[14] parties finalised a discussion by amending the annex, stating that CO_2 storage under the sea bottom is explicitly allowed with some limitations. The limitation is expressed as no matters are allowed to be added for deposition, after the prime CO_2 capture process. Further technical clarification is now under preparation. The OSPAR parties have for some time been through a similar discussion and will probably make a decision by end of 2007.

4.2 Access and Property Rights

Property rights often determine who has or will have access to a project site and are therefore a crucial aspect of any CCS project and must be defined in order to encourage investment and properly regulate the storage site. The three main areas of property rights are surface (injection of the CO_2), subsurface (reservoir), and the CO_2 itself and because the definition of property rights also influences liability, they must be clearly defined.[7] It is also critical to determine if, when, and how private liability is transferred to the public sector, establish who determines to whom property rights, public and private methods of acquiring the rights, and how to manage the title of the actual CO_2.

The issue of access and property rights is a question of national and international laws. In national law, the question is whether reservoirs and aquifers are subject to state ownership, or whether they may be used freely for this purpose by any legal subject. In Norway, the right to use aquifers and reservoirs for petroleum activities is regulated by the Petroleum Act 17. According to this Act the State has the property right to underground petroleum resources on the continental shelf and the exclusive right to exploitation of these resources. As owner, the State may regulate the use of petroleum reservoirs, and aquifers for either pure deposit of CO_2 or injection of CO_2 to enhance oil recovery 18. The most relevant case is the ongoing injection of CO_2 from the Sleipner Gas Field. When reservoir formations are used "for the sole purpose of disposal of CO_2 that is not a product from petroleum activities" on the Norwegian continental shelf, then exploitation is covered by the scope of application within the Act for the Continental Shelf 19 in lieu of the Petroleum Act 18. The Continental Shelf Act covers scientific research and exploration, and exploitation of underground natural resources other than petroleum, in internal Norwegian waters, the territorial sea and on the continental shelf. According to Section 2 of the Act the State has the right to such "underground natural resources" and the quoted statement is interpreted as covering aquifers and reservoirs for use as CO_2 deposit.[18] This means that the state has the exclusive right to such use, to control such use and to issue necessary regulations.

In international law, the question is if the coastal state has sovereign and exclusive rights to use the underground for CO_2 injection purposes. This issue is regulated by the UN Convention of the Law of the Sea.[15] According to this Convention, it has been concluded that Norway has sovereign rights to use underground aquifers and reservoirs on the continental shelf and in the extended economic zone (EEZ) for injection of CO_2 for both deposit purposes and enhanced oil recovery.[18] However, as many oil and gas reservoirs including aquifers in the continental shelf are shared with neighbouring countries, Norway can not unilaterally decide to use such reservoirs and aquifers for CO_2 injection without an agreement among the parties.

Most of the unresolved issues related to access and property rights apply to onshore projects and because very little case law exists for property rights for onshore CCS projects, access and property rights have typically been determined

on a case-by-case basis.[7] Many offshore projects are under the purview of international treaties, where regulatory frameworks are already in the process of being developed. Since property rights for CCS are still a new issue, and standards for addressing this issue are not clearly defined, making it difficult to determine property rights in the long term. Clear titles and transferable rights would ensure a regularized operating environment and establish the chain of liability and responsibility in the event of CO_2 leakage, migration, or other problems.[7]

4.3 Intellectual Property Rights (IPR)

Intellectual Property Rights (IPR) applies to the various legal entitlements which attach to certain types of information, ideas, or other forms of innovations. Although the holder of this legal entitlement is generally entitled to exercise various exclusive rights in relation to the subject matter of the IPR, these laws are becoming increasingly harmonised through the effects of international treaties such as the 1994 World Trade Organization (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs).[20]

IPR issues are critical when it comes to the transfer of technology, especially in the absence of a stringent regulatory framework. A robust IPR regime in developing countries is crucial for encouraging developed countries to invest in CCS technologies for transfer and deployment in developing countries. IPR has been addressed through the Consortium Agreement made up between all partners of the Sleipner project. The European Commission, through its 6th Framework Program for Research and Development, has a set of rules to be followed, but the Sleipner partners have surpassed these rules in that they have granted themselves broad, worldwide, and irrevocable rights to use the results of the Sleipner project.[7] Therefore there is a need to develop a consistent CCS-specific IPR legal regime that include modelling, measuring and monitoring instruments, and other technological methods.

4.4 Monitoring and Verification Requirements

Standards for the Measurement, Monitoring, and Verification (MMV) of injected CO_2 are crucial to any regulatory or legal framework for CCS because they provide for the collection of vital data on containment, reactivity of CO_2 with

surrounding well materials, seismic activity, leakage, and long-term storage.[7] These are necessary for input to repeated model simulations, risk assessment to ensure that the CO_2 behaves as expected or possibly revise the operation plans or start preventive remediation (mitigation strategy). In some cases observation wells are essential for MMV of injected CO_2. Existing MMV procedures are site-specific and this makes it difficult to develop a single framework with a uniform set of requirements. We propose to establish a regulatory framework that entail MMV based on performance modelling coupled with risk assessment approach for both the short-term (life span of the project) and long-term (certain years after closure) periods. There is a need to define the term "long-term" and the definition could be based on the output of the performance prediction. The monitoring tools can vary from site to site (e.g., seismic or geochemical) but the framework is thought to create consistency and uniformity.

Sleipner has employed both 3D and 4D seismic monitoring techniques, as well as time-lapse gravimetry throughout the project and the operator (Statoil) is continuing to carry out the activity by using the seismic surveying. The work demonstrated that the injected CO_2 is well monitored with no leakages from the geological storage reservoir. Monitoring and modelling proved to be key tools in understanding the whole reservoir performance. However, there are no established guidelines for the monitoring in the long-term, including who should be doing the monitoring and for how long the site is going to be monitored.

4.5 Liability

Liability is one of the most essential regulatory issues facing CCS projects. It will impact the costs of CCS projects and will be crucial in advancing public acceptance of the technologies and processes involved. Liability issues can be divided into short-and long-term, with the preponderance of unresolved liability issues relating to long-term storage.[7]

Short-term Liability: a common liability issue raised in connection with the short-term aspects of CCS projects is operational liability, which refers to the environmental, health, and safety risks associated with capture, transport, and injection of CO_2. Operational liability is similar to that already dealt with in the oil and gas industry. Such risks have been successfully managed for decades in

the context of enhanced oil recovery and analogous activities[21] and they are therefore easier to manage and plan for, and could be addressed in a regulatory framework relatively quickly.

Long-term Liability: requires more urgent regulations. There are three types of liability issues that are relevant for long-term CCS projects: environmental, *in situ,* and trans-national liability.[7] In the event of any CO_2 leakage or migration to the atmosphere, *in situ* or trans-border, responsibility must be assigned to address any harm caused to the global climate, health and environmental damage to the air, soil, water, and overall ecosystem. It is also important to state who is responsible for the mitigation actions. Failure to properly address these issues could lead to negative public perceptions.

In the case of CO_2 leaking into the atmosphere and causing "environmental liability," this is probably best addressed as part of a broad climate policy designed to control greenhouse gases.[22] The issues of trans-border liability can be addressed by intergovernmental agreements and international treaties. It is possible that CO_2 could leak far from its injection point and storage area, and if that leakage point is in another country or in international waters, a framework for determining which party is liable for clean up, remediation, or loss of resources should be established.[23]

A major issue with long-term liability is simply the timeframe itself.[7] The term "long-term" may be referenced as the time spanning after the operational stage (short-term). However, it is difficult to set when the shift from short- to long-term should occur because this can partly depend on the scale of future CCS projects. Considering that CCS projects are designed to last for centuries, it may be difficult to set up MMV for such long periods of time, but it is known that in mining operations and underground works such as tunnels in copper and other mines are used to be left behind, after careful remediation of the site.. Water draining in to these structures cause corrosion and polluted water can enter the nature in principle without limitation in time as CO_2 storage. Therefore the same existing national rules and regulations which govern these activities can with modifications be adapted to CO_2 storage. Transferring the responsibility from the operator to the State at the end of the injection period requires specific clarification and this can be built on existing national laws in countries of interest.

Also, a basic compliance system should be established to assure accountability and proper enforcement in the event of leakage or other damage. Determining responsibility for cost coverage is crucial, and several options are proposed 7 and 21.

In Norway the Pollution Control Act 24 has special rules on liability for environmental damage, based on strict and severe liability for the operator of the installation or activity that causes the damage. CO_2 injection/storage is in principle included in the law as long as there is leakage from the storage formation which brings hazard or pollution as all any other activities which are threat for pollution. Both the Mining Act 25 and the Petroleum Act 17 also put that the operator should clean up, secure life of people and nature for unlimited time, and must have the authorities/governments approval before the operator leaves the place. These rules, however, do not apply to damages caused by the injection of CO_2 and should be considered for amendments to include both offshore and onshore activities.

5. Discussions and Conclusion

Efforts are underway in the development of national and international rules and regulations for CCS projects[23]and[26]. A consistent effort to address the major unresolved regulatory issues related to CCS, such as long-term stewardship of the stored CO_2 is required for rapid implementation of the technology. A process is already started in several countries and regions under cooperation, e.g., Australia, Canada and EU to thoroughly examine national and international laws to determine how they should be adjusted in countries of interest to clarify the definition of CO_2 including impurities if any and the status of CCS technologies and their use. As access and property right is the issue of national and international laws and also influences liability, they must be clearly defined and should be prioritized.

Monitoring and Verification component plays a great role in outlining the legal frameworks for CCS and should be based on performance modelling coupled with risk assessment approach for both the short-term (life span of the project) and long-term (certain years after closure) periods. Observation wells are essential and can play key role for MMV of injected CO_2. However, MMV is

still handled on a case-by-case basis and none of the existing projects including Sleipner specify the length of time that monitoring will be required or who will be responsible for monitoring in the long-term which addresses one of the major gaps in laying out the legal framework. For example in Gorgon project the project developers and the Western Australian Department of Industry and Resources have developed a set of site closure criteria that include a requirement for the project developers to show that the site is safe.[26] The government places the burden of proving long-term safety on the project developers and reduces some of the risk to the government of taking over long-term stewardship of the storage site and the injected CO_2. However, the Australian guiding principles have not yet developed guidelines for how the government should monitor and take care of the site in the long-term, indicating the difficulty in handling such issues. This is partly due to lack in the definition of the term "long-term". We advocate that long-term be defined as the time after the operational stage (short-term) with certain years after closure based on outputs from performance prediction.

There is a need to address especially the long-term liability issues regardless of whether these are environment, in situ, or trans-border. The term "long-term" may be referenced as the time spanning after the operational stage (short-term) plus certain years after closure of the site as mentioned earlier. However, it is difficult to set when the shift from short- to long-term should occur because this can partly depend on the scale and life span of future CCS projects. It is difficult also to set up MMV for long periods of time, but there should at least be parameters and guidelines laid down based on performance modelling and risk assessment procedures for both short and long terms. Long-term liability is well addressed under the national laws of Norway;[17,18,19,20,21,22,23,24 and 25] however, these laws need to be tuned to suit the geological storage of CO_2. Lessons can be learned from the Gorgon project and the newly released guiding principles in Australia[26] which offer a general framework for organizing and classifying the various phases and activities involved in a CCS project. This again enables more consistency in defining regulations, including when and where to assign ownership and liability and thus can be used to develop an internationally consistent legal frameworks for future CCS projects. To establish an

internationally agreed guiding framework for CCS deployment we propose that legal and regulatory frameworks take into account the technical aspects with respect to the geological storage options including the issues that can arise in geological storage of CO_2 specifically site selection, the scale, and performance prediction and risk assessment issues as well as mitigation strategies in the events of leakage.

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8

Livelihood Issues and Concerns of Women and Men in Small Mines and Quarries of South Asia

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The global trend of informalisation of women's work is also evident in what is commonly known as Artisanal and Small-Scale Mining (ASM) practices. Women constitute a large segment of workers in the informal mines and quarries all over the world, working as cutters, diggers, sievers, panners, crushers, processors and transporters of a broad range of minerals from sand, gravel and stones to gemstones, gold and diamonds. Small mines and quarries are extremely diverse in their nature, but comprise a repository of extremely poor people. Women are quite invisible although they participate in large numbers in these mineral extraction practices. This article focuses on the small mines and quarries of South Asia, and reviews the gender and livelihood issues and concerns in these mines. This research presented here is exploratory in nature, making some estimates based on proxy indicators and field surveys, and addresses a gap in existing knowledge in ASM and

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Source: www.asmasiapacific.org

on gender roles in the informal work in the mines and quarries in South Asia. The article aims at providing the necessary backdrop, relevant information and interpretation of their livelihood needs for developing policy measures in relation to the informal mining industry in South Asia and for sensitisation of stakeholders to the issues rooted in gender. The more specific objectives of the research are to examine women's roles and participation in a range of informal mining practices in the region within the overall livelihoods framework.

Women in Artisanal and Small Mines

A recent estimate suggests that over 20 million people in the world depend on mineral resource extraction on an informal basis for their living, a figure that is immensely more than those employed by the formal mining industries. Indeed, employment in the formal mining sector is steadily declining (ILO, 2002). For many, the mineral extraction practices form a continuation of traditional modes of life, but there are also those seeking, seasonally, extra cash income, those made jobless by economic reforms and also refugees displaced by big project developments. Internationally these informal modes of mineral extraction practices are collectively known as 'Artisanal and Small-Scale Mining' (or ASM in brief). Estimates of the number of people involved in ASM depend on what is meant by ASM, the focus often being on gold, diamonds and other high value materials, but, when bulk commodities are included such as coal, limestone, sand and gravel, the numbers skyrocket.

The significant contribution of small mining to the world mineral production was noted early on by mining engineers (see for example Argall, 1978; Carman, 1985; Noestaller, 1987; 1994). These mines and quarries are part of the burgeoning informal or 'unorganised' sector of third world economies; however the term 'informal' is often used synonymously with 'illegal'. The strong anti-mining movements led by pro-environment groups have generally focused on three main areas: the negative aspects of unregulated mineral extraction; not differentiating between ASM and large-scale mining and overlooking the question of livelihoods of the large numbers of people involved and their

livelihoods in ASM (Bhanumathi, 2004; Vagholikar et. al., 2003). The official attitude is often to regulate, regularize and formalize the supply chains and links especially in the high value mineral products such as gold and diamonds (CASM, 2005). It is well-known that women comprise a significant part of the labour force in the informal income-generating activities and women do indeed constitute a large segment of workers in the informal[1] mines all over the world. This article examines this area of work and livelihoods of women and men, the regional focus being South Asia. The patriarchal social structure of South Asian societies tends to obscure the contributions made by the women workers in these mines, and the roles and livelihood concerns of women and men. The global report on ASM by Hentschel et. al., (2002) as part of the Mines, Minerals and Sustainable Development (MMSD) process, a policy process taken up by the Global Mining Initiative, has only a very small section on South Asian ASM, and even a shorter one on gender.

This article presents a review of the emerging issues related to livelihoods around mines and quarries in South Asia and addresses a gap in existing knowledge in ASM and on gender roles in the informal mines. It is part of a wider, exploratory and ongoing research based on the case study method by several partners and myself in selected locations.[2] Although a large number of lives depend on the incomes generated from small-scale mineral extraction, and women perform a range of productive or income-generating activities around these mines including those at home, this article focuses only on women as compared to men working in ASM. Women workers in ASM form the proverbial 'poorest of the poor', in urgent need of interventions to improve their freedom and ability to choose livelihoods. The article aims at providing the necessary backdrop, relevant information and interpretation of their livelihood needs for developing policy measures in relation to the informal mining industry in South Asia and for sensitisation of stakeholders to the issues rooted in gender. The more specific objectives of the research are to examine women's roles and participation in a range of informal mining practices in the region within the overall livelihoods framework.

The proportion of women among the workers in the small mines and quarries varies from country to country, according to location, nature and value of the mineral, processing techniques used, marketing systems, local social

milieu, availability of alternative occupations and other factors. In actual mining jobs, panning, processing, transportation and related jobs on the fields, the percentage of women can vary from a low of 10% to a high of 50%. It has been noted (for example in a report on women *ninja* miners of Mongolia by MBDA 2004) that often ASM is a dangerous and physically demanding activity, leading to a gender division of labour in which mean undertake the 'heavy jobs', women take care of most day-to-day chores. However, Moretti (2005: 5) observed that limited female participation is not exclusively a matter of personal preference but the outcome of men's nearly complete domination of the contemporary space of production and social reproduction. Moretti's work gives the example of Mount Kaindi's (Papua New Guinea) extractive landscape where in accordance with 'traditional' principles of land ownership almost all registered mining leases, tributary rights and customary land are held by men and transmitted patrilineally. Even in matrilineal societies such as the Maroons of Suriname, Heemskerk (2000: 7) noted the apparent autonomy hides gender inequality in relative access of women and men to political power, money, capital assets and contacts with the outside world. Amutabi and Lutta-Mukhebi (2001: 5) explain this disempowered status in terms of lack of land rights, 'in mining areas in Kenya ... women have only access to but do not control land. This does not make it possible for women to have full control over the mining activities effectively. The traditional social system deprives women control of mining pits and only allows them access through men.

Thus, their overall status in the production process is low'. A similar pattern may be observed in Latin American ASM communities; women occupy a number of roles as labourers undertaking the most labour-intensive and informal jobs in Bolivia (as *palliris),* or are associated with subsistence activities such as those in Colombia (Veiga 1997). Hilson (2001; 2002) documented the involvement of women in Ghanaian small-scale mining showing women comprise approximately 15% of the legal small-scale metal mining labour force and about 50% of the ASM or *galampsey* industry. Women are represented more heavily in lower value industrial minerals, the proportion rising to over 75% in salt mining. Hinton et. al., (2003: 13) noted that the key factors in determining gender roles and status of women in ASM include: 'women's and men's access to and control of, resources; their ability to attain knowledge of resources, their decision-making

capacity or political power; and beliefs or attitudes that support or impede the transformation of gender roles.' Observing the gender roles, Amutabi and Lutta-Mukhebi (2001: 15) comment:

> 'at Mukibira, it was noticeable that women do most of the work. They help in digging pits, panning, washing and selection using mercury. They also do the marketing, as they seem to be preferred by buyers. This is because women are generally regarded as being more honest then men'. Graulau (2006: 299) put women's labour as the core of capital accumulation in the mining frontiers of Brazilian Amazon: 'Vulnerability of women's labour in *garimpagen* is inscribed in broader processes of capital accumulation in the Amazon region Women's abour has been crucial in the expansion of capitalism and the reproduction of its modes of production in the mining frontier.'

In Asia, even in countries like the Philippines, where traditionally ASM has provided livelihood to a large number of people as the primary occupation with some shifting cultivation, the numbers of women in ASM have been rising (Caballero 2006). Only sparse data are available on China but according to Professor Shen Li, of the Chinese Academy of Sciences, the number of people could reach 100 million if cheap industrial minerals such as sand, stone and gravels are included.[3] In South Asia, like everywhere else with the rise in the numbers of quarries, and decline in alternative occupations. Given the seasonality of these jobs, insecurity and low wages, and the global trend of feminisation, informalisation and casualisation of women's labour, it can safely be assumed that the work participation of women in the ASM will also rise. UNIFEM (2005: 59) notes that three dimensions of work and arrangements are relevant in determining the nature, costs and benefits of informal work: place of work, employment relations and production systems.

In ASM in South Asia, women are not owner-entrepreneurs, having no control over the land or the mineral resource contained therein; they are employed as casual workers usually by labour contractors, in low-technology, labour-intensive processes. This gives rise to high direct and indirect costs of ASM work: long hours and unscheduled overtime, lack of benefits and social protection, occupational health hazards, high indebtedness and periodic/seasonal shocks to work, insecurity of work and incomes, variability and volatility of income, lack of training, and lack of legal status, organisation and voice.

It is, however, important to bear in mind the lack of a unified definition of ASM in South Asia, as 'artisanal' is often equated with traditional practices such as panning or gemstone mining in inclines or shafts. The term 'quarry' popularly implies shallow or surface workings whereas 'small mines' may also mean deep underground but un-mechanised operations. The governments commonly use the term 'quarries' to imply licensed ASM operations. In this report, I have used the terms 'small mines and quarries' as well as 'ASM' to mean all licensed small, medium and some large mechanized enterprises, unlicensed and unregulated and small operations, scavenging operations, and finally non-legal (beyond the legal domain) practices of small scale mining. A range of minerals is mined in South Asia, but excepting the gemstones industry of Sri Lanka and some scattered gold and diamond extractions in India and Pakistan, the largest segment of the minerals are low value, building/construction materials (such as stones of various sort, gravels, sands and clays, and limestone) and coal; there are one or two exceptions such as some export-oriented marble and mica.

I have used the livelihood approach[4] with special emphasis on understanding gender roles and relations in the small scale mines and mining communities, and on understanding the gender needs and interests amongst the ASM workers. The ways women and men seek and sustain a livelihood are different; as gender roles are different, so are the livelihoods gendered activities. Understanding the livelihood strategies of poor women as well as management of scarce natural resource at their disposal are of critical importance for making developmental interventions successful and equally benefit both women and men (Valdivia and Gilles, 2001). Labonne (1999) and Carnegie (2002) have used this approach in the earlier studies of ASM communities in Africa, whilst Jennings (1999) brought the attention to the labour and social issues in global ASM.

The article first gives an approximate indication of numbers based on existing information on the small mines and quarries, then describes the livelihoods and forms and structures of production, examines the position of women and men in ASM, and reviews the gender concerns thereof (Lahiri-Dutt 2005 gives more on the methodology). Extensive field surveys provide the basis of my observations on the proportion of women workers in ASM, the ethnic and social groupings that they come from, the sorts of jobs they perform, how much they earn in what kinds of working conditions, health issues and safety, household and intra-household

resource allocation in miner families, household and labour market linkages, linkages between education, health and nutrition, access to various kinds of services, ownership of land and other property, the strategic and gender needs of these women, and the policy implications of their participation in these mines.

Numbers: Much more than Meets the Eyes

The foremost problem affecting research on the ASM sector anywhere in the world is the paucity of data or even literature which stems from a mix of reasons: omitted from official data because of their smallness; poor records on account of their informality; fear of government interference etc. (Heemskerk 2005, p. 84-85). Lack of distinction between child and women's labour by government departments is also an impediment. In South Asia, these are even more acute due to the poor recording of quarries, their workers and their production figures, the illegal nature of some operations, and the attention on classifying the minerals into major and minor categories, leaving the minor minerals completely under the discretion of individual states or provinces.

Because of these difficulties, I have used qualitative methods to improve the understanding of women's participation and contributions in the mines and quarries through visits to the field to establish contacts with key personnel and civil society groups working on the ground. As India is the major mining country in South Asia, a greater research effort was devoted to it. In addition, I engaged with local stakeholders, including mine owners' associations, government officials, resource persons, trade union workers and NGOs. This partnering process led to a wider engagement, community mapping of needs and strengths, and was intended to be a sensitisation process as well as a research process. There are some earlier works; in case of India, I built on the foundations of Chakravorty (2001), Chakraborty (2002), Ghosh (1996), Sahu (1992), Rudra (2002), and Ghose (1996; 1994; 1991; 1986), in particular the work done by National Institute of Small Mines (NISM) on the Orissa manganese mines and the stone quarries of West Bengal.

Chakraborty (2001) indicated that just over 12% of ASM workers were women. His data were derived from those mines which formally report to DGMS, and are not comprehensive. Indeed Chakraborty points out that just in one part of West Bengal alone (Pacami-Hatgacha), there are an estimated 38,000

working in the (basalt) stone quarries which is over seven times the number given in the DGMS All-India list for stone quarries. Pacami-Hatgacha is not the only cluster of stone quarries in the state of West Bengal; many other quarries exist particularly in the Rajmahal or Chotanagpur plateau fringe, and a large number of people are engaged in sedimentary stones and gravel quarrying in the Himalayan foothills in the north of the state as well as gravel collection from river beds in North Bengal. If we assume there are 100,000 quarry workers who provide for the 80 million population of West Bengal and that demand for such a bulk product is driven by population, there would be about 1.25 million such workers in all of India. To this number must be added those working in other ASM, largely in illegal coal mines and gold panning. That my approach is justified can be appreciated from the fact that the Tamil Nadu Commissioners in 1995 noted there were 750,000 quarry workers in that state alone. With a population of 62 million in 2001, this would lead, as per West Bengal, to an estimate of more than 12 million workers in the quarries for the whole of India. Other estimates and data are –

- 2 million people working in the M&Q sector, most of whom fall in the bonded labour category http://www.dalits.org/CasteRaceandWCAR.html
- 2.5 million[5] in M&Q (NSSO 60th round).
- 64% of all unorganized labour falls within the agriculture and mining sectors (http://planningcommission.nic.in/midterm/english-pdf/chapter-08.pdf).

To these numbers must be added those who work in illegal mining as they would be very reluctant to admit to such a practice, so that a total of 3 million people in the ASM sector would be not unreasonable.

With regard to numbers of women, they undoubtedly constitute a large segment of workers in the artisanal, small and informal mines all over the world (WMMF, 2000). As in most cases the quarry workers come from rural and agricultural backgrounds ~30% of whom are women in India (Krishnaraj and Shah, 2004, p. 44-45), the proportion of women in the mines and quarries reflects a similar division. In fact, of all female workers, ~85% are employed in primary sector activities in India (Krishnaraj and Shah, 2004, p. 46). There are no definitive data recorded with regard to women's participation in the unorganized mines and quarries in India; in the formal sector, women's proportional

employment has been steadily declining since the independence of India as per a Ministry of Labour's Statistical Profile on Women and Labour (Fifth Issue, 1998) – from 1.02% in all mines in 1901 to 0.05% in 1991, from ~50% in coal mines to only 4%. In view of the fact that women's employment in all industrial categories have gone up during recent years, the report notes that this decline in women's employment is possibly indicative of their substitution by men. Consequently, the small mines and quarries absorb the cheap labour of women in large numbers as contract workers under conditions of bondage and utter exploitation.

The Global Report by the Mining, Minerals and Sustainable Development (MMSD) Project on Artisanal and Small Scale mining (Hentschel et. al., 2002: 21) pointed out that: 'In contrast to large-scale mining, the involvement of women in small-scale mining activities is generally high'. The number of women participating in informal mining activities has increased over time. Hinton *et. al.,* (2003) estimated that approximately 30% are women but in Asia the proportion is less than 10%. This figure is widely referred to, although it is not based on official information. It is also unclear if women and children are lumped together in this figure, a practice not uncommon in ASM (see CASM, 2004). Given the high rate of participation of women in informal work especially in the primary sector in South Asia, in places in my view, the proportion of women is higher than just 10% and may well be growing (ILO 1999: 25).

For Sri Lanka some official statistics are available (Department of Census and Statistics Sri Lanka), which list 1,689 mining and quarrying operations with an average of 10 employees each in year 2000. These statistics include those activities with more than 5 employees. However, besides these ~1700, many operations are small, individual or family-run, and hence unreported. If we take the number of operations at a conservative 2,000 and take the average number of labourers as 10 as per the report, we get a figure of 20,000 people in actual digging and quarrying operations in Sri Lanka. Women's labour is concentrated in assisting the artisanal gemstone miners, and in the cutting and polishing processes of gemstones.

For Pakistan, official statistics estimated that about 23,000 persons were employed in mining and quarrying for the year 2003-'04. However, this is a country where the mining sector is yet to develop along modern lines and most

mining, including that of semi-precious stones, is undertaken artisanally in the remote and inaccessible areas of Baluchistan and North West Frontier Province where governance structures are loose (For more details, see www.sbp.org.pk/departments/stats/PakEconomy_HandBook/Chap_10.pdf). However, if we take the Indian situation as a rough guide, then of a 53 million workforce, nearly 400,000 would be in ASM sector, a similar discrepancy as between official DGMS numbers and other estimates.

In the case of Nepal, the labour force survey carried out for 1998-'99 made no mention of mining and quarrying, but UNECAP traders manual for Nepal lists 0.08% of the active male population over ten and 0.04% of women are employed in the M&Q sector http://www.unescap.org/tid/publication/t&ipub2311.pdf. The labour participation rate of those in the 16-64 age group is high (almost 90%) http://www.ilo.org/public/english/employment/gems/eeo/download/nepal.pdf. These data lead to an estimate of ~ 120,000 in the M&Q sector. Again, any illegal mining activity would have to be added. If we turn to the Indian data as a benchmark we would estimate a value of about 130,000 workers, remarkably similar.

No statistics are available from Bhutan, although field visits have pointed to the large number of stone quarries along the Himalayan foothills.

In the northeastern corner of Bangladesh, bordering Assam, at least 100,000 people are involved in dredging the river beds and quarrying the foothills for stones and gravel in Sylhet, based on my own observations and local informants. Some of these gravel quarries are licensed but including the unlicensed, along with the scavengers, the total employment figure would probably be much higher. Similarly, there are gravel miners and sand miners all over India digging out low value stone products as industrial or building material from dried up river beds and hills. As many of these are seasonal livelihoods, I have chosen to use a conservative approach in arriving at my rough estimation of 3 million.

Mineral-based Livelihoods in South Asia

In national economies of South Asia, mineral revenues constitute only a small part: for example, although India is currently one of the major miners of the world, this fact does not show up in the breakdown of its GDP. This is because of

low capital accumulation from many of these mines and the fact that the small quarries and traditional mineral processing activities are part of the 'informal sector' of Indian economy which, according to an expert view, comprises around ~88% of the total economy (Harriss-White 2003). The large number of people surviving on mineral extraction use low levels of technology; in many of these mines only simple tools are used, every stage of processing being done by the human hand. Whereas low-value products like stone and gravel are meant primarily for local or domestic consumption, some of the minerals can have high values and serve non-local markets, such as marble from Rajasthan or the gem stones of Pakistan. Even low-value products such as stones may be exported although the exact amount of revenue earned by them is unrecorded.

Many of the mineral-based livelihoods are a direct continuation from traditional artisanal mining. The long history of mining is evidenced from old texts such as Kautilya's *Arthashastra* that was written in c250BCE (see Shamasastry, 1956, p. 82-89). It gave detailed instructions on the methods of testing gems and also methods of extracting minerals from hard and soft ore bodies, and of making gold and silver coins from the metals thus obtained. From the documentation, it can be assumed that mining was a well-accepted livelihood activity.[6] The introduction of scientific knowledge through engineering institutions and modern legal frameworks of resource governance in British period meant that many of the old systems were destroyed and a new understanding of mining as an area of work requiring a range of licenses and permits, formal knowledge of geology and production. The legal frameworks established during the colonial times aimed at the control the mineral resources by the British state. Colonial mining also brought in European models of labour relations and management techniques. Consequently, traditional artisanal mining gradually ended up outside the legalized sphere of resource governance, becoming invisible and in many cases even illegal as per the current mode of mineral classification. In addition to traditional mining, there are also unclear and non-legal spaces in mining created again by definitional lacunae. For example, Meghalaya is a 'fifth schedule' state in Indian Northeast, implying that mineral resources there belong to local land owners. However, coal, which is abundant there, is classified as a 'major mineral' meaning that technically it can only be mined by the state or major players. Consequently the 30,000 or so engaged in coal mining in Meghalaya fall in the vacuum of this non-legal space.

This legal complexity adds to the illegitimacy of quarrying; in South Asia, as elsewhere, the 'battle' for the legal recognition of artisanal mining goes on (Cramer 1990).

The forms of production in small mines and quarries vary depending on the type of mineral, its value, its extent and the processes employed and the structure of the organisation.[7] In general, small mine operators complain about the lengthy legal procedures (see Goyal, 2005) and demand a 'one-stop shop' for government clearance. A range of interest groups are involved in administering small mines and quarries in the South Asian countries. However, it is important to note that these categories are not mutually exclusive, and may not be present in all quarries.

- Various government departments – Mines and Geology for license to mine; the local forest department which establishes the status of the area in their records and through physical verification, and issues a 'No Objection Certificate' (NOC); the Ministry of Environment and Forests to ascertain the implications and repercussions on local forests; the District Collector; the Sub-district or *tehsil* officials or the *Patwaris,* and the head of the village council or *Panchayat pradhan* – all requiring to survey the current use of the land and to provide NOCs. In some cases, State Pollution Boards are also involved.
- Mine (or quarry) owners or the lessees obtain the permits/licenses/permissions, invest the capital, and hire contractors to run the day to day mining operations. These owners often have local associations. The proportion of women in both these categories is almost zero.
- Contractors, managers, supervisors, account-keeper etc., This is also an entirely male domain of work.
- Mine workers – often there may be *three* subdivisions in this category: those who dig, those who carry loads, and those who process. Women's labour is usually found to be concentrated in the two latter sub-groups. In case of many illegal and non-legal mines, the main cutter may have the responsibility of selling the diggings or panned products to local customers after semi-processing.
- Local customers/buyers who sell it in turn to *mahajans* or dealers after further processing. For example in case of coal, the local customers may take the mineral home for coking. This group may also include dealers purchasing

crude minerals from mine-owners in case of legal mines. In case of illegal mines, purchases are made from local suppliers and then sell it to local market after semi-processing. Women are almost never found in any of these roles.

- In case of larger scale operations or higher value products, such as some marble or mica, there are the manufacturing exporters and their agents.
- Unregistered workshops who semi-process crude mineral output and maybe process final products.
- Household industry where women and men work under the putting-out system. In case of mica or gemstones, this becomes an important group.

Production relations in the small mines and quarries are characterised by semi-feudal and precapitalist forms as well as capitalist wage relations, making exploitation easier partly due to their often remote location. Living and working conditions are deplorable; small and low temporary huts with plastic sheets for roofing, no clean and safe accessible drinking water supply, no electricity, no health services and no educational facilities for the children to naturally join in to support the family at times of ill-health of the elders, not uncommon or infrequent.

A common feature in labour organisation in small mines and quarries is sub-contracting. As the mine owner sub-contracts a *thekedar* for the regular supply and control of labour. The small mines and quarries have permanent, casual, contract, self-employed producers, dependent producers and unpaid family members. Permanent workers may be protected by labour legislation but casual labourers, recruited on a short-term basis are not. The contract labourers are recruited either for certain numbers of days or for certain amounts of work (piece-rate), and are paid accordingly without being covered by any sort of legislation. The unregistered processing plants or workshops are run by self-employed producers with hired labour as dependent producers. The unpaid family labour may include women and children, who are extending a helping hand to improve the family's chances of survival. It is notable that women are never recruited as long-term wageworkers. The casualisation of work occurs more where parts of the production process are sub-contracted to smaller units by the larger production units. The work is casual and also highly seasonal; most quarries either shut down or reduce production in the monsoon months. The

workers either choose to work in the agricultural fields or are forced to seek other jobs. This seasonality in production influences all aspects of production including the recruitment of casual and contract workers. In illegal mines and quarries, the male head of the household can be described as a self-employed producer. In household production units women may also participate as home-based workers, with girls helping or training as unpaid family labour.

The small mines and quarries employ both migrants and members of local communities. Migration can play different roles in the livelihoods of poor households of ASM workers; it is a part of the normal livelihood/survival strategy of the poor and does not occur only during times of emergency in the counties of India, although the rate of migration increases at times of socio-economic distress, political crisis and/or natural disasters. Friendship networks, kin relations and village ties provide sources of information regarding a new mineral deposit or new quarries where scavenging might be possible or jobs could be had. Women commonly migrate with their families and provide a family unit of labour, including young children who are able to work. Seasonality of mobility implies that many small mining and quarrying workers are poor landless farmers or other rural workers seeking additional and cash income on a temporary basis during the non-farming seasons (such as during the dry winter period in the Indian subcontinent cash-income opportunities in ASM during the drier part of the year. Such seasonal migrations from poverty-stricken rural areas to economically better-off areas or to mineral-rich tracts for cash incomes at times of agricultural stress or quiescence are not uncommon.

Sudden shocks to livelihoods such as droughts also increase the helplessness of the rural poor and force them to seek jobs outside of the farming economy, and the small mines and quarries are often the primary absorbers of such communities. Consequently, if they live in a mineral-rich tract, local communities tend to fall back upon working in quarries or scavenging from old and abandoned, or even operational large mines. If they live in agricultural areas, groups and families often migrate in search of such jobs to mining areas. For example, the largest segment of workers in the collieries of northeastern India comes from Nepal.

Natural disasters or environmental hazards also encourage a large number of displaced rural landless to join the mines and quarries. In a region where agriculture is still intended primarily for subsistence and is heavily dependent on monsoon rains, a couple of successive years of drought often forces rural labourers out of the villages. Similarly, floods or storms, earthquakes and location-specific hazards such as river-bank erosion in the flood plains often drive poor people into the small mines and quarries seeking jobs. In many large mining areas, lack of attention to preserving ecological integrity has caused the decay of farming and destruction of local natural resources, and the involvement of peasants in what is often seen as illegitimate practices by the state authorities. Persistent conflicts including low-key violence and the exercise of muscle power based on local politics or ethnic/religious context threaten the well-being of poor, causing their flight not only into the big cities but also into mining-quarrying jobs. Ethnic violence in Sri Lanka and political instability in rural Nepal have been crucial in ensuring a steady supply of cheap labour into the artisanal gemstone quarries and the stone quarries along the Himalayan foothills. Above all, displacement due to large scale developmental projects, particularly large dams and mining-power generation schemes, have been well-known to drive poor peasants into informal, risky and insecure forms of occupations such as those in the small mines and quarries (Rao 2005). As women as new migrants move into small mines and quarries as workers, they usually have little or no support network. These support networks were useful in looking after children, in facing harassments, in tackling discrimination, and in preventing physical integrity. New vulnerabilities that are nearly impossible to deal alone are created for women migrants working in the mines and quarries.

Women's Status and Position in the ASM

CASM/World Bank (2002: 22) does not see artisanal mining as strictly a mining problem 'but rather as a poverty issue which must be addressed by a comprehensive approach.' As people enter the informal mining sector as an alternative to subsistence agriculture, families may have marginally better incomes for maintenance. However, the mines and quarries are ailed by numerous factors, including: a high degree of health, safety, and environmental risks; limited access to credit and a lack of equipment and appropriate technology; disorganization, which often means illegal activity; and sometimes

conflicts with large mining companies. Gender crosscuts each of these factors. Yet, it is not commonly recognised as such. If informal mining is to develop into a sustainable activity, these individual issues need to be examined through a gender lens.

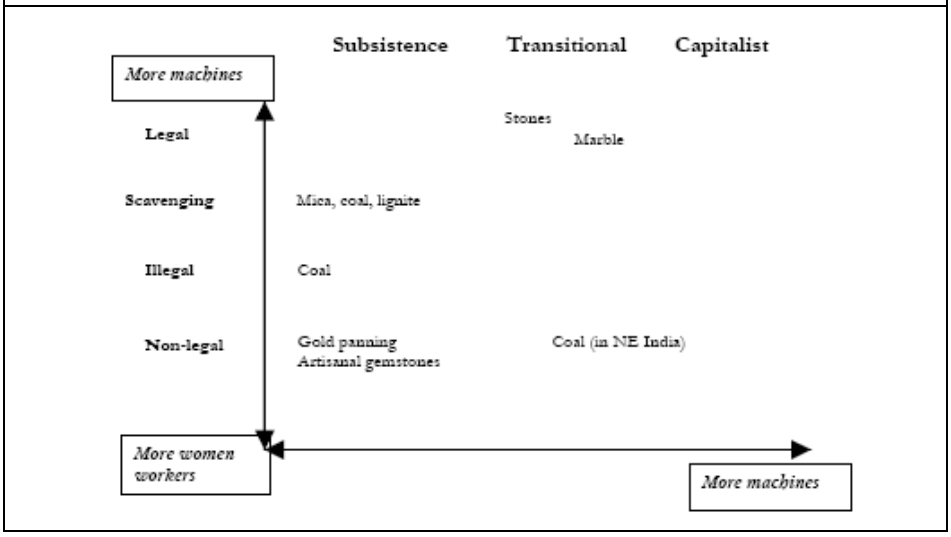
Chakravorty notes in his report on India (2001, p. 38),

> ... employment of women is very popular in opencast mines because they are more regular and dependable and do not indulge in excessive drinking Women are in demand also for hand sorting and blending for improving the quality of extracted minerals which can not be gainfully carried out mechanically.

This observation indicates the gender-blind nature of knowledge in ASM, because of its failure to enquire into crucial issues such as the concentration of women in the more arduous manual jobs. The lengthy report also devotes only a limited attention to gender issues. Most women in ASM are from indigenous and similarly marginal ethnic communities such as low castes (Lahiri-Dutt, 2003b). Women work in large numbers, in risky and manual jobs in the mines, with little or no safety or security, at low wages and often as part of family labour. The sexual division of labour in the small mines and quarries presented by Chattopadhyay (2002) for the mica factories in Giridih in Eastern India clearly shows that men tend to do more specialised and skilled jobs that often involve the use of machines. In South Asia, women's lack of ownership of productive resources probably is the most crucial factor in ensuring their low status in almost all land-based production systems (Agarwal 1994). In the absence of a collateral, the lack of access to credit becomes a significant problem in mining; even in South Africa (where women's mining associations have attempted to overcome the barriers such as lack of collaterals for loans) poor education and negative attitudes of bankers towards women miners, only 6% women have access to loans. In South Asia, women most commonly do not own small or artisanal mines, nor even cut the minerals themselves, but work as transporters or loaders, and as processors of minerals. This leads to the unfortunate lack of identification of women as 'miners' (Susapu and Crispin in 2001 noted this phenomenon also in Papua New Guinea). The culturally rooted gender bias is then reinforced in South Asia through legal instruments that limit women's labour to specific jobs in specific places and times.

The range of ASM practices is such that to reduce complexity and to give some simplistic ideas about where women's labour is concentrated, I have drawn the following broad diagram. It depicts the economic organisation, production relations and levels of capital accumulation on the horizontal axis as a function of legal status. The diagram shows the increased use of machines with increasing legality factor and capitalist mode of production. The maximum concentration of women's labour is to be broadly found in the non-legal and manual, subsistence mining practices.

Figure 1: Place of Women Workers in Small Mines and Quarries



The diagram illustrates the need for relating gender and development policies in the ASM sector.

Gender and Livelihoods and ASM

The small mining and quarrying sector in South Asia is a repository of concentrated poverty and extreme forms of exploitation of the workers, both women and men. Mining work is commonly done on a contract basis, often at piece-rates, but also for daily wages. Jobs in the small mines and quarries are sexually segregated, reflecting what is often referred to as horizontal segregation, offering women and men restricted entry to particular jobs. For example, local transportation or materials is almost always done in head loads of baskets by

women, whereas the technical jobs requiring skill or use of machines are almost always reserved for men. As mine owners put it, women are docile, possessing the proverbial 'nimble fingers', and are not supposed to do heavy work. However, in almost all small mines and quarries, it is women who head load the cut mineral ores from the mine site to the crusher, factory or the truck stop. Obviously, head loading of 20-30 kilograms is not considered within the mine to be unsuitable for women but this is one area that needs immediate intervention. Women working in the small mines and quarries are at the mercy of the petty contractors who tend to subordinate them through direct and indirect means of oppression including physical exploitation. Food insecurity of the family, direct responsibility of providing food for young children, and the non-availability of better paid and regular jobs drive them to take up work in the quarries.

Women in ASM are involved in *three* different categories of jobs: a) in the extractive process, b) as workers in sorting, transporting and crushing of the preparation of minerals, and c) as food and beverages suppliers, clerks and secretaries, peons, nurses etc., In small mines and quarries, it is the first two groups that are most common. These women are in most cases from extremely poor, *adivasi* (indigenous), *dalit* (downtrodden – lower castes) communities, with low levels of literacy, usually in younger age categories (age groups 5-30 years), and commonly working in head loading, carrying, stone breaking, sorting, cleaning and such other jobs. Parthasarathy (2004) describes the life of a woman in a quarry:

> 'A typical day of a woman mineworker starts at 6 a.m. when she packs her lunch, usually the traditional pakhalo (boiled rice soaked overnight in its own starch water) and sets off on foot for the mine site... Other women mineworkers in nearby villages trudge 7 km to work each way. At the mine site they work continuously till noon, after which they take an hour's break and return to work till 4 p.m. Then they start the long walk back home, hurrying to get back to their hearth to cook for their families, to collect water from the village well, to wash and clean up.... Badoni Purthi who started working as a contract labourer after her husband Dobor Purthi, who worked in the underground mines died of tuberculosis, has five children whom she leaves behind at home to fend themselves. But the women who were breast feeding infants had to take the infants to the

> mine site where there was a crèche and only one harried 'house mother' to look after everyone's children. This being the case the women said that they also took along one of the older children to take care of siblings. ... Many of the women mineworkers of Bondaniya were contract labourers and only a few were directly employed by the companies. Indeed the women complained that one of the companies actively discourages any direct employment and would rather hire a contractor, who in turn prospers by engaging cheap labour who are denied benefits accruing to the women mineworkers directly employed by the company, like bonus, wage increments, provident fund etc., ... Due to the piece rate women and men are paid differential wages: Padmini Koi gets Rs.70 a day for the same eight-hour working day as a man who gets Rs.75 because women are said to be slower than the men in filling up the boxes.'

This description brings out the overall working condition for women: lower wages then men, no equipment or safety gear or safety education, no toilets or living facilities within close proximity, rare and unpaid holidays, and unpaid pregnancies. Often this is associated with physical and sexual exploitation by the contractors, co-workers and other local men. The occupational hazards range from ill-health such as respiratory problems, silicosis, tuberculosis, leukemia, arthritis, poor vision and deafness to reproductive tract problems. They occur due to constant exposure to dust and noise, poor water supply and sanitation. Whereas major accidents claim mostly the lives of men due to their preponderance in the underground jobs, minor accidents due to blasting or falls are also common for both women and men. Snake bites in conditions of inundation can also claim lives.

The poor working conditions leads to severe occupational diseases and health issues. Amongst them, air-borne diseases of the respiratory tract such as tuberculosis and silicosis are most important, reducing the working ability and lifespan on the workers.[8] Surveys conducted by the Indian Council of Medical Research have reported incidence rates amongst stone quarry workers between 16 to 57% of silicosis in different parts of the country. The incidence is high in Rajasthan, where mining and quarrying is second only to agriculture as sources of employment; according to another study conducted by the Department of Chest Diseases of the Medical College in Jodhpur, and the NGO

Gramin Vikas Vigyan Samiti (GRAVIS). Radiological investigations showed that 56% of mineworkers in Rajasthan are affected with silicosis or silica-tuberculosis. If these numbers are indicative of the general incidence of such disease, then at least 800,000 workers in the small mines and quarries might be affected just in the state of Rajasthan. Air pollution – primarily the presence of suspended Particulate Matter (PM) in the air – also affects surrounding village residents indeed silica dust is just one component of airborne PM. The Supreme Court Guideline of 1997 rules out the location of stone crusher within a kilometre radius of human habitation, but this guideline has not been strictly implemented.

Water-borne diseases are also extremely common, including frequent outbreaks of enteric diseases amongst all workers. The average lifespan of a quarry worker, according to a civil society group (Prasaar) working on occupational health issues around Delhi quarries, is not more than 50 years. According to the Executive Director of Prasaar, Mr Azad, at the time of taking up the jobs in the quarries, a worker is fully aware of the death trap lying ahead, but the lack of alternatives force a person in his twenties to work in the quarries. In his view, the average working life of a worker -both women and men – is between 12-15 years. After a decade or so of working in the collieries, the worker becomes ill and gradually becomes unable to work, eventually dying in the late 40s or early 50s. The degraded working and living conditions, and uncertainties of life also encourage excessive alcohol consumption habits amongst the quarry workers – both women and men falling victims of the habit. Alcoholism is prevalent primarily amongst men, but affecting women and the family, leading to domestic violence (such as wife-beating and ill-treatment of children), confrontations amongst neighbours and workmates and desertion of wives by husbands, and above all plunging the entire family into poverty and perpetual indebtedness.

Women are at the bottom of the hierarchy of production playing major roles in subsistence as well as commercialized small mining and quarrying, but generally have very low level of control over the products of their labour or to act as autonomous subjects.

The question of bondage, a contemporary form of slavery, is a widely used method of labour employment in ASM in South Asian countries.[9] Srivastava (2005: 3) defines bondage as, 'a system of forced, or partly forced, labour under

which the debtor enters into an agreement, oral or written, with the creditor'. In South Asia's caste-bound and hierarchical society, bondage of an individual man turns into inter-generational bondage, child bondage, loyalty bondage, and bondage through land allotment spilling over to other members of the family, especially women (widow bondage) and girl children who have the least control over their fates (see Sreedharan and Muniyapa 2000; Bakshi 2002; also Lerche 1995 for distinctively different approaches to the question of bondage). Quarry workers and gem cutters are highly represented amongst those in bondage (see Kapadia's 1995 work). Mendelsohn's (1991) research described the intervention of a non-governmental organisation to release the stone quarry workers around New Delhi. Olsen and Ramana Murthy (2000) traced the condition of contract and bonded labourers in Andhra Pradesh. Debt bondage, the most prevalent form amongst the various kinds of bondage, enslaves more men but for women, it can mean double exploitation' (Herzfeld 2002). When a woman marries a bonded labour, she also marries the conditions of his bondage. In case of a woman head of household being in bondage, the consequences are forced work for long, often outside of usual quarry jobs, and complete disempowerment.

In Pakistan's small mines and quarries Saleem (2003) showed the 'vicious circle' of bonded labour where about 80-85% of them came from only two districts, Swat and Shangla of North West Frontier Province (NWFP): 'An agent of the mine owners, who always remains behind the scene in most cases, recruits the people for this exhausting grind by giving them "advance money". The advance money ranges from Rs 40,000 to 45,000 in Balochistan, Rs 25,000 to 30,000 in Sindh and at its lowest in the NWFP.' Ercelawn and Nauman (2001) described the condition of both women and men bonded labourers in Pakistan. The bonded labourers in Nepal are called *kamaiyas* and belong mainly to the Tharu community (Sharma et. al., 2001). Deep in poverty, they are forced to borrow rice and other food from the landlords and get trapped into bondage. Once indebted, the borrower and his heirs are all bonded to the landlord, but the condition of women in these families is the worst.

The relationship between women's labour and bondage is acknowledged, but the question of linkages between gender and child labour[10] in the small mines and quarries is still ill-understood. This is because of the fact that even to this day, 'women and children' are seen as a single category in many official

circles.[11] This often leads to a justification of protective legislation such as the prohibition of women's work in the mines and quarries.[12] It is indeed true that women are accompanied by children into the small mines and quarries, but in fact more children accompany their fathers as apprentices than their mothers. The question of child labour also involves the question of 'gender' within the category of 'the child', as girl children usually are at a greater disadvantage than the boys because of their gender.

The Indian Constitution prohibits the employment of child labour in factories and mines.[13] According to the Child Labour (Prohibition and Regulation) Act 1986, children are prohibited from working in quarrying and mining as these fall under 'hazardous industries.' In spite of this preventive measure, children continue to be engaged in mining and quarrying work in entire South Asia, as a more docile and cheaper form of labour. The Government of India has begun a National Child Labour Programme which is designed to release and rehabilitate children under the purview of the Act.

The connection between poverty and work in ASM is apparent in South Asia, yet, workers in small mines and quarries do not form the 'target' population in the various poverty reduction country programmes. Existing documents and the emerging pro-poor strategies of development are largely silent on formulating specific interventions for reducing poverty in these communities, and remain focused upon agricultural and other resource-based communities. The major policy initiative in the mining sector includes the National Mineral Policy of India,[14] which mentions 'Small Deposits' (7.12) only once in passing: 'Efforts will be made to promote small scale mining of small deposits in a scientific and efficient manner while safeguarding vital environmental and ecological imperatives. In grant of mineral concessions for small deposits in Scheduled Areas, preference shall be given to the Scheduled Tribes'. This mention does not differentiate between traditional and non-traditional artisanal practices and small businesses such as quarries. It is also notable that no mechanism of giving preference to the tribal or indigenous peoples to take up grants of mineral concessions has yet been set in place. On the other hand, the inalienable and non-transferable tribal land is regularly usurped through corruption by more powerful and better-off groups. It is not uncommon to find a person of tribal origin working as a wage labourer in a quarry operating on the land that was originally owned by himself or his family members.

The ill-effects of large scale mining in India, particularly the utter neglect of social and gender concerns therein, have triggered off resistance movements resulting in a negative attitude against all types of mining in the minds of environmentalists and human rights advocates. Consequently, the owners who try to make a quick profit from exploiting small mineral deposits and the workers are demonised, and the mineworkers remain invisible in the pro-environmental agenda. The mine owners' argue that their profit levels are low and the government procedures in setting up a quarry are far too complicated and lengthy (Goyal, 2005). In general, they neglect to recognise workers' rights to a safe and enabling working environment. On the other hand, cash-strapped state governments, usually in charge of administering the mines and earning revenues from them, see the small mines and quarries as a way to 'develop' the state, meaning enhancing the state exchequer. The environmentalists have pointed out that the cumulative effects of the small mines and quarries are no less then the large mines, the latter being at least nominally subject to environmental regulations. The impacts of these mines and quarries include dereliction of land, deforestation and lowering of the ground water table, pollution of local air and water sources, and rapid social and cultural change amongst local communities. These impacts draw the attention away from the extreme poverty driving the local and migrant poor to take up jobs in the mines and quarries, and the informal or unorganised nature of them mean that they remain outside of the purview of the governments. There is also an antagonism between large scale mining and scavenging operations on them that often exist as parasites. The interface between large scale mining and agriculture is also problematic; poor environmental care has resulted in the dereliction of large areas of land in mineral tracts and displaced a large percentage of peasants from their traditional livelihoods, without opening many alternative economic opportunities for them (Lahiri-Dutt, 1999). Resettlement and rehabilitation processes for mining displaced people have left much to be desired (Lahiri-Dutt and Herbert, 2005). As a result, illegal mining is rife in the coal-bearing tracts of eastern India, and one of the studies estimated the amount of illegally-mined coal distributed just by ordinary bicycles is around 2.5 million tonnes annually just in the eastern coal-producing region (Lahiri-Dutt and Williams, 2005). Therefore, conflicts of interests between large-scale resource projects and small mines and quarries are not uncommon.

Policy Implications of Gender in South Asian ASM

The livelihood issues and subsistence effects of small mines and quarries are considerable, especially amongst the indigenous and rural communities. The South Asian mining industry and bureaucracy generally neglects to prioritise the social issues surrounding the small mines and quarries, instead valorising the improvement of techno-economic efficiency in all spheres from exploration to exploitation, including management and control. Small mines and quarries operate in remote areas with little infrastructure, enabling the exploration of otherwise uneconomic resources, and a high degree of flexibility because of low overheads. The government notes that small mines and quarries may also fit in well with existing social and production structures, particularly if seasonal operation is required to be compatible with agricultural production in the same area. The ability of small mines and quarries to generate employment, income, and entrepreneurial skills in rural areas can restrain migration to urban areas. In addition, because they are generally locally owned, small mines and quarries can provide a larger net gain to the community and to the national economy than do larger, centrally or foreign-owned mines. On the other hand, small mining and quarrying is well-known for being inefficient, suffering from poor working conditions, safety and health problems, and causing environmental degradation (Hickie and Wade, 1998). There is no doubt, therefore, that the small mines and quarries, which make an important contribution to economic growth, need to be integrated fully into their respective local economies. However, the process may be more difficult in reality due to the extremely poor working conditions, low wages and semi-feudal structures and production relations that still exist.

Gender equity is a core development issue – 'a development objective in its own right' (King and Mason, 2001). Promoting gender equality as part of a development strategy in the small mines and quarries should not mean continuing with or reinforcing the low status of women as compared to men but to create situations that might enable all people to earn a decent living from a decent workplace, allowing escape from poverty and improvement in the standard of living. The gender roles of workers in the small mines are changing with current economic changes, and these have often negatively impacted upon women's decision-making power within the mine, the mining community and the

family. Empowering the women miners has the potential to bring tangible developmental results than interventions such as the regularization of the informal mines.

For women earning benefits from ASM, first of all, it is imperative to make their productive work more visible, and to make their voices heard. At present, women and their labour are almost invisible in the quarries, and their issues are neglected. Work is a part of any human being's life, and women and men toiling in the small mines and quarries in South Asian countries are not an exception. The work in the mines must not be seen as a negative or undesirable thing in itself; and legal frameworks restricting women's work need to be revisited immediately. Women's work in mining has been a contested area since the advent of modern mining in Europe, and the response in general had been to 'protect' women from the poor conditions existing in the mines. In all South Asian countries, women's work in underground mines and at night is prohibited by the law in an effort to protect them. The results of protective measures have not been effective, as we know that when poverty is the driving force, more women than men take up the subsistence burdens of their families, irrespective of legal structures that regulate their work. Equal rights to work and consequent economic benefits from the small mines and quarries, on the other hand, can be seen as enabling and empowering for women. The need is to improve the conditions surrounding women's work, and in this regard, measures such as protecting women's interests, safety and health, providing a safe and secure working environment, assuring continued employment and old age security for citizens, and improvements in wage levels. For this purpose, a concerted effort is needed as many of these ills are closely associated with rural poverty, patriarchal society and consequent exploitation of women. The need is also to ensure a more equitable distribution of economic benefits from ASM between women and men. This would also involve giving incentives to women to own small mines and quarries – possibly through a greater attention to land ownership and training programs – for their economic and social empowerment. These legal and economic measures are connected to a range of social and technical measures: ensuring health and giving education to create livelihood options, training women to use machines that lessen manual work burdens, and providing training on risk, safety and security to improve the overall productive efficiency.

International efforts have been taken to address specific issues in ASM such as UNIDO's Global Mercury Project (see at http://www.unido.org/doc/44254) to control the unsafe use of mercury in gold amalgamation to improve local ecology and environmental health. ILO's major program, International Program for the Elimination of Child Labour (IPEC – see at http://www.ilo.org/public/english/standards/ipec/newsroom/index.htm), has been operating through governments, employers, workers, non-governmental organisations and teachers. Whilst South Asian countries have benefited from them, a distinct gender focus is missing from these global projects. Commitment to gender mainstreaming would begin at the international policy level and trickle down to the individual country's strategy level. The promotion of micro-credit programs can provide financing for women in communities on mineral tracts. Church and Guerin (nd) have shown how small interventions as microfinance and credit for women have been effective in dealing with the problem of debt bondage in certain cases. They have also pointed out that financing women have been more effective in poverty eradication than providing credit to male heads of households. Elsewhere, there are examples of locally based non-governmental organisations such as Mine Labour Protection Campaign (in Rajasthan marble and stone quarries – see http://www.minelabour.org/newsview.php?newsid=-16), BIRSA (see http://www.birsa.org/), Jharkhand Mines Area Coordination Committee (see www.firstpeoplesfirst.in) and JOHAR (in Jharkhand stone and limestone quarries see www.johar.in) for making marginal improvements in women mineworkers' lives and for making their voices heard.

For women in the small mines and quarries in particular, the immediate need is to eliminate gender bias and harassment, and accept their multiple and productive roles in the economy, in the society and at home. This will enhance women's ability to ensure food security for the family and provide for children more effectively (Ramchandran 2006). It is also important to better understand the small mines and quarries as an integral and legitimate aspect of the livelihoods of innumerable women and men in South Asian informal sector. Improving the record keeping, increasing the understanding of production relations and processes, and tracking the processes of change through gender-based data collection and analyses would be the first step towards building pro-poor policies that actually work effectively at the grassroots level.

Development policy in recent years has increasingly focussed its attention on the area of women's work in the informal economy including the small mining sector (Heemskerk, 2003). However, as we noted in our research, women form the poorest in the small mining economy that itself is a repository of extreme poverty and exploitation. Such is their invisibility that often the perceptions of stakeholders regarding women's work roles and issues surrounding their work are not well-developed and omitted from the opinions of experts. For example, there is not yet a real appreciation of the production relations that tie women and men into bondages of various sort within the mines and quarries. Another example is the use of technology; the ability to use technology or 'appropriate technology' is often seen by the ASM experts as gender-neutral and the panacea for all social ills. However, in my study, I noticed that technology intensive mining processes not only tend to exclude women but relegate them to lower status and low skilled jobs. Often these are more risky and dangerous jobs, and reproduce the social biases against women workers within the industrial production in mines and quarries. Consequently, the status of women in the ASM economy is low, and the strategic and gender needs and concerns of women are not fulfilled. The existing laws regarding the small mines and quarries are unclear and ill-defined; the legal framework on women's work needs to be revisited. This is not uncommon for any part of the informal sector. However, small mining and quarrying, is here to stay. Leases for small mines and quarries are becoming a source of revenue for the states, and the state Mineral Development Corporations are aggressively advancing mining and quarrying. However, the responsibility of these corporations to not extend in ensuring gender equity, safe working environment and secure wages. Being loosely controlled, even the licensed quarries create environmental pollution and hazards for the region and local residents. Near metropolitan cities and capitals, for example, environmental degradation caused by the quarries has led to several Public Interest Litigation and the rise of powerful civil society movements.

These considerations lead us to ask the simple yet critical question, 'will promoting women's work in the ASM sector in India improve the quality of life for rural poor women of the country?' This question has great implications for developing pro-poor livelihood policies that are effective in three areas: sustaining the economic benefits for the states, for the families and the individuals – in other words sustaining the development from mineral extraction; raising the well-being of the innumerable poor people engaged annually or

seasonally in small mining and quarrying – in other words poverty alleviation through income generation; and in raising the standards of living in meeting the Millennium Development Goals. The answer is definitely in the positive, although the need of the hour is to develop a gender sensitive and pro-poor framework of developmental interventions that would be effective in dealing with the big challenges that small mines and quarries pose to the Indian policy-makers.

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Endnotes

1 'Informal' here implies the large range of activities and practices in mining and quarrying: digging, cutting, panning, processing, breaking, amalgamating, carrying, transporting, and marketing of a wide range of minerals or products from the earth's surface or the interior. In my earlier works (Lahiri-Dutt 2003(a); 2004). I have used the term informal as coterminous of ASM.

2 Some of the material – including those done by our partners – from this research is now available at our website (see www.asmasiapacific.org).

3 Personal communication. However, Professor Li is an authority on ASM in China and the head also of CASM China network. See http://www.casmsite.org/regional_CASM-China.htm

4 The word 'livelihood' means the command an individual, family or other social group has over an income/or bundles of resources that can be used or exchanged to satisfy its needs. This may involve information, cultural knowledge, social networks, legal rights as well as tools, land or other physical resources. (Blakie et. al., 1994; Valdivia et. al., 1996). The livelihood approach to understanding survival strategies of the poor people as well as development processes has received a spurt in the last decade.

5 I am thankful to Professor Amitabha Kundu of Centre for Studies in Regional Development, Jawaharlal Nehru University, New Delhi, for this information.

6 Illegal mining also occurred, and *Arthashastra* gave instructions on how to deal: 'A mine worker who steals mineral products except precious stones shall be punished with a fine of eight times their value. Any person who steals mineral products or carries on mining operations without license shall be bound (with chains) and caused to work (as a prisoner).'

7 The form of production is essentially based on the type of relationship between the owner and the workers, and the type of production process carried out in an industry (Harris, 1982: 947).

8 'The potential hazards from silicosis have been known for a long time, and a number of state governments (in India) have passed legislation to address this. However such developments have meant nothing in practice; to date, no person affected with silicosis has ever received any compensation or reimbursement of costs of treatment by the court orders in Rajasthan. Besides the fact that almost none of the mineworkers are aware of the regulations and laws, the procedure for filing a compensation petition is very complicated. The biggest hurdle in the whole process is the difficulty in obtaining a certificate from the Pneumoconiosis Board. With the board inordinately delayed – and even then largely idle – actual relief for the mineworkers remains out of reach.' (full report available from www.indiatogether.org/2005/aug/env-lungdust.htm accessed on 23 December, 2005).

9 The first systematic survey of bonded labour carried out by the Gandhi Peace Foundation and National Labour Institute in 1978 placed the number of bonded labourers at 2.62 million. The survey also found that 61.5% of the bonded labourers were from Schedules Castes (SC, lower castes) and 25% were from Scheduled Tribes (ST, indigenous peoples or *adivasis)* (Sarma, 1981). The National Commission on Rural Labour (NCRL) in 1991 presented a clearer picture of bonded labour in India, and noted that bondage among women on account of social as well as economic factors and mentioned the examples of indebtedness-induced prostitution of women and children. The Commission also mentioned the high incidence of child bondage and tribal exploitation in many parts of the country. Of the vast number of bonded labourers in South Asia, a large proportion is toiling away in the small mines and quarries, and crushers (Ministry of Labour, 1991). The United Nations Working Group on Contemporary Forms of Slavery estimated in 1999 that 10 million of 20 million slaves of the modern world live in India alone. Of this number, more than

half are women and children. Human Rights Watch (1996) puts the figure at a higher level: 'Approximately fifteen million children work as bonded labourers in India'.

10 The term is used to mean children between 5 to 14 years of age, in gainful occupation injurious to their physical, mental, moral and social development, used as synonyms of 'employed child' or 'working child', young people who are leading adult lives working long hours for low wages.

11 Many national or state machineries for women set up during the 1950s in most third world countries still reflect a welfare approach' to women's issues in their nomenclature; in India for example, the ministry is still known as Ministry and Women and Children's Welfare and in Bangladesh Women and Children's Affairs, putting women and children's concerns m the same category. The implicit understanding behind such nomenclature is the acceptance of motherhood being the primary roles and responsibility of women. It is assumed that women will automatically benefit from improvements in the conditions of their families assuming in the benefits trickling down through the male head of household (Elson 1995). Changes are also in the air; the Pakistan government now calls the relevant institution the Ministry of Women Development and Sri Lanka Ministry of Women's Empowerment and Social Welfare, although essentially these institutions remain weak and under-resourced.

12 The general approach so far in South Asia has been to create 'special' measures for women in various fields. Examples of such protective measures are many: beginning from the recent 73rd and 74th amendments of the Indian Constitution reserving seats for women to enhancing their political participation to old Acts or legal provisions such as breast feeding breaks for women workers under The Plantation Labour Act, 1951; prohibition of night work, provision of crèches (for factories employing over 13 women workers) under The Factories Act, 1948; and finally, the prohibition of women from working underground under The Indian Mines Act of 1952. Often, in informal sector employment, these provisions are not followed. In fact, often in cases of accidents or collapse of unofficial mines or quarries, women have been found underground, either dead or injured. Above all, these very measures are cited as barriers for the gainful employment of women. Intended as a means to protect them from the harsh working conditions, these measures usually work to act against women in the labour market.

13 Article 24 of the Indian Constitution states that no child up to the age of 14 shall be employed in any factory or mine. The Labour Act of 1951, the Mines Act of 1952, and the Factories Act of 1954 also strictly prohibit the employment of child labour.

14 Other countries of the region do not yet have any definitive Mineral Sector Policy. Pakistan is on its way towards building up one, but if the Mineral Sector Development Policy Note of November 20, 2003, is of any importance, the country is still m the stage of broadly outlining the mitigation issues of large scale mining and institutional support to ASM.

List of Cases

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Snapshot

Mining: Environment and Health Concerns

The execution of various mining operations on large scale over a period of time causes environmental degradation by pollution of surface and ground water, erosion of land surface, air pollution, soil erosion, and destruction of the rock bodies, deforestation, ecological disturbance and the formation of sinkholes. Mining can affect surrounding surface and ground water due to infiltration or dispersion of the affluent materials and heavy minerals released out of the mineral extraction process. The uncontrolled dust released into the atmosphere by mining excavation causes air pollution and also respiratory disorders. Poor working conditions and accidents occur at mine sites due to the technical failures and human negligence. Mining operations damage the environment and ecology to an unacceptable degree, unless carefully planned and controlled. The right balance between the mining and environmental protection is essential and requires proper planning.

This edited book attempts to present new dimensions of mining and environment and focuses on important legal issues of occupational health and safety standards in the mining areas. It is hoped that this book would benefit legal practioners, mining corporate executives, investors and research scholars.